GNU Unifont

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Chapter 1

GNU Unifont

1.1 GNU Unifont C Utilities

This documentation covers C utility programs for creating GNU Unifont glyphs and fonts.

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1.3 Introduction

Unifont is the creation of Roman Czyborra, who created Perl utilities for generating a dual-width Bitmap Distribution Format (BDF) font 16 pixels tall, unifont.bdf, from an input file named unifont.hex. The unifont.hex file contained two fields separated by a colon: a Unicode code point as four hexadecimal digits, and a hexadecimal string of 32 or 64 characters representing the glyph bitmap pattern. Roman also wrote other Perl scripts for manipulating unifont.hex files.

Jungshik Shin wrote a Perl script, johab2ucs2, to convert Hangul syllable glyph elements into Hangul Johab-encoded fonts. These glyph elements are compatible with Jaekyung "Jake" Song's Hanterm terminal emulator. Paul Hardy modified johab2ucs2 and drew Hangul Syllables Unicode elements for compatibility with this Johab encoding and with Hanterm. These new glyphs were created to avoid licensing issues with the Hangul Syllables glyphs that were in the original unifont.hex file.

Over time, Unifont was extended to allow correct positioning of combining marks in a TrueType font, coverage beyond Unicode Plane 0, and the addition of Under-ConScript Unicode Registry (UCSUR) glyphs. There is also partial support for experimental quadruple-width glyphs.

Paul Hardy wrote the first pair of C programs, unihex2bmp.c and unibmp2hex.c, to facilitate editing the bitmaps at their real aspect ratio. These programs allow conversion between the Unifont .hex format and a Windows Bitmap or Wireless Bitmap file for editing with a graphics editor. This was followed by make files, other C programs, Perl scripts, and shell scripts.

Luis Alejandro González Miranda wrote scripts for converting unifont.hex into a TrueType font using FontForge.

Andrew Miller wrote additional Perl programs for directly rendering unifont.hex files, for converting unifont.hex to and from Portable Network Graphics (PNG) files for editing based upon Paul Hardy's BMP conversion programs, and also wrote other Perl scripts.

David Corbett wrote a Perl script to rotate glyphs in a unifont.hex file and an awk script to substitute new glyphs for old glyphs of the same Unicode code point in a unifont.hex file.

何志翔 (He Zhixiang) wrote a program to convert Unifont files into OpenType fonts, hex2otf.c.

Minseo Lee created new Hangul glyphs for the original Unifont Johab 10/3 or 4/4 encoding. This was followed immediately after by Ho-Seok Ee, who created Hangul glyphs for a new, simpler Johab 6/3/1 encoding that are now in Unifont.

1.4 The C Programs

This documentation only covers C programs and their header files. These programs are typically longer than the Unifont package's Perl scripts, which being much smaller are easier to understand. The C programs are, in alphabetical order:

Program	Description
hex2otf.c	Convert a GNU Unifont .hex file to an OpenType font
johab2syl.c	Generate Hangul Syllables range with simple positioning

Program	Description
unibdf2hex	Convert a BDF file into a unifont.hex file
unibmp2hex	Turn a .bmp or .wbmp glyph matrix into a GNU Unifont hex glyph set of 256 characters
unibmpbump	Adjust a Microsoft bitmap (.bmp) file that was created by unihex2png but converted to .bmp

Program	Description
unicoverage.c	Show the coverage of Unicode plane scripts for a GNU Unifont hex glyph file
unidup.c	Check for duplicate code points in sorted unifont.hex file
unifont1pbm.c	Read a Unifont .hex file from standard input and produce one glyph per .bmp bitmap file as output

Program	Description
unifontpic	See the "Big Picture": the entire Unifont in one BMP bitmap
unigen-hangul	Generate modern and ancient Hangul syllables with shifting of final consonants combined with diphthongs having two long vertical strokes on the right
unigencircles	Superimpose dashed combining circles on combining glyphs

Program	Description
unigenwidth	IEEE 1003.1-2008 setup to calculate wchar_t string widths
unihex2bmp	Turn a GNU Unifont hex glyph page of 256 code points into a bitmap for editing
unihexgen	Generate a series of glyphs containing hexadecimal code points

Program	Description
unihexposetranspose	Transpose Unifont .hex glyph bitmaps to simplify sending to graphics display controller chips that read bitmaps as a series of columns 8 rows (one byte) high

Program	Description
unijohab2html.c	Read a hangul-base.hex file and produce an HTML page as output showing juxtaposition and overlapping of all letter combinations in modern and ancient Hangul syllables
unipagecount.c	Count the number of glyphs defined in each page of 256 code points

1.5 Perl Scripts

The very first program written for Unifont conversion was Roman Czyborra's hexdraw Perl script. That one script would convert a unifont.hex file into a text file with 16 lines per glyph (one for each glyph row) followed by a blank line aftr each glyph. That allowed editing unifont.hex glyphs with a text-based editor.

Combined with Roman's hex2bdf Perl script to convert a unifont.hex file into a BDF font, these two scripts formed a complete package for editing Unifont and generating the resulting BDF fonts.

There was no combining mark support initially, and the original unifont.hex file included combining circles with combining mark glyphs.

The list below gives a brief description of these and the other Perl scripts that are in the Unifont package src subdirectory.

Perl Script	Description
bdfimploder	Convert a BDF font into GNU Unifont .hex format
hex2bdf	Convert a GNU Unifont .hex file into a BDF font
hex2sfd	Convert a GNU Unifont .hex file into a FontForge .sfd format

Perl Script	Description
hexbraille	Algorithmically generate the Unicode Braille range (U+28xx)
hexdraw	Convert a GNU Unifont .hex file to and from an ASCII text file
hexkinya	Create the Private Use Area Kinya syllables
hexmerge	Merge two or more GNU Unifont .hex font files into one

Perl Script	Description
johab2ucs2	Convert a Johab BDF font into GNU Unifont Hangul Syllables
unifont-viewer	View a .hex font file with a graphical user interface
unifontchojung	Extract Hangul syllables that have no final consonant
unifontksx	Extract Hangul syllables that comprise KS X 1001:1992

Perl Script	Description
unihex2png	GNU Unifont .hex file to Portable Network Graphics converter
unihexfill	Generate range of Unifont 4- or 6-digit hexadecimal glyp
unihexrotate	Rotate Unifont hex glyphs in quarter turn increments
unipng2hex	Portable Network Graphics to GNU Unifont .hex file converter

Chapter 2

Data Structure Index

2.1 Data Structures

Here are the data structures with brief descriptions:

Chapter 3

File Index

3.1 File List

Here is a list of all documented files with brief descriptions:

Chapter 4

Data Structure Documentation

4.1 Buffer Struct Reference

Generic data structure for a linked list of buffer elements.

Data Fields

- size_t capacity
- byte * begin
- byte * next
- byte * end

4.1.1 Detailed Description

Generic data structure for a linked list of buffer elements.

A buffer can act as a vector (when filled with 'store*' functions), or a temporary output area (when filled with 'cache*' functions). The 'store*' functions use native endian. The 'cache*' functions use big endian or other formats in OpenType. Beware of memory alignment.

Definition at line 133 of file hex2otf.c.

4.1.2 Field Documentation

4.1.2.1 begin

byte* Buffer::begin

Definition at line 136 of file hex2otf.c.

4.1.2.2 capacity

size_t Buffer::capacity

Definition at line 135 of file hex2otf.c.

4.1.2.3 end

byte * Buffer::end

Definition at line 136 of file hex2otf.c.

4.1.2.4 next

byte * Buffer::next

Definition at line 136 of file hex2otf.c.

The documentation for this struct was generated from the following file:

- src/hex2otf.c

4.2 Font Struct Reference

Data structure to hold information for one font.

Collaboration diagram for Font:

Data Fields

- Buffer * tables
- Buffer * glyphs
- uint_fast32_t glyphCount
- pixels_t maxWidth

4.2.1 Detailed Description

Data structure to hold information for one font.

Definition at line 628 of file hex2otf.c.

4.2.2 Field Documentation

4.2.2.1 glyphCount

uint_fast32_t Font::glyphCount

Definition at line 632 of file hex2otf.c.

4.2.2.2 glyphs

Buffer* Font::glyphs

Definition at line 631 of file hex2otf.c.

4.2.2.3 maxWidth

pixels_t Font::maxWidth

Definition at line 633 of file hex2otf.c.

4.2.2.4 tables

Buffer* Font::tables

Definition at line 630 of file hex2otf.c.

The documentation for this struct was generated from the following file:

- src/hex2otf.c

4.3 Glyph Struct Reference

Data structure to hold data for one bitmap glyph.

Data Fields

- uint_least32_t codePoint
  undefined for glyph 0
- byte bitmap [GLYPH_MAX_BYTE_COUNT]
  hexadecimal bitmap character array
- uint_least8_t byteCount
  length of bitmap data
- bool combining
  whether this is a combining glyph
- pixels_t pos
- pixels_t lsb
  left side bearing (x position of leftmost contour point)

4.3.1 Detailed Description

Data structure to hold data for one bitmap glyph.

This data structure holds data to represent one Unifont bitmap glyph: Unicode code point, number of bytes in its bitmap array, whether or not it is a combining character, and an offset from the glyph origin to the start of the bitmap.

Definition at line 614 of file hex2otf.c.

4.3.2 Field Documentation

4.3.2.1 bitmap

byte Glyph::bitmap[GLYPH_MAX_BYTE_COUNT]

hexadecimal bitmap character array

Definition at line 617 of file hex2otf.c.

4.3.2.2 byteCount

uint_least8_t Glyph::byteCount

length of bitmap data

Definition at line 618 of file hex2otf.c.

4.3.2.3 codePoint

uint_least32_t Glyph::codePoint

undefined for glyph 0

Definition at line 616 of file hex2otf.c.

4.3.2.4 combining

bool Glyph::combining

whether this is a combining glyph

Definition at line 619 of file hex2otf.c.

4.3.2.5 lsb

pixels_t Glyph::lsb

left side bearing (x position of leftmost contour point)

Definition at line 622 of file hex2otf.c.

4.3.2.6 pos

pixels_t Glyph::pos

number of pixels the glyph should be moved to the right (negative number means moving to the left)

Definition at line 620 of file hex2otf.c.

The documentation for this struct was generated from the following file:

- src/hex2otf.c

4.4 NamePair Struct Reference

Data structure for a font ID number and name character string.

#include <hex2otf.h>

Data Fields

- int id
- const char * str

4.4.1 Detailed Description

Data structure for a font ID number and name character string.

Definition at line 77 of file hex2otf.h.

4.4.2 Field Documentation

4.4.2.1 id

int NamePair::id

Definition at line 79 of file hex2otf.h.

4.4.2.2 str

const char* NamePair::str

Definition at line 80 of file hex2otf.h.

The documentation for this struct was generated from the following file:

- src/hex2otf.h

4.5 Options Struct Reference

Data structure to hold options for OpenType font output.

Data Fields

- bool truetype
- bool blankOutline
- bool bitmap
- bool gpos
- bool gsub
- int cff
- const char * hex
- const char * pos
- const char * out
- NameStrings nameStrings

4.5.1 Detailed Description

Data structure to hold options for OpenType font output.

This data structure holds the status of options that can be specified as command line arguments for creating the output OpenType font file.

Definition at line 2453 of file hex2otf.c.

4.5.2 Field Documentation

4.5.2.1 bitmap

bool Options::bitmap

Definition at line 2455 of file hex2otf.c.

4.5.2.2 blankOutline

bool Options::blankOutline

Definition at line 2455 of file hex2otf.c.

4.5.2.3 cff

int Options::cff

Definition at line 2456 of file hex2otf.c.

4.5.2.4 gpos

bool Options::gpos

Definition at line 2455 of file hex2otf.c.

4.5.2.5 gsub

bool Options::gsub

Definition at line 2455 of file hex2otf.c.

4.5.2.6 hex

const char* Options::hex

Definition at line 2457 of file hex2otf.c.

4.5.2.7 nameStrings

NameStrings Options::nameStrings

Definition at line 2458 of file hex2otf.c.

4.5.2.8 out

const char * Options::out

Definition at line 2457 of file hex2otf.c.

4.5.2.9 pos

const char * Options::pos

Definition at line 2457 of file hex2otf.c.

4.5.2.10 truetype

bool Options::truetype

Definition at line 2455 of file hex2otf.c.

The documentation for this struct was generated from the following file:

- src/hex2otf.c

4.6 PARAMS Struct Reference

Data Fields

- unsigned starting_codept
- unsigned cho_start
- unsigned cho_end
- unsigned jung_start
- unsigned jung_end
- unsigned jong_start
- unsigned jong_end
- FILE * infp
- FILE * outfp

4.6.1 Detailed Description

Definition at line 55 of file unigen-hangul.c.

4.6.2 Field Documentation

4.6.2.1 cho_end

unsigned PARAMS::cho_end

Definition at line 57 of file unigen-hangul.c.

4.6.2.2 cho_start

unsigned PARAMS::cho_start

Definition at line 57 of file unigen-hangul.c.

4.6.2.3 infp

FILE* PARAMS::infp

Definition at line 60 of file unigen-hangul.c.

4.6.2.4 jong_end

unsigned PARAMS::jong_end

Definition at line 59 of file unigen-hangul.c.

4.6.2.5 jong_start

unsigned PARAMS::jong_start

Definition at line 59 of file unigen-hangul.c.

4.6.2.6 jung_end

unsigned PARAMS::jung_end

Definition at line 58 of file unigen-hangul.c.

4.6.2.7 jung_start

unsigned PARAMS::jung_start

Definition at line 58 of file unigen-hangul.c.

4.6.2.8 outfp

FILE* PARAMS::outfp

Definition at line 61 of file unigen-hangul.c.

4.6.2.9 starting_codept

unsigned PARAMS::starting_codept

Definition at line 56 of file unigen-hangul.c.

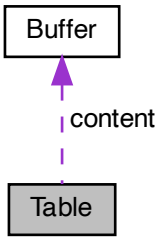
The documentation for this struct was generated from the following file:

- src/unigen-hangul.c

4.7 Table Struct Reference

Data structure for an OpenType table.

Collaboration diagram for Table:



Data Fields

- uint_fast32_t tag
- Buffer * content

4.7.1 Detailed Description

Data structure for an OpenType table.

This data structure contains a table tag and a pointer to the start of the buffer that holds data for this OpenType table.

For information on the OpenType tables and their structure, see https://docs.microsoft.com/en-us/typography/opentype/spec/otff#font-tables.

Definition at line 645 of file hex2otf.c.

4.7.2 Field Documentation

4.7.2.1 content

Buffer* Table::content

Definition at line 648 of file hex2otf.c.

4.7.2.2 tag

uint_fast32_t Table::tag

Definition at line 647 of file hex2otf.c.

The documentation for this struct was generated from the following file:

- src/hex2otf.c

4.8 TableRecord Struct Reference

Data structure for data associated with one OpenType table.

Data Fields

- uint_least32_t tag
- uint_least32_t offset
- uint_least32_t length
- uint_least32_t checksum

4.8.1 Detailed Description

Data structure for data associated with one OpenType table.

This data structure contains an OpenType table's tag, start within an OpenType font file, length in bytes, and checksum at the end of the table.

Definition at line 747 of file hex2otf.c.

4.8.2 Field Documentation

4.8.2.1 checksum

uint_least32_t TableRecord::checksum

Definition at line 749 of file hex2otf.c.

4.8.2.2 length

uint_least32_t TableRecord::length

Definition at line 749 of file hex2otf.c.

4.8.2.3 offset

uint_least32_t TableRecord::offset

Definition at line 749 of file hex2otf.c.

4.8.2.4 tag

uint_least32_t TableRecord::tag

Definition at line 749 of file hex2otf.c.

The documentation for this struct was generated from the following file:

- src/hex2otf.c

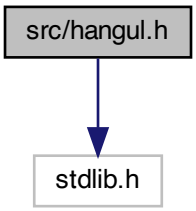
Chapter 5

File Documentation

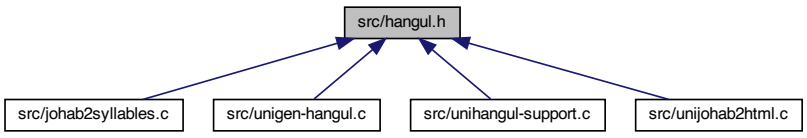
5.1 src/hangul.h File Reference

Define constants and function prototypes for using Hangul glyphs.

#include <stdlib.h>
Include dependency graph for hangul.h:



This graph shows which files directly or indirectly include this file:



Macros

- #define MAXLINE 256

  Length of maximum file input line.
- #define EXTENDED_HANGUL /* Use rare Hangul code points beyond U+1100 */
- #define PUA_START 0xE000
- #define PUA_END 0xE8FF
- #define MAX_GLYPHS (PUA_END - PUA_START + 1) /* Maximum .hex file glyphs */
- #define CHO_UNICODE_START 0x1100

  Modern Hangul choseong start.
- #define CHO_UNICODE_END 0x115E

  Hangul Jamo choseong end.
- #define CHO_EXTA_UNICODE_START 0xA960

  Hangul Extended-A choseong start.
- #define CHO_EXTA_UNICODE_END 0xA97C

  Hangul Extended-A choseong end.
- #define JUNG_UNICODE_START 0x1161

  Modern Hangul jungseong start.
- #define JUNG_UNICODE_END 0x11A7

  Modern Hangul jungseong end.
- #define JUNG_EXTB_UNICODE_START 0xD7B0

  Hangul Extended-B jungseong start.
- #define JUNG_EXTB_UNICODE_END 0xD7C6

  Hangul Extended-B jungseong end.
- #define JONG_UNICODE_START 0x11A8

  Modern Hangul jongseong start.
- #define JONG_UNICODE_END 0x11FF

  Modern Hangul jongseong end.
- #define JONG_EXTB_UNICODE_START 0xD7CB

  Hangul Extended-B jongseong start.
- #define JONG_EXTB_UNICODE_END 0xD7FB

  Hangul Extended-B jongseong end.
- #define NCHO_MODERN 19

  19 modern Hangul Jamo choseong
- #define NCHO_ANCIENT 76

  ancient Hangul Jamo choseong
- #define NCHO_EXTA 29

  Hangul Extended-A choseong.
- #define NCHO_EXTA_RSRVD 3

  Reserved at end of Extended-A choseong.
- #define NJUNG_MODERN 21

  21 modern Hangul Jamo jungseong
- #define NJUNG_ANCIENT 50

  ancient Hangul Jamo jungseong
- #define NJUNG_EXTB 23

  Hangul Extended-B jungseong.
- #define NJUNG_EXTB_RSRVD 4

Reserved at end of Extended-B junseong.

- #define NJONG_MODERN 27

  28 modern Hangul Jamo jongseong
- #define NJONG_ANCIENT 61

  ancient Hangul Jamo jongseong
- #define NJONG_EXTB 49

  Hangul Extended-B jongseong.
- #define NJONG_EXTB_RSRVD 4

  Reserved at end of Extended-B jonseong.
- #define CHO_VARIATIONS 6

  6 choseong variations
- #define JUNG_VARIATIONS 3

  3 jungseong variations
- #define JONG_VARIATIONS 1

  1 jongseong variation
- #define CHO_HEX 0x0001

  Location of first choseong (location 0x0000 is a blank glyph)
- #define CHO_ANCIENT_HEX (CHO_HEX + CHO_VARIATIONS * NCHO_MODERN)

  Location of first ancient choseong.
- #define CHO_EXTA_HEX (CHO_ANCIENT_HEX + CHO_VARIATIONS * NCHO_ANCIENT)

  U+A960 Extended-A choseong.
- #define CHO_LAST_HEX (CHO_EXTA_HEX + CHO_VARIATIONS * (NCHO_EXTA + NCHO_EXTA_RSRVD) - 1)

  U+A97F Extended-A last location in .hex file, including reserved Unicode code points at end.
- #define JUNG_HEX (CHO_LAST_HEX + 1)

  Location of first jungseong (will be 0x2FB)
- #define JUNG_ANCIENT_HEX (JUNG_HEX + JUNG_VARIATIONS * NJUNG_MODERN)

  Location of first ancient jungseong.
- #define JUNG_EXTB_HEX (JUNG_ANCIENT_HEX + JUNG_VARIATIONS * NJUNG_ANCIENT)

  U+D7B0 Extended-B jungseong.
- #define JUNG_LAST_HEX (JUNG_EXTB_HEX + JUNG_VARIATIONS * (NJUNG_EXTB + NJUNG_EXTB_RSRVD) - 1)

  U+D7CA Extended-B last location in .hex file, including reserved Unicode code points at end.
- #define JONG_HEX (JUNG_LAST_HEX + 1)

  Location of first jongseong (will be 0x421)
- #define JONG_ANCIENT_HEX (JONG_HEX + JONG_VARIATIONS * NJONG_MODERN)

  Location of first ancient jongseong.
- #define JONG_EXTB_HEX (JONG_ANCIENT_HEX + JONG_VARIATIONS * NJONG_ANCIENT)

  U+D7CB Extended-B jongseong.
- #define JONG_LAST_HEX (JONG_EXTB_HEX + JONG_VARIATIONS * (NJONG_EXTB + NJONG_EXTB_RSRVD) - 1)

  U+D7FF Extended-B last location in .hex file, including reserved Unicode code points at end.
- #define JAMO_HEX 0x0500

  Start of U+1100..U+11FF glyphs.
- #define JAMO_END 0x05FF

  End of U+1100..U+11FF glyphs.
- #define JAMO_EXTA_HEX 0x0600

Start of U+A960..U+A97F glyphs.

- #define JAMO_EXTA_END 0x061F

  End of U+A960..U+A97F glyphs.

- #define JAMO_EXTB_HEX 0x0620

  Start of U+D7B0..U+D7FF glyphs.

- #define JAMO_EXTB_END 0x066F

  End of U+D7B0..U+D7FF glyphs.

- #define TOTAL_CHO (NCHO_MODERN + NCHO_ANCIENT + NCHO_EXTA)
- #define TOTAL_JUNG (NJUNG_MODERN + NJUNG_ANCIENT + NJUNG_EXTB)
- #define TOTAL_JONG (NJONG_MODERN + NJONG_ANCIENT + NJONG_EXTB)

Functions

- unsigned hangul_read_base8 (FILE *infp, unsigned char base[][32])

  Read hangul-base.hex file into a unsigned char array.

- unsigned hangul_read_base16 (FILE *infp, unsigned base[][16])

  Read hangul-base.hex file into a unsigned array.

- void hangul_decompose (unsigned codept, int *initial, int *medial, int *final)

  Decompose a Hangul Syllables code point into three letters.

- unsigned hangul_compose (int initial, int medial, int final)

  Compose a Hangul syllable into a code point, or 0 if none exists.

- void hangul_hex_indices (int choseong, int jungseong, int jongseong, int *cho_index, int *jung_index, int *jong_index)

  Determine index values to the bitmaps for a syllable's components.

- void hangul_variations (int choseong, int jungseong, int jongseong, int *cho_var, int *jung_var, int *jong_var)

  Determine the variations of each letter in a Hangul syllable.

- int is_wide_vowel (int vowel)

  Whether vowel has rightmost vertical stroke to the right.

- int cho_variation (int choseong, int jungseong, int jongseong)

  Return the Johab 6/3/1 choseong variation for a syllable.

- int jung_variation (int choseong, int jungseong, int jongseong)

  Return the Johab 6/3/1 jungseong variation.

- int jong_variation (int choseong, int jungseong, int jongseong)

  Return the Johab 6/3/1 jongseong variation.

- void hangul_syllable (int choseong, int jungseong, int jongseong, unsigned char hangul_base[][32], unsigned char *syllable)

  Given letters in a Hangul syllable, return a glyph.

- int glyph_overlap (unsigned *glyph1, unsigned *glyph2)

  See if two glyphs overlap.

- void combine_glyphs (unsigned *glyph1, unsigned *glyph2, unsigned *combined_glyph)

  Combine two glyphs into one glyph.

- void one_jamo (unsigned glyph_table[MAX_GLYPHS][16], unsigned jamo, unsigned *jamo_glyph)

  Convert Hangul Jamo choseong, jungseong, and jongseong into a glyph.

- void combined_jamo (unsigned glyph_table[MAX_GLYPHS][16], unsigned cho, unsigned jung, unsigned jong, unsigned *combined_glyph)

  Convert Hangul Jamo choseong, jungseong, and jongseong into a glyph.

- void print_glyph_txt (FILE *fp, unsigned codept, unsigned *this_glyph)

  Print one glyph in Unifont hexdraw plain text style.

- void print_glyph_hex (FILE *fp, unsigned codept, unsigned *this_glyph)

  Print one glyph in Unifont hexdraw hexadecimal string style.

5.1.1 Detailed Description

Define constants and function prototypes for using Hangul glyphs.

Author

Paul Hardy

Copyright

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Definition in file hangul.h.

5.1.2 Macro Definition Documentation

5.1.2.1 CHO_ANCIENT_HEX

#define CHO_ANCIENT_HEX (CHO_HEX + CHO_VARIATIONS * NCHO_MODERN)

Location of first ancient choseong.

Definition at line 99 of file hangul.h.

5.1.2.2 CHO_EXTA_HEX

#define CHO_EXTA_HEX (CHO_ANCIENT_HEX + CHO_VARIATIONS * NCHO_ANCIENT)

U+A960 Extended-A choseong.

Definition at line 102 of file hangul.h.

5.1.2.3 CHO_EXTA_UNICODE_END

#define CHO_EXTA_UNICODE_END 0xA97C

Hangul Extended-A choseong end.

Definition at line 53 of file hangul.h.

5.1.2.4 CHO_EXTA_UNICODE_START

#define CHO_EXTA_UNICODE_START 0xA960

Hangul Extended-A choseong start.

Definition at line 52 of file hangul.h.

5.1.2.5 CHO_HEX

#define CHO_HEX 0x0001

Location of first choseong (location 0x0000 is a blank glyph)

Definition at line 96 of file hangul.h.

5.1.2.6 CHO_LAST_HEX

#define CHO_LAST_HEX (CHO_EXTA_HEX + CHO_VARIATIONS * (NCHO_EXTA + NCHO_EXTA_RSRVD) - 1)

U+A97F Extended-A last location in .hex file, including reserved Unicode code points at end.

Definition at line 105 of file hangul.h.

5.1.2.7 CHO_UNICODE_END

#define CHO_UNICODE_END 0x115E

Hangul Jamo choseong end.

Definition at line 51 of file hangul.h.

5.1.2.8 CHO_UNICODE_START

#define CHO_UNICODE_START 0x1100

Modern Hangul choseong start.

Definition at line 50 of file hangul.h.

5.1.2.9 CHO_VARIATIONS

#define CHO_VARIATIONS 6

6 choseong variations

Definition at line 88 of file hangul.h.

5.1.2.10 EXTENDED_HANGUL

#define EXTENDED_HANGUL /* Use rare Hangul code points beyond U+1100 */

Definition at line 35 of file hangul.h.

5.1.2.11 JAMO_END

#define JAMO_END 0x05FF

End of U+1100..U+11FF glyphs.

Definition at line 133 of file hangul.h.

5.1.2.12 JAMO_EXTA_END

#define JAMO_EXTA_END 0x061F

End of U+A960..U+A97F glyphs.

Definition at line 137 of file hangul.h.

5.1.2.13 JAMO_EXTA_HEX

#define JAMO_EXTA_HEX 0x0600

Start of U+A960..U+A97F glyphs.

Definition at line 136 of file hangul.h.

5.1.2.14 JAMO_EXTB_END

#define JAMO_EXTB_END 0x066F

End of U+D7B0..U+D7FF glyphs.

Definition at line 141 of file hangul.h.

5.1.2.15 JAMO_EXTB_HEX

#define JAMO_EXTB_HEX 0x0620

Start of U+D7B0..U+D7FF glyphs.

Definition at line 140 of file hangul.h.

5.1.2.16 JAMO_HEX

#define JAMO_HEX 0x0500

Start of U+1100..U+11FF glyphs.

Definition at line 132 of file hangul.h.

5.1.2.17 JONG_ANCIENT_HEX

#define JONG_ANCIENT_HEX (JONG_HEX + JONG_VARIATIONS * NJONG_MODERN)

Location of first ancient jongseong.

Definition at line 123 of file hangul.h.

5.1.2.18 JONG_EXTB_HEX

#define JONG_EXTB_HEX (JONG_ANCIENT_HEX + JONG_VARIATIONS * NJONG_ANCIENT)

U+D7CB Extended-B jongseong.

Definition at line 126 of file hangul.h.

5.1.2.19 JONG_EXTB_UNICODE_END

#define JONG_EXTB_UNICODE_END 0xD7FB

Hangul Extended-B jongseong end.

Definition at line 63 of file hangul.h.

5.1.2.20 JONG_EXTB_UNICODE_START

#define JONG_EXTB_UNICODE_START 0xD7CB

Hangul Extended-B jongseong start.

Definition at line 62 of file hangul.h.

5.1.2.21 JONG_HEX

#define JONG_HEX (JUNG_LAST_HEX + 1)

Location of first jongseong (will be 0x421)

Definition at line 120 of file hangul.h.

5.1.2.22 JONG_LAST_HEX

#define JONG_LAST_HEX (JONG_EXTB_HEX + JONG_VARIATIONS * (NJONG_EXTB + NJONG_EXTB_RSRVD) - 1)

U+D7FF Extended-B last location in .hex file, including reserved Unicode code points at end.

Definition at line 129 of file hangul.h.

5.1.2.23 JONG_UNICODE_END

#define JONG_UNICODE_END 0x11FF

Modern Hangul jongseong end.

Definition at line 61 of file hangul.h.

5.1.2.24 JONG_UNICODE_START

#define JONG_UNICODE_START 0x11A8

Modern Hangul jongseong start.

Definition at line 60 of file hangul.h.

5.1.2.25 JONG_VARIATIONS

#define JONG_VARIATIONS 1

1 jongseong variation

Definition at line 90 of file hangul.h.

5.1.2.26 JUNG_ANCIENT_HEX

#define JUNG_ANCIENT_HEX (JUNG_HEX + JUNG_VARIATIONS * NJUNG_MODERN)

Location of first ancient jungseong.

Definition at line 111 of file hangul.h.

5.1.2.27 JUNG_EXTB_HEX

#define JUNG_EXTB_HEX (JUNG_ANCIENT_HEX + JUNG_VARIATIONS * NJUNG_ANCIENT)

U+D7B0 Extended-B jungseong.

Definition at line 114 of file hangul.h.

5.1.2.28 JUNG_EXTB_UNICODE_END

#define JUNG_EXTB_UNICODE_END 0xD7C6

Hangul Extended-B jungseong end.

Definition at line 58 of file hangul.h.

5.1.2.29 JUNG_EXTB_UNICODE_START

#define JUNG_EXTB_UNICODE_START 0xD7B0

Hangul Extended-B jungseong start.

Definition at line 57 of file hangul.h.

5.1.2.30 JUNG_HEX

#define JUNG_HEX (CHO_LAST_HEX + 1)

Location of first jungseong (will be 0x2FB)

Definition at line 108 of file hangul.h.

5.1.2.31 JUNG_LAST_HEX

#define JUNG_LAST_HEX (JUNG_EXTB_HEX + JUNG_VARIATIONS * (NJUNG_EXTB + NJUNG_EXTB_RSRVD) - 1)

U+D7CA Extended-B last location in .hex file, including reserved Unicode code points at end.

Definition at line 117 of file hangul.h.

5.1.2.32 JUNG_UNICODE_END

#define JUNG_UNICODE_END 0x11A7

Modern Hangul jungseong end.

Definition at line 56 of file hangul.h.

5.1.2.33 JUNG_UNICODE_START

#define JUNG_UNICODE_START 0x1161

Modern Hangul jungseong start.

Definition at line 55 of file hangul.h.

5.1.2.34 JUNG_VARIATIONS

```
#define JUNG_VARIATIONS 3
```

3 jungseong variations

Definition at line 89 of file hangul.h.

5.1.2.35 MAX_GLYPHS

```
#define MAX_GLYPHS (PUA_END - PUA_START + 1) /* Maximum .hex file glyphs */
```

Definition at line 40 of file hangul.h.

5.1.2.36 MAXLINE

```
#define MAXLINE 256
```

Length of maximum file input line.

Definition at line 33 of file hangul.h.

5.1.2.37 NCHO_ANCIENT

```
#define NCHO_ANCIENT 76
```

ancient Hangul Jamo choseong

Definition at line 70 of file hangul.h.

5.1.2.38 NCHO_EXTA

```
#define NCHO_EXTA 29
```

Hangul Extended-A choseong.

Definition at line 71 of file hangul.h.

5.1.2.39 NCHO_EXTA_RSRVD

#define NCHO_EXTA_RSRVD 3

Reserved at end of Extended-A choseong.

Definition at line 72 of file hangul.h.

5.1.2.40 NCHO_MODERN

#define NCHO_MODERN 19

19 modern Hangul Jamo choseong

Definition at line 69 of file hangul.h.

5.1.2.41 NJONG_ANCIENT

#define NJONG_ANCIENT 61

ancient Hangul Jamo jongseong

Definition at line 80 of file hangul.h.

5.1.2.42 NJONG_EXTB

#define NJONG_EXTB 49

Hangul Extended-B jongseong.

Definition at line 81 of file hangul.h.

5.1.2.43 NJONG_EXTB_RSRVD

#define NJONG_EXTB_RSRVD 4

Reserved at end of Extended-B jonseong.

Definition at line 82 of file hangul.h.

5.1.2.44 NJONG_MODERN

#define NJONG_MODERN 27

28 modern Hangul Jamo jongseong

Definition at line 79 of file hangul.h.

5.1.2.45 NJUNG_ANCIENT

#define NJUNG_ANCIENT 50

ancient Hangul Jamo jungseong

Definition at line 75 of file hangul.h.

5.1.2.46 NJUNG_EXTB

#define NJUNG_EXTB 23

Hangul Extended-B jungseong.

Definition at line 76 of file hangul.h.

5.1.2.47 NJUNG_EXTB_RSRVD

#define NJUNG_EXTB_RSRVD 4

Reserved at end of Extended-B junseong.

Definition at line 77 of file hangul.h.

5.1.2.48 NJUNG_MODERN

#define NJUNG_MODERN 21

21 modern Hangul Jamo jungseong

Definition at line 74 of file hangul.h.

5.1.2.49 PUA_END

#define PUA_END 0xE8FF

Definition at line 39 of file hangul.h.

5.1.2.50 PUA_START

#define PUA_START 0xE000

Definition at line 38 of file hangul.h.

5.1.2.51 TOTAL_CHO

#define TOTAL_CHO (NCHO_MODERN + NCHO_ANCIENT + NCHO_EXTA)

Definition at line 150 of file hangul.h.

5.1.2.52 TOTAL_JONG

#define TOTAL_JONG (NJONG_MODERN + NJONG_ANCIENT + NJONG_EXTB)

Definition at line 152 of file hangul.h.

5.1.2.53 TOTAL_JUNG

#define TOTAL_JUNG (NJUNG_MODERN + NJUNG_ANCIENT + NJUNG_EXTB)

Definition at line 151 of file hangul.h.

5.1.3 Function Documentation

5.1.3.1 cho_variation()

```
int cho_variation (
                int choseong,
                int jungseong,
                int jongseong )
```

Return the Johab 6/3/1 choseong variation for a syllable.

This function takes the two or three (if jongseong is included) letters that comprise a syllable and determine the variation of the initial consonant (choseong).

Each choseong has 6 variations:

Variation Occurrence
0 Choseong with a vertical vowel such as "A". 1 Choseong with a horizontal vowel such as "O". 2 Choseong with a vertical and horizontal vowel such as "WA". 3 Same as variation 0, but with jongseong (final consonant). 4 Same as variation 1, but with jongseong (final consonant). Also a horizontal vowel pointing down, such as U and YU. 5 Same as variation 2, but with jongseong (final consonant). Also a horizontal vowel pointing down with vertical element, such as WEO, WE, and WI.
In addition, if the vowel is horizontal and a downward-pointing stroke as in the modern letters U, WEO, WE, WI, and YU, and in archaic letters YU-YEO, YU-YE, YU-I, araea, and araea-i, then 3 is added to the initial variation of 0 to 2, resulting in a choseong variation of 3 to 5, respectively.

Parameters

in	choseong	The 1st letter in the syllable.
in	jungseong	The 2nd letter in the syllable.
in	jongseong	The 3rd letter in the syllable.

Returns

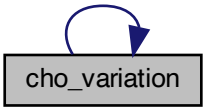
The choseong variation, 0 to 5.

Definition at line 350 of file unihangul-support.c.

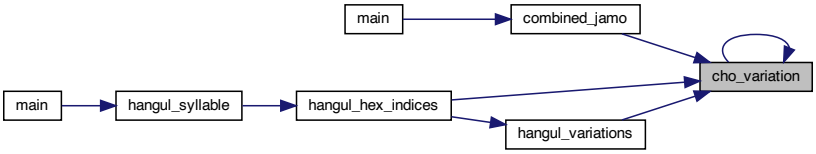
```
00350                                                   {
00351     int cho_variation;  /* Return value */
00352
00353     /*
00354 The Choseong cho_var is determined by the
00355 21 modern + 50 ancient Jungseong, and whether
```

```
00356 or not the syllable contains a final consonant
00357 (Jongseong).
00358 */
00359   static int choseong_var [TOTAL_JUNG + 1] = {
00360         /*
00361 Modern Jungseong in positions 0..20.
00362 */
00363 /* Location Variations  Unicode Range    Vowel #    Vowel Names  */
00364 /* -------- ----------  --------------   -------    ----------- */
00365 /* 0x2FB */ 0, 0, 0, // U+1161..U+1163-->[ 0.. 2]  A,   AE,  YA
00366 /* 0x304 */ 0, 0, 0, // U+1164..U+1166-->[ 3.. 5]  YAE, EO,  E
00367 /* 0x30D */ 0, 0,    // U+1167..U+1168-->[ 6.. 7]  YEO, YE
00368 /* 0x313 */ 1,       // U+1169        -->[ 8]      O
00369 /* 0x316 */ 2, 2, 2, // U+116A..U+116C-->[ 9..11]  WA,  WAE, WE
00370 /* 0x31F */ 1, 4,    // U+116D..U+116E-->[12..13]  YO,  U
00371 /* 0x325 */ 5, 5, 5, // U+116F..U+1171-->[14..16]  WEO, WE,  WI
00372 /* 0x32E */ 4, 1,    // U+1172..U+1173-->[17..18]  YU,  EU
00373 /* 0x334 */ 2,       // U+1174        -->[19]      YI
00374 /* 0x337 */ 0,       // U+1175        -->[20]      I
00375         /*
00376 Ancient Jungseong in positions 21..70.
00377 */
00378 /* Location  Variations  Unicode Range    Vowel #      Vowel Names  */
00379 /* --------  ----------  --------------   -------      ----------- */
00380 /* 0x33A: */ 2, 5, 2, // U+1176..U+1178-->[21..23]  A-O,    A-U,   YA-O
00381 /* 0x343: */ 2, 2, 5, // U+1179..U+117B-->[24..26]  YA-YO,  EO-O,  EU-U
00382 /* 0x34C: */ 2, 2, 5, // U+117C..U+117E-->[27..29]  EO-EU, YEO-O,  YEO-U
00383 /* 0x355: */ 2, 5, 5, // U+117F..U+1181-->[30..32]  O-EO,   O-E,    O-YE,
00384 /* 0x35E: */ 4, 4, 2, // U+1182..U+1184-->[33..35]  O-O,    O-U,   YO-YA,
00385 /* 0x367: */ 2, 2, 5, // U+1185..U+1187-->[36..38]  YO-YAE, YO-YEO, YO-O,
00386 /* 0x370: */ 2, 5, 5, // U+1188..U+118A-->[39..41]  YO-I,   U-A,    U-AE,
00387 /* 0x379: */ 5, 5, 5, // U+118B..U+118D-->[42..44] U-EO-EU, U-YE,   U-U,
00388 /* 0x382: */ 5, 5, 5, // U+118E..U+1190-->[45..47]  YU-A,   YU-EO,  YU-E,
00389 /* 0x38B: */ 5, 5, 2, // U+1191..U+1193-->[48..50]  YU-YEO, YU-YE,  YU-U,
00390 /* 0x394: */ 5, 2, 2, // U+1194..U+1196-->[51..53]  YU-I,   EU-U,   EU-EU,
00391 /* 0x39D: */ 2, 0, 0, // U+1197..U+1199-->[54..56]  YI-U,   I-A,    I-YA,
00392 /* 0x3A6: */ 2, 5, 2, // U+119A..U+119C-->[57..59]  I-O,    I-U,    I-EU,
00393 /* 0x3AF: */ 0, 1, 2, // U+119D..U+119F-->[60..62] I-ARAEA, ARAEA, ARAEA-EO,
00394 /* 0x3B8: */ 1, 2, 1, // U+11A0..U+11A2-->[63..65] ARAEA-U, ARAEA-I,SSANGARAEA,
00395 /* 0x3C1: */ 2, 5, 0, // U+11A3..U+11A5-->[66..68]  A-EU,   YA-U,  YEO-YA,
00396 /* 0x3CA: */ 2, 2,    // U+11A6..U+11A7-->[69..70]  O-YA,   O-YAE,
00397 #ifdef EXTENDED_HANGUL
00398 /* 0x3D0: */ 2, 4, 5, // U+D7B0..U+D7B2-->[71..73]  O-YEO,  O-O-I, YO-A,
00399 /* 0x3D9: */ 5, 2, 5, // U+D7B3..U+D7B5-->[74..76]  YO-AE,  YO-EO,  U-YEO,
00400 /* 0x3E2: */ 5, 5, 4, // U+D7B6..U+D7B8-->[77..79]  U-I-I, YU-AE,  YU-O,
00401 /* 0x3EB: */ 5, 2, 5, // U+D7B9..U+D7BB-->[80..82]  EU-A,   EU-EO,  EU-E,
00402 /* 0x3F4: */ 4, 2, 3, // U+D7BC..U+D7BE-->[83..85]  EU-O,   I-YA-O, I-YAE,
00403 /* 0x3FD: */ 3, 3, 2, // U+D7BF..U+D7C1-->[86..88]  I-YEO,  I-YE,   I-O-I,
00404 /* 0x406: */ 2, 2, 0, // U+D7C2..U+D7C4-->[89..91]  I-YO,   I-YU,   I-I,
00405 /* 0x40F: */ 2, 2,    // U+D7C5..U+D7C6-->[92..93] ARAEA-A, ARAEA-E,
00406 /* 0x415: */ -1       // Mark end of list of vowels.
00407 #else
00408 /* 0x310: */ -1       // Mark end of list of vowels.
00409 #endif
00410   };
00411
00412
00413   if (jungseong < 0 || jungseong >= TOTAL_JUNG) {
00414     cho_variation = -1;
00415   }
00416   else {
00417     cho_variation = choseong_var [jungseong];
00418     if (choseong >= 0 && jongseong >= 0 && cho_variation < 3)
00419       cho_variation += 3;
00420   }
00421
00422
00423   return cho_variation;
00424 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.1.3.2 combine_glyphs()

```
void combine_glyphs (
                unsigned * glyph1,
                unsigned * glyph2,
                unsigned * combined_glyph )
```

Combine two glyphs into one glyph.

Parameters

in	glyph1	The first glyph to overlap.
in	glyph2	The second glyph to overlap.

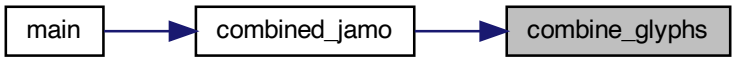
Parameters

out	combined_glyph	The returned combination glyph.

Definition at line 637 of file unihangul-support.c.

```
00638                                       {
00639     int i;
00640
00641     for (i = 0; i < 16; i++)
00642       combined_glyph [i] = glyph1 [i] | glyph2 [i];
00643
00644     return;
00645 }
```

Here is the caller graph for this function:



5.1.3.3 combined_jamo()

```
void combined_jamo (
                unsigned glyph_table[MAX_GLYPHS][16],
                unsigned cho,
                unsigned jung,
                unsigned jong,
                unsigned * combined_glyph )
```

Convert Hangul Jamo choseong, jungseong, and jongseong into a glyph.

This function converts input Hangul choseong, jungseong, and jongseong Unicode code triplets into a Hangul syllable. Any of those with an out of range code point are assigned a blank glyph for combining.

This function performs the following steps:

1) Determine the sequence number of choseong, jungseong, and jongseong, from 0 to the total number of choseong, jungseong, or jongseong, respectively, minus one. The sequence for each is as follows:

   a) Choseong: Unicode code points of U+1100..U+115E and then U+A960..U+A97C.

   b) Jungseong: Unicode code points of U+1161..U+11A7 and then U+D7B0..U+D7C6.

   c) Jongseong: Unicode code points of U+11A8..U+11FF and then U+D7CB..U+D7FB.

2) From the choseong, jungseong, and jongseong sequence number, determine the variation of choseong and jungseong (there is only one jongseong variation, although it is shifted right by one column for some vowels with a pair of long vertical strokes on the right side).

3) Convert the variation numbers for the three syllable components to index locations in the glyph array.

4) Combine the glyph array glyphs into a syllable.

Parameters

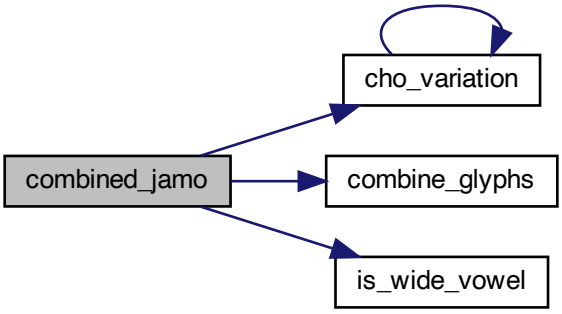
in	glyph_table	The collection of all jamo glyphs.
in	cho	The choseong Unicode code point, 0 or 0x1100..0x115F.
in	jung	The jungseong Unicode code point, 0 or 0x1160..0x11A7.
in	jong	The jongseong Unicode code point, 0 or 0x11A8..0x11FF.
out	combined_glyph	The output glyph, 16 columns in each of 16 rows.

Definition at line 787 of file unihangul-support.c.

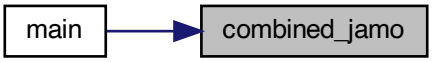
```
00789                                   {
00790
00791   int i;  /* Loop variable. */
00792   int cho_num,   jung_num,   jong_num;
00793   int cho_group, jung_group, jong_group;
00794   int cho_index, jung_index, jong_index;
00795
00796   unsigned tmp_glyph[16]; /* Hold shifted jongsung for wide vertical vowel. */
00797
00798   int  cho_variation (int choseong, int jungseong, int jongseong);
00799
00800   void combine_glyphs (unsigned *glyph1, unsigned *glyph2,
00801                        unsigned *combined_glyph);
00802
00803
00804   /* Choose a blank glyph for each syllalbe by default. */
00805   cho_index = jung_index = jong_index = 0x000;
00806
00807   /*
00808 Convert Unicode code points to jamo sequence number
00809 of each letter, or -1 if letter is not in valid range.
00810 */
00811   if (cho >= 0x1100 && cho <= 0x115E)
00812     cho_num = cho - CHO_UNICODE_START;
00813   else if (cho >= CHO_EXTA_UNICODE_START &&
00814            cho < (CHO_EXTA_UNICODE_START + NCHO_EXTA))
00815     cho_num = cho - CHO_EXTA_UNICODE_START + NCHO_MODERN + NJONG_ANCIENT;
00816   else
00817     cho_num = -1;
00818
00819   if (jung >= 0x1161 && jung <= 0x11A7)
00820     jung_num = jung - JUNG_UNICODE_START;
00821   else if (jung >= JUNG_EXTB_UNICODE_START &&
00822            jung < (JUNG_EXTB_UNICODE_START + NJUNG_EXTB))
00823     jung_num = jung - JUNG_EXTB_UNICODE_START + NJUNG_MODERN + NJUNG_ANCIENT;
00824   else
00825     jung_num = -1;
00826
00827   if (jong >= 0x11A8 && jong <= 0x11FF)
00828     jong_num = jong - JONG_UNICODE_START;
00829   else if (jong >= JONG_EXTB_UNICODE_START &&
00830            jong < (JONG_EXTB_UNICODE_START + NJONG_EXTB))
00831     jong_num = jong - JONG_EXTB_UNICODE_START + NJONG_MODERN + NJONG_ANCIENT;
00832   else
00833     jong_num = -1;
00834
00835   /*
00836 Choose initial consonant (choseong) variation based upon
00837 the vowel (jungseong) if both are specified.
00838 */
00839   if (cho_num < 0) {
00840     cho_index = cho_group = 0;  /* Use blank glyph for choseong. */
00841   }
00842   else {
00843     if (jung_num < 0 && jong_num < 0) {  /* Choseong is by itself. */
00844       cho_group = 0;
00845       if (cho_index < (NCHO_MODERN + NCHO_ANCIENT))
00846         cho_index = cho_num + JAMO_HEX;
00847       else  /* Choseong is in Hangul Jamo Extended-A range. */
00848         cho_index = cho_num - (NCHO_MODERN + NCHO_ANCIENT)
00849                             + JAMO_EXTA_HEX;
00850     }
00851     else {
00852       if (jung_num >= 0) {  /* Valid jungseong with choseong. */
00853         cho_group = cho_variation (cho_num, jung_num, jong_num);
00854       }
00855       else {  /* Invalid vowel; see if final consonant is valid. */
00856         /*
00857 If initial consonant and final consonant are specified,
00858 set cho_group to 4, which is the group tha would apply
00859 to a horizontal-only vowel such as Hangul "O", so the
00860 consonant appears full-width.
00861 */
00862         cho_group = 0;
00863         if (jong_num >= 0) {
00864           cho_group = 4;
00865         }
00866       }
00867       cho_index = CHO_HEX + CHO_VARIATIONS * cho_num +
00868                   cho_group;
00869     }  /* Choseong combined with jungseong and/or jongseong. */
```

```
00870   }  /* Valid choseong. */
00871
00872   /*
00873 Choose vowel (jungseong) variation based upon the choseong
00874 and jungseong.
00875 */
00876   jung_index = jung_group = 0;  /* Use blank glyph for jungseong. */
00877
00878   if (jung_num >= 0) {
00879     if (cho_num < 0 && jong_num < 0) {  /* Jungseong is by itself. */
00880       jung_group = 0;
00881       jung_index = jung_num + JUNG_UNICODE_START;
00882     }
00883     else {
00884       if (jong_num >= 0) {  /* If there is a final consonant. */
00885         if (jong_num == 3) /* Nieun; choose variation 3. */
00886           jung_group = 2;
00887         else
00888           jung_group = 1;
00889       }  /* Valid jongseong. */
00890       /* If valid choseong but no jongseong, choose jungseong variation 0. */
00891       else if (cho_num >= 0)
00892         jung_group = 0;
00893     }
00894     jung_index = JUNG_HEX + JUNG_VARIATIONS * jung_num + jung_group;
00895   }
00896
00897   /*
00898 Choose final consonant (jongseong) based upon whether choseong
00899 and/or jungseong are present.
00900 */
00901   if (jong_num < 0) {
00902     jong_index = jong_group = 0;  /* Use blank glyph for jongseong. */
00903   }
00904   else {  /* Valid jongseong. */
00905     if (cho_num < 0 && jung_num < 0) {  /* Jongseong is by itself. */
00906       jong_group = 0;
00907       jong_index = jung_num + 0x4A8;
00908     }
00909     else {  /* There is only one jongseong variation if combined. */
00910       jong_group = 0;
00911       jong_index = JONG_HEX + JONG_VARIATIONS * jong_num +
00912                    jong_group;
00913     }
00914   }
00915
00916   /*
00917 Now that we know the index locations for choseong, jungseong, and
00918 jongseong glyphs, combine them into one glyph.
00919 */
00920   combine_glyphs (glyph_table [cho_index], glyph_table [jung_index],
00921                   combined_glyph);
00922
00923   if (jong_index > 0) {
00924     /*
00925 If the vowel has a vertical stroke that is one column
00926 away from the right border, shift this jongseung right
00927 by one column to line up with the rightmost vertical
00928 stroke in the vowel.
00929 */
00930     if (is_wide_vowel (jung_num)) {
00931       for (i = 0; i < 16; i++) {
00932         tmp_glyph [i] = glyph_table [jong_index] [i] » 1;
00933       }
00934       combine_glyphs (combined_glyph, tmp_glyph,
00935                       combined_glyph);
00936     }
00937     else {
00938       combine_glyphs (combined_glyph, glyph_table [jong_index],
00939                       combined_glyph);
00940     }
00941   }
00942
00943   return;
00944 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.1.3.4 glyph_overlap()

```
int glyph_overlap (
                unsigned * glyph1,
                unsigned * glyph2 )
```

See if two glyphs overlap.

Parameters

in	glyph1	The first glyph, as a 16-row bitmap.

Parameters

in	glyph2	The second glyph, as a 16-row bitmap.

Returns

0 if no overlaps between glyphs, 1 otherwise.

Definition at line 613 of file unihangul-support.c.

```
00613                                                {
00614   int overlaps;  /* Return value; 0 if no overlaps, -1 if overlaps. */
00615   int i;
00616
00617   /* Check for overlaps between the two glyphs. */
00618
00619   i = 0;
00620   do {
00621     overlaps = (glyph1[i] & glyph2[i]) != 0;
00622     i++;
00623   }  while (i < 16 && overlaps == 0);
00624
00625   return overlaps;
00626 }
```

5.1.3.5 hangul_compose()

```
unsigned hangul_compose (
                int initial,
                int medial,
                int final )
```

Compose a Hangul syllable into a code point, or 0 if none exists.

This function takes three letters that can form a modern Hangul syllable and returns the corresponding Unicode Hangul Syllables code point in the range 0xAC00 to 0xD7A3.

If a three-letter combination includes one or more archaic letters, it will not map into the Hangul Syllables range. In that case, the returned code point will be 0 to indicate that no valid Hangul Syllables code point exists.

Parameters

in	initial	The first letter (choseong), 0 to 18.
in	medial	The second letter (jungseong), 0 to 20.

Parameters

in	final	The third letter (jongseong), 0 to 26 or -1 if none.

Returns

The Unicode Hangul Syllables code point, 0xAC00 to 0xD7A3.

Definition at line 201 of file unihangul-support.c.

```
00201                                           {
00202     unsigned codept;
00203
00204
00205     if (initial >= 0 && initial <= 18 &&
00206         medial  >= 0 && medial  <= 20 &&
00207         final   >= 0 && final   <= 26) {
00208
00209       codept  = 0xAC00;
00210       codept += initial * 21 * 28;
00211       codept += medial  * 28;
00212       codept += final + 1;
00213     }
00214     else {
00215       codept = 0;
00216     }
00217
00218     return codept;
00219 }
```

5.1.3.6 hangul_decompose()

```
void hangul_decompose (
                unsigned codept,
                int * initial,
                int * medial,
                int * final )
```

Decompose a Hangul Syllables code point into three letters.
Decompose a Hangul Syllables code point (U+AC00..U+D7A3) into:

- Choseong 0-19
- Jungseong 0-20
- Jongseong 0-27 or -1 if no jongseong

All letter values are set to -1 if the letters do not form a syllable in the Hangul Syllables range. This function only handles modern Hangul, because that is all that is in the Hangul Syllables range.

Parameters

in	codept	The Unicode code point to decode, from 0xAC00 to 0xD7A3.
out	initial	The 1st letter (choseong) in the syllable.
out	initial	The 2nd letter (jungseong) in the syllable.
out	initial	The 3rd letter (jongseong) in the syllable.

Definition at line 167 of file unihangul-support.c.

```
00167                                                   {
00168
00169     if (codept < 0xAC00 || codept > 0xD7A3) {
00170         *initial = *medial = *final = -1;
00171     }
00172     else {
00173         codept  -= 0xAC00;
00174         *initial =  codept / (28  * 21);
00175         *medial  = (codept /  28) % 21;
00176         *final   =  codept %  28 - 1;
00177     }
00178
00179     return;
00180 }
```

Here is the caller graph for this function:

5.1.3.7 hangul_hex_indices()

```
void hangul_hex_indices (
            int choseong,
            int jungseong,
            int jongseong,
            int * cho_index,
            int * jung_index,
            int * jong_index )
```

Determine index values to the bitmaps for a syllable's components.
This function reads these input values for modern and ancient Hangul letters:

- Choseong number (0 to the number of modern and archaic choseong - 1.
- Jungseong number (0 to the number of modern and archaic jungseong - 1.
- Jongseong number (0 to the number of modern and archaic jongseong - 1, or -1 if none.

It then determines the variation of each letter given the combination with the other two letters (or just choseong and jungseong if the jongseong value is -1).
These variations are then converted into index locations within the glyph array that was read in from the hangul-base.hex file. Those index locations can then be used to form a composite syllable.
There is no restriction to only use the modern Hangul letters.

Parameters

in	choseong	The 1st letter in the syllable.
in	jungseong	The 2nd letter in the syllable.

Parameters

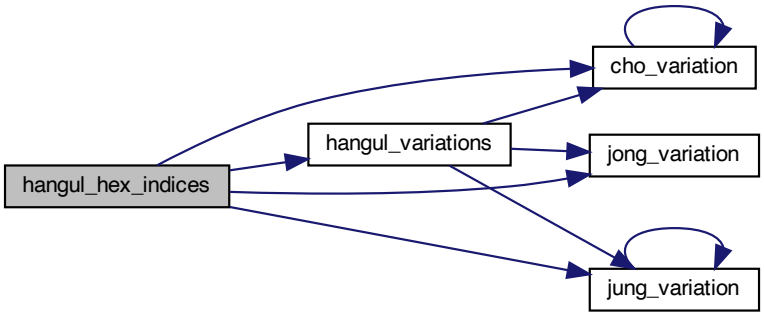
in	jongseong	The 3rd letter in the syllable, or -1 if none.
out	cho_index	Index location to the 1st letter variation from the hangul-base.hex file.
out	jung_index	Index location to the 2nd letter variation from the hangul-base.hex file.
out	jong_index	Index location to the 3rd letter variation from the hangul-base.hex file.

Definition at line 249 of file unihangul-support.c.

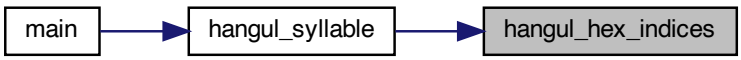
```
00250                                                   {
00251
00252     int cho_variation, jung_variation, jong_variation;  /* Letter variations */
00253
00254     void hangul_variations (int choseong, int jungseong, int jongseong,
```

```
00255           int *cho_variation, int *jung_variation, int *jong_variation);
00256
00257
00258   hangul_variations (choseong, jungseong, jongseong,
00259                      &cho_variation, &jung_variation, &jong_variation);
00260
00261    *cho_index = CHO_HEX +  choseong * CHO_VARIATIONS +  cho_variation;
00262   *jung_index = JUNG_HEX      + jungseong * JUNG_VARIATIONS      + jung_variation;;
00263   *jong_index = jongseong < 0 ? 0x0000 :
00264                 JONG_HEX + jongseong * JONG_VARIATIONS + jong_variation;
00265
00266   return;
00267 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.1.3.8 hangul_read_base16()

unsigned hangul_read_base16 (
FILE * infp,
unsigned base[][16])

Read hangul-base.hex file into a unsigned array.
Read a Hangul base .hex file with separate choseong, jungseong, and jongseong glyphs for syllable formation. The order is:

- Empty glyph in 0x0000 position.
- Initial consonants (choseong).
- Medial vowels and dipthongs (jungseong).

- Final consonants (jongseong).
- Individual letter forms in isolation, not for syllable formation.

The letters are arranged with all variations for one letter before continuing to the next letter. In the current encoding, there are 6 variations of choseong, 3 of jungseong, and 1 of jongseong per letter.

Parameters

in	Input	file pointer; can be stdin.
out	Array	of bit patterns, with 16 16-bit values per letter.

Returns

The maximum code point value read in the file.

Definition at line 116 of file unihangul-support.c.

```
00116                                           {
00117   unsigned codept;
00118   unsigned max_codept;
00119   int      i, j;
00120   char     instring[MAXLINE];
00121
00122
00123   max_codept = 0;
00124
00125   while (fgets (instring, MAXLINE, infp) != NULL) {
00126     sscanf (instring, "%X", &codept);
00127     codept -= PUA_START;
00128     /* If code point is within range, add it */
00129     if (codept < MAX_GLYPHS) {
00130       /* Find the start of the glyph bitmap. */
00131       for (i = 1; instring[i] != '\0' && instring[i] != ':'; i++);
00132       if (instring[i] == ':') {
00133         i++;  /* Skip over ':' to get to start of bitmap. */
00134         for (j = 0; j < 16; j++) {
00135           sscanf (&instring[i], "%4X", &base[codept][j]);
00136           i += 4;
00137         }
00138         if (codept > max_codept) max_codept = codept;
00139       }
00140     }
00141   }
00142
00143   return max_codept;
00144 }
```

Here is the caller graph for this function:

5.1.3.9 hangul_read_base8()

```
unsigned hangul_read_base8 (
            FILE * infp,
            unsigned char base[][32] )
```

Read hangul-base.hex file into a unsigned char array.
Read a Hangul base .hex file with separate choseong, jungseong, and jongseong glyphs for syllable formation. The order is:

- Empty glyph in 0x0000 position.
- Initial consonants (choseong).
- Medial vowels and dipthongs (jungseong).
- Final consonants (jongseong).
- Individual letter forms in isolation, not for syllable formation.

The letters are arranged with all variations for one letter before continuing to the next letter. In the current encoding, there are 6 variations of choseong, 3 of jungseong, and 1 of jongseong per letter.

Parameters

in	Input	file pointer; can be stdin.
out	Array	of bit patterns, with 32 8-bit values per letter.

Returns

The maximum code point value read in the file.

Definition at line 63 of file unihangul-support.c.

```
00063                                           {
00064   unsigned codept;
00065   unsigned max_codept;
00066   int      i, j;
00067   char     instring[MAXLINE];
00068
00069
00070   max_codept = 0;
00071
00072   while (fgets (instring, MAXLINE, infp) != NULL) {
00073     sscanf (instring, "%X", &codept);
00074     codept -= PUA_START;
00075     /* If code point is within range, add it */
00076     if (codept < MAX_GLYPHS) {
00077       /* Find the start of the glyph bitmap. */
00078       for (i = 1; instring[i] != '\0' && instring[i] != ':'; i++);
00079       if (instring[i] == ':') {
00080         i++;  /* Skip over ':' to get to start of bitmap. */
00081         for (j = 0; j < 32; j++) {
00082           sscanf (&instring[i], "%2hhX", &base[codept][j]);
00083           i += 2;
00084         }
00085         if (codept > max_codept) max_codept = codept;
00086       }
00087     }
00088   }
00089
00090   return max_codept;
00091 }
```

Here is the caller graph for this function:

5.1.3.10 hangul_syllable()

```
void hangul_syllable (
                int choseong,
                int jungseong,
                int jongseong,
                unsigned char hangul_base[][32],
                unsigned char * syllable )
```

Given letters in a Hangul syllable, return a glyph.

This function returns a glyph bitmap comprising up to three Hangul letters that form a syllable. It reads the three component letters (choseong, jungseong, and jungseong), then calls a function that determines the appropriate variation of each letter, returning the letter bitmap locations in the glyph array. Then these letter bitmaps are combined with a logical OR operation to produce a final bitmap, which forms a 16 row by 16 column bitmap glyph.

Parameters

in	choseong	The 1st letter in the composite glyph.
in	jungseong	The 2nd letter in the composite glyph.
in	jongseong	The 3rd letter in the composite glyph.
in	hangul_base	The glyphs read from the "hangul_base.hex" file.

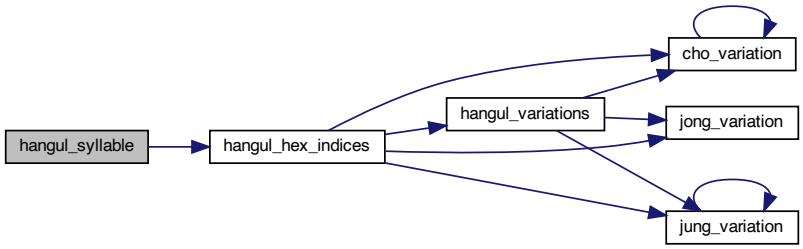
Returns

syllable The composite syllable, as a 16 by 16 pixel bitmap.

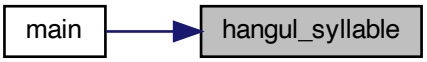
Definition at line 583 of file unihangul-support.c.

```
00584                                                   {
00585
00586     int       i;  /* loop variable */
00587     int       cho_hex, jung_hex, jong_hex;
00588     unsigned char glyph_byte;
00589
00590
00591     hangul_hex_indices (choseong, jungseong, jongseong,
00592                         &cho_hex, &jung_hex, &jong_hex);
00593
00594     for (i = 0; i < 32; i++) {
00595       glyph_byte  = hangul_base [cho_hex][i];
00596       glyph_byte |= hangul_base [jung_hex][i];
00597       if (jong_hex >= 0) glyph_byte |= hangul_base [jong_hex][i];
00598       syllable[i] = glyph_byte;
00599     }
00600
00601     return;
00602 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.1.3.11 hangul_variations()

```
void hangul_variations (
            int choseong,
            int jungseong,
            int jongseong,
            int * cho_var,
            int * jung_var,
            int * jong_var )
```

Determine the variations of each letter in a Hangul syllable.
Given the three letters that will form a syllable, return the variation of each letter used to form the composite glyph.
This function can determine variations for both modern and archaic Hangul letters; it is not limited to only the letters combinations that comprise the Unicode Hangul Syllables range.
This function reads these input values for modern and ancient Hangul letters:

- Choseong number (0 to the number of modern and archaic choseong - 1.
- Jungseong number (0 to the number of modern and archaic jungseong - 1.
- Jongseong number (0 to the number of modern and archaic jongseong - 1, or -1 if none.

It then determines the variation of each letter given the combination with the other two letters (or just choseong and jungseong if the jongseong value is -1).

Parameters

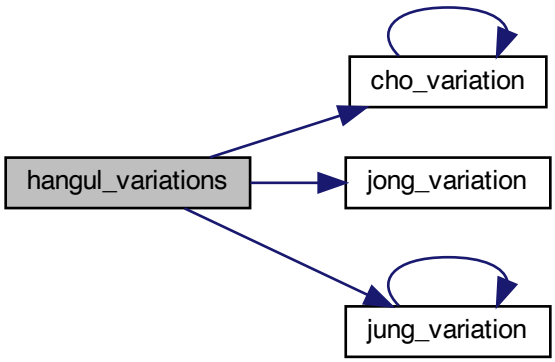
in	choseong	The 1st letter in the syllable.
in	jungseong	The 2nd letter in the syllable.
in	jongseong	The 3rd letter in the syllable, or -1 if none.
out	cho_var	Variation of the 1st letter from the hangul-base.hex file.
out	jung_var	Variation of the 2nd letter from the hangul-base.hex file.
out	jong_var	Variation of the 3rd letter from the hangul-base.hex file.

Definition at line 298 of file unihangul-support.c.

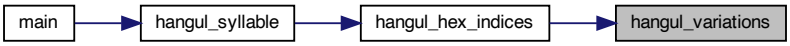
```
00299                                                   {
00300
00301     int  cho_variation (int choseong, int jungseong, int jongseong);
00302     int jung_variation (int choseong, int jungseong, int jongseong);
```

```
00303    int jong_variation (int choseong, int jungseong, int jongseong);
00304
00305    /*
00306 Find the variation for each letter component.
00307 */
00308     *cho_var =  cho_variation (choseong, jungseong, jongseong);
00309    *jung_var = jung_variation (choseong, jungseong, jongseong);
00310    *jong_var = jong_variation (choseong, jungseong, jongseong);
00311
00312
00313    return;
00314 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.1.3.12 is_wide_vowel()

int is_wide_vowel (
int vowel)

Whether vowel has rightmost vertical stroke to the right.

Parameters

in	vowel	Vowel number, from 0 to TOTAL_JUNG - 1.

Returns

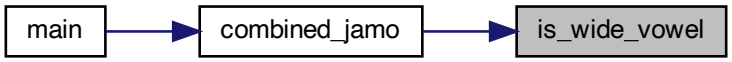
1 if this vowel's vertical stroke is wide on the right side; else 0.

Definition at line 434 of file unihangul-support.c.

```
00434                       {
00435   int retval;  /* Return value. */
00436
00437   static int wide_vowel [TOTAL_JUNG + 1] = {
00438         /*
00439 Modern Jungseong in positions 0..20.
00440 */
00441 /* Location Variations  Unicode Range    Vowel #    Vowel Names  */
00442 /* -------- ----------  --------------   -------    ----------- */
00443 /* 0x2FB */ 0, 1, 0, // U+1161..U+1163-->[ 0.. 2]  A,   AE,  YA
00444 /* 0x304 */ 1, 0, 1, // U+1164..U+1166-->[ 3.. 5]  YAE, EO,  E
00445 /* 0x30D */ 0, 1,    // U+1167..U+1168-->[ 6.. 7]  YEO, YE
00446 /* 0x313 */ 0,       // U+1169       -->[ 8]       O
00447 /* 0x316 */ 0, 1, 0, // U+116A..U+116C-->[ 9..11]  WA,  WAE, WE
00448 /* 0x31F */ 0, 0,    // U+116D..U+116E-->[12..13]  YO,  U
00449 /* 0x325 */ 0, 1, 0, // U+116F..U+1171-->[14..16]  WEO, WE,  WI
00450 /* 0x32E */ 0, 0,    // U+1172..U+1173-->[17..18]  YU,  EU
00451 /* 0x334 */ 0,       // U+1174       -->[19]       YI
00452 /* 0x337 */ 0,       // U+1175       -->[20]       I
00453         /*
00454 Ancient Jungseong in positions 21..70.
00455 */
00456 /* Location  Variations  Unicode Range    Vowel #       Vowel Names  */
00457 /* --------  ----------  --------------   -------       ----------- */
00458 /* 0x33A: */ 0, 0, 0, // U+1176..U+1178-->[21..23]   A-O,    A-U,   YA-O
00459 /* 0x343: */ 0, 0, 0, // U+1179..U+117B-->[24..26]   YA-YO,  EO-O,  EU-U
00460 /* 0x34C: */ 0, 0, 0, // U+117C..U+117E-->[27..29]   EO-EU, YEO-O,  YEO-U
00461 /* 0x355: */ 0, 1, 1, // U+117F..U+1181-->[30..32]   O-EO,   O-E,    O-YE,
00462 /* 0x35E: */ 0, 0, 0, // U+1182..U+1184-->[33..35]   O-O,    O-U,   YO-YA,
00463 /* 0x367: */ 1, 0, 0, // U+1185..U+1187-->[36..38]   YO-YAE, YO-YEO, YO-O,
00464 /* 0x370: */ 0, 0, 1, // U+1188..U+118A-->[39..41]   YO-I,   U-A,   U-AE,
00465 /* 0x379: */ 0, 1, 0, // U+118B..U+118D-->[42..44]  U-EO-EU,  U-YE,  U-U,
00466 /* 0x382: */ 0, 0, 1, // U+118E..U+1190-->[45..47]   YU-A,   YU-EO,  YU-E,
00467 /* 0x38B: */ 0, 1, 0, // U+1191..U+1193-->[48..50]   YU-YEO, YU-YE,  YU-U,
00468 /* 0x394: */ 0, 0, 0, // U+1194..U+1196-->[51..53]   YU-I,   EU-U,   EU-EU,
00469 /* 0x39D: */ 0, 0, 0, // U+1197..U+1199-->[54..56]   YI-U,   I-A,    I-YA,
00470 /* 0x3A6: */ 0, 0, 0, // U+119A..U+119C-->[57..59]   I-O,    I-U,    I-EU,
00471 /* 0x3AF: */ 0, 0, 0, // U+119D..U+119F-->[60..62] I-ARAEA, ARAEA, ARAEA-EO,
00472 /* 0x3B8: */ 0, 0, 0, // U+11A0..U+11A2-->[63..65] ARAEA-U, ARAEA-I,SSANGARAEA,
00473 /* 0x3C1: */ 0, 0, 0, // U+11A3..U+11A5-->[66..68]   A-EU,  YA-U,  YEO-YA,
00474 /* 0x3CA: */ 0, 1,    // U+11A6..U+11A7-->[69..70]   O-YA,   O-YAE
00475 #ifdef EXTENDED_HANGUL
00476 /* 0x3D0: */ 0, 0, 0, // U+D7B0..U+D7B2-->[71..73]   O-YEO,  O-O-I, YO-A,
00477 /* 0x3D9: */ 1, 0, 0, // U+D7B3..U+D7B5-->[74..76]   YO-AE,  YO-EO,  U-YEO,
00478 /* 0x3E2: */ 1, 1, 0, // U+D7B6..U+D7B8-->[77..79]   U-I-I, YU-AE,  YU-O,
00479 /* 0x3EB: */ 0, 0, 1, // U+D7B9..U+D7BB-->[80..82]   EU-A,   EU-EO,  EU-E,
00480 /* 0x3F4: */ 0, 0, 1, // U+D7BC..U+D7BE-->[83..85]   EU-O,   I-YA-O, I-YAE,
00481 /* 0x3FD: */ 0, 1, 0, // U+D7BF..U+D7C1-->[86..88]   I-YEO,  I-YE,   I-O-I,
00482 /* 0x406: */ 0, 0, 1, // U+D7C2..U+D7C4-->[89..91]   I-YO,   I-YU,   I-I,
00483 /* 0x40F: */ 0, 1,    // U+D7C5..U+D7C6-->[92..93] ARAEA-A, ARAEA-E,
00484 /* 0x415: */ -1       // Mark end of list of vowels.
00485 #else
00486 /* 0x310: */ -1       // Mark end of list of vowels.
00487 #endif
00488   };
00489
00490
00491   if (vowel >= 0 && vowel < TOTAL_JUNG) {
```

```
00492       retval = wide_vowel [vowel];
00493     }
00494     else {
00495       retval = 0;
00496     }
00497
00498
00499     return retval;
00500 }
```

Here is the caller graph for this function:



5.1.3.13 jong_variation()

```
int jong_variation (
                int choseong,
                int jungseong,
                int jongseong )   [inline]
```

Return the Johab 6/3/1 jongseong variation.

There is only one jongseong variation, so this function always returns 0. It is a placeholder function for possible future adaptation to other johab encodings.

Parameters

in	choseong	The 1st letter in the syllable.
in	jungseong	The 2nd letter in the syllable.
in	jongseong	The 3rd letter in the syllable.

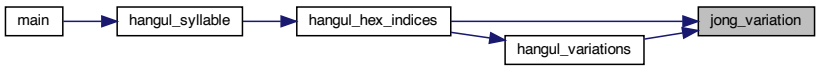
Returns

The jongseong variation, always 0.

Definition at line 558 of file unihangul-support.c.

```
00558                                       {
00559
00560     return 0;  /* There is only one Jongseong variation. */
00561 }
```

Here is the caller graph for this function:



5.1.3.14 jung_variation()

```
int jung_variation (
            int choseong,
            int jungseong,
            int jongseong )   [inline]
```

Return the Johab 6/3/1 jungseong variation.

This function takes the two or three (if jongseong is included) letters that comprise a syllable and determine the variation of the vowel (jungseong).

Each jungseong has 3 variations:

Variation Occurrence

0 Jungseong with only chungseong (no jungseong). 1 Jungseong with chungseong and jungseong (except nieun). 2 Jungseong with chungseong and jungseong nieun.

Parameters

in	choseong	The 1st letter in the syllable.
in	jungseong	The 2nd letter in the syllable.
in	jongseong	The 3rd letter in the syllable.

Returns

The jungseong variation, 0 to 2.

Definition at line 524 of file unihangul-support.c.

```
00524                                                {
00525   int jung_variation;  /* Return value */
00526
00527   if (jungseong < 0) {
00528     jung_variation = -1;
00529   }
00530   else {
00531     jung_variation = 0;
00532     if (jongseong >= 0) {
00533       if (jongseong == 3)
00534         jung_variation = 2;  /* Vowel for final Nieun. */
00535       else
00536         jung_variation = 1;
00537     }
00538   }
00539
00540
00541   return jung_variation;
00542 }
```

Here is the call graph for this function:

Here is the caller graph for this function:

5.1.3.15 one_jamo()

```
void one_jamo (
            unsigned glyph_table[MAX_GLYPHS][16],
            unsigned jamo,
            unsigned * jamo_glyph )
```

Convert Hangul Jamo choseong, jungseong, and jongseong into a glyph.

Parameters

in	glyph_table	The collection of all jamo glyphs.
in	jamo	The Unicode code point, 0 or 0x1100..0x115F.
out	jamo_glyph	The output glyph, 16 columns in each of 16 rows.

Definition at line 717 of file unihangul-support.c.

```
00718                                       {
00719
00720     int i;  /* Loop variable */
00721     int glyph_index;  /* Location of glyph in "hangul-base.hex" array */
00722
00723
00724     /* If jamo is invalid range, use blank glyph, */
00725     if (jamo >= 0x1100 && jamo <= 0x11FF) {
00726       glyph_index = jamo - 0x1100 + JAMO_HEX;
00727     }
00728     else if (jamo >= 0xA960 && jamo <= 0xA97F) {
00729       glyph_index = jamo - 0xA960 + JAMO_EXTA_HEX;
00730     }
00731     else if (jamo >= 0xD7B0 && jamo <= 0xD7FF) {
00732       glyph_index = jamo - 0x1100 + JAMO_EXTB_HEX;
00733     }
00734     else {
00735       glyph_index = 0;
00736     }
00737
00738     for (i = 0; i < 16; i++) {
00739       jamo_glyph [i] = glyph_table [glyph_index] [i];
00740     }
00741
00742     return;
00743 }
```

5.1.3.16 print_glyph_hex()

```
void print_glyph_hex (
                FILE * fp,
                unsigned codept,
                unsigned * this_glyph )
```

Print one glyph in Unifont hexdraw hexadecimal string style.

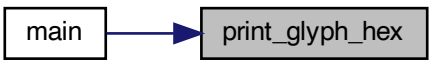
Parameters

in	fp	The file pointer for output.
in	codept	The Unicode code point to print with the glyph.
in	this_glyph	The 16-row by 16-column glyph to print.

Definition at line 692 of file unihangul-support.c.

```
00692                                                   {
00693
00694     int i;
00695
00696
00697     fprintf (fp, "%04X:", codept);
00698
00699     /* for each this_glyph row */
00700     for (i = 0; i < 16; i++) {
00701       fprintf (fp, "%04X", this_glyph[i]);
00702     }
00703     fputc ('\n', fp);
00704
00705     return;
00706 }
```

Here is the caller graph for this function:



5.1.3.17 print_glyph_txt()

```
void print_glyph_txt (
                FILE * fp,
                unsigned codept,
                unsigned * this_glyph )
```

Print one glyph in Unifont hexdraw plain text style.

Parameters

in	fp	The file pointer for output.
in	codept	The Unicode code point to print with the glyph.
in	this_glyph	The 16-row by 16-column glyph to print.

Definition at line 656 of file unihangul-support.c.

```
00656                                                   {
00657     int i;
00658     unsigned mask;
00659
00660
00661     fprintf (fp, "%04X:", codept);
00662
00663     /* for each this_glyph row */
00664     for (i = 0; i < 16; i++) {
00665       mask = 0x8000;
00666       fputc ('\t', fp);
00667       while (mask != 0x0000) {
00668         if (mask & this_glyph [i]) {
00669           fputc ('#', fp);
00670         }
00671         else {
00672           fputc ('-', fp);
00673         }
00674         mask >>= 1;  /* shift to next bit in this_glyph row */
00675       }
00676       fputc ('\n', fp);
00677     }
00678     fputc ('\n', fp);
00679
00680     return;
00681 }
```

5.2 hangul.h

Go to the documentation of this file.

```
00001 /**
00002 @file hangul.h
00003
00004 @brief Define constants and function prototypes for using Hangul glyphs.
00005
00006 @author Paul Hardy
00007
00008 @copyright Copyright © 2023 Paul Hardy
00009 */
00010 /*
00011 LICENSE:
00012
00013 This program is free software: you can redistribute it and/or modify
00014 it under the terms of the GNU General Public License as published by
00015 the Free Software Foundation, either version 2 of the License, or
00016 (at your option) any later version.
00017
00018 This program is distributed in the hope that it will be useful,
00019 but WITHOUT ANY WARRANTY; without even the implied warranty of
00020 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
00021 GNU General Public License for more details.
00022
00023 You should have received a copy of the GNU General Public License
00024 along with this program.  If not, see <http://www.gnu.org/licenses/>.
00025 */
00026
00027 #ifndef _HANGUL_H_
00028 #define _HANGUL_H_
00029
00030 #include <stdlib.h>
00031
00032
00033 #define MAXLINE     256 ///< Length of maximum file input line.
00034
00035 #define EXTENDED_HANGUL /* Use rare Hangul code points beyond U+1100 */
00036
00037 /* Definitions to move Hangul .hex file contents into the Private Use Area. */
00038 #define PUA_START   0xE000
00039 #define PUA_END     0xE8FF
00040 #define MAX_GLYPHS  (PUA_END - PUA_START + 1) /* Maximum .hex file glyphs */
00041
00042 /*
00043 Unicode ranges for Hangul choseong, jungseong, and jongseong.
00044
00045 U+1100..U+11FF is the main range of modern and ancient Hangul jamo.
00046 U+A960..U+A97C is the range for extended Hangul choseong.
00047 U+D7B0..U+D7C6 is the range for extended Hangul jungseong.
00048 U+D7CB..U+D7FB is the range for extended Hangul jongseong.
00049 */
00050 #define CHO_UNICODE_START   0x1100  ///< Modern Hangul choseong start
00051 #define CHO_UNICODE_END     0x115E  ///< Hangul Jamo choseong end
00052 #define CHO_EXTA_UNICODE_START  0xA960  ///< Hangul Extended-A choseong start
00053 #define CHO_EXTA_UNICODE_END    0xA97C  ///< Hangul Extended-A choseong end
00054
00055 #define JUNG_UNICODE_START  0x1161  ///< Modern Hangul jungseong start
00056 #define JUNG_UNICODE_END    0x11A7  ///< Modern Hangul jungseong end
00057 #define JUNG_EXTB_UNICODE_START 0xD7B0  ///< Hangul Extended-B jungseong start
00058 #define JUNG_EXTB_UNICODE_END   0xD7C6  ///< Hangul Extended-B jungseong end
00059
00060 #define JONG_UNICODE_START  0x11A8  ///< Modern Hangul jongseong start
00061 #define JONG_UNICODE_END    0x11FF  ///< Modern Hangul jongseong end
00062 #define JONG_EXTB_UNICODE_START 0xD7CB  ///< Hangul Extended-B jongseong start
00063 #define JONG_EXTB_UNICODE_END   0xD7FB  ///< Hangul Extended-B jongseong end
00064
00065
00066 /*
00067 Number of modern and ancient letters in hangul-base.hex file.
00068 */
00069 #define NCHO_MODERN  19 ///< 19 modern Hangul Jamo choseong
00070 #define NCHO_ANCIENT     76 ///< ancient Hangul Jamo choseong
00071 #define NCHO_EXTA    29 ///< Hangul Extended-A choseong
00072 #define NCHO_EXTA_RSRVD   3 ///< Reserved at end of Extended-A choseong
00073
00074 #define NJUNG_MODERN     21 ///< 21 modern Hangul Jamo jungseong
00075 #define NJUNG_ANCIENT    50 ///< ancient Hangul Jamo jungseong
00076 #define NJUNG_EXTB   23 ///< Hangul Extended-B jungseong
00077 #define NJUNG_EXTB_RSRVD  4 ///< Reserved at end of Extended-B junseong
```

```
00078
00079 #define NJONG_MODERN     27 ///< 28 modern Hangul Jamo jongseong
00080 #define NJONG_ANCIENT    61 ///< ancient Hangul Jamo jongseong
00081 #define NJONG_EXTB   49 ///< Hangul Extended-B jongseong
00082 #define NJONG_EXTB_RSRVD  4 ///< Reserved at end of Extended-B jonseong
00083
00084
00085 /*
00086 Number of variations of each component in a Johab 6/3/1 arrangement.
00087 */
00088 #define CHO_VARIATIONS  6   ///< 6 choseong variations
00089 #define JUNG_VARIATIONS 3   ///< 3 jungseong variations
00090 #define JONG_VARIATIONS 1   ///< 1 jongseong variation
00091
00092 /*
00093 Starting positions in the hangul-base.hex file for each component.
00094 */
00095 /// Location of first choseong (location 0x0000 is a blank glyph)
00096 #define CHO_HEX      0x0001
00097
00098 /// Location of first ancient choseong
00099 #define CHO_ANCIENT_HEX (CHO_HEX         + CHO_VARIATIONS * NCHO_MODERN)
00100
00101 /// U+A960 Extended-A choseong
00102 #define CHO_EXTA_HEX    (CHO_ANCIENT_HEX + CHO_VARIATIONS * NCHO_ANCIENT)
00103
00104 /// U+A97F Extended-A last location in .hex file, including reserved Unicode code points at end
00105 #define CHO_LAST_HEX    (CHO_EXTA_HEX    + CHO_VARIATIONS * (NCHO_EXTA + NCHO_EXTA_RSRVD) - 1)
00106
00107 /// Location of first jungseong (will be 0x2FB)
00108 #define JUNG_HEX    (CHO_LAST_HEX + 1)
00109
00110 /// Location of first ancient jungseong
00111 #define JUNG_ANCIENT_HEX (JUNG_HEX         + JUNG_VARIATIONS * NJUNG_MODERN)
00112
00113 /// U+D7B0 Extended-B jungseong
00114 #define JUNG_EXTB_HEX    (JUNG_ANCIENT_HEX + JUNG_VARIATIONS * NJUNG_ANCIENT)
00115
00116 /// U+D7CA Extended-B last location in .hex file, including reserved Unicode code points at end
00117 #define JUNG_LAST_HEX   (JUNG_EXTB_HEX     + JUNG_VARIATIONS * (NJUNG_EXTB +
      NJUNG_EXTB_RSRVD) - 1)
00118
00119 /// Location of first jongseong (will be 0x421)
00120 #define JONG_HEX     (JUNG_LAST_HEX + 1)
00121
00122 /// Location of first ancient jongseong
00123 #define JONG_ANCIENT_HEX (JONG_HEX         + JONG_VARIATIONS * NJONG_MODERN)
00124
00125 /// U+D7CB Extended-B jongseong
00126 #define JONG_EXTB_HEX    (JONG_ANCIENT_HEX + JONG_VARIATIONS * NJONG_ANCIENT)
00127
00128 /// U+D7FF Extended-B last location in .hex file, including reserved Unicode code points at end
00129 #define JONG_LAST_HEX   (JONG_EXTB_HEX     + JONG_VARIATIONS * (NJONG_EXTB +
      NJONG_EXTB_RSRVD) - 1)
00130
00131 /* Common modern and ancient Hangul Jamo range */
00132 #define JAMO_HEX    0x0500  ///< Start of U+1100..U+11FF glyphs
00133 #define JAMO_END    0x05FF  ///< End   of U+1100..U+11FF glyphs
00134
00135 /* Hangul Jamo Extended-A range */
00136 #define JAMO_EXTA_HEX   0x0600  ///< Start of U+A960..U+A97F glyphs
00137 #define JAMO_EXTA_END   0x061F  ///< End   of U+A960..U+A97F glyphs
00138
00139 /* Hangul Jamo Extended-B range */
00140 #define JAMO_EXTB_HEX   0x0620  ///< Start of U+D7B0..U+D7FF glyphs
00141 #define JAMO_EXTB_END   0x066F  ///< End   of U+D7B0..U+D7FF glyphs
00142
00143 /*
00144 These values allow enumeration of all modern and ancient letters.
00145
00146 If RARE_HANGUL is defined, include Hangul code points above U+11FF.
00147 */
00148 #ifdef EXTENDED_HANGUL
00149
00150 #define TOTAL_CHO   (NCHO_MODERN  + NCHO_ANCIENT  + NCHO_EXTA )
00151 #define TOTAL_JUNG      (NJUNG_MODERN + NJUNG_ANCIENT + NJUNG_EXTB)
00152 #define TOTAL_JONG  (NJONG_MODERN + NJONG_ANCIENT + NJONG_EXTB)
00153
00154 #else
00155
00156 #define TOTAL_CHO   (NCHO_MODERN  + NCHO_ANCIENT )
```

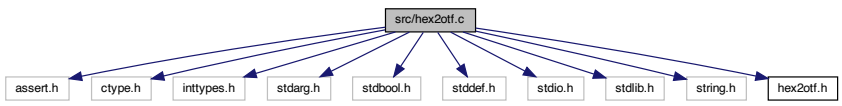
```
00157 #define TOTAL_JUNG      (NJUNG_MODERN + NJUNG_ANCIENT)
00158 #define TOTAL_JONG  (NJONG_MODERN + NJONG_ANCIENT)
00159
00160 #endif
00161
00162
00163 /*
00164 Function Prototypes.
00165 */
00166
00167 unsigned hangul_read_base8  (FILE *infp,  unsigned char base[][32]);
00168 unsigned hangul_read_base16 (FILE *infp, unsigned base[][16]);
00169
00170 void     hangul_decompose (unsigned codept,
00171                            int *initial, int *medial, int *final);
00172 unsigned hangul_compose   (int initial, int medial, int final);
00173
00174 void hangul_hex_indices (int choseong, int jungseong, int jongseong,
00175                          int *cho_index, int *jung_index, int *jong_index);
00176 void hangul_variations (int choseong, int jungseong, int jongseong,
00177                         int *cho_var, int *jung_var, int *jong_var);
00178 int is_wide_vowel  (int vowel);
00179 int  cho_variation (int choseong, int jungseong, int jongseong);
00180 int jung_variation (int choseong, int jungseong, int jongseong);
00181 int jong_variation (int choseong, int jungseong, int jongseong);
00182
00183 void hangul_syllable (int choseong, int jungseong, int jongseong,
00184                       unsigned char hangul_base[][32], unsigned char *syllable);
00185 int glyph_overlap (unsigned *glyph1, unsigned *glyph2);
00186 void combine_glyphs (unsigned *glyph1, unsigned *glyph2,
00187                      unsigned *combined_glyph);
00188 void one_jamo (unsigned glyph_table [MAX_GLYPHS][16],
00189                unsigned jamo, unsigned *jamo_glyph);
00190 void combined_jamo (unsigned glyph_table [MAX_GLYPHS][16],
00191                     unsigned cho, unsigned jung, unsigned jong,
00192                     unsigned *combined_glyph);
00193 void print_glyph_txt (FILE *fp, unsigned codept, unsigned *this_glyph);
00194 void print_glyph_hex (FILE *fp, unsigned codept, unsigned *this_glyph);
00195
00196
00197 #endif
```

5.3 src/hex2otf.c File Reference

hex2otf - Convert GNU Unifont .hex file to OpenType font

```
#include <assert.h>
#include <ctype.h>
#include <inttypes.h>
#include <stdarg.h>
#include <stdbool.h>
#include <stddef.h>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include "hex2otf.h"
```

Include dependency graph for hex2otf.c:



Data Structures

- struct Buffer

  Generic data structure for a linked list of buffer elements.
- struct Glyph

  Data structure to hold data for one bitmap glyph.
- struct Font

  Data structure to hold information for one font.
- struct Table

  Data structure for an OpenType table.
- struct TableRecord

  Data structure for data associated with one OpenType table.
- struct Options

  Data structure to hold options for OpenType font output.

Macros

- #define VERSION "1.0.1"

  Program version, for "--version" option.
- #define U16MAX 0xffff

  Maximum UTF-16 code point value.
- #define U32MAX 0xffffffff

  Maximum UTF-32 code point value.
- #define PRI_CP "U+%.4"PRIXFAST32

  Format string to print Unicode code point.
- #define static_assert(a, b) (assert(a))

  If "a" is true, return string "b".
- #define BX(shift, x) ((uintmax_t)(!!(x)) << (shift))

  Truncate & shift word.
- #define B0(shift) BX((shift), 0)

  Clear a given bit in a word.
- #define B1(shift) BX((shift), 1)

  Set a given bit in a word.
- #define GLYPH_MAX_WIDTH 16

  Maximum glyph width, in pixels.
- #define GLYPH_HEIGHT 16

  Maximum glyph height, in pixels.
- #define GLYPH_MAX_BYTE_COUNT (GLYPH_HEIGHT * GLYPH_MAX_WIDTH / 8)

  Number of bytes to represent one bitmap glyph as a binary array.
- #define DESCENDER 2

  Count of pixels below baseline.
- #define ASCENDER (GLYPH_HEIGHT - DESCENDER)

  Count of pixels above baseline.
- #define FUPEM 64

  Font units per em.
- #define MAX_GLYPHS 65536

  An OpenType font has at most 65536 glyphs.
- #define MAX_NAME_IDS 256

Name IDs 0-255 are used for standard names.

- #define FU(x) ((x) * FUPEM / GLYPH_HEIGHT)

  Convert pixels to font units.
- #define PW(x) ((x) / (GLYPH_HEIGHT / 8))

  Convert glyph byte count to pixel width.
- #define defineStore(name, type)

  Temporary define to look up an element in an array of given type.
- #define addByte(shift)
- #define getRowBit(rows, x, y) ((rows)[(y)] & x0 >> (x))
- #define flipRowBit(rows, x, y) ((rows)[(y)] ^= x0 >> (x))
- #define stringCount (sizeof strings / sizeof *strings)
- #define cacheCFF32(buf, x) (cacheU8 ((buf), 29), cacheU32 ((buf), (x)))

Typedefs

- typedef unsigned char byte

  Definition of "byte" type as an unsigned char.
- typedef int_least8_t pixels_t

  This type must be able to represent max(GLYPH_MAX_WIDTH, GLYPH_HEIGHT).
- typedef struct Buffer Buffer

  Generic data structure for a linked list of buffer elements.
- typedef const char * NameStrings[MAX_NAME_IDS]

  Array of OpenType names indexed directly by Name IDs.
- typedef struct Glyph Glyph

  Data structure to hold data for one bitmap glyph.
- typedef struct Font Font

  Data structure to hold information for one font.
- typedef struct Table Table

  Data structure for an OpenType table.
- typedef struct Options Options

  Data structure to hold options for OpenType font output.

Enumerations

- enum LocaFormat { LOCA_OFFSET16 = 0 , LOCA_OFFSET32 = 1 }

  Index to Location ("loca") offset information.
- enum ContourOp { OP_CLOSE , OP_POINT }

  Specify the current contour drawing operation.
- enum FillSide { FILL_LEFT , FILL_RIGHT }

  Fill to the left side (CFF) or right side (TrueType) of a contour.

Functions

- void fail (const char *reason,...)

  Print an error message on stderr, then exit.
- void initBuffers (size_t count)

  Initialize an array of buffer pointers to all zeroes.
- void cleanBuffers ()

  Free all allocated buffer pointers.

- Buffer * newBuffer (size_t initialCapacity)

  Create a new buffer.
- void ensureBuffer (Buffer *buf, size_t needed)

  Ensure that the buffer has at least the specified minimum size.
- void freeBuffer (Buffer *buf)

  Free the memory previously allocated for a buffer.
- defineStore (storeU8, uint_least8_t)
- void cacheU8 (Buffer *buf, uint_fast8_t value)

  Append one unsigned byte to the end of a byte array.
- void cacheU16 (Buffer *buf, uint_fast16_t value)

  Append two unsigned bytes to the end of a byte array.
- void cacheU32 (Buffer *buf, uint_fast32_t value)

  Append four unsigned bytes to the end of a byte array.
- void cacheCFFOperand (Buffer *buf, int_fast32_t value)

  Cache charstring number encoding in a CFF buffer.
- void cacheZeros (Buffer *buf, size_t count)

  Append 1 to 4 bytes of zeroes to a buffer, for padding.
- void cacheBytes (Buffer *restrict buf, const void *restrict src, size_t count)

  Append a string of bytes to a buffer.
- void cacheBuffer (Buffer *restrict bufDest, const Buffer *restrict bufSrc)

  Append bytes of a table to a byte buffer.
- void writeBytes (const byte bytes[], size_t count, FILE *file)

  Write an array of bytes to an output file.
- void writeU16 (uint_fast16_t value, FILE *file)

  Write an unsigned 16-bit value to an output file.
- void writeU32 (uint_fast32_t value, FILE *file)

  Write an unsigned 32-bit value to an output file.
- void addTable (Font *font, const char tag[static 4], Buffer *content)

  Add a TrueType or OpenType table to the font.
- void organizeTables (Font *font, bool isCFF)

  Sort tables according to OpenType recommendations.
- int byTableTag (const void *a, const void *b)

  Compare tables by 4-byte unsigned table tag value.
- void writeFont (Font *font, bool isCFF, const char *fileName)

  Write OpenType font to output file.
- bool readCodePoint (uint_fast32_t *codePoint, const char *fileName, FILE *file)

  Read up to 6 hexadecimal digits and a colon from file.
- void readGlyphs (Font *font, const char *fileName)

  Read glyph definitions from a Unifont .hex format file.
- int byCodePoint (const void *a, const void *b)

  Compare two Unicode code points to determine which is greater.
- void positionGlyphs (Font *font, const char *fileName, pixels_t *xMin)

  Position a glyph within a 16-by-16 pixel bounding box.
- void sortGlyphs (Font *font)

  Sort the glyphs in a font by Unicode code point.
- void buildOutline (Buffer *result, const byte bitmap[], const size_t byteCount, const enum FillSide fillSide)

Build a glyph outline.

- void prepareOffsets (size_t *sizes)

  Prepare 32-bit glyph offsets in a font table.
- Buffer * prepareStringIndex (const NameStrings names)

  Prepare a font name string index.
- void fillCFF (Font *font, int version, const NameStrings names)

  Add a CFF table to a font.
- void fillTrueType (Font *font, enum LocaFormat *format, uint_fast16_t *maxPoints, uint_fast16_t *maxContours)

  Add a TrueType table to a font.
- void fillBlankOutline (Font *font)

  Create a dummy blank outline in a font table.
- void fillBitmap (Font *font)

  Fill OpenType bitmap data and location tables.
- void fillHeadTable (Font *font, enum LocaFormat locaFormat, pixels_t xMin)

  Fill a "head" font table.
- void fillHheaTable (Font *font, pixels_t xMin)

  Fill a "hhea" font table.
- void fillMaxpTable (Font *font, bool isCFF, uint_fast16_t maxPoints, uint_fast16_t maxContours)

  Fill a "maxp" font table.
- void fillOS2Table (Font *font)

  Fill an "OS/2" font table.
- void fillHmtxTable (Font *font)

  Fill an "hmtx" font table.
- void fillCmapTable (Font *font)

  Fill a "cmap" font table.
- void fillPostTable (Font *font)

  Fill a "post" font table.
- void fillGposTable (Font *font)

  Fill a "GPOS" font table.
- void fillGsubTable (Font *font)

  Fill a "GSUB" font table.
- void cacheStringAsUTF16BE (Buffer *buf, const char *str)

  Cache a string as a big-ending UTF-16 surrogate pair.
- void fillNameTable (Font *font, NameStrings nameStrings)

  Fill a "name" font table.
- void printVersion ()

  Print program version string on stdout.
- void printHelp ()

  Print help message to stdout and then exit.
- const char * matchToken (const char *operand, const char *key, char delimiter)

  Match a command line option with its key for enabling.
- Options parseOptions (char *const argv[const])

  Parse command line options.
- int main (int argc, char *argv[])

  The main function.

Variables

- Buffer * allBuffers

  Initial allocation of empty array of buffer pointers.
- size_t bufferCount

  Number of buffers in a Buffer * array.
- size_t nextBufferIndex

  Index number to tail element of Buffer * array.

5.3.1 Detailed Description

hex2otf - Convert GNU Unifont .hex file to OpenType font
This program reads a Unifont .hex format file and a file containing combining mark offset information, and produces an OpenType font file.

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Author

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Definition in file hex2otf.c.

5.3.2 Macro Definition Documentation

5.3.2.1 addByte

```
#define addByte(
                shift )
```

Value:

```
if (p == end) \
    break; \
record->checksum += (uint_fast32_t)*p++ « (shift);
```

5.3.2.2 ASCENDER

#define ASCENDER (GLYPH_HEIGHT - DESCENDER)
Count of pixels above baseline.
Definition at line 79 of file hex2otf.c.

5.3.2.3 B0

```
#define B0(
                shift ) BX((shift), 0)
```

Clear a given bit in a word.
Definition at line 66 of file hex2otf.c.

5.3.2.4 B1

```
#define B1(
        shift ) BX((shift), 1)
```

Set a given bit in a word.
Definition at line 67 of file hex2otf.c.

5.3.2.5 BX

```
#define BX(
        shift,
        x ) ((uintmax_t)(!!(x)) << (shift))
```

Truncate & shift word.
Definition at line 65 of file hex2otf.c.

5.3.2.6 defineStore

```
#define defineStore(
        name,
        type )
```

Value:

```
void name (Buffer *buf, type value) \
{ \
    type *slot = getBufferSlot (buf, sizeof value); \
    *slot = value; \
}
```

Temporary define to look up an element in an array of given type.
This defintion is used to create lookup functions to return a given element in unsigned arrays of size 8, 16, and 32 bytes, and in an array of pixels.
Definition at line 350 of file hex2otf.c.

5.3.2.7 DESCENDER

```
#define DESCENDER 2
```

Count of pixels below baseline.
Definition at line 76 of file hex2otf.c.

5.3.2.8 FU

```
#define FU(
        x ) ((x) * FUPEM / GLYPH_HEIGHT)
```

Convert pixels to font units.
Definition at line 91 of file hex2otf.c.

5.3.2.9 FUPEM

```
#define FUPEM 64
```

Font units per em.
Definition at line 82 of file hex2otf.c.

5.3.2.10 GLYPH_HEIGHT

#define GLYPH_HEIGHT 16
Maximum glyph height, in pixels.
Definition at line 70 of file hex2otf.c.

5.3.2.11 GLYPH_MAX_BYTE_COUNT

#define GLYPH_MAX_BYTE_COUNT (GLYPH_HEIGHT * GLYPH_MAX_WIDTH / 8)
Number of bytes to represent one bitmap glyph as a binary array.
Definition at line 73 of file hex2otf.c.

5.3.2.12 GLYPH_MAX_WIDTH

#define GLYPH_MAX_WIDTH 16
Maximum glyph width, in pixels.
Definition at line 69 of file hex2otf.c.

5.3.2.13 MAX_GLYPHS

#define MAX_GLYPHS 65536
An OpenType font has at most 65536 glyphs.
Definition at line 85 of file hex2otf.c.

5.3.2.14 MAX_NAME_IDS

#define MAX_NAME_IDS 256
Name IDs 0-255 are used for standard names.
Definition at line 88 of file hex2otf.c.

5.3.2.15 PRI_CP

#define PRI_CP "U+%.4"PRIXFAST32
Format string to print Unicode code point.
Definition at line 58 of file hex2otf.c.

5.3.2.16 PW

#define PW(
x) ((x) / (GLYPH_HEIGHT / 8))
Convert glyph byte count to pixel width.
Definition at line 94 of file hex2otf.c.

5.3.2.17 static_assert

#define static_assert(
a,
b) (assert(a))
If "a" is true, return string "b".
Definition at line 61 of file hex2otf.c.

5.3.2.18 U16MAX

#define U16MAX 0xffff
Maximum UTF-16 code point value.
Definition at line 55 of file hex2otf.c.

5.3.2.19 U32MAX

#define U32MAX 0xffffffff
Maximum UTF-32 code point value.
Definition at line 56 of file hex2otf.c.

5.3.2.20 VERSION

#define VERSION "1.0.1"
Program version, for "--version" option.
Definition at line 51 of file hex2otf.c.

5.3.3 Typedef Documentation

5.3.3.1 Buffer

typedef struct Buffer Buffer
Generic data structure for a linked list of buffer elements.
A buffer can act as a vector (when filled with 'store∗' functions), or a temporary output area (when filled with 'cache∗' functions). The 'store∗' functions use native endian. The 'cache∗' functions use big endian or other formats in OpenType. Beware of memory alignment.

5.3.3.2 byte

typedef unsigned char byte
Definition of "byte" type as an unsigned char.
Definition at line 97 of file hex2otf.c.

5.3.3.3 Glyph

typedef struct Glyph Glyph
Data structure to hold data for one bitmap glyph.
This data structure holds data to represent one Unifont bitmap glyph: Unicode code point, number of bytes in its bitmap array, whether or not it is a combining character, and an offset from the glyph origin to the start of the bitmap.

5.3.3.4 NameStrings

typedef const char∗ NameStrings[MAX_NAME_IDS]
Array of OpenType names indexed directly by Name IDs.
Definition at line 604 of file hex2otf.c.

5.3.3.5 Options

typedef struct Options Options
Data structure to hold options for OpenType font output.
This data structure holds the status of options that can be specified as command line arguments for creating the output OpenType font file.

5.3.3.6 pixels_t

typedef int_least8_t pixels_t
This type must be able to represent max(GLYPH_MAX_WIDTH, GLYPH_HEIGHT).
Definition at line 100 of file hex2otf.c.

5.3.3.7 Table

typedef struct Table Table
Data structure for an OpenType table.
This data structure contains a table tag and a pointer to the start of the buffer that holds data for this OpenType table.
For information on the OpenType tables and their structure, see https://docs.microsoft.com/en-us/typography/opentype/spec/otff#font-tables.

5.3.4 Enumeration Type Documentation

5.3.4.1 ContourOp

enum ContourOp
Specify the current contour drawing operation.

Enumerator

OP_CLOSE	Close the current contour path that was being drawn.
OP_POINT	Add one more (x,y) point to the contor being drawn.

Definition at line 1136 of file hex2otf.c.

```
01136             {
01137     OP_CLOSE,    ///< Close the current contour path that was being drawn.
01138     OP_POINT     ///< Add one more (x,y) point to the contor being drawn.
01139 };
```

5.3.4.2 FillSide

enum FillSide

Fill to the left side (CFF) or right side (TrueType) of a contour.

Enumerator

FILL_LEFT	Draw outline counter-clockwise (CFF, PostScript).
FILL_RIGHT	Draw outline clockwise (TrueType).

Definition at line 1144 of file hex2otf.c.

```
01144             {
01145     FILL_LEFT,    ///< Draw outline counter-clockwise (CFF, PostScript).
01146     FILL_RIGHT    ///< Draw outline clockwise (TrueType).
01147 };
```

5.3.4.3 LocaFormat

enum LocaFormat

Index to Location ("loca") offset information.

This enumerated type encodes the type of offset to locations in a table. It denotes Offset16 (16-bit) and Offset32 (32-bit) offset types.

Enumerator

LOCA_OFFSET16	Offset to location is a 16-bit Offset16 value.

Enumerator

LOCA_OFFSET32	Offset to location is a 32-bit Offset32 value.

Definition at line 658 of file hex2otf.c.

```
00658             {
00659     LOCA_OFFSET16 = 0,    ///< Offset to location is a 16-bit Offset16 value
00660     LOCA_OFFSET32 = 1     ///< Offset to location is a 32-bit Offset32 value
00661 };
```

5.3.5 Function Documentation

5.3.5.1 addTable()

```
void addTable (
            Font * font,
            const char tag[static 4],
            Buffer * content )
```

Add a TrueType or OpenType table to the font.

This function adds a TrueType or OpenType table to a font. The 4-byte table tag is passed as an unsigned 32-bit integer in big-endian format.

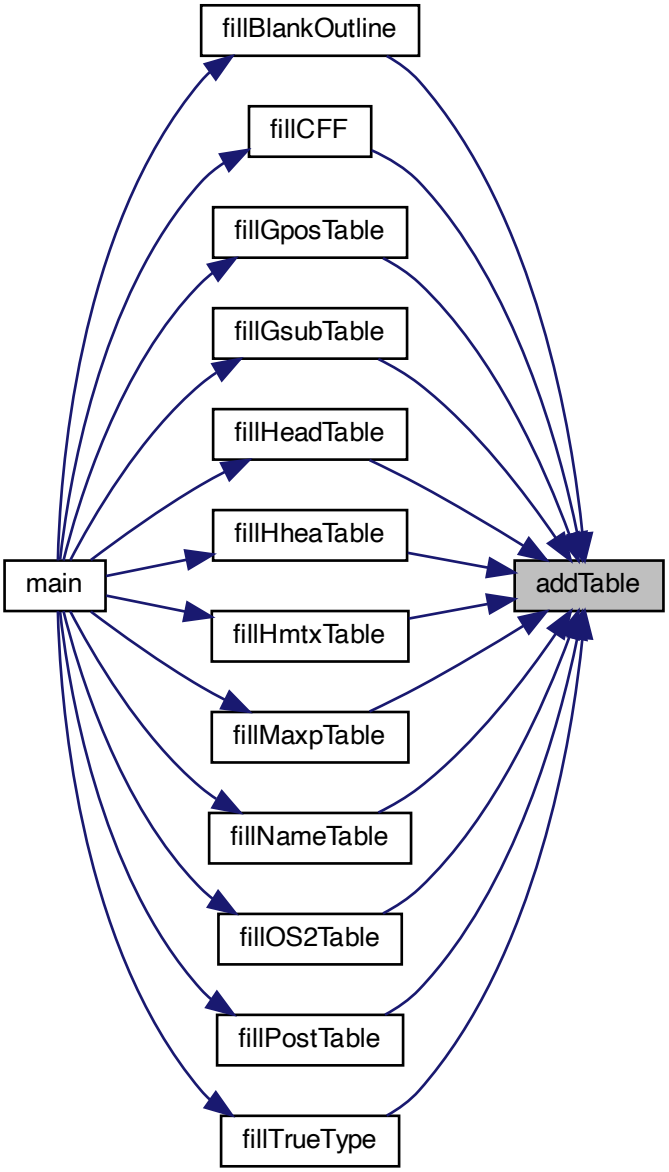
Parameters

in,out	font	The font to which a font table will be added.
in	tag	The 4-byte table name.
in	content	The table bytes to add, of type Buffer *.

Definition at line 694 of file hex2otf.c.

```
00695 {
00696     Table *table = getBufferSlot (font->tables, sizeof (Table));
00697     table->tag = tagAsU32 (tag);
00698     table->content = content;
00699 }
```

Here is the caller graph for this function:



5.3.5.2 buildOutline()

```
void buildOutline (
            Buffer * result,
            const byte bitmap[],
            const size_t byteCount,
            const enum FillSide fillSide )
```

Build a glyph outline.
This function builds a glyph outline from a Unifont glyph bitmap.

Parameters

out	result	The resulting glyph outline.
in	bitmap	A bitmap array.
in	byteCount	the number of bytes in the input bitmap array.
in	fillSide	Enumerated indicator to fill left or right side.

Get the value of a given bit that is in a given row.
Invert the value of a given bit that is in a given row.
Definition at line 1160 of file hex2otf.c.

```
01162 {
01163     enum Direction {RIGHT, LEFT, DOWN, UP}; // order is significant
01164
01165     // respective coordinate deltas
01166     const pixels_t dx[] = {1, -1, 0, 0}, dy[] = {0, 0, -1, 1};
01167
01168     assert (byteCount % GLYPH_HEIGHT == 0);
01169     const uint_fast8_t bytesPerRow = byteCount / GLYPH_HEIGHT;
01170     const pixels_t glyphWidth = bytesPerRow * 8;
01171     assert (glyphWidth <= GLYPH_MAX_WIDTH);
01172
01173 #if GLYPH_MAX_WIDTH < 32
01174         typedef uint_fast32_t row_t;
01175 #elif GLYPH_MAX_WIDTH < 64
01176         typedef uint_fast64_t row_t;
01177 #else
01178 #error GLYPH_MAX_WIDTH is too large.
01179 #endif
01180
01181     row_t pixels[GLYPH_HEIGHT + 2] = {0};
01182     for (pixels_t row = GLYPH_HEIGHT; row > 0; row--)
```

```
01183         for (pixels_t b = 0; b < bytesPerRow; b++)
01184             pixels[row] = pixels[row] « 8 | *bitmap++;
01185     typedef row_t graph_t[GLYPH_HEIGHT + 1];
01186     graph_t vectors[4];
01187     const row_t *lower = pixels, *upper = pixels + 1;
01188     for (pixels_t row = 0; row <= GLYPH_HEIGHT; row++)
01189     {
01190         const row_t m = (fillSide == FILL_RIGHT) - 1;
01191         vectors[RIGHT][row] = (m ^ (*lower « 1)) & (~m ^ (*upper « 1));
01192         vectors[LEFT ][row] = (m ^ (*upper     )) & (~m ^ (*lower     ));
01193         vectors[DOWN ][row] = (m ^ (*lower     )) & (~m ^ (*lower « 1));
01194         vectors[UP   ][row] = (m ^ (*upper « 1)) & (~m ^ (*upper     ));
01195         lower++;
01196         upper++;
01197     }
01198     graph_t selection = {0};
01199     const row_t x0 = (row_t)1 « glyphWidth;
01200
01201 /// Get the value of a given bit that is in a given row.
01202 #define getRowBit(rows, x, y)  ((rows)[(y)] &  x0 » (x))
01203
01204 /// Invert the value of a given bit that is in a given row.
01205 #define flipRowBit(rows, x, y) ((rows)[(y)] ^= x0 » (x))
01206
01207     for (pixels_t y = GLYPH_HEIGHT; y >= 0; y--)
01208     {
01209         for (pixels_t x = 0; x <= glyphWidth; x++)
01210         {
01211             assert (!getRowBit (vectors[LEFT], x, y));
01212             assert (!getRowBit (vectors[UP], x, y));
01213             enum Direction initial;
01214
01215             if (getRowBit (vectors[RIGHT], x, y))
01216                 initial = RIGHT;
01217             else if (getRowBit (vectors[DOWN], x, y))
01218                 initial = DOWN;
01219             else
01220                 continue;
01221
01222             static_assert ((GLYPH_MAX_WIDTH + 1) * (GLYPH_HEIGHT + 1) * 2 <=
01223                 U16MAX, "potential overflow");
01224
01225             uint_fast16_t lastPointCount = 0;
01226             for (bool converged = false;;)
01227             {
01228                 uint_fast16_t pointCount = 0;
01229                 enum Direction heading = initial;
01230                 for (pixels_t tx = x, ty = y;;)
01231                 {
01232                     if (converged)
01233                     {
01234                         storePixels (result, OP_POINT);
01235                         storePixels (result, tx);
01236                         storePixels (result, ty);
01237                     }
01238                     do
01239                     {
01240                         if (converged)
01241                             flipRowBit (vectors[heading], tx, ty);
01242                         tx += dx[heading];
01243                         ty += dy[heading];
01244                     } while (getRowBit (vectors[heading], tx, ty));
01245                     if (tx == x && ty == y)
01246                         break;
01247                     static_assert ((UP ^ DOWN) == 1 && (LEFT ^ RIGHT) == 1,
01248                         "wrong enums");
01249                     heading = (heading & 2) ^ 2;
01250                     heading |= !!getRowBit (selection, tx, ty);
01251                     heading ^= !getRowBit (vectors[heading], tx, ty);
01252                     assert (getRowBit (vectors[heading], tx, ty));
01253                     flipRowBit (selection, tx, ty);
01254                     pointCount++;
01255                 }
01256                 if (converged)
01257                     break;
01258                 converged = pointCount == lastPointCount;
01259                 lastPointCount = pointCount;
01260             }
01261
01262             storePixels (result, OP_CLOSE);
01263         }
```

```
01264     }
01265 #undef getRowBit
01266 #undef flipRowBit
01267 }
```

5.3.5.3 byCodePoint()

```
int byCodePoint (
                const void * a,
                const void * b )
```

Compare two Unicode code points to determine which is greater.

This function compares the Unicode code points contained within two Glyph data structures. The function returns 1 if the first code point is greater, and -1 if the second is greater.

Parameters

in	a	A Glyph data structure containing the first code point.
in	b	A Glyph data structure containing the second code point.

Returns

1 if the code point a is greater, -1 if less, 0 if equal.

Definition at line 1040 of file hex2otf.c.

```
01041 {
01042     const Glyph *const ga = a, *const gb = b;
01043     int gt = ga->codePoint > gb->codePoint;
01044     int lt = ga->codePoint < gb->codePoint;
01045     return gt - lt;
01046 }
```

5.3.5.4 byTableTag()

```
int byTableTag (
                const void * a,
                const void * b )
```

Compare tables by 4-byte unsigned table tag value.
This function takes two pointers to a TableRecord data structure and extracts the four-byte tag structure element for each. The two 32-bit numbers are then compared. If the first tag is greater than the first, then gt = 1 and lt = 0, and so 1 - 0 = 1 is returned. If the first is less than the second, then gt = 0 and lt = 1, and so 0 - 1 = -1 is returned.

Parameters

in	a	Pointer to the first TableRecord structure.
in	b	Pointer to the second TableRecord structure.

Returns

1 if the tag in "a" is greater, -1 if less, 0 if equal.

Definition at line 767 of file hex2otf.c.

```
00768 {
00769     const struct TableRecord *const ra = a, *const rb = b;
00770     int gt = ra->tag > rb->tag;
00771     int lt = ra->tag < rb->tag;
00772     return gt - lt;
00773 }
```

5.3.5.5 cacheBuffer()

```
void cacheBuffer (
                Buffer *restrict bufDest,
                const Buffer *restrict bufSrc )
```

Append bytes of a table to a byte buffer.

Parameters

in,out	bufDest	The buffer to which the new bytes are appended.
in	bufSrc	The bytes to append to the buffer array.

Definition at line 523 of file hex2otf.c.

```
00524 {
00525     size_t length = countBufferedBytes (bufSrc);
00526     ensureBuffer (bufDest, length);
00527     memcpy (bufDest->next, bufSrc->begin, length);
00528     bufDest->next += length;
00529 }
```

5.3.5.6 cacheBytes()

```
void cacheBytes (
            Buffer *restrict buf,
            const void *restrict src,
            size_t count )
```

Append a string of bytes to a buffer.
This function appends an array of 1 to 4 bytes to the end of a buffer.

Parameters

in,out	buf	The buffer to which the bytes are appended.

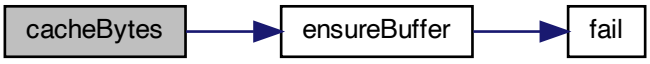
Parameters

in	src	The array of bytes to append to the buffer.
in	count	The number of bytes containing zeroes to append.

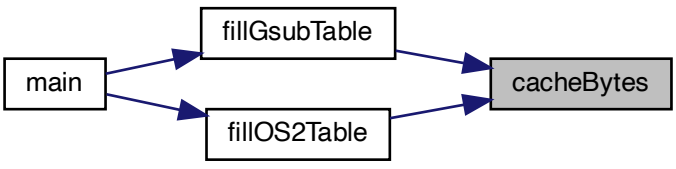
Definition at line 509 of file hex2otf.c.

```
00510 {
00511     ensureBuffer (buf, count);
00512     memcpy (buf->next, src, count);
00513     buf->next += count;
00514 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.7 cacheCFFOperand()

```
void cacheCFFOperand (
                Buffer * buf,
                int_fast32_t value )
```

Cache charstring number encoding in a CFF buffer.

This function caches two's complement 8-, 16-, and 32-bit words as per Adobe's Type 2 Charstring encoding for operands. These operands are used in Compact Font Format data structures.
Byte values can have offsets, for which this function compensates, optionally followed by additional bytes:

Byte Range	Offset	Bytes	Adjusted Range
0 to 11	0	1	0 to 11 (operators)
12	0	2	Next byte is 8-bit op code
13 to 18	0	1	13 to 18 (operators)
19 to 20	0	2+	hintmask and cntrmask operators
21 to 27	0	1	21 to 27 (operators)
28	0	3	16-bit 2's complement number
29 to 31	0	1	29 to 31 (operators)
32 to 246	-139	1	-107 to +107
247 to 250	+108	2	+108 to +1131
251 to 254	-108	2	-108 to -1131
255	0	5	16-bit integer and 16-bit fraction

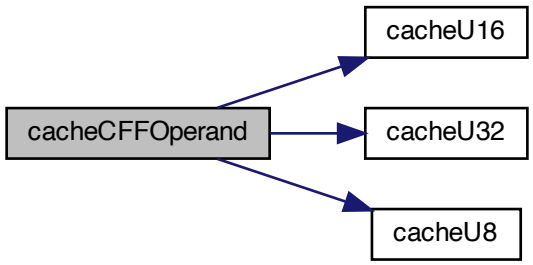
Parameters

in,out	buf	The buffer to which the operand value is appended.
in	value	The operand value.

Definition at line 460 of file hex2otf.c.

```
00461 {
00462     if (-107 <= value && value <= 107)
00463         cacheU8 (buf, value + 139);
00464     else if (108 <= value && value <= 1131)
00465     {
00466         cacheU8 (buf, (value - 108) / 256 + 247);
00467         cacheU8 (buf, (value - 108) % 256);
00468     }
00469     else if (-32768 <= value && value <= 32767)
00470     {
00471         cacheU8 (buf, 28);
00472         cacheU16 (buf, value);
00473     }
00474     else if (-2147483647 <= value && value <= 2147483647)
00475     {
00476         cacheU8 (buf, 29);
00477         cacheU32 (buf, value);
00478     }
00479     else
00480         assert (false); // other encodings are not used and omitted
00481     static_assert (GLYPH_MAX_WIDTH <= 107, "More encodings are needed.");
00482 }
```

Here is the call graph for this function:



5.3.5.8 cacheStringAsUTF16BE()

```
void cacheStringAsUTF16BE (
                Buffer * buf,
                const char * str )
```

Cache a string as a big-ending UTF-16 surrogate pair.
This function encodes a UTF-8 string as a big-endian UTF-16 surrogate pair.

Parameters

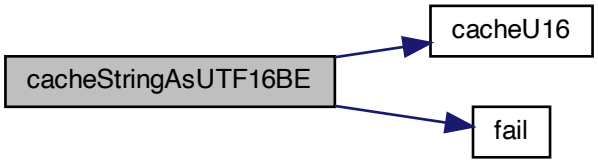
in,out	buf	Pointer to a Buffer struct to update.
in	str	The character array to encode.

Definition at line 2316 of file hex2otf.c.

```
02317 {
02318     for (const char *p = str; *p; p++)
02319     {
02320         byte c = *p;
02321         if (c < 0x80)
02322         {
02323             cacheU16 (buf, c);
02324             continue;
02325         }
02326         int length = 1;
02327         byte mask = 0x40;
02328         for (; c & mask; mask >= 1)
02329             length++;
02330         if (length == 1 || length > 4)
02331             fail ("Ill-formed UTF-8 sequence.");
```

```
02332         uint_fast32_t codePoint = c & (mask - 1);
02333         for (int i = 1; i < length; i++)
02334         {
02335             c = *++p;
02336             if ((c & 0xc0) != 0x80) // NUL checked here
02337                 fail ("Ill-formed UTF-8 sequence.");
02338             codePoint = (codePoint « 6) | (c & 0x3f);
02339         }
02340         const int lowerBits = length==2 ? 7 : length==3 ? 11 : 16;
02341         if (codePoint » lowerBits == 0)
02342             fail ("Ill-formed UTF-8 sequence."); // sequence should be shorter
02343         if (codePoint >= 0xd800 && codePoint <= 0xdfff)
02344             fail ("Ill-formed UTF-8 sequence.");
02345         if (codePoint > 0x10ffff)
02346             fail ("Ill-formed UTF-8 sequence.");
02347         if (codePoint > 0xffff)
02348         {
02349             cacheU16 (buf, 0xd800 | (codePoint - 0x10000) » 10);
02350             cacheU16 (buf, 0xdc00 | (codePoint & 0x3ff));
02351         }
02352         else
02353             cacheU16 (buf, codePoint);
02354     }
02355 }
```

Here is the call graph for this function:



5.3.5.9 cacheU16()

```
void cacheU16 (
                Buffer * buf,
                uint_fast16_t value )
```

Append two unsigned bytes to the end of a byte array.

This function adds two bytes to the end of a byte array. The buffer is updated to account for the newly-added bytes.

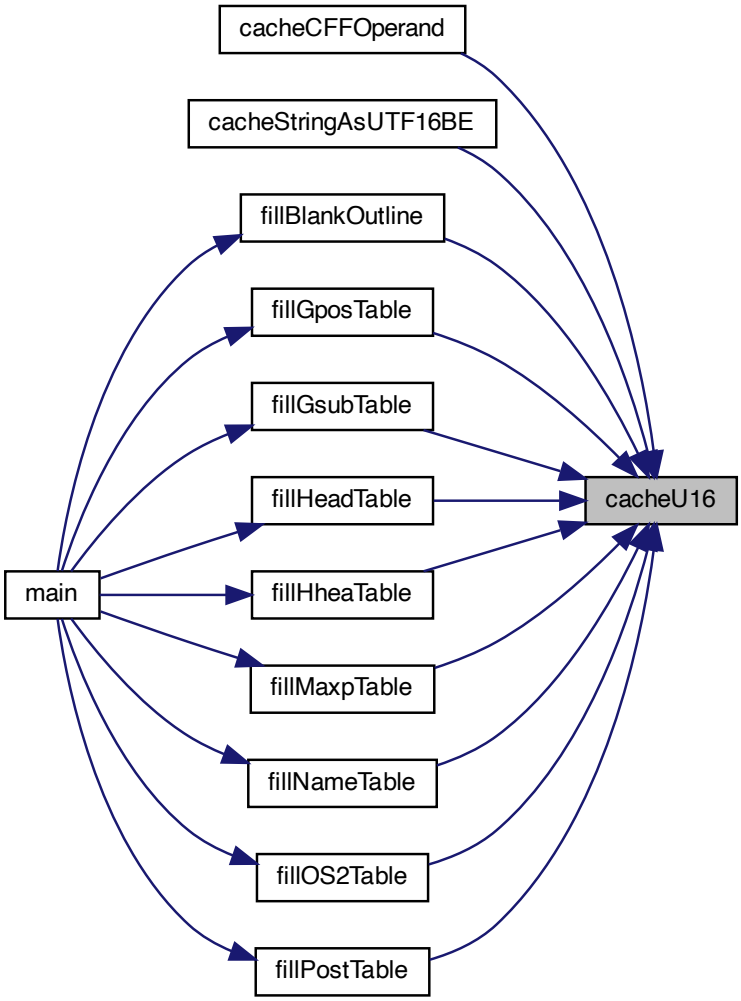
Parameters

in,out	buf	The array of bytes to which to append two new bytes.
in	value	The 16-bit unsigned value to append to the buf array.

Definition at line 412 of file hex2otf.c.

```
00413 {
00414     cacheU (buf, value, 2);
00415 }
```

Here is the caller graph for this function:



5.3.5.10 cacheU32()

```
void cacheU32 (
            Buffer * buf,
            uint_fast32_t value )
```

Append four unsigned bytes to the end of a byte array.

This function adds four bytes to the end of a byte array. The buffer is updated to account for the newly-added bytes.

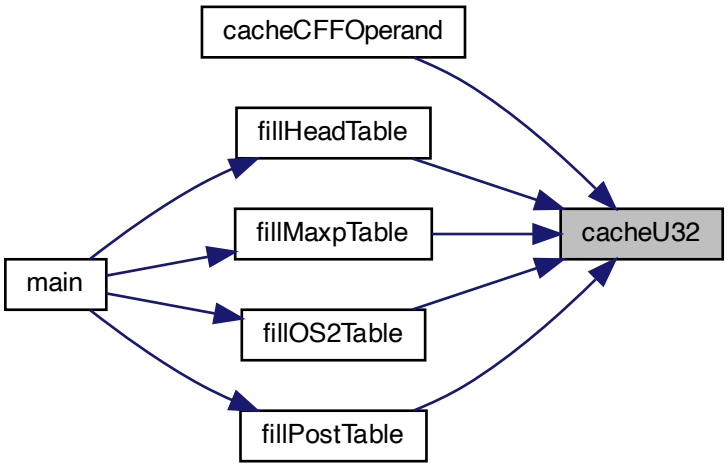
Parameters

in,out	buf	The array of bytes to which to append four new bytes.
in	value	The 32-bit unsigned value to append to the buf array.

Definition at line 427 of file hex2otf.c.

```
00428 {
00429     cacheU (buf, value, 4);
00430 }
```

Here is the caller graph for this function:



5.3.5.11 cacheU8()

```
void cacheU8 (
        Buffer * buf,
        uint_fast8_t value )
```

Append one unsigned byte to the end of a byte array.
This function adds one byte to the end of a byte array. The buffer is updated to account for the newly-added byte.

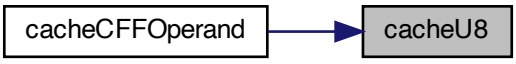
Parameters

in,out	buf	The array of bytes to which to append a new byte.
in	value	The 8-bit unsigned value to append to the buf array.

Definition at line 397 of file hex2otf.c.

```
00398 {
00399     storeU8 (buf, value & 0xff);
00400 }
```

Here is the caller graph for this function:



5.3.5.12 cacheZeros()

```
void cacheZeros (
        Buffer * buf,
        size_t count )
```

Append 1 to 4 bytes of zeroes to a buffer, for padding.

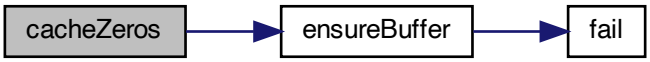
Parameters

in,out	buf	The buffer to which the operand value is appended.
in	count	The number of bytes containing zeroes to append.

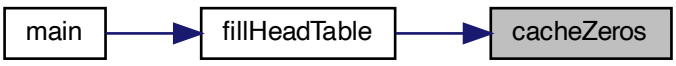
Definition at line 491 of file hex2otf.c.

```
00492 {
00493     ensureBuffer (buf, count);
00494     memset (buf->next, 0, count);
00495     buf->next += count;
00496 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.13 cleanBuffers()

void cleanBuffers ( )

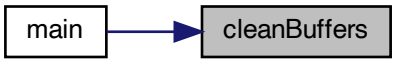
Free all allocated buffer pointers.

This function frees all buffer pointers previously allocated in the initBuffers function.

Definition at line 170 of file hex2otf.c.

```
00171 {
00172     for (size_t i = 0; i < bufferCount; i++)
00173         if (allBuffers[i].capacity)
00174             free (allBuffers[i].begin);
00175     free (allBuffers);
00176     bufferCount = 0;
00177 }
```

Here is the caller graph for this function:



5.3.5.14 defineStore()

defineStore (
storeU8 ,
uint_least8_t)

Definition at line 356 of file hex2otf.c.

```
00375 {
00376     assert (1 <= bytes && bytes <= 4);
00377     ensureBuffer (buf, bytes);
00378     switch (bytes)
00379     {
00380         case 4: *buf->next++ = value » 24 & 0xff; // fall through
00381         case 3: *buf->next++ = value » 16 & 0xff; // fall through
00382         case 2: *buf->next++ = value » 8  & 0xff; // fall through
00383         case 1: *buf->next++ = value      & 0xff;
00384     }
00385 }
```

5.3.5.15 ensureBuffer()

void ensureBuffer (
Buffer * buf,
size_t needed)

Ensure that the buffer has at least the specified minimum size.

This function takes a buffer array of type Buffer and the necessary minimum number of elements as inputs, and attempts to increase the size of the buffer if it must be larger.

If the buffer is too small and cannot be resized, the program will terminate with an error message and an exit status of EXIT_FAILURE.

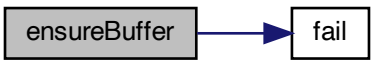
Parameters

in,out	buf	The buffer to check.
in	needed	The required minimum number of elements in the buffer.

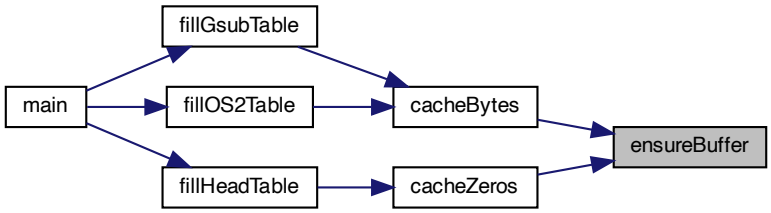
Definition at line 239 of file hex2otf.c.

```
00240 {
00241     if (buf->end - buf->next >= needed)
00242         return;
00243     ptrdiff_t occupied = buf->next - buf->begin;
00244     size_t required = occupied + needed;
00245     if (required < needed) // overflow
00246         fail ("Cannot allocate %zu + %zu bytes of memory.", occupied, needed);
00247     if (required > SIZE_MAX / 2)
00248         buf->capacity = required;
00249     else while (buf->capacity < required)
00250         buf->capacity *= 2;
00251     void *extended = realloc (buf->begin, buf->capacity);
00252     if (!extended)
00253         fail ("Failed to allocate %zu bytes of memory.", buf->capacity);
00254     buf->begin = extended;
00255     buf->next = buf->begin + occupied;
00256     buf->end = buf->begin + buf->capacity;
00257 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.16 fail()

```
void fail (
            const char * reason,
            ... )
```

Print an error message on stderr, then exit.
This function prints the provided error string and optional following arguments to stderr, and then exits with a status of EXIT_FAILURE.

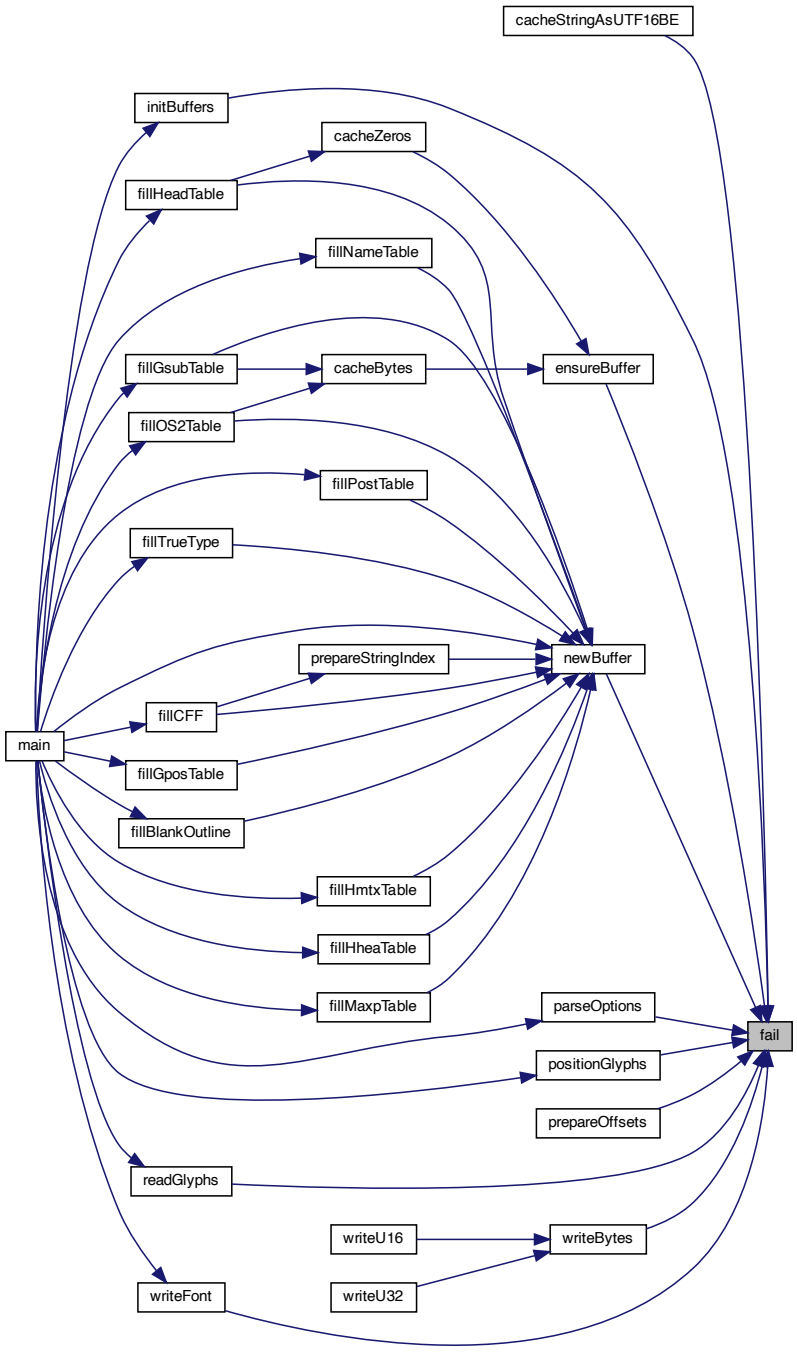
Parameters

in	reason	The output string to describe the error.
in	...	Optional following arguments to output.

Definition at line 113 of file hex2otf.c.

```
00114 {
00115     fputs ("ERROR: ", stderr);
00116     va_list args;
00117     va_start (args, reason);
00118     vfprintf (stderr, reason, args);
00119     va_end (args);
00120     putc ('\n', stderr);
00121     exit (EXIT_FAILURE);
00122 }
```

Here is the caller graph for this function:



5.3.5.17 fillBitmap()

void fillBitmap (

Font * font)

Fill OpenType bitmap data and location tables.

This function fills an Embedded Bitmap Data (EBDT) Table and an Embedded Bitmap Location (EBLC) Table with glyph bitmap information. These tables enable embedding bitmaps in OpenType fonts. No Embedded Bitmap Scaling (EBSC) table is used for the bitmap glyphs, only EBDT and EBLC.

Parameters

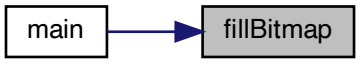
in,out	font	Pointer to a Font struct in which to add bitmaps.

Definition at line 1728 of file hex2otf.c.

```
01729 {
01730     const Glyph *const glyphs = getBufferHead (font->glyphs);
01731     const Glyph *const glyphsEnd = getBufferTail (font->glyphs);
01732     size_t bitmapsSize = 0;
01733     for (const Glyph *glyph = glyphs; glyph < glyphsEnd; glyph++)
01734         bitmapsSize += glyph->byteCount;
01735     Buffer *ebdt = newBuffer (4 + bitmapsSize);
01736     addTable (font, "EBDT", ebdt);
01737     cacheU16 (ebdt, 2); // majorVersion
01738     cacheU16 (ebdt, 0); // minorVersion
01739     uint_fast8_t byteCount = 0; // unequal to any glyph
01740     pixels_t pos = 0;
01741     bool combining = false;
01742     Buffer *rangeHeads = newBuffer (32);
01743     Buffer *offsets = newBuffer (64);
01744     for (const Glyph *glyph = glyphs; glyph < glyphsEnd; glyph++)
01745     {
01746         if (glyph->byteCount != byteCount || glyph->pos != pos ||
01747             glyph->combining != combining)
01748         {
01749             storeU16 (rangeHeads, glyph - glyphs);
01750             storeU32 (offsets, countBufferedBytes (ebdt));
01751             byteCount = glyph->byteCount;
01752             pos = glyph->pos;
01753             combining = glyph->combining;
01754         }
01755         cacheBytes (ebdt, glyph->bitmap, byteCount);
01756     }
01757     const uint_least16_t *ranges = getBufferHead (rangeHeads);
01758     const uint_least16_t *rangesEnd = getBufferTail (rangeHeads);
01759     uint_fast32_t rangeCount = rangesEnd - ranges;
01760     storeU16 (rangeHeads, font->glyphCount);
01761     Buffer *eblc = newBuffer (4096);
01762     addTable (font, "EBLC", eblc);
01763     cacheU16 (eblc, 2); // majorVersion
01764     cacheU16 (eblc, 0); // minorVersion
01765     cacheU32 (eblc, 1); // numSizes
01766     { // bitmapSizes[0]
01767         cacheU32 (eblc, 56); // indexSubTableArrayOffset
01768         cacheU32 (eblc, (8 + 20) * rangeCount); // indexTablesSize
01769         cacheU32 (eblc, rangeCount); // numberOfIndexSubTables
01770         cacheU32 (eblc, 0); // colorRef
01771         { // hori
01772             cacheU8 (eblc, ASCENDER); // ascender
01773             cacheU8 (eblc, -DESCENDER); // descender
01774             cacheU8 (eblc, font->maxWidth); // widthMax
01775             cacheU8 (eblc, 1); // caretSlopeNumerator
01776             cacheU8 (eblc, 0); // caretSlopeDenominator
01777             cacheU8 (eblc, 0); // caretOffset
01778             cacheU8 (eblc, 0); // minOriginSB
01779             cacheU8 (eblc, 0); // minAdvanceSB
01780             cacheU8 (eblc, ASCENDER); // maxBeforeBL
01781             cacheU8 (eblc, -DESCENDER); // minAfterBL
01782             cacheU8 (eblc, 0); // pad1
```

```
01783             cacheU8 (eblc, 0); // pad2
01784         }
01785         { // vert
01786             cacheU8 (eblc, ASCENDER); // ascender
01787             cacheU8 (eblc, -DESCENDER); // descender
01788             cacheU8 (eblc, font->maxWidth); // widthMax
01789             cacheU8 (eblc, 1); // caretSlopeNumerator
01790             cacheU8 (eblc, 0); // caretSlopeDenominator
01791             cacheU8 (eblc, 0); // caretOffset
01792             cacheU8 (eblc, 0); // minOriginSB
01793             cacheU8 (eblc, 0); // minAdvanceSB
01794             cacheU8 (eblc, ASCENDER); // maxBeforeBL
01795             cacheU8 (eblc, -DESCENDER); // minAfterBL
01796             cacheU8 (eblc, 0); // pad1
01797             cacheU8 (eblc, 0); // pad2
01798         }
01799         cacheU16 (eblc, 0); // startGlyphIndex
01800         cacheU16 (eblc, font->glyphCount - 1); // endGlyphIndex
01801         cacheU8 (eblc, 16); // ppemX
01802         cacheU8 (eblc, 16); // ppemY
01803         cacheU8 (eblc, 1); // bitDepth
01804         cacheU8 (eblc, 1); // flags = Horizontal
01805     }
01806     { // IndexSubTableArray
01807         uint_fast32_t offset = rangeCount * 8;
01808         for (const uint_least16_t *p = ranges; p < rangesEnd; p++)
01809         {
01810             cacheU16 (eblc, *p); // firstGlyphIndex
01811             cacheU16 (eblc, p[1] - 1); // lastGlyphIndex
01812             cacheU32 (eblc, offset); // additionalOffsetToIndexSubtable
01813             offset += 20;
01814         }
01815     }
01816     { // IndexSubTables
01817         const uint_least32_t *offset = getBufferHead (offsets);
01818         for (const uint_least16_t *p = ranges; p < rangesEnd; p++)
01819         {
01820             const Glyph *glyph = &glyphs[*p];
01821             cacheU16 (eblc, 2); // indexFormat
01822             cacheU16 (eblc, 5); // imageFormat
01823             cacheU32 (eblc, *offset++); // imageDataOffset
01824             cacheU32 (eblc, glyph->byteCount); // imageSize
01825             { // bigMetrics
01826                 cacheU8 (eblc, GLYPH_HEIGHT); // height
01827                 const uint_fast8_t width = PW (glyph->byteCount);
01828                 cacheU8 (eblc, width); // width
01829                 cacheU8 (eblc, glyph->pos); // horiBearingX
01830                 cacheU8 (eblc, ASCENDER); // horiBearingY
01831                 cacheU8 (eblc, glyph->combining ? 0 : width); // horiAdvance
01832                 cacheU8 (eblc, 0); // vertBearingX
01833                 cacheU8 (eblc, 0); // vertBearingY
01834                 cacheU8 (eblc, GLYPH_HEIGHT); // vertAdvance
01835             }
01836         }
01837     }
01838     freeBuffer (rangeHeads);
01839     freeBuffer (offsets);
01840 }
```

Here is the caller graph for this function:



5.3.5.18 fillBlankOutline()

void fillBlankOutline (
Font * font)

Create a dummy blank outline in a font table.

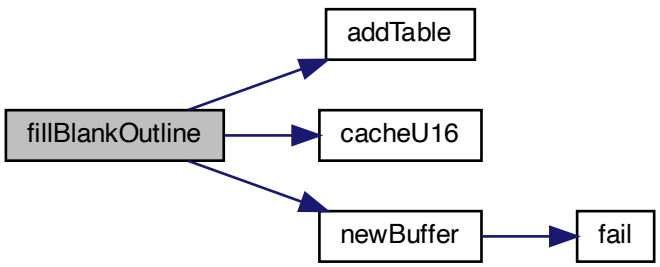
Parameters

in,out	font	Pointer to a Font struct to insert a blank outline.

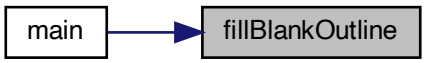
Definition at line 1697 of file hex2otf.c.

```
01698 {
01699     Buffer *glyf = newBuffer (12);
01700     addTable (font, "glyf", glyf);
01701     // Empty table is not allowed, but an empty outline for glyph 0 suffices.
01702     cacheU16 (glyf, 0); // numberOfContours
01703     cacheU16 (glyf, FU (0)); // xMin
01704     cacheU16 (glyf, FU (0)); // yMin
01705     cacheU16 (glyf, FU (0)); // xMax
01706     cacheU16 (glyf, FU (0)); // yMax
01707     cacheU16 (glyf, 0); // instructionLength
01708     Buffer *loca = newBuffer (2 * (font->glyphCount + 1));
01709     addTable (font, "loca", loca);
01710     cacheU16 (loca, 0); // offsets[0]
01711     assert (countBufferedBytes (glyf) % 2 == 0);
01712     for (uint_fast32_t i = 1; i <= font->glyphCount; i++)
01713         cacheU16 (loca, countBufferedBytes (glyf) / 2); // offsets[i]
01714 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.19 fillCFF()

void fillCFF (
Font * font,
int version,
const NameStrings names)

Add a CFF table to a font.

Parameters

in,out	font	Pointer to a Font struct to contain the CFF table.
in	version	Version of CFF table, with value 1 or 2.
in	names	List of NameStrings.

Use fixed width integer for variables to simplify offset calculation.
Definition at line 1329 of file hex2otf.c.

```
01330 {
01331     // HACK: For convenience, CFF data structures are hard coded.
01332     assert (0 < version && version <= 2);
01333     Buffer *cff = newBuffer (65536);
01334     addTable (font, version == 1 ? "CFF " : "CFF2", cff);
01335
01336 /// Use fixed width integer for variables to simplify offset calculation.
01337 #define cacheCFF32(buf, x) (cacheU8 ((buf), 29), cacheU32 ((buf), (x)))
01338
01339     // In Unifont, 16px glyphs are more common. This is used by CFF1 only.
01340     const pixels_t defaultWidth = 16, nominalWidth = 8;
01341     if (version == 1)
```

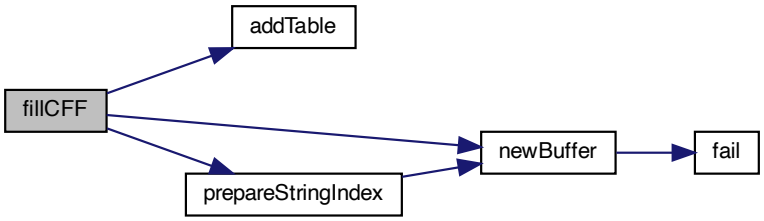
```
01342 {
01343     Buffer *strings = prepareStringIndex (names);
01344     size_t stringsSize = countBufferedBytes (strings);
01345     const char *cffName = names[6];
01346     assert (cffName);
01347     size_t nameLength = strlen (cffName);
01348     size_t namesSize = nameLength + 5;
01349     // These sizes must be updated together with the data below.
01350     size_t offsets[] = {4, namesSize, 45, stringsSize, 2, 5, 8, 32, 4, 0};
01351     prepareOffsets (offsets);
01352     { // Header
01353         cacheU8 (cff, 1); // major
01354         cacheU8 (cff, 0); // minor
01355         cacheU8 (cff, 4); // hdrSize
01356         cacheU8 (cff, 1); // offSize
01357     }
01358     assert (countBufferedBytes (cff) == offsets[0]);
01359     { // Name INDEX (should not be used by OpenType readers)
01360         cacheU16 (cff, 1); // count
01361         cacheU8 (cff, 1); // offSize
01362         cacheU8 (cff, 1); // offset[0]
01363         if (nameLength + 1 > 255) // must be too long; spec limit is 63
01364             fail ("PostScript name is too long.");
01365         cacheU8 (cff, nameLength + 1); // offset[1]
01366         cacheBytes (cff, cffName, nameLength);
01367     }
01368     assert (countBufferedBytes (cff) == offsets[1]);
01369     { // Top DICT INDEX
01370         cacheU16 (cff, 1); // count
01371         cacheU8 (cff, 1); // offSize
01372         cacheU8 (cff, 1); // offset[0]
01373         cacheU8 (cff, 41); // offset[1]
01374         cacheCFFOperand (cff, 391); // "Adobe"
01375         cacheCFFOperand (cff, 392); // "Identity"
01376         cacheCFFOperand (cff, 0);
01377         cacheBytes (cff, (byte[]){12, 30}, 2); // ROS
01378         cacheCFF32 (cff, font->glyphCount);
01379         cacheBytes (cff, (byte[]){12, 34}, 2); // CIDCount
01380         cacheCFF32 (cff, offsets[6]);
01381         cacheBytes (cff, (byte[]){12, 36}, 2); // FDArray
01382         cacheCFF32 (cff, offsets[5]);
01383         cacheBytes (cff, (byte[]){12, 37}, 2); // FDSelect
01384         cacheCFF32 (cff, offsets[4]);
01385         cacheU8 (cff, 15); // charset
01386         cacheCFF32 (cff, offsets[8]);
01387         cacheU8 (cff, 17); // CharStrings
01388     }
01389     assert (countBufferedBytes (cff) == offsets[2]);
01390     { // String INDEX
01391         cacheBuffer (cff, strings);
01392         freeBuffer (strings);
01393     }
01394     assert (countBufferedBytes (cff) == offsets[3]);
01395     cacheU16 (cff, 0); // Global Subr INDEX
01396     assert (countBufferedBytes (cff) == offsets[4]);
01397     { // Charsets
01398         cacheU8 (cff, 2); // format
01399         { // Range2[0]
01400             cacheU16 (cff, 1); // first
01401             cacheU16 (cff, font->glyphCount - 2); // nLeft
01402         }
01403     }
01404     assert (countBufferedBytes (cff) == offsets[5]);
01405     { // FDSelect
01406         cacheU8 (cff, 3); // format
01407         cacheU16 (cff, 1); // nRanges
01408         cacheU16 (cff, 0); // first
01409         cacheU8 (cff, 0); // fd
01410         cacheU16 (cff, font->glyphCount); // sentinel
01411     }
01412     assert (countBufferedBytes (cff) == offsets[6]);
01413     { // FDArray
01414         cacheU16 (cff, 1); // count
01415         cacheU8 (cff, 1); // offSize
01416         cacheU8 (cff, 1); // offset[0]
01417         cacheU8 (cff, 28); // offset[1]
01418         cacheCFFOperand (cff, 393);
01419         cacheBytes (cff, (byte[]){12, 38}, 2); // FontName
01420         // Windows requires FontMatrix in Font DICT.
01421         const byte unit[] = {0x1e,0x15,0x62,0x5c,0x6f}; // 1/64 (0.015625)
01422         cacheBytes (cff, unit, sizeof unit);
```

```
01423           cacheCFFOperand (cff, 0);
01424           cacheCFFOperand (cff, 0);
01425           cacheBytes (cff, unit, sizeof unit);
01426           cacheCFFOperand (cff, 0);
01427           cacheCFFOperand (cff, 0);
01428           cacheBytes (cff, (byte[]){12, 7}, 2); // FontMatrix
01429           cacheCFFOperand (cff, offsets[8] - offsets[7]); // size
01430           cacheCFF32 (cff, offsets[7]); // offset
01431           cacheU8 (cff, 18); // Private
01432       }
01433       assert (countBufferedBytes (cff) == offsets[7]);
01434       { // Private
01435           cacheCFFOperand (cff, FU (defaultWidth));
01436           cacheU8 (cff, 20); // defaultWidthX
01437           cacheCFFOperand (cff, FU (nominalWidth));
01438           cacheU8 (cff, 21); // nominalWidthX
01439       }
01440       assert (countBufferedBytes (cff) == offsets[8]);
01441   }
01442   else
01443   {
01444       assert (version == 2);
01445       // These sizes must be updated together with the data below.
01446       size_t offsets[] = {5, 21, 4, 10, 0};
01447       prepareOffsets (offsets);
01448       { // Header
01449           cacheU8 (cff, 2); // majorVersion
01450           cacheU8 (cff, 0); // minorVersion
01451           cacheU8 (cff, 5); // headerSize
01452           cacheU16 (cff, offsets[1] - offsets[0]); // topDictLength
01453       }
01454       assert (countBufferedBytes (cff) == offsets[0]);
01455       { // Top DICT
01456           const byte unit[] = {0x1e,0x15,0x62,0x5c,0x6f}; // 1/64 (0.015625)
01457           cacheBytes (cff, unit, sizeof unit);
01458           cacheCFFOperand (cff, 0);
01459           cacheCFFOperand (cff, 0);
01460           cacheBytes (cff, unit, sizeof unit);
01461           cacheCFFOperand (cff, 0);
01462           cacheCFFOperand (cff, 0);
01463           cacheBytes (cff, (byte[]){12, 7}, 2); // FontMatrix
01464           cacheCFFOperand (cff, offsets[2]);
01465           cacheBytes (cff, (byte[]){12, 36}, 2); // FDArray
01466           cacheCFFOperand (cff, offsets[3]);
01467           cacheU8 (cff, 17); // CharStrings
01468       }
01469       assert (countBufferedBytes (cff) == offsets[1]);
01470       cacheU32 (cff, 0); // Global Subr INDEX
01471       assert (countBufferedBytes (cff) == offsets[2]);
01472       { // Font DICT INDEX
01473           cacheU32 (cff, 1); // count
01474           cacheU8 (cff, 1); // offSize
01475           cacheU8 (cff, 1); // offset[0]
01476           cacheU8 (cff, 4); // offset[1]
01477           cacheCFFOperand (cff, 0);
01478           cacheCFFOperand (cff, 0);
01479           cacheU8 (cff, 18); // Private
01480       }
01481       assert (countBufferedBytes (cff) == offsets[3]);
01482   }
01483   { // CharStrings INDEX
01484       Buffer *offsets = newBuffer (4096);
01485       Buffer *charstrings = newBuffer (4096);
01486       Buffer *outline = newBuffer (1024);
01487       const Glyph *glyph = getBufferHead (font->glyphs);
01488       const Glyph *const endGlyph = glyph + font->glyphCount;
01489       for (; glyph < endGlyph; glyph++)
01490       {
01491           // CFF offsets start at 1
01492           storeU32 (offsets, countBufferedBytes (charstrings) + 1);
01493
01494           pixels_t rx = -glyph->pos;
01495           pixels_t ry = DESCENDER;
01496           resetBuffer (outline);
01497           buildOutline (outline, glyph->bitmap, glyph->byteCount, FILL_LEFT);
01498           enum CFFOp {rmoveto=21, hmoveto=22, vmoveto=4, hlineto=6,
01499               vlineto=7, endchar=14};
01500           enum CFFOp pendingOp = 0;
01501           const int STACK_LIMIT = version == 1 ? 48 : 513;
01502           int stackSize = 0;
01503           bool isDrawing = false;
```

```
01504           pixels_t width = glyph->combining ? 0 : PW (glyph->byteCount);
01505           if (version == 1 && width != defaultWidth)
01506           {
01507               cacheCFFOperand (charstrings, FU (width - nominalWidth));
01508               stackSize++;
01509           }
01510           for (const pixels_t *p = getBufferHead (outline),
01511                *const end = getBufferTail (outline); p < end;)
01512           {
01513               int s = 0;
01514               const enum ContourOp op = *p++;
01515               if (op == OP_POINT)
01516               {
01517                   const pixels_t x = *p++, y = *p++;
01518                   if (x != rx)
01519                   {
01520                       cacheCFFOperand (charstrings, FU (x - rx));
01521                       rx = x;
01522                       stackSize++;
01523                       s |= 1;
01524                   }
01525                   if (y != ry)
01526                   {
01527                       cacheCFFOperand (charstrings, FU (y - ry));
01528                       ry = y;
01529                       stackSize++;
01530                       s |= 2;
01531                   }
01532                   assert (!(isDrawing && s == 3));
01533               }
01534               if (s)
01535               {
01536                   if (!isDrawing)
01537                   {
01538                       const enum CFFOp moves[] = {0, hmoveto, vmoveto,
01539                           rmoveto};
01540                       cacheU8 (charstrings, moves[s]);
01541                       stackSize = 0;
01542                   }
01543                   else if (!pendingOp)
01544                       pendingOp = (enum CFFOp[]){0, hlineto, vlineto}[s];
01545               }
01546               else if (!isDrawing)
01547               {
01548                   // only when the first point happens to be (0, 0)
01549                   cacheCFFOperand (charstrings, FU (0));
01550                   cacheU8 (charstrings, hmoveto);
01551                   stackSize = 0;
01552               }
01553               if (op == OP_CLOSE || stackSize >= STACK_LIMIT)
01554               {
01555                   assert (stackSize <= STACK_LIMIT);
01556                   cacheU8 (charstrings, pendingOp);
01557                   pendingOp = 0;
01558                   stackSize = 0;
01559               }
01560               isDrawing = op != OP_CLOSE;
01561           }
01562           if (version == 1)
01563               cacheU8 (charstrings, endchar);
01564       }
01565       size_t lastOffset = countBufferedBytes (charstrings) + 1;
01566 #if SIZE_MAX > U32MAX
01567           if (lastOffset > U32MAX)
01568               fail ("CFF data exceeded size limit.");
01569 #endif
01570       storeU32 (offsets, lastOffset);
01571       int offsetSize = 1 + (lastOffset > 0xff)
01572                          + (lastOffset > 0xffff)
01573                          + (lastOffset > 0xffffff);
01574       // count (must match 'numGlyphs' in 'maxp' table)
01575       cacheU (cff, font->glyphCount, version * 2);
01576       cacheU8 (cff, offsetSize); // offSize
01577       const uint_least32_t *p = getBufferHead (offsets);
01578       const uint_least32_t *const end = getBufferTail (offsets);
01579       for (; p < end; p++)
01580           cacheU (cff, *p, offsetSize); // offsets
01581       cacheBuffer (cff, charstrings); // data
01582       freeBuffer (offsets);
01583       freeBuffer (charstrings);
01584       freeBuffer (outline);
```

```
01585     }
01586 #undef cacheCFF32
01587 }
```

Here is the call graph for this function:



Here is the caller graph for this function:

5.3.5.20 fillCmapTable()

void fillCmapTable (
Font * font)

Fill a ”cmap” font table.
The ”cmap” table contains character to glyph index mapping information.

Parameters

in,out	font	The Font struct to which to add the table.

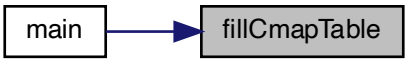
Definition at line 2109 of file hex2otf.c.

```
02110 {
02111     Glyph *const glyphs = getBufferHead (font->glyphs);
02112     Buffer *rangeHeads = newBuffer (16);
02113     uint_fast32_t rangeCount = 0;
```

```
02114     uint_fast32_t bmpRangeCount = 1; // 1 for the last 0xffff-0xffff range
02115     glyphs[0].codePoint = glyphs[1].codePoint; // to start a range at glyph 1
02116     for (uint_fast16_t i = 1; i < font->glyphCount; i++)
02117     {
02118         if (glyphs[i].codePoint != glyphs[i - 1].codePoint + 1)
02119         {
02120             storeU16 (rangeHeads, i);
02121             rangeCount++;
02122             bmpRangeCount += glyphs[i].codePoint < 0xffff;
02123         }
02124     }
02125     Buffer *cmap = newBuffer (256);
02126     addTable (font, "cmap", cmap);
02127     // Format 4 table is always generated for compatibility.
02128     bool hasFormat12 = glyphs[font->glyphCount - 1].codePoint > 0xffff;
02129     cacheU16 (cmap, 0); // version
02130     cacheU16 (cmap, 1 + hasFormat12); // numTables
02131     { // encodingRecords[0]
02132         cacheU16 (cmap, 3); // platformID
02133         cacheU16 (cmap, 1); // encodingID
02134         cacheU32 (cmap, 12 + 8 * hasFormat12); // subtableOffset
02135     }
02136     if (hasFormat12) // encodingRecords[1]
02137     {
02138         cacheU16 (cmap, 3); // platformID
02139         cacheU16 (cmap, 10); // encodingID
02140         cacheU32 (cmap, 36 + 8 * bmpRangeCount); // subtableOffset
02141     }
02142     const uint_least16_t *ranges = getBufferHead (rangeHeads);
02143     const uint_least16_t *const rangesEnd = getBufferTail (rangeHeads);
02144     storeU16 (rangeHeads, font->glyphCount);
02145     { // format 4 table
02146         cacheU16 (cmap, 4); // format
02147         cacheU16 (cmap, 16 + 8 * bmpRangeCount); // length
02148         cacheU16 (cmap, 0); // language
02149         if (bmpRangeCount * 2 > U16MAX)
02150             fail ("Too many ranges in 'cmap' table.");
02151         cacheU16 (cmap, bmpRangeCount * 2); // segCountX2
02152         uint_fast16_t searchRange = 1, entrySelector = -1;
02153         while (searchRange <= bmpRangeCount)
02154         {
02155             searchRange «= 1;
02156             entrySelector++;
02157         }
02158         cacheU16 (cmap, searchRange); // searchRange
02159         cacheU16 (cmap, entrySelector); // entrySelector
02160         cacheU16 (cmap, bmpRangeCount * 2 - searchRange); // rangeShift
02161         { // endCode[]
02162             const uint_least16_t *p = ranges;
02163             for (p++; p < rangesEnd && glyphs[*p].codePoint < 0xffff; p++)
02164                 cacheU16 (cmap, glyphs[*p - 1].codePoint);
02165             uint_fast32_t cp = glyphs[*p - 1].codePoint;
02166             if (cp > 0xfffe)
02167                 cp = 0xfffe;
02168             cacheU16 (cmap, cp);
02169             cacheU16 (cmap, 0xffff);
02170         }
02171         cacheU16 (cmap, 0); // reservedPad
02172         { // startCode[]
02173             for (uint_fast32_t i = 0; i < bmpRangeCount - 1; i++)
02174                 cacheU16 (cmap, glyphs[ranges[i]].codePoint);
02175             cacheU16 (cmap, 0xffff);
02176         }
02177         { // idDelta[]
02178             const uint_least16_t *p = ranges;
02179             for (; p < rangesEnd && glyphs[*p].codePoint < 0xffff; p++)
02180                 cacheU16 (cmap, *p - glyphs[*p].codePoint);
02181             uint_fast16_t delta = 1;
02182             if (p < rangesEnd && *p == 0xffff)
02183                 delta = *p - glyphs[*p].codePoint;
02184             cacheU16 (cmap, delta);
02185         }
02186         { // idRangeOffsets[]
02187             for (uint_least16_t i = 0; i < bmpRangeCount; i++)
02188                 cacheU16 (cmap, 0);
02189         }
02190     }
02191     if (hasFormat12) // format 12 table
02192     {
02193         cacheU16 (cmap, 12); // format
02194         cacheU16 (cmap, 0); // reserved
```

```
02195         cacheU32 (cmap, 16 + 12 * rangeCount); // length
02196         cacheU32 (cmap, 0); // language
02197         cacheU32 (cmap, rangeCount); // numGroups
02198
02199         // groups[]
02200         for (const uint__least16_t *p = ranges; p < rangesEnd; p++)
02201         {
02202             cacheU32 (cmap, glyphs[*p].codePoint); // startCharCode
02203             cacheU32 (cmap, glyphs[p[1] - 1].codePoint); // endCharCode
02204             cacheU32 (cmap, *p); // startGlyphID
02205         }
02206     }
02207     freeBuffer (rangeHeads);
02208 }
```

Here is the caller graph for this function:



5.3.5.21 fillGposTable()

```
void fillGposTable (
                Font * font )
```

Fill a ”GPOS” font table.
The ”GPOS” table contains information for glyph positioning.

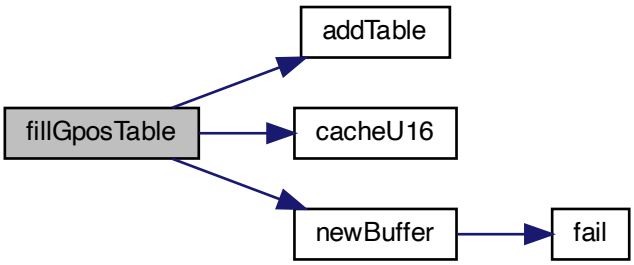
Parameters

in,out	font	The Font struct to which to add the table.

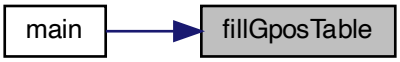
Definition at line 2241 of file hex2otf.c.

```
02242 {
02243     Buffer *gpos = newBuffer (16);
02244     addTable (font, ”GPOS”, gpos);
02245     cacheU16 (gpos, 1); // majorVersion
02246     cacheU16 (gpos, 0); // minorVersion
02247     cacheU16 (gpos, 10); // scriptListOffset
02248     cacheU16 (gpos, 12); // featureListOffset
02249     cacheU16 (gpos, 14); // lookupListOffset
02250     { // ScriptList table
02251         cacheU16 (gpos, 0); // scriptCount
02252     }
02253     { // Feature List table
02254         cacheU16 (gpos, 0); // featureCount
02255     }
02256     { // Lookup List Table
02257         cacheU16 (gpos, 0); // lookupCount
02258     }
```

02259 }
Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.22 fillGsubTable()

void fillGsubTable (
Font * font)
Fill a "GSUB" font table.
The "GSUB" table contains information for glyph substitution.

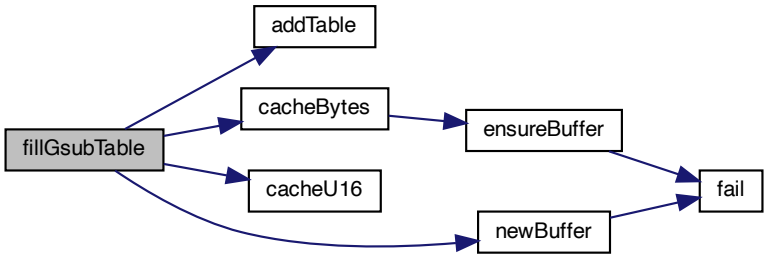
Parameters

in,out	font	The Font struct to which to add the table.

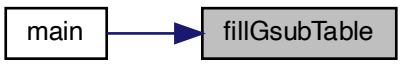
Definition at line 2269 of file hex2otf.c.
02270 {
02271 Buffer *gsub = newBuffer (38);

```
02272     addTable (font, "GSUB", gsub);
02273     cacheU16 (gsub, 1); // majorVersion
02274     cacheU16 (gsub, 0); // minorVersion
02275     cacheU16 (gsub, 10); // scriptListOffset
02276     cacheU16 (gsub, 34); // featureListOffset
02277     cacheU16 (gsub, 36); // lookupListOffset
02278     { // ScriptList table
02279        cacheU16 (gsub, 2); // scriptCount
02280        { // scriptRecords[0]
02281           cacheBytes (gsub, "DFLT", 4); // scriptTag
02282           cacheU16 (gsub, 14); // scriptOffset
02283        }
02284        { // scriptRecords[1]
02285           cacheBytes (gsub, "thai", 4); // scriptTag
02286           cacheU16 (gsub, 14); // scriptOffset
02287        }
02288        { // Script table
02289           cacheU16 (gsub, 4); // defaultLangSysOffset
02290           cacheU16 (gsub, 0); // langSysCount
02291           { // Default Language System table
02292              cacheU16 (gsub, 0); // lookupOrderOffset
02293              cacheU16 (gsub, 0); // requiredFeatureIndex
02294              cacheU16 (gsub, 0); // featureIndexCount
02295           }
02296        }
02297     }
02298     { // Feature List table
02299        cacheU16 (gsub, 0); // featureCount
02300     }
02301     { // Lookup List Table
02302        cacheU16 (gsub, 0); // lookupCount
02303     }
02304 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.23 fillHeadTable()

```
void fillHeadTable (
            Font * font,
            enum LocaFormat locaFormat,
            pixels_t xMin )
```

Fill a ”head” font table.
The ”head” table contains font header information common to the whole font.

Parameters

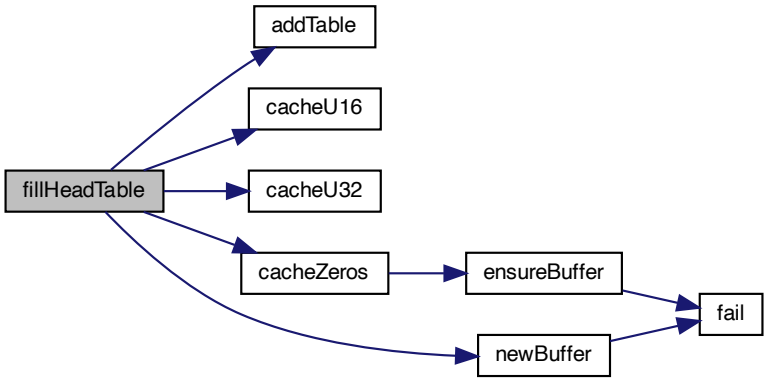
in,out	font	The Font struct to which to add the table.
in	locaFormat	The ”loca” offset index location table.
in	xMin	The minimum x-coordinate for a glyph.

Definition at line 1853 of file hex2otf.c.

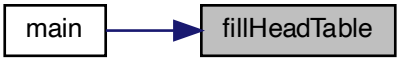
```
01854 {
01855     Buffer *head = newBuffer (56);
01856     addTable (font, ”head”, head);
01857     cacheU16 (head, 1); // majorVersion
01858     cacheU16 (head, 0); // minorVersion
01859     cacheZeros (head, 4); // fontRevision (unused)
01860     // The 'checksumAdjustment' field is a checksum of the entire file.
01861     // It is later calculated and written directly in the 'writeFont' function.
01862     cacheU32 (head, 0); // checksumAdjustment (placeholder)
01863     cacheU32 (head, 0x5f0f3cf5); // magicNumber
01864     const uint_fast16_t flags =
01865         + B1 ( 0) // baseline at y=0
01866         + B1 ( 1) // LSB at x=0 (doubtful; probably should be LSB=xMin)
01867         + B0 ( 2) // instructions may depend on point size
01868         + B0 ( 3) // force internal ppem to integers
01869         + B0 ( 4) // instructions may alter advance width
01870         + B0 ( 5) // not used in OpenType
01871         + B0 ( 6) // not used in OpenType
01872         + B0 ( 7) // not used in OpenType
01873         + B0 ( 8) // not used in OpenType
01874         + B0 ( 9) // not used in OpenType
01875         + B0 (10) // not used in OpenType
01876         + B0 (11) // font transformed
01877         + B0 (12) // font converted
01878         + B0 (13) // font optimized for ClearType
01879         + B0 (14) // last resort font
01880         + B0 (15) // reserved
01881     ;
01882     cacheU16 (head, flags); // flags
```

```
01883     cacheU16 (head, FUPEM); // unitsPerEm
01884     cacheZeros (head, 8); // created (unused)
01885     cacheZeros (head, 8); // modified (unused)
01886     cacheU16 (head, FU (xMin)); // xMin
01887     cacheU16 (head, FU (-DESCENDER)); // yMin
01888     cacheU16 (head, FU (font->maxWidth)); // xMax
01889     cacheU16 (head, FU (ASCENDER)); // yMax
01890     // macStyle (must agree with 'fsSelection' in 'OS/2' table)
01891     const uint_fast16_t macStyle =
01892         + B0 (0) // bold
01893         + B0 (1) // italic
01894         + B0 (2) // underline
01895         + B0 (3) // outline
01896         + B0 (4) // shadow
01897         + B0 (5) // condensed
01898         + B0 (6) // extended
01899         //    7-15  reserved
01900     ;
01901     cacheU16 (head, macStyle);
01902     cacheU16 (head, GLYPH_HEIGHT); // lowestRecPPEM
01903     cacheU16 (head, 2); // fontDirectionHint
01904     cacheU16 (head, locaFormat); // indexToLocFormat
01905     cacheU16 (head, 0); // glyphDataFormat
01906 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.24 fillHheaTable()

void fillHheaTable (

Font * font,
pixels_t xMin)

Fill a "hhea" font table.
The "hhea" table contains horizontal header information, for example left and right side bearings.

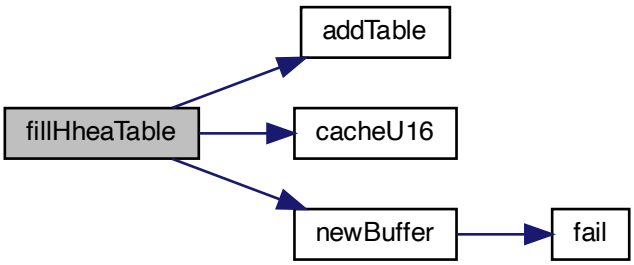
Parameters

in,out	font	The Font struct to which to add the table.
in	xMin	The minimum x-coordinate for a glyph.

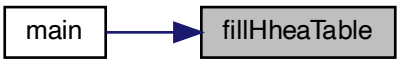
Definition at line 1918 of file hex2otf.c.

```
01919 {
01920     Buffer *hhea = newBuffer (36);
01921     addTable (font, "hhea", hhea);
01922     cacheU16 (hhea, 1); // majorVersion
01923     cacheU16 (hhea, 0); // minorVersion
01924     cacheU16 (hhea, FU (ASCENDER)); // ascender
01925     cacheU16 (hhea, FU (-DESCENDER)); // descender
01926     cacheU16 (hhea, FU (0)); // lineGap
01927     cacheU16 (hhea, FU (font->maxWidth)); // advanceWidthMax
01928     cacheU16 (hhea, FU (xMin)); // minLeftSideBearing
01929     cacheU16 (hhea, FU (0)); // minRightSideBearing (unused)
01930     cacheU16 (hhea, FU (font->maxWidth)); // xMaxExtent
01931     cacheU16 (hhea, 1); // caretSlopeRise
01932     cacheU16 (hhea, 0); // caretSlopeRun
01933     cacheU16 (hhea, 0); // caretOffset
01934     cacheU16 (hhea, 0); // reserved
01935     cacheU16 (hhea, 0); // reserved
01936     cacheU16 (hhea, 0); // reserved
01937     cacheU16 (hhea, 0); // reserved
01938     cacheU16 (hhea, 0); // metricDataFormat
01939     cacheU16 (hhea, font->glyphCount); // numberOfHMetrics
01940 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.25 fillHmtxTable()

void fillHmtxTable (
Font * font)

Fill an ”hmtx” font table.
The ”hmtx” table contains horizontal metrics information.

Parameters

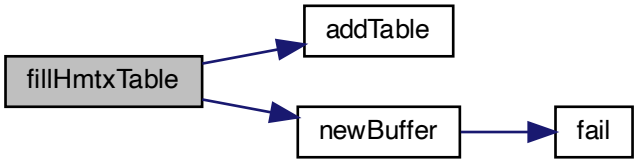
in,out	font	The Font struct to which to add the table.

Definition at line 2087 of file hex2otf.c.

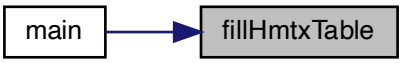
```
02088 {
02089     Buffer *hmtx = newBuffer (4 * font->glyphCount);
02090     addTable (font, ”hmtx”, hmtx);
02091     const Glyph *const glyphs = getBufferHead (font->glyphs);
```

```
02092     const Glyph *const glyphsEnd = getBufferTail (font->glyphs);
02093     for (const Glyph *glyph = glyphs; glyph < glyphsEnd; glyph++)
02094     {
02095         int_fast16_t aw = glyph->combining ? 0 : PW (glyph->byteCount);
02096         cacheU16 (hmtx, FU (aw)); // advanceWidth
02097         cacheU16 (hmtx, FU (glyph->lsb)); // lsb
02098     }
02099 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.26 fillMaxpTable()

```
void fillMaxpTable (
                Font * font,
                bool isCFF,
                uint_fast16_t maxPoints,
                uint_fast16_t maxContours )
```

Fill a ”maxp” font table.
The ”maxp” table contains maximum profile information, such as the memory required to contain the font.

Parameters

in,out	font	The Font struct to which to add the table.

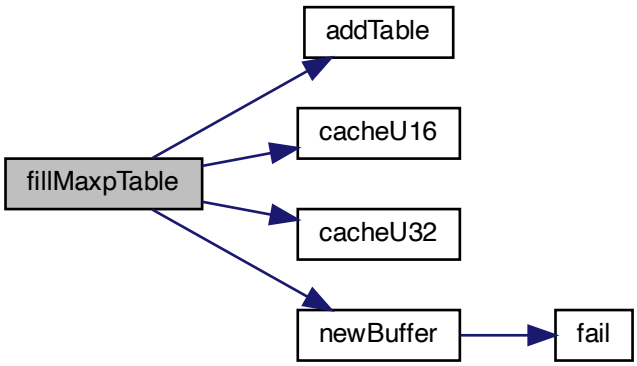
Parameters

in	isCFF	true if a CFF font is included, false otherwise.
in	maxPoints	Maximum points in a non-composite glyph.
in	maxContours	Maximum contours in a non-composite glyph.

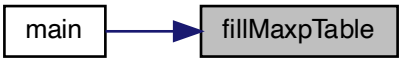
Definition at line 1954 of file hex2otf.c.

```
01956 {
01957     Buffer *maxp = newBuffer (32);
01958     addTable (font, "maxp", maxp);
01959     cacheU32 (maxp, isCFF ? 0x00005000 : 0x00010000); // version
01960     cacheU16 (maxp, font->glyphCount); // numGlyphs
01961     if (isCFF)
01962         return;
01963     cacheU16 (maxp, maxPoints); // maxPoints
01964     cacheU16 (maxp, maxContours); // maxContours
01965     cacheU16 (maxp, 0); // maxCompositePoints
01966     cacheU16 (maxp, 0); // maxCompositeContours
01967     cacheU16 (maxp, 0); // maxZones
01968     cacheU16 (maxp, 0); // maxTwilightPoints
01969     cacheU16 (maxp, 0); // maxStorage
01970     cacheU16 (maxp, 0); // maxFunctionDefs
01971     cacheU16 (maxp, 0); // maxInstructionDefs
01972     cacheU16 (maxp, 0); // maxStackElements
01973     cacheU16 (maxp, 0); // maxSizeOfInstructions
01974     cacheU16 (maxp, 0); // maxComponentElements
01975     cacheU16 (maxp, 0); // maxComponentDepth
01976 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.27 fillNameTable()

void fillNameTable (
Font * font,
NameStrings nameStrings)

Fill a ”name” font table.
The ”name” table contains name information, for example for Name IDs.

Parameters

in,out	font	The Font struct to which to add the table.

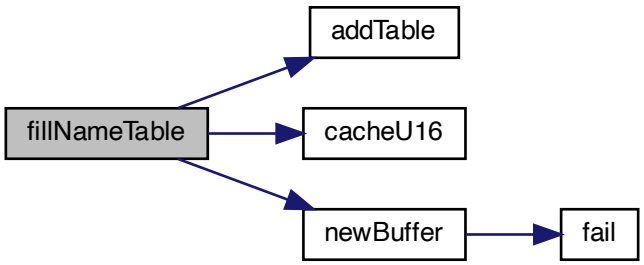
Parameters

in	names	List of NameStrings.

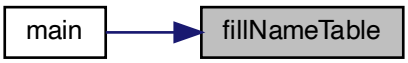
Definition at line 2366 of file hex2otf.c.

```
02367 {
02368     Buffer *name = newBuffer (2048);
02369     addTable (font, "name", name);
02370     size_t nameStringCount = 0;
02371     for (size_t i = 0; i < MAX_NAME_IDS; i++)
02372         nameStringCount += !!nameStrings[i];
02373     cacheU16 (name, 0); // version
02374     cacheU16 (name, nameStringCount); // count
02375     cacheU16 (name, 2 * 3 + 12 * nameStringCount); // storageOffset
02376     Buffer *stringData = newBuffer (1024);
02377     // nameRecord[]
02378     for (size_t i = 0; i < MAX_NAME_IDS; i++)
02379     {
02380         if (!nameStrings[i])
02381             continue;
02382         size_t offset = countBufferedBytes (stringData);
02383         cacheStringAsUTF16BE (stringData, nameStrings[i]);
02384         size_t length = countBufferedBytes (stringData) - offset;
02385         if (offset > U16MAX || length > U16MAX)
02386             fail ("Name strings are too long.");
02387         // Platform ID 0 (Unicode) is not well supported.
02388         // ID 3 (Windows) seems to be the best for compatibility.
02389         cacheU16 (name, 3); // platformID = Windows
02390         cacheU16 (name, 1); // encodingID = Unicode BMP
02391         cacheU16 (name, 0x0409); // languageID = en-US
02392         cacheU16 (name, i); // nameID
02393         cacheU16 (name, length); // length
02394         cacheU16 (name, offset); // stringOffset
02395     }
02396     cacheBuffer (name, stringData);
02397     freeBuffer (stringData);
02398 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.28 fillOS2Table()

void fillOS2Table (
Font * font)

Fill an "OS/2" font table.
The "OS/2" table contains OS/2 and Windows font metrics information.

Parameters

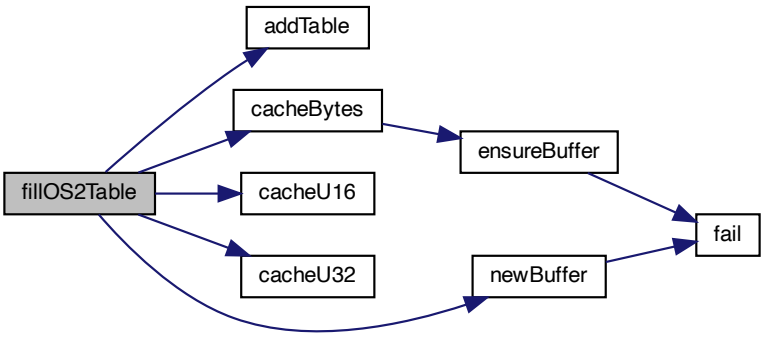
in,out	font	The Font struct to which to add the table.

Definition at line 1986 of file hex2otf.c.

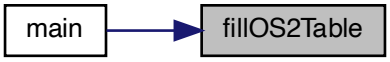
```
01987 {
01988     Buffer *os2 = newBuffer (100);
01989     addTable (font, "OS/2", os2);
01990     cacheU16 (os2, 5); // version
01991     // HACK: Average glyph width is not actually calculated.
01992     cacheU16 (os2, FU (font->maxWidth)); // xAvgCharWidth
01993     cacheU16 (os2, 400); // usWeightClass = Normal
01994     cacheU16 (os2, 5); // usWidthClass = Medium
01995     const uint_fast16_t typeFlags =
01996         + B0 (0) // reserved
01997         // usage permissions, one of:
01998             // Default: Installable embedding
01999             + B0 (1) // Restricted License embedding
02000             + B0 (2) // Preview & Print embedding
02001             + B0 (3) // Editable embedding
02002         //    4-7   reserved
02003         + B0 (8) // no subsetting
02004         + B0 (9) // bitmap embedding only
02005         //    10-15 reserved
02006     ;
02007     cacheU16 (os2, typeFlags); // fsType
02008     cacheU16 (os2, FU (5)); // ySubscriptXSize
02009     cacheU16 (os2, FU (7)); // ySubscriptYSize
02010     cacheU16 (os2, FU (0)); // ySubscriptXOffset
02011     cacheU16 (os2, FU (1)); // ySubscriptYOffset
02012     cacheU16 (os2, FU (5)); // ySuperscriptXSize
02013     cacheU16 (os2, FU (7)); // ySuperscriptYSize
02014     cacheU16 (os2, FU (0)); // ySuperscriptXOffset
02015     cacheU16 (os2, FU (4)); // ySuperscriptYOffset
02016     cacheU16 (os2, FU (1)); // yStrikeoutSize
02017     cacheU16 (os2, FU (5)); // yStrikeoutPosition
02018     cacheU16 (os2, 0x080a); // sFamilyClass = Sans Serif, Matrix
```

```
02019     const byte panose[] =
02020     {
02021         2, // Family Kind = Latin Text
02022         11, // Serif Style = Normal Sans
02023         4, // Weight = Thin
02024         // Windows would render all glyphs to the same width,
02025         // if 'Proportion' is set to 'Monospaced' (as Unifont should be).
02026         // 'Condensed' is the best alternative according to metrics.
02027         6, // Proportion = Condensed
02028         2, // Contrast = None
02029         2, // Stroke = No Variation
02030         2, // Arm Style = Straight Arms
02031         8, // Letterform = Normal/Square
02032         2, // Midline = Standard/Trimmed
02033         4, // X-height = Constant/Large
02034     };
02035     cacheBytes (os2, panose, sizeof panose); // panose
02036     // HACK: All defined Unicode ranges are marked functional for convenience.
02037     cacheU32 (os2, 0xffffffff); // ulUnicodeRange1
02038     cacheU32 (os2, 0xffffffff); // ulUnicodeRange2
02039     cacheU32 (os2, 0xffffffff); // ulUnicodeRange3
02040     cacheU32 (os2, 0x0effffff); // ulUnicodeRange4
02041     cacheBytes (os2, "GNU ", 4); // achVendID
02042     // fsSelection (must agree with 'macStyle' in 'head' table)
02043     const uint_fast16_t selection =
02044         + B0 (0) // italic
02045         + B0 (1) // underscored
02046         + B0 (2) // negative
02047         + B0 (3) // outlined
02048         + B0 (4) // strikeout
02049         + B0 (5) // bold
02050         + B1 (6) // regular
02051         + B1 (7) // use sTypo* metrics in this table
02052         + B1 (8) // font name conforms to WWS model
02053         + B0 (9) // oblique
02054         //    10-15 reserved
02055     ;
02056     cacheU16 (os2, selection);
02057     const Glyph *glyphs = getBufferHead (font->glyphs);
02058     uint_fast32_t first = glyphs[1].codePoint;
02059     uint_fast32_t last = glyphs[font->glyphCount - 1].codePoint;
02060     cacheU16 (os2, first < U16MAX ? first : U16MAX); // usFirstCharIndex
02061     cacheU16 (os2, last  < U16MAX ? last  : U16MAX); // usLastCharIndex
02062     cacheU16 (os2, FU (ASCENDER)); // sTypoAscender
02063     cacheU16 (os2, FU (-DESCENDER)); // sTypoDescender
02064     cacheU16 (os2, FU (0)); // sTypoLineGap
02065     cacheU16 (os2, FU (ASCENDER)); // usWinAscent
02066     cacheU16 (os2, FU (DESCENDER)); // usWinDescent
02067     // HACK: All reasonable code pages are marked functional for convenience.
02068     cacheU32 (os2, 0x603f01ff); // ulCodePageRange1
02069     cacheU32 (os2, 0xffff0000); // ulCodePageRange2
02070     cacheU16 (os2, FU (8)); // sxHeight
02071     cacheU16 (os2, FU (10)); // sCapHeight
02072     cacheU16 (os2, 0); // usDefaultChar
02073     cacheU16 (os2, 0x20); // usBreakChar
02074     cacheU16 (os2, 0); // usMaxContext
02075     cacheU16 (os2, 0); // usLowerOpticalPointSize
02076     cacheU16 (os2, 0xffff); // usUpperOpticalPointSize
02077 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.29 fillPostTable()

void fillPostTable (
Font * font)

Fill a "post" font table.
The "post" table contains information for PostScript printers.

Parameters

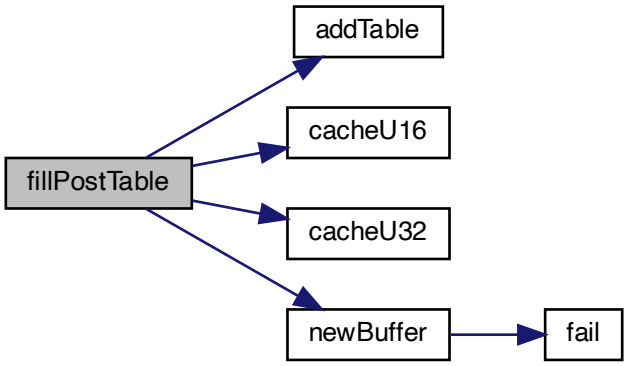
in,out	font	The Font struct to which to add the table.

Definition at line 2218 of file hex2otf.c.

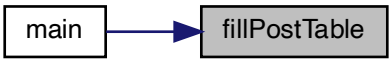
```
02219 {
02220     Buffer *post = newBuffer (32);
```

```
02221     addTable (font, "post", post);
02222     cacheU32 (post, 0x00030000); // version = 3.0
02223     cacheU32 (post, 0); // italicAngle
02224     cacheU16 (post, 0); // underlinePosition
02225     cacheU16 (post, 1); // underlineThickness
02226     cacheU32 (post, 1); // isFixedPitch
02227     cacheU32 (post, 0); // minMemType42
02228     cacheU32 (post, 0); // maxMemType42
02229     cacheU32 (post, 0); // minMemType1
02230     cacheU32 (post, 0); // maxMemType1
02231 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.30 fillTrueType()

```
void fillTrueType (
            Font * font,
            enum LocaFormat * format,
            uint_fast16_t * maxPoints,
            uint_fast16_t * maxContours )
```

Add a TrueType table to a font.

Parameters

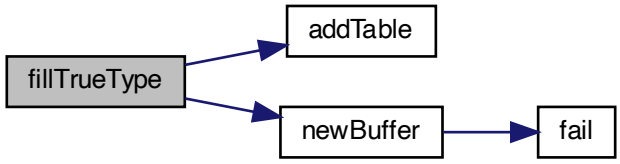
in,out	font	Pointer to a Font struct to contain the TrueType table.
in	format	The TrueType "loca" table format, Offset16 or Offset32.
in	names	List of NameStrings.

Definition at line 1597 of file hex2otf.c.

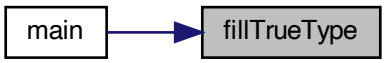
```
01599 {
01600     Buffer *glyf = newBuffer (65536);
01601     addTable (font, "glyf", glyf);
01602     Buffer *loca = newBuffer (4 * (font->glyphCount + 1));
01603     addTable (font, "loca", loca);
01604     *format = LOCA_OFFSET32;
01605     Buffer *endPoints = newBuffer (256);
01606     Buffer *flags = newBuffer (256);
01607     Buffer *xs = newBuffer (256);
01608     Buffer *ys = newBuffer (256);
01609     Buffer *outline = newBuffer (1024);
01610     Glyph *const glyphs = getBufferHead (font->glyphs);
01611     const Glyph *const glyphsEnd = getBufferTail (font->glyphs);
01612     for (Glyph *glyph = glyphs; glyph < glyphsEnd; glyph++)
01613     {
01614         cacheU32 (loca, countBufferedBytes (glyf));
01615         pixels_t rx = -glyph->pos;
01616         pixels_t ry = DESCENDER;
01617         pixels_t xMin = GLYPH_MAX_WIDTH, xMax = 0;
01618         pixels_t yMin = ASCENDER, yMax = -DESCENDER;
01619         resetBuffer (endPoints);
01620         resetBuffer (flags);
01621         resetBuffer (xs);
01622         resetBuffer (ys);
01623         resetBuffer (outline);
01624         buildOutline (outline, glyph->bitmap, glyph->byteCount, FILL_RIGHT);
01625         uint_fast32_t pointCount = 0, contourCount = 0;
01626         for (const pixels_t *p = getBufferHead (outline),
01627              *const end = getBufferTail (outline); p < end;)
01628         {
01629             const enum ContourOp op = *p++;
01630             if (op == OP_CLOSE)
01631             {
01632                 contourCount++;
01633                 assert (contourCount <= U16MAX);
01634                 cacheU16 (endPoints, pointCount - 1);
01635                 continue;
01636             }
01637             assert (op == OP_POINT);
```

```
01638           pointCount++;
01639           assert (pointCount <= U16MAX);
01640           const pixels_t x = *p++, y = *p++;
01641           uint_fast8_t pointFlags =
01642               + B1 (0) // point is on curve
01643               + BX (1, x != rx) // x coordinate is 1 byte instead of 2
01644               + BX (2, y != ry) // y coordinate is 1 byte instead of 2
01645               + B0 (3) // repeat
01646               + BX (4, x >= rx) // when x is 1 byte: x is positive;
01647                                 // when x is 2 bytes: x unchanged and omitted
01648               + BX (5, y >= ry) // when y is 1 byte: y is positive;
01649                                 // when y is 2 bytes: y unchanged and omitted
01650               + B1 (6) // contours may overlap
01651               + B0 (7) // reserved
01652           ;
01653           cacheU8 (flags, pointFlags);
01654           if (x != rx)
01655               cacheU8 (xs, FU (x > rx ? x - rx : rx - x));
01656           if (y != ry)
01657               cacheU8 (ys, FU (y > ry ? y - ry : ry - y));
01658           if (x < xMin) xMin = x;
01659           if (y < yMin) yMin = y;
01660           if (x > xMax) xMax = x;
01661           if (y > yMax) yMax = y;
01662           rx = x;
01663           ry = y;
01664       }
01665       if (contourCount == 0)
01666           continue; // blank glyph is indicated by the 'loca' table
01667       glyph->lsb = glyph->pos + xMin;
01668       cacheU16 (glyf, contourCount); // numberOfContours
01669       cacheU16 (glyf, FU (glyph->pos + xMin)); // xMin
01670       cacheU16 (glyf, FU (yMin)); // yMin
01671       cacheU16 (glyf, FU (glyph->pos + xMax)); // xMax
01672       cacheU16 (glyf, FU (yMax)); // yMax
01673       cacheBuffer (glyf, endPoints); // endPtsOfContours[]
01674       cacheU16 (glyf, 0); // instructionLength
01675       cacheBuffer (glyf, flags); // flags[]
01676       cacheBuffer (glyf, xs); // xCoordinates[]
01677       cacheBuffer (glyf, ys); // yCoordinates[]
01678       if (pointCount > *maxPoints)
01679           *maxPoints = pointCount;
01680       if (contourCount > *maxContours)
01681           *maxContours = contourCount;
01682   }
01683   cacheU32 (loca, countBufferedBytes (glyf));
01684   freeBuffer (endPoints);
01685   freeBuffer (flags);
01686   freeBuffer (xs);
01687   freeBuffer (ys);
01688   freeBuffer (outline);
01689 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.31 freeBuffer()

void freeBuffer (
Buffer * buf)

Free the memory previously allocated for a buffer.
This function frees the memory allocated to an array of type Buffer *.

Parameters

in	buf	The pointer to an array of type Buffer *.

Definition at line 337 of file hex2otf.c.

```
00338 {
00339     free (buf->begin);
00340     buf->capacity = 0;
00341 }
```

5.3.5.32 initBuffers()

void initBuffers (
size_t count)

Initialize an array of buffer pointers to all zeroes.
This function initializes the "allBuffers" array of buffer pointers to all zeroes.

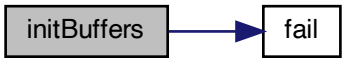
Parameters

in	count	The number of buffer array pointers to allocate.

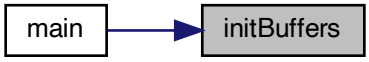
Definition at line 152 of file hex2otf.c.

```
00153 {
00154     assert (count > 0);
00155     assert (bufferCount == 0); // uninitialized
00156     allBuffers = calloc (count, sizeof *allBuffers);
00157     if (!allBuffers)
00158         fail ("Failed to initialize buffers.");
00159     bufferCount = count;
00160     nextBufferIndex = 0;
00161 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.33 main()

```
int main (
                int argc,
                char * argv[] )
```

The main function.

Parameters

in	argc	The number of command-line arguments.
in	argv	The array of command-line arguments.

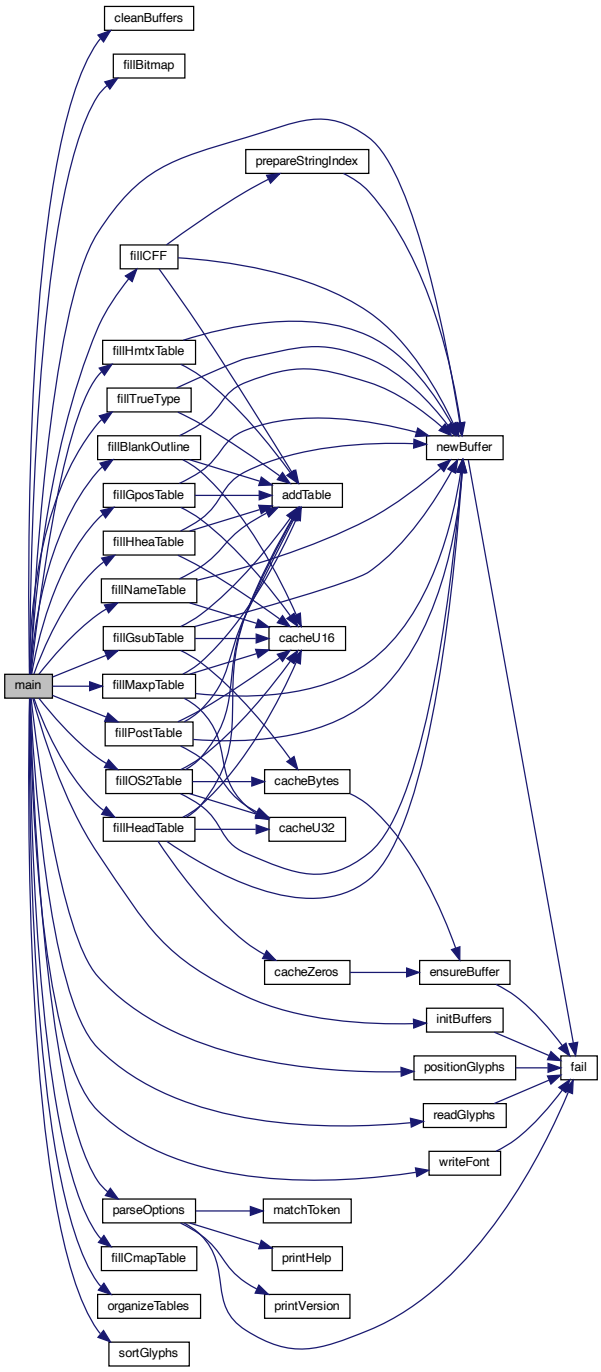
Returns

EXIT_FAILURE upon fatal error, EXIT_SUCCESS otherwise.

Definition at line 2603 of file hex2otf.c.

```
02604 {
02605     initBuffers (16);
02606     atexit (cleanBuffers);
02607     Options opt = parseOptions (argv);
02608     Font font;
02609     font.tables = newBuffer (sizeof (Table) * 16);
02610     font.glyphs = newBuffer (sizeof (Glyph) * MAX_GLYPHS);
02611     readGlyphs (&font, opt.hex);
02612     sortGlyphs (&font);
02613     enum LocaFormat loca = LOCA_OFFSET16;
02614     uint_fast16_t maxPoints = 0, maxContours = 0;
02615     pixels_t xMin = 0;
02616     if (opt.pos)
02617         positionGlyphs (&font, opt.pos, &xMin);
02618     if (opt.gpos)
02619         fillGposTable (&font);
02620     if (opt.gsub)
02621         fillGsubTable (&font);
02622     if (opt.cff)
02623         fillCFF (&font, opt.cff, opt.nameStrings);
02624     if (opt.truetype)
02625         fillTrueType (&font, &loca, &maxPoints, &maxContours);
02626     if (opt.blankOutline)
02627         fillBlankOutline (&font);
02628     if (opt.bitmap)
02629         fillBitmap (&font);
02630     fillHeadTable (&font, loca, xMin);
02631     fillHheaTable (&font, xMin);
02632     fillMaxpTable (&font, opt.cff, maxPoints, maxContours);
02633     fillOS2Table (&font);
02634     fillNameTable (&font, opt.nameStrings);
02635     fillHmtxTable (&font);
02636     fillCmapTable (&font);
02637     fillPostTable (&font);
02638     organizeTables (&font, opt.cff);
02639     writeFont (&font, opt.cff, opt.out);
02640     return EXIT_SUCCESS;
02641 }
```

Here is the call graph for this function:



5.3.5.34 matchToken()

const char * matchToken (

const char * operand,
const char * key,
char delimiter)

Match a command line option with its key for enabling.

Parameters

in	operand	A pointer to the specified operand.
in	key	Pointer to the option structure.
in	delimeter	The delimiter to end searching.

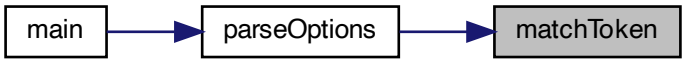
Returns

Pointer to the first character of the desired option.

Definition at line 2470 of file hex2otf.c.

```
02471 {
02472     while (*key)
02473         if (*operand++ != *key++)
02474             return NULL;
02475     if (!*operand || *operand++ == delimiter)
02476         return operand;
02477     return NULL;
02478 }
```

Here is the caller graph for this function:



5.3.5.35 newBuffer()

Buffer * newBuffer (
size_t initialCapacity)

Create a new buffer.
This function creates a new buffer array of type Buffer, with an initial size of initialCapacity elements.

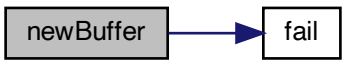
Parameters

in	initialCapacity	The initial number of elements in the buffer.

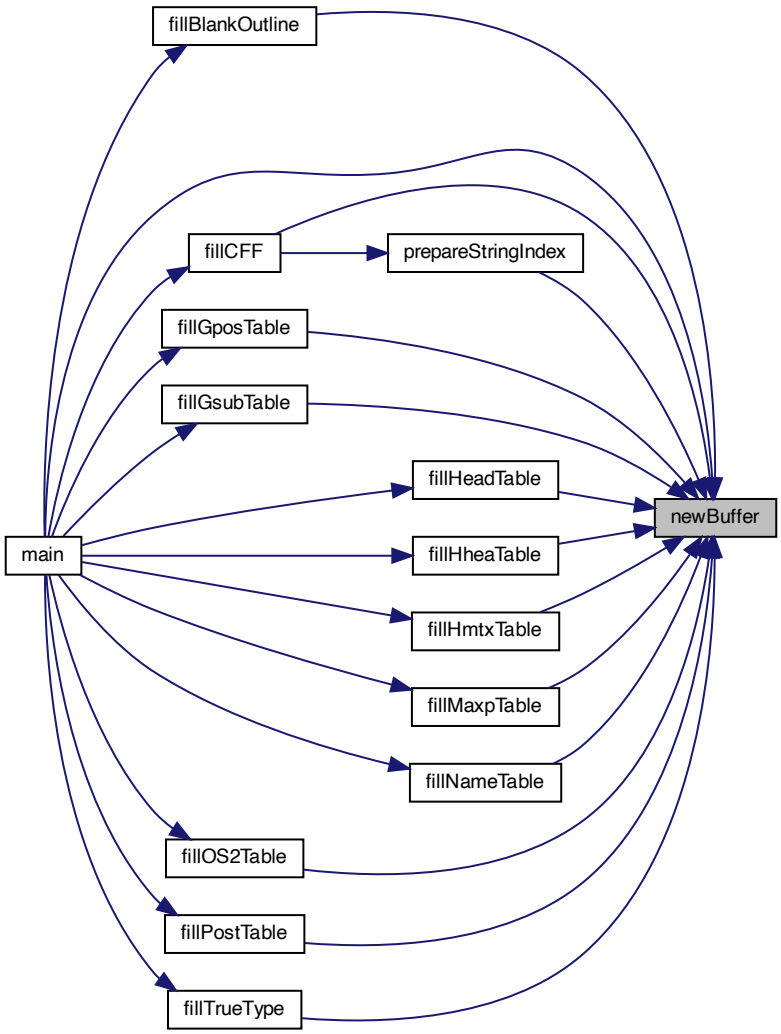
Definition at line 188 of file hex2otf.c.

```
00189 {
00190     assert (initialCapacity > 0);
00191     Buffer *buf = NULL;
00192     size_t sentinel = nextBufferIndex;
00193     do
00194     {
00195         if (nextBufferIndex == bufferCount)
00196             nextBufferIndex = 0;
00197         if (allBuffers[nextBufferIndex].capacity == 0)
00198         {
00199             buf = &allBuffers[nextBufferIndex++];
00200             break;
00201         }
00202     } while (++nextBufferIndex != sentinel);
00203     if (!buf) // no existing buffer available
00204     {
00205         size_t newSize = sizeof (Buffer) * bufferCount * 2;
00206         void *extended = realloc (allBuffers, newSize);
00207         if (!extended)
00208             fail ("Failed to create new buffers.");
00209         allBuffers = extended;
00210         memset (allBuffers + bufferCount, 0, sizeof (Buffer) * bufferCount);
00211         buf = &allBuffers[bufferCount];
00212         nextBufferIndex = bufferCount + 1;
00213         bufferCount *= 2;
00214     }
00215     buf->begin = malloc (initialCapacity);
00216     if (!buf->begin)
00217         fail ("Failed to allocate %zu bytes of memory.", initialCapacity);
00218     buf->capacity = initialCapacity;
00219     buf->next = buf->begin;
00220     buf->end = buf->begin + initialCapacity;
00221     return buf;
00222 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.36 organizeTables()

void organizeTables (
Font * font,
bool isCFF)

Sort tables according to OpenType recommendations.
The various tables in a font are sorted in an order recommended for TrueType font files.

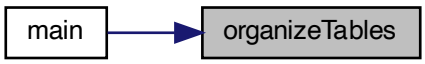
Parameters

in,out	font	The font in which to sort tables.
in	isCFF	True iff Compact Font Format (CFF) is being used.

Definition at line 711 of file hex2otf.c.

```
00712 {
00713     const char *const cffOrder[] = {"head","hhea","maxp","OS/2","name",
00714         "cmap","post","CFF ",NULL};
00715     const char *const truetypeOrder[] = {"head","hhea","maxp","OS/2",
00716         "hmtx","LTSH","VDMX","hdmx","cmap","fpgm","prep","cvt ","loca",
00717         "glyf","kern","name","post","gasp","PCLT","DSIG",NULL};
00718     const char *const *const order = isCFF ? cffOrder : truetypeOrder;
00719     Table *unordered = getBufferHead (font->tables);
00720     const Table *const tablesEnd = getBufferTail (font->tables);
00721     for (const char *const *p = order; *p; p++)
00722     {
00723         uint_fast32_t tag = tagAsU32 (*p);
00724         for (Table *t = unordered; t < tablesEnd; t++)
00725         {
00726             if (t->tag != tag)
00727                 continue;
00728             if (t != unordered)
00729             {
00730                 Table temp = *unordered;
00731                 *unordered = *t;
00732                 *t = temp;
00733             }
00734             unordered++;
00735             break;
00736         }
00737     }
00738 }
```

Here is the caller graph for this function:



5.3.5.37 parseOptions()

Options parseOptions (
char *const argv[const])

Parse command line options.

Option	Data Type	Description
truetype	bool	Generate TrueType outlines
blankOutline	bool	Generate blank outlines
bitmap	bool	Generate embedded bitmap
gpos	bool	Generate a dummy GPOS table
gsub	bool	Generate a dummy GSUB table
cff	int	Generate CFF 1 or CFF 2 outlines
hex	const char *	Name of Unifont .hex file
pos	const char *	Name of Unifont combining data file
out	const char *	Name of output font file
nameStrings	NameStrings	Array of TrueType font Name IDs

Parameters

in	argv	Pointer to array of command line options.

Returns

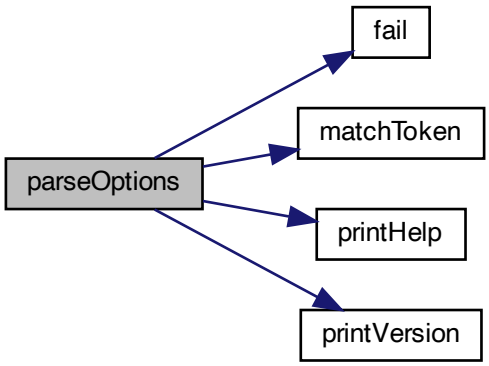
Data structure to hold requested command line options.

Definition at line 2500 of file hex2otf.c.

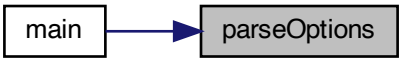
```
02501 {
02502     Options opt = {0}; // all options default to 0, false and NULL
02503     const char *format = NULL;
02504     struct StringArg
02505     {
02506         const char *const key;
02507         const char **const value;
02508     } strArgs[] =
02509     {
02510         {"hex", &opt.hex},
02511         {"pos", &opt.pos},
02512         {"out", &opt.out},
02513         {"format", &format},
02514         {NULL, NULL} // sentinel
02515     };
02516     for (char *const *argp = argv + 1; *argp; argp++)
02517     {
02518         const char *const arg = *argp;
02519         struct StringArg *p;
02520         const char *value = NULL;
02521         if (strcmp (arg, "--help") == 0)
02522             printHelp ();
02523         if (strcmp (arg, "--version") == 0)
02524             printVersion ();
02525         for (p = strArgs; p->key; p++)
02526             if ((value = matchToken (arg, p->key, '=')))
02527                 break;
02528         if (p->key)
02529         {
02530             if (!*value)
02531                 fail ("Empty argument: '%s'.", p->key);
02532             if (*p->value)
02533                 fail ("Duplicate argument: '%s'.", p->key);
```

```
02534           *p->value = value;
02535       }
02536       else // shall be a name string
02537       {
02538           char *endptr;
02539           unsigned long id = strtoul (arg, &endptr, 10);
02540           if (endptr == arg || id >= MAX_NAME_IDS || *endptr != '=')
02541               fail ("Invalid argument: '%s'.", arg);
02542           endptr++; // skip '='
02543           if (opt.nameStrings[id])
02544               fail ("Duplicate name ID: %lu.", id);
02545           opt.nameStrings[id] = endptr;
02546       }
02547   }
02548   if (!opt.hex)
02549       fail ("Hex file is not specified.");
02550   if (opt.pos && opt.pos[0] == '\0')
02551       opt.pos = NULL; // Position file is optional. Empty path means none.
02552   if (!opt.out)
02553       fail ("Output file is not specified.");
02554   if (!format)
02555       fail ("Format is not specified.");
02556   for (const NamePair *p = defaultNames; p->str; p++)
02557       if (!opt.nameStrings[p->id])
02558           opt.nameStrings[p->id] = p->str;
02559   bool cff = false, cff2 = false;
02560   struct Symbol
02561   {
02562       const char *const key;
02563       bool *const found;
02564   } symbols[] =
02565   {
02566       {"cff", &cff},
02567       {"cff2", &cff2},
02568       {"truetype", &opt.truetype},
02569       {"blank", &opt.blankOutline},
02570       {"bitmap", &opt.bitmap},
02571       {"gpos", &opt.gpos},
02572       {"gsub", &opt.gsub},
02573       {NULL, NULL} // sentinel
02574   };
02575   while (*format)
02576   {
02577       const struct Symbol *p;
02578       const char *next = NULL;
02579       for (p = symbols; p->key; p++)
02580           if ((next = matchToken (format, p->key, ',')))
02581               break;
02582       if (!p->key)
02583           fail ("Invalid format.");
02584       *p->found = true;
02585       format = next;
02586   }
02587   if (cff + cff2 + opt.truetype + opt.blankOutline > 1)
02588       fail ("At most one outline format can be accepted.");
02589   if (!(cff || cff2 || opt.truetype || opt.bitmap))
02590       fail ("Invalid format.");
02591   opt.cff = cff + cff2 * 2;
02592   return opt;
02593 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.38 positionGlyphs()

```
void positionGlyphs (
            Font * font,
            const char * fileName,
            pixels_t * xMin )
```

Position a glyph within a 16-by-16 pixel bounding box.

Position a glyph within the 16-by-16 pixel drawing area and note whether or not the glyph is a combining character.

N.B.: Glyphs must be sorted by code point before calling this function.

Parameters

in,out	font	Font data structure pointer to store glyphs.
in	fileName	Name of glyph file to read.
in	xMin	Minimum x-axis value (for left side bearing).

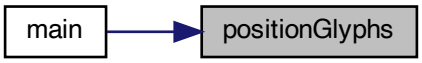
Definition at line 1061 of file hex2otf.c.

```
01062 {
01063     *xMin = 0;
01064     FILE *file = fopen (fileName, "r");
01065     if (!file)
01066         fail ("Failed to open file '%s'.", fileName);
01067     Glyph *glyphs = getBufferHead (font->glyphs);
01068     const Glyph *const endGlyph = glyphs + font->glyphCount;
01069     Glyph *nextGlyph = &glyphs[1]; // predict and avoid search
01070     for (;;)
01071     {
01072         uint_fast32_t codePoint;
01073         if (readCodePoint (&codePoint, fileName, file))
01074             break;
01075         Glyph *glyph = nextGlyph;
01076         if (glyph == endGlyph || glyph->codePoint != codePoint)
01077         {
01078             // Prediction failed. Search.
01079             const Glyph key = { .codePoint = codePoint };
01080             glyph = bsearch (&key, glyphs + 1, font->glyphCount - 1,
01081                 sizeof key, byCodePoint);
01082             if (!glyph)
01083                 fail ("Glyph "PRI_CP" is positioned but not defined.",
01084                     codePoint);
01085         }
01086         nextGlyph = glyph + 1;
01087         char s[8];
01088         if (!fgets (s, sizeof s, file))
01089             fail ("%s: Read error.", fileName);
01090         char *end;
01091         const long value = strtol (s, &end, 10);
01092         if (*end != '\n' && *end != '\0')
01093             fail ("Position of glyph "PRI_CP" is invalid.", codePoint);
01094         // Currently no glyph is moved to the right,
01095         // so positive position is considered out of range.
01096         // If this limit is to be lifted,
01097         // 'xMax' of bounding box in 'head' table shall also be updated.
01098         if (value < -GLYPH_MAX_WIDTH || value > 0)
01099             fail ("Position of glyph "PRI_CP" is out of range.", codePoint);
01100         glyph->combining = true;
01101         glyph->pos = value;
01102         glyph->lsb = value; // updated during outline generation
01103         if (value < *xMin)
01104             *xMin = value;
```

```
01105     }
01106     fclose (file);
01107 }
```

Here is the call graph for this function:

Here is the caller graph for this function:



5.3.5.39 prepareOffsets()

```
void prepareOffsets (
                size_t * sizes )
```

Prepare 32-bit glyph offsets in a font table.

Parameters

in	sizes	Array of glyph sizes, for offset calculations.

Definition at line 1275 of file hex2otf.c.

```
01276 {
01277     size_t *p = sizes;
01278     for (size_t *i = sizes + 1; *i; i++)
01279         *i += *p++;
01280     if (*p > 2147483647U) // offset not representable
01281         fail ("CFF table is too large.");
01282 }
```

Here is the call graph for this function:

5.3.5.40 prepareStringIndex()

Buffer * prepareStringIndex (
const NameStrings names)

Prepare a font name string index.

Parameters

in	names	List of name strings.

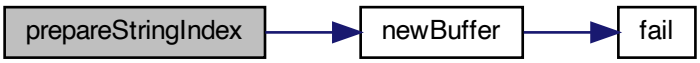
Returns

Pointer to a Buffer struct containing the string names.

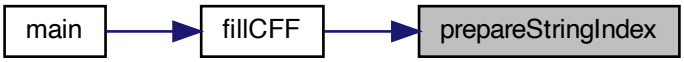
Get the number of elements in array char *strings[].
Definition at line 1291 of file hex2otf.c.

```
01292 {
01293     Buffer *buf = newBuffer (256);
01294     assert (names[6]);
01295     const char *strings[] = {"Adobe", "Identity", names[6]};
01296 /// Get the number of elements in array char *strings[].
01297 #define stringCount (sizeof strings / sizeof *strings)
01298     static_assert (stringCount <= U16MAX, "too many strings");
01299     size_t offset = 1;
01300     size_t lengths[stringCount];
01301     for (size_t i = 0; i < stringCount; i++)
01302     {
01303         assert (strings[i]);
01304         lengths[i] = strlen (strings[i]);
01305         offset += lengths[i];
01306     }
01307     int offsetSize = 1 + (offset > 0xff)
01308                        + (offset > 0xffff)
01309                        + (offset > 0xffffff);
01310     cacheU16 (buf, stringCount); // count
01311     cacheU8 (buf, offsetSize); // offSize
01312     cacheU (buf, offset = 1, offsetSize); // offset[0]
01313     for (size_t i = 0; i < stringCount; i++)
01314         cacheU (buf, offset += lengths[i], offsetSize); // offset[i + 1]
01315     for (size_t i = 0; i < stringCount; i++)
01316         cacheBytes (buf, strings[i], lengths[i]);
01317 #undef stringCount
01318     return buf;
01319 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.41 printHelp()

void printHelp ( )

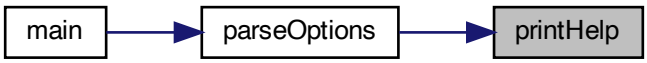
Print help message to stdout and then exit.

Print help message if invoked with the "--help" option, and then exit successfully.

Definition at line 2426 of file hex2otf.c.

```
02426             {
02427     printf ("Synopsis: hex2otf <options>:\n\n");
02428     printf ("    hex=<filename>        Specify Unifont .hex input file.\n");
02429     printf ("    pos=<filename>        Specify combining file. (Optional)\n");
02430     printf ("    out=<filename>        Specify output font file.\n");
02431     printf ("    format=<f1>,<f2>,...  Specify font format(s); values:\n");
02432     printf ("                          cff\n");
02433     printf ("                          cff2\n");
02434     printf ("                          truetype\n");
02435     printf ("                          blank\n");
02436     printf ("                          bitmap\n");
02437     printf ("                          gpos\n");
02438     printf ("                          gsub\n");
02439     printf ("\nExample:\n\n");
02440     printf ("    hex2otf hex=Myfont.hex out=Myfont.otf format=cff\n\n");
02441     printf ("For more information, consult the hex2otf(1) man page.\n\n");
02442
02443     exit (EXIT_SUCCESS);
02444 }
```

Here is the caller graph for this function:



5.3.5.42 printVersion()

```
void printVersion ( )
```

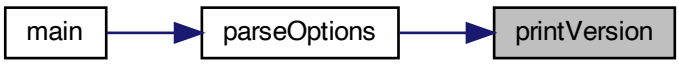
Print program version string on stdout.

Print program version if invoked with the "--version" option, and then exit successfully.

Definition at line 2407 of file hex2otf.c.

```
02407                {
02408     printf ("hex2otf (GNU Unifont) %s\n", VERSION);
02409     printf ("Copyright \u00A9 2022 \u4F55\u5FD7\u7FD4 (He Zhixiang)\n");
02410     printf ("License GPLv2+: GNU GPL version 2 or later\n");
02411     printf ("<https://gnu.org/licenses/gpl.html>\n");
02412     printf ("This is free software: you are free to change and\n");
02413     printf ("redistribute it.  There is NO WARRANTY, to the extent\n");
02414     printf ("permitted by law.\n");
02415
02416     exit (EXIT_SUCCESS);
02417 }
```

Here is the caller graph for this function:



5.3.5.43 readCodePoint()

```
bool readCodePoint (
                uint_fast32_t * codePoint,
                const char * fileName,
                FILE * file )
```

Read up to 6 hexadecimal digits and a colon from file.

This function reads up to 6 hexadecimal digits followed by a colon from a file.

If the end of the file is reached, the function returns true. The file name is provided to include in an error message if the end of file was reached unexpectedly.

Parameters

out	codePoint	The Unicode code point.
in	fileName	The name of the input file.
in	file	Pointer to the input file stream.

Returns

true if at end of file, false otherwise.

Definition at line 919 of file hex2otf.c.

```
00920 {
00921     *codePoint = 0;
00922     uint_fast8_t digitCount = 0;
00923     for (;;)
00924     {
00925         int c = getc (file);
00926         if (isxdigit (c) && ++digitCount <= 6)
00927         {
00928             *codePoint = (*codePoint « 4) | nibbleValue (c);
00929             continue;
00930         }
00931         if (c == ':' && digitCount > 0)
00932             return false;
00933         if (c == EOF)
00934         {
00935             if (digitCount == 0)
00936                 return true;
00937             if (feof (file))
00938                 fail ("%s: Unexpected end of file.", fileName);
00939             else
00940                 fail ("%s: Read error.", fileName);
00941         }
00942         fail ("%s: Unexpected character: %#.2x.", fileName, (unsigned)c);
00943     }
00944 }
```

5.3.5.44 readGlyphs()

```
void readGlyphs (
            Font * font,
            const char * fileName )
```

Read glyph definitions from a Unifont .hex format file.
This function reads in the glyph bitmaps contained in a Unifont .hex format file. These input files contain one glyph bitmap per line. Each line is of the form

<hexadecimal code point> ':' <hexadecimal bitmap sequence>

The code point field typically consists of 4 hexadecimal digits for a code point in Unicode Plane 0, and 6 hexadecimal digits for code points above Plane 0. The hexadecimal bitmap sequence is 32 hexadecimal digits long for a glyph that is 8 pixels wide by 16 pixels high, and 64 hexadecimal digits long for a glyph that is 16 pixels wide by 16 pixels high.

Parameters

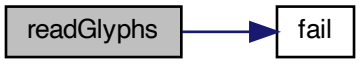
in,out	font	The font data structure to update with new glyphs.
in	fileName	The name of the Unifont .hex format input file.

Definition at line 966 of file hex2otf.c.

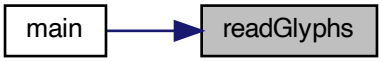
```
00967 {
00968     FILE *file = fopen (fileName, "r");
00969     if (!file)
00970         fail ("Failed to open file '%s'.", fileName);
00971     uint_fast32_t glyphCount = 1; // for glyph 0
00972     uint_fast8_t maxByteCount = 0;
00973     { // Hard code the .notdef glyph.
00974         const byte bitmap[] = "\0\0\0~fZZzvv~vv~\0\0"; // same as U+FFFD
00975         const size_t byteCount = sizeof bitmap - 1;
00976         assert (byteCount <= GLYPH_MAX_BYTE_COUNT);
00977         assert (byteCount % GLYPH_HEIGHT == 0);
00978         Glyph *notdef = getBufferSlot (font->glyphs, sizeof (Glyph));
00979         memcpy (notdef->bitmap, bitmap, byteCount);
00980         notdef->byteCount = maxByteCount = byteCount;
00981         notdef->combining = false;
00982         notdef->pos = 0;
00983         notdef->lsb = 0;
00984     }
00985     for (;;)
00986     {
00987         uint_fast32_t codePoint;
00988         if (readCodePoint (&codePoint, fileName, file))
00989             break;
00990         if (++glyphCount > MAX_GLYPHS)
00991             fail ("OpenType does not support more than %lu glyphs.",
00992                 MAX_GLYPHS);
00993         Glyph *glyph = getBufferSlot (font->glyphs, sizeof (Glyph));
00994         glyph->codePoint = codePoint;
00995         glyph->byteCount = 0;
00996         glyph->combining = false;
00997         glyph->pos = 0;
00998         glyph->lsb = 0;
00999         for (byte *p = glyph->bitmap;; p++)
01000         {
01001             int h, l;
01002             if (isxdigit (h = getc (file)) && isxdigit (l = getc (file)))
01003             {
01004                 if (++glyph->byteCount > GLYPH_MAX_BYTE_COUNT)
01005                     fail ("Hex stream of "PRI_CP" is too long.", codePoint);
01006                 *p = nibbleValue (h) << 4 | nibbleValue (l);
01007             }
01008             else if (h == '\n' || (h == EOF && feof (file)))
01009                 break;
01010             else if (ferror (file))
01011                 fail ("%s: Read error.", fileName);
```

```
01012             else
01013                 fail ("Hex stream of "PRI_CP" is invalid.", codePoint);
01014         }
01015         if (glyph->byteCount % GLYPH_HEIGHT != 0)
01016             fail ("Hex length of "PRI_CP" is indivisible by glyph height %d.",
01017                 codePoint, GLYPH_HEIGHT);
01018         if (glyph->byteCount > maxByteCount)
01019             maxByteCount = glyph->byteCount;
01020     }
01021     if (glyphCount == 1)
01022         fail ("No glyph is specified.");
01023     font->glyphCount = glyphCount;
01024     font->maxWidth = PW (maxByteCount);
01025     fclose (file);
01026 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.45 sortGlyphs()

```
void sortGlyphs (
                Font * font )
```

Sort the glyphs in a font by Unicode code point.

This function reads in an array of glyphs and sorts them by Unicode code point. If a duplicate code point is encountered, that will result in a fatal error with an error message to stderr.

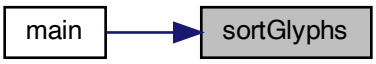
Parameters

in,out	font	Pointer to a Font structure with glyphs to sort.

Definition at line 1119 of file hex2otf.c.

```
01120 {
01121     Glyph *glyphs = getBufferHead (font->glyphs);
01122     const Glyph *const glyphsEnd = getBufferTail (font->glyphs);
01123     glyphs++; // glyph 0 does not need sorting
01124     qsort (glyphs, glyphsEnd - glyphs, sizeof *glyphs, byCodePoint);
01125     for (const Glyph *glyph = glyphs; glyph < glyphsEnd - 1; glyph++)
01126     {
01127         if (glyph[0].codePoint == glyph[1].codePoint)
01128             fail ("Duplicate code point: "PRI_CP".", glyph[0].codePoint);
01129         assert (glyph[0].codePoint < glyph[1].codePoint);
01130     }
01131 }
```

Here is the caller graph for this function:



5.3.5.46 writeBytes()

```
void writeBytes (
            const byte bytes[],
            size_t count,
            FILE * file )
```

Write an array of bytes to an output file.

Parameters

in	bytes	An array of unsigned bytes to write.

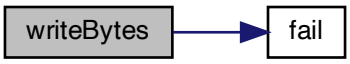
Parameters

in	file	The file pointer for writing, of type FILE *.

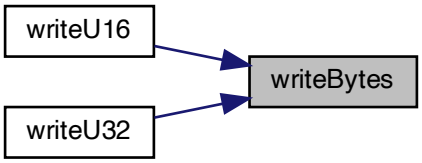
Definition at line 538 of file hex2otf.c.

```
00539 {
00540     if (fwrite (bytes, count, 1, file) != 1 && count != 0)
00541         fail ("Failed to write %zu bytes to output file.", count);
00542 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.47 writeFont()

```
void writeFont (
                Font * font,
                bool isCFF,
                const char * fileName )
```

Write OpenType font to output file.

This function writes the constructed OpenType font to the output file named "filename".

Parameters

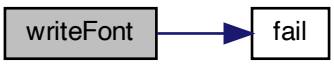
in	font	Pointer to the font, of type Font *.
in	isCFF	Boolean indicating whether the font has CFF data.
in	filename	The name of the font file to create.

Add a byte shifted by 24, 16, 8, or 0 bits.
Definition at line 786 of file hex2otf.c.

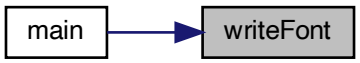
```
00787 {
00788     FILE *file = fopen (fileName, "wb");
00789     if (!file)
00790         fail ("Failed to open file '%s'.", fileName);
00791     const Table *const tables = getBufferHead (font->tables);
00792     const Table *const tablesEnd = getBufferTail (font->tables);
00793     size_t tableCount = tablesEnd - tables;
00794     assert (0 < tableCount && tableCount <= U16MAX);
00795     size_t offset = 12 + 16 * tableCount;
00796     uint_fast32_t totalChecksum = 0;
00797     Buffer *tableRecords =
00798         newBuffer (sizeof (struct TableRecord) * tableCount);
00799     for (size_t i = 0; i < tableCount; i++)
00800     {
00801         struct TableRecord *record =
00802             getBufferSlot (tableRecords, sizeof *record);
00803         record->tag = tables[i].tag;
00804         size_t length = countBufferedBytes (tables[i].content);
00805 #if SIZE_MAX > U32MAX
00806             if (offset > U32MAX)
00807                 fail ("Table offset exceeded 4 GiB.");
00808             if (length > U32MAX)
00809                 fail ("Table size exceeded 4 GiB.");
00810 #endif
00811         record->length = length;
00812         record->checksum = 0;
00813         const byte *p = getBufferHead (tables[i].content);
00814         const byte *const end = getBufferTail (tables[i].content);
00815
00816 /// Add a byte shifted by 24, 16, 8, or 0 bits.
00817 #define addByte(shift) \
00818 if (p == end) \
00819 break; \
00820 record->checksum += (uint_fast32_t)*p++ « (shift);
00821
00822         for (;;)
00823         {
00824             addByte (24)
00825             addByte (16)
```

```
00826             addByte (8)
00827             addByte (0)
00828         }
00829         #undef addByte
00830         cacheZeros (tables[i].content, (~length + 1U) & 3U);
00831         record->offset = offset;
00832         offset += countBufferedBytes (tables[i].content);
00833         totalChecksum += record->checksum;
00834     }
00835     struct TableRecord *records = getBufferHead (tableRecords);
00836     qsort (records, tableCount, sizeof *records, byTableTag);
00837     // Offset Table
00838     uint_fast32_t sfntVersion = isCFF ? 0x4f54544f : 0x00010000;
00839     writeU32 (sfntVersion, file); // sfntVersion
00840     totalChecksum += sfntVersion;
00841     uint_fast16_t entrySelector = 0;
00842     for (size_t k = tableCount; k != 1; k »= 1)
00843         entrySelector++;
00844     uint_fast16_t searchRange = 1 « (entrySelector + 4);
00845     uint_fast16_t rangeShift = (tableCount - (1 « entrySelector)) « 4;
00846     writeU16 (tableCount, file); // numTables
00847     writeU16 (searchRange, file); // searchRange
00848     writeU16 (entrySelector, file); // entrySelector
00849     writeU16 (rangeShift, file); // rangeShift
00850     totalChecksum += (uint_fast32_t)tableCount « 16;
00851     totalChecksum += searchRange;
00852     totalChecksum += (uint_fast32_t)entrySelector « 16;
00853     totalChecksum += rangeShift;
00854     // Table Records (always sorted by table tags)
00855     for (size_t i = 0; i < tableCount; i++)
00856     {
00857         // Table Record
00858         writeU32 (records[i].tag, file); // tableTag
00859         writeU32 (records[i].checksum, file); // checkSum
00860         writeU32 (records[i].offset, file); // offset
00861         writeU32 (records[i].length, file); // length
00862         totalChecksum += records[i].tag;
00863         totalChecksum += records[i].checksum;
00864         totalChecksum += records[i].offset;
00865         totalChecksum += records[i].length;
00866     }
00867     freeBuffer (tableRecords);
00868     for (const Table *table = tables; table < tablesEnd; table++)
00869     {
00870         if (table->tag == 0x68656164) // 'head' table
00871         {
00872             byte *begin = getBufferHead (table->content);
00873             byte *end = getBufferTail (table->content);
00874             writeBytes (begin, 8, file);
00875             writeU32 (0xb1b0afbaU - totalChecksum, file); // checksumAdjustment
00876             writeBytes (begin + 12, end - (begin + 12), file);
00877             continue;
00878         }
00879         writeBuffer (table->content, file);
00880     }
00881     fclose (file);
00882 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.3.5.48 writeU16()

```
void writeU16 (
            uint_fast16_t value,
            FILE * file )
```

Write an unsigned 16-bit value to an output file.
This function writes a 16-bit unsigned value in big-endian order to an output file specified with a file pointer.

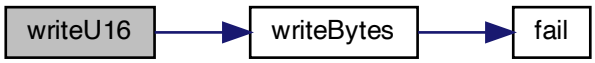
Parameters

in	value	The 16-bit value to write.
in	file	The file pointer for writing, of type FILE *.

Definition at line 554 of file hex2otf.c.

```
00555 {
00556     byte bytes[] =
00557     {
00558         (value » 8) & 0xff,
00559         (value     ) & 0xff,
00560     };
00561     writeBytes (bytes, sizeof bytes, file);
00562 }
```

Here is the call graph for this function:



5.3.5.49 writeU32()

```
void writeU32 (
            uint_fast32_t value,
            FILE * file )
```

Write an unsigned 32-bit value to an output file.
This function writes a 32-bit unsigned value in big-endian order to an output file specified with a file pointer.

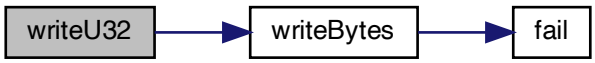
Parameters

in	value	The 32-bit value to write.
in	file	The file pointer for writing, of type FILE *.

Definition at line 574 of file hex2otf.c.

```
00575 {
00576     byte bytes[] =
00577     {
00578         (value » 24) & 0xff,
00579         (value » 16) & 0xff,
00580         (value »  8) & 0xff,
00581         (value      ) & 0xff,
00582     };
00583     writeBytes (bytes, sizeof bytes, file);
00584 }
```

Here is the call graph for this function:



5.3.6 Variable Documentation

5.3.6.1 allBuffers

Buffer* allBuffers
Initial allocation of empty array of buffer pointers.
Definition at line 139 of file hex2otf.c.

5.3.6.2 bufferCount

size_t bufferCount
Number of buffers in a Buffer * array.
Definition at line 140 of file hex2otf.c.

5.3.6.3 nextBufferIndex

size_t nextBufferIndex
Index number to tail element of Buffer * array.
Definition at line 141 of file hex2otf.c.

5.4 hex2otf.c

Go to the documentation of this file.

```
00001 /**
00002 @file hex2otf.c
00003
00004 @brief hex2otf - Convert GNU Unifont .hex file to OpenType font
00005
00006 This program reads a Unifont .hex format file and a file containing
00007 combining mark offset information, and produces an OpenType font file.
00008
00009 @copyright Copyright © 2022 何志翔 (He Zhixiang)
00010
00011 @author 何志翔 (He Zhixiang)
00012 */
00013
00014 /*
00015 LICENSE:
00016
00017 This program is free software; you can redistribute it and/or
00018 modify it under the terms of the GNU General Public License
00019 as published by the Free Software Foundation; either version 2
00020 of the License, or (at your option) any later version.
00021
00022 This program is distributed in the hope that it will be useful,
00023 but WITHOUT ANY WARRANTY; without even the implied warranty of
```

```
00024 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
00025 GNU General Public License for more details.
00026
00027 You should have received a copy of the GNU General Public License
00028 along with this program; if not, write to the Free Software
00029 Foundation, Inc., 51 Franklin Street, Fifth Floor, Boston, MA
00030 02110-1301, USA.
00031
00032 NOTE: It is a violation of the license terms of this software
00033 to delete or override license and copyright information contained
00034 in the hex2otf.h file if creating a font derived from Unifont glyphs.
00035 Fonts derived from Unifont can add names to the copyright notice
00036 for creators of new or modified glyphs.
00037 */
00038
00039 #include <assert.h>
00040 #include <ctype.h>
00041 #include <inttypes.h>
00042 #include <stdarg.h>
00043 #include <stdbool.h>
00044 #include <stddef.h>
00045 #include <stdio.h>
00046 #include <stdlib.h>
00047 #include <string.h>
00048
00049 #include "hex2otf.h"
00050
00051 #define VERSION "1.0.1"  ///< Program version, for "--version" option.
00052
00053 // This program assumes the execution character set is compatible with ASCII.
00054
00055 #define U16MAX 0xffff       ///< Maximum UTF-16 code point value.
00056 #define U32MAX 0xffffffff   ///< Maximum UTF-32 code point value.
00057
00058 #define PRI_CP "U+%.4"PRIXFAST32 ///< Format string to print Unicode code point.
00059
00060 #ifndef static_assert
00061 #define static_assert(a, b) (assert(a)) ///< If "a" is true, return string "b".
00062 #endif
00063
00064 // Set or clear a particular bit.
00065 #define BX(shift, x) ((uintmax_t)(!!(x)) « (shift)) ///< Truncate & shift word.
00066 #define B0(shift) BX((shift), 0)    ///< Clear a given bit in a word.
00067 #define B1(shift) BX((shift), 1)    ///< Set   a given bit in a word.
00068
00069 #define GLYPH_MAX_WIDTH 16  ///< Maximum glyph width, in pixels.
00070 #define GLYPH_HEIGHT 16     ///< Maximum glyph height, in pixels.
00071
00072 /// Number of bytes to represent one bitmap glyph as a binary array.
00073 #define GLYPH_MAX_BYTE_COUNT (GLYPH_HEIGHT * GLYPH_MAX_WIDTH / 8)
00074
00075 /// Count of pixels below baseline.
00076 #define DESCENDER 2
00077
00078 /// Count of pixels above baseline.
00079 #define ASCENDER (GLYPH_HEIGHT - DESCENDER)
00080
00081 /// Font units per em.
00082 #define FUPEM 64
00083
00084 /// An OpenType font has at most 65536 glyphs.
00085 #define MAX_GLYPHS 65536
00086
00087 /// Name IDs 0-255 are used for standard names.
00088 #define MAX_NAME_IDS 256
00089
00090 /// Convert pixels to font units.
00091 #define FU(x) ((x) * FUPEM / GLYPH_HEIGHT)
00092
00093 /// Convert glyph byte count to pixel width.
00094 #define PW(x) ((x) / (GLYPH_HEIGHT / 8))
00095
00096 /// Definition of "byte" type as an unsigned char.
00097 typedef unsigned char byte;
00098
00099 /// This type must be able to represent max(GLYPH_MAX_WIDTH, GLYPH_HEIGHT).
00100 typedef int_least8_t pixels_t;
00101
00102 /**
00103 @brief Print an error message on stderr, then exit.
00104
```

```
00105 This function prints the provided error string and optional
00106 following arguments to stderr, and then exits with a status
00107 of EXIT_FAILURE.
00108
00109 @param[in] reason The output string to describe the error.
00110 @param[in] ... Optional following arguments to output.
00111 */
00112 void
00113 fail (const char *reason, ...)
00114 {
00115     fputs ("ERROR: ", stderr);
00116     va_list args;
00117     va_start (args, reason);
00118     vfprintf (stderr, reason, args);
00119     va_end (args);
00120     putc ('\n', stderr);
00121     exit (EXIT_FAILURE);
00122 }
00123
00124 /**
00125 @brief Generic data structure for a linked list of buffer elements.
00126
00127 A buffer can act as a vector (when filled with 'store*' functions),
00128 or a temporary output area (when filled with 'cache*' functions).
00129 The 'store*' functions use native endian.
00130 The 'cache*' functions use big endian or other formats in OpenType.
00131 Beware of memory alignment.
00132 */
00133 typedef struct Buffer
00134 {
00135     size_t capacity; // = 0 iff this buffer is free
00136     byte *begin, *next, *end;
00137 } Buffer;
00138
00139 Buffer *allBuffers; ///< Initial allocation of empty array of buffer pointers.
00140 size_t bufferCount;  ///< Number of buffers in a Buffer * array.
00141 size_t nextBufferIndex; ///< Index number to tail element of Buffer * array.
00142
00143 /**
00144 @brief Initialize an array of buffer pointers to all zeroes.
00145
00146 This function initializes the "allBuffers" array of buffer
00147 pointers to all zeroes.
00148
00149 @param[in] count The number of buffer array pointers to allocate.
00150 */
00151 void
00152 initBuffers (size_t count)
00153 {
00154     assert (count > 0);
00155     assert (bufferCount == 0); // uninitialized
00156     allBuffers = calloc (count, sizeof *allBuffers);
00157     if (!allBuffers)
00158         fail ("Failed to initialize buffers.");
00159     bufferCount = count;
00160     nextBufferIndex = 0;
00161 }
00162
00163 /**
00164 @brief Free all allocated buffer pointers.
00165
00166 This function frees all buffer pointers previously allocated
00167 in the initBuffers function.
00168 */
00169 void
00170 cleanBuffers ()
00171 {
00172     for (size_t i = 0; i < bufferCount; i++)
00173         if (allBuffers[i].capacity)
00174             free (allBuffers[i].begin);
00175     free (allBuffers);
00176     bufferCount = 0;
00177 }
00178
00179 /**
00180 @brief Create a new buffer.
00181
00182 This function creates a new buffer array of type Buffer,
00183 with an initial size of initialCapacity elements.
00184
00185 @param[in] initialCapacity The initial number of elements in the buffer.
```

```
00186 */
00187 Buffer *
00188 newBuffer (size_t initialCapacity)
00189 {
00190     assert (initialCapacity > 0);
00191     Buffer *buf = NULL;
00192     size_t sentinel = nextBufferIndex;
00193     do
00194     {
00195         if (nextBufferIndex == bufferCount)
00196             nextBufferIndex = 0;
00197         if (allBuffers[nextBufferIndex].capacity == 0)
00198         {
00199             buf = &allBuffers[nextBufferIndex++];
00200             break;
00201         }
00202     } while (++nextBufferIndex != sentinel);
00203     if (!buf) // no existing buffer available
00204     {
00205         size_t newSize = sizeof (Buffer) * bufferCount * 2;
00206         void *extended = realloc (allBuffers, newSize);
00207         if (!extended)
00208             fail ("Failed to create new buffers.");
00209         allBuffers = extended;
00210         memset (allBuffers + bufferCount, 0, sizeof (Buffer) * bufferCount);
00211         buf = &allBuffers[bufferCount];
00212         nextBufferIndex = bufferCount + 1;
00213         bufferCount *= 2;
00214     }
00215     buf->begin = malloc (initialCapacity);
00216     if (!buf->begin)
00217         fail ("Failed to allocate %zu bytes of memory.", initialCapacity);
00218     buf->capacity = initialCapacity;
00219     buf->next = buf->begin;
00220     buf->end = buf->begin + initialCapacity;
00221     return buf;
00222 }
00223
00224 /**
00225 @brief Ensure that the buffer has at least the specified minimum size.
00226
00227 This function takes a buffer array of type Buffer and the
00228 necessary minimum number of elements as inputs, and attempts
00229 to increase the size of the buffer if it must be larger.
00230
00231 If the buffer is too small and cannot be resized, the program
00232 will terminate with an error message and an exit status of
00233 EXIT_FAILURE.
00234
00235 @param[in,out] buf The buffer to check.
00236 @param[in] needed The required minimum number of elements in the buffer.
00237 */
00238 void
00239 ensureBuffer (Buffer *buf, size_t needed)
00240 {
00241     if (buf->end - buf->next >= needed)
00242         return;
00243     ptrdiff_t occupied = buf->next - buf->begin;
00244     size_t required = occupied + needed;
00245     if (required < needed) // overflow
00246         fail ("Cannot allocate %zu + %zu bytes of memory.", occupied, needed);
00247     if (required > SIZE_MAX / 2)
00248         buf->capacity = required;
00249     else while (buf->capacity < required)
00250         buf->capacity *= 2;
00251     void *extended = realloc (buf->begin, buf->capacity);
00252     if (!extended)
00253         fail ("Failed to allocate %zu bytes of memory.", buf->capacity);
00254     buf->begin = extended;
00255     buf->next = buf->begin + occupied;
00256     buf->end = buf->begin + buf->capacity;
00257 }
00258
00259 /**
00260 @brief Count the number of elements in a buffer.
00261
00262 @param[in] buf The buffer to be examined.
00263 @return The number of elements in the buffer.
00264 */
00265 static inline size_t
00266 countBufferedBytes (const Buffer *buf)
```

```
00267 {
00268     return buf->next - buf->begin;
00269 }
00270
00271 /**
00272 @brief Get the start of the buffer array.
00273
00274 @param[in] buf The buffer to be examined.
00275 @return A pointer of type Buffer * to the start of the buffer.
00276 */
00277 static inline void *
00278 getBufferHead (const Buffer *buf)
00279 {
00280     return buf->begin;
00281 }
00282
00283 /**
00284 @brief Get the end of the buffer array.
00285
00286 @param[in] buf The buffer to be examined.
00287 @return A pointer of type Buffer * to the end of the buffer.
00288 */
00289 static inline void *
00290 getBufferTail (const Buffer *buf)
00291 {
00292     return buf->next;
00293 }
00294
00295 /**
00296 @brief Add a slot to the end of a buffer.
00297
00298 This function ensures that the buffer can grow by one slot,
00299 and then returns a pointer to the new slot within the buffer.
00300
00301 @param[in] buf The pointer to an array of type Buffer *.
00302 @param[in] slotSize The new slot number.
00303 @return A pointer to the new slot within the buffer.
00304 */
00305 static inline void *
00306 getBufferSlot (Buffer *buf, size_t slotSize)
00307 {
00308     ensureBuffer (buf, slotSize);
00309     void *slot = buf->next;
00310     buf->next += slotSize;
00311     return slot;
00312 }
00313
00314 /**
00315 @brief Reset a buffer pointer to the buffer's beginning.
00316
00317 This function resets an array of type Buffer * to point
00318 its tail to the start of the array.
00319
00320 @param[in] buf The pointer to an array of type Buffer *.
00321 */
00322 static inline void
00323 resetBuffer (Buffer *buf)
00324 {
00325     buf->next = buf->begin;
00326 }
00327
00328 /**
00329 @brief Free the memory previously allocated for a buffer.
00330
00331 This function frees the memory allocated to an array
00332 of type Buffer *.
00333
00334 @param[in] buf The pointer to an array of type Buffer *.
00335 */
00336 void
00337 freeBuffer (Buffer *buf)
00338 {
00339     free (buf->begin);
00340     buf->capacity = 0;
00341 }
00342
00343 /**
00344 @brief Temporary define to look up an element in an array of given type.
00345
00346 This defintion is used to create lookup functions to return
00347 a given element in unsigned arrays of size 8, 16, and 32 bytes,
```

```
00348 and in an array of pixels.
00349 */
00350 #define defineStore(name, type) \
00351 void name (Buffer *buf, type value) \
00352 { \
00353 type *slot = getBufferSlot (buf, sizeof value); \
00354 *slot = value; \
00355 }
00356 defineStore (storeU8, uint_least8_t)
00357 defineStore (storeU16, uint_least16_t)
00358 defineStore (storeU32, uint_least32_t)
00359 defineStore (storePixels, pixels_t)
00360 #undef defineStore
00361
00362 /**
00363 @brief Cache bytes in a big-endian format.
00364
00365 This function adds from 1, 2, 3, or 4 bytes to the end of
00366 a byte array in big-endian order.  The buffer is updated
00367 to account for the newly-added bytes.
00368
00369 @param[in,out] buf The array of bytes to which to append new bytes.
00370 @param[in] value The bytes to add, passed as a 32-bit unsigned word.
00371 @param[in] bytes The number of bytes to append to the buffer.
00372 */
00373 void
00374 cacheU (Buffer *buf, uint_fast32_t value, int bytes)
00375 {
00376     assert (1 <= bytes && bytes <= 4);
00377     ensureBuffer (buf, bytes);
00378     switch (bytes)
00379     {
00380         case 4: *buf->next++ = value » 24 & 0xff; // fall through
00381         case 3: *buf->next++ = value » 16 & 0xff; // fall through
00382         case 2: *buf->next++ = value » 8  & 0xff; // fall through
00383         case 1: *buf->next++ = value      & 0xff;
00384     }
00385 }
00386
00387 /**
00388 @brief Append one unsigned byte to the end of a byte array.
00389
00390 This function adds one byte to the end of a byte array.
00391 The buffer is updated to account for the newly-added byte.
00392
00393 @param[in,out] buf The array of bytes to which to append a new byte.
00394 @param[in] value The 8-bit unsigned value to append to the buf array.
00395 */
00396 void
00397 cacheU8 (Buffer *buf, uint_fast8_t value)
00398 {
00399     storeU8 (buf, value & 0xff);
00400 }
00401
00402 /**
00403 @brief Append two unsigned bytes to the end of a byte array.
00404
00405 This function adds two bytes to the end of a byte array.
00406 The buffer is updated to account for the newly-added bytes.
00407
00408 @param[in,out] buf The array of bytes to which to append two new bytes.
00409 @param[in] value The 16-bit unsigned value to append to the buf array.
00410 */
00411 void
00412 cacheU16 (Buffer *buf, uint_fast16_t value)
00413 {
00414     cacheU (buf, value, 2);
00415 }
00416
00417 /**
00418 @brief Append four unsigned bytes to the end of a byte array.
00419
00420 This function adds four bytes to the end of a byte array.
00421 The buffer is updated to account for the newly-added bytes.
00422
00423 @param[in,out] buf The array of bytes to which to append four new bytes.
00424 @param[in] value The 32-bit unsigned value to append to the buf array.
00425 */
00426 void
00427 cacheU32 (Buffer *buf, uint_fast32_t value)
00428 {
```

```
00429     cacheU (buf, value, 4);
00430 }
00431
00432 /**
00433 @brief Cache charstring number encoding in a CFF buffer.
00434
00435 This function caches two's complement 8-, 16-, and 32-bit
00436 words as per Adobe's Type 2 Charstring encoding for operands.
00437 These operands are used in Compact Font Format data structures.
00438
00439 Byte values can have offsets, for which this function
00440 compensates, optionally followed by additional bytes:
00441
00442 Byte Range   Offset   Bytes   Adjusted Range
00443 ----------   ------   -----   --------------
00444 0 to 11        0       1     0 to 11 (operators)
00445 12            0       2     Next byte is 8-bit op code
00446 13 to 18       0       1     13 to 18 (operators)
00447 19 to 20       0       2+    hintmask and cntrmask operators
00448 21 to 27       0       1     21 to 27 (operators)
00449 28            0       3     16-bit 2's complement number
00450 29 to 31       0       1     29 to 31 (operators)
00451 32 to 246    -139      1     -107 to +107
00452 247 to 250    +108      2     +108 to +1131
00453 251 to 254    -108      2     -108 to -1131
00454 255           0       5     16-bit integer and 16-bit fraction
00455
00456 @param[in,out] buf The buffer to which the operand value is appended.
00457 @param[in] value The operand value.
00458 */
00459 void
00460 cacheCFFOperand (Buffer *buf, int_fast32_t value)
00461 {
00462     if (-107 <= value && value <= 107)
00463         cacheU8 (buf, value + 139);
00464     else if (108 <= value && value <= 1131)
00465     {
00466         cacheU8 (buf, (value - 108) / 256 + 247);
00467         cacheU8 (buf, (value - 108) % 256);
00468     }
00469     else if (-32768 <= value && value <= 32767)
00470     {
00471         cacheU8 (buf, 28);
00472         cacheU16 (buf, value);
00473     }
00474     else if (-2147483647 <= value && value <= 2147483647)
00475     {
00476         cacheU8 (buf, 29);
00477         cacheU32 (buf, value);
00478     }
00479     else
00480         assert (false); // other encodings are not used and omitted
00481     static_assert (GLYPH_MAX_WIDTH <= 107, "More encodings are needed.");
00482 }
00483
00484 /**
00485 @brief Append 1 to 4 bytes of zeroes to a buffer, for padding.
00486
00487 @param[in,out] buf The buffer to which the operand value is appended.
00488 @param[in] count The number of bytes containing zeroes to append.
00489 */
00490 void
00491 cacheZeros (Buffer *buf, size_t count)
00492 {
00493     ensureBuffer (buf, count);
00494     memset (buf->next, 0, count);
00495     buf->next += count;
00496 }
00497
00498 /**
00499 @brief Append a string of bytes to a buffer.
00500
00501 This function appends an array of 1 to 4 bytes to the end of
00502 a buffer.
00503
00504 @param[in,out] buf The buffer to which the bytes are appended.
00505 @param[in] src The array of bytes to append to the buffer.
00506 @param[in] count The number of bytes containing zeroes to append.
00507 */
00508 void
00509 cacheBytes (Buffer *restrict buf, const void *restrict src, size_t count)
```

```
00510 {
00511     ensureBuffer (buf, count);
00512     memcpy (buf->next, src, count);
00513     buf->next += count;
00514 }
00515
00516 /**
00517 @brief Append bytes of a table to a byte buffer.
00518
00519 @param[in,out] bufDest The buffer to which the new bytes are appended.
00520 @param[in] bufSrc The bytes to append to the buffer array.
00521 */
00522 void
00523 cacheBuffer (Buffer *restrict bufDest, const Buffer *restrict bufSrc)
00524 {
00525     size_t length = countBufferedBytes (bufSrc);
00526     ensureBuffer (bufDest, length);
00527     memcpy (bufDest->next, bufSrc->begin, length);
00528     bufDest->next += length;
00529 }
00530
00531 /**
00532 @brief Write an array of bytes to an output file.
00533
00534 @param[in] bytes An array of unsigned bytes to write.
00535 @param[in] file The file pointer for writing, of type FILE *.
00536 */
00537 void
00538 writeBytes (const byte bytes[], size_t count, FILE *file)
00539 {
00540     if (fwrite (bytes, count, 1, file) != 1 && count != 0)
00541         fail ("Failed to write %zu bytes to output file.", count);
00542 }
00543
00544 /**
00545 @brief Write an unsigned 16-bit value to an output file.
00546
00547 This function writes a 16-bit unsigned value in big-endian order
00548 to an output file specified with a file pointer.
00549
00550 @param[in] value The 16-bit value to write.
00551 @param[in] file The file pointer for writing, of type FILE *.
00552 */
00553 void
00554 writeU16 (uint_fast16_t value, FILE *file)
00555 {
00556     byte bytes[] =
00557     {
00558         (value » 8) & 0xff,
00559         (value     ) & 0xff,
00560     };
00561     writeBytes (bytes, sizeof bytes, file);
00562 }
00563
00564 /**
00565 @brief Write an unsigned 32-bit value to an output file.
00566
00567 This function writes a 32-bit unsigned value in big-endian order
00568 to an output file specified with a file pointer.
00569
00570 @param[in] value The 32-bit value to write.
00571 @param[in] file The file pointer for writing, of type FILE *.
00572 */
00573 void
00574 writeU32 (uint_fast32_t value, FILE *file)
00575 {
00576     byte bytes[] =
00577     {
00578         (value » 24) & 0xff,
00579         (value » 16) & 0xff,
00580         (value »  8) & 0xff,
00581         (value     ) & 0xff,
00582     };
00583     writeBytes (bytes, sizeof bytes, file);
00584 }
00585
00586 /**
00587 @brief Write an entire buffer array of bytes to an output file.
00588
00589 This function determines the size of a buffer of bytes and
00590 writes that number of bytes to an output file specified with
```

```
00591 a file pointer.  The number of bytes is determined from the
00592 length information stored as part of the Buffer * data structure.
00593
00594 @param[in] buf An array containing unsigned bytes to write.
00595 @param[in] file The file pointer for writing, of type FILE *.
00596 */
00597 static inline void
00598 writeBuffer (const Buffer *buf, FILE *file)
00599 {
00600     writeBytes (getBufferHead (buf), countBufferedBytes (buf), file);
00601 }
00602
00603 /// Array of OpenType names indexed directly by Name IDs.
00604 typedef const char *NameStrings[MAX_NAME_IDS];
00605
00606 /**
00607 @brief Data structure to hold data for one bitmap glyph.
00608
00609 This data structure holds data to represent one Unifont bitmap
00610 glyph: Unicode code point, number of bytes in its bitmap array,
00611 whether or not it is a combining character, and an offset from
00612 the glyph origin to the start of the bitmap.
00613 */
00614 typedef struct Glyph
00615 {
00616     uint_least32_t codePoint; ///< undefined for glyph 0
00617     byte bitmap[GLYPH_MAX_BYTE_COUNT]; ///< hexadecimal bitmap character array
00618     uint_least8_t byteCount; ///< length of bitmap data
00619     bool combining; ///< whether this is a combining glyph
00620     pixels_t pos; ///< number of pixels the glyph should be moved to the right
00621 ///< (negative number means moving to the left)
00622     pixels_t lsb; ///< left side bearing (x position of leftmost contour point)
00623 } Glyph;
00624
00625 /**
00626 @brief Data structure to hold information for one font.
00627 */
00628 typedef struct Font
00629 {
00630     Buffer *tables;
00631     Buffer *glyphs;
00632     uint_fast32_t glyphCount;
00633     pixels_t maxWidth;
00634 } Font;
00635
00636 /**
00637 @brief Data structure for an OpenType table.
00638
00639 This data structure contains a table tag and a pointer to the
00640 start of the buffer that holds data for this OpenType table.
00641
00642 For information on the OpenType tables and their structure, see
00643 https://docs.microsoft.com/en-us/typography/opentype/spec/otff#font-tables.
00644 */
00645 typedef struct Table
00646 {
00647     uint_fast32_t tag;
00648     Buffer *content;
00649 } Table;
00650
00651 /**
00652 @brief Index to Location ("loca") offset information.
00653
00654 This enumerated type encodes the type of offset to locations
00655 in a table.  It denotes Offset16 (16-bit) and Offset32 (32-bit)
00656 offset types.
00657 */
00658 enum LocaFormat {
00659     LOCA_OFFSET16 = 0,    ///< Offset to location is a 16-bit Offset16 value
00660     LOCA_OFFSET32 = 1     ///< Offset to location is a 32-bit Offset32 value
00661 };
00662
00663 /**
00664 @brief Convert a 4-byte array to the machine's native 32-bit endian order.
00665
00666 This function takes an array of 4 bytes in big-endian order and
00667 converts it to a 32-bit word in the endian order of the native machine.
00668
00669 @param[in] tag The array of 4 bytes in big-endian order.
00670 @return The 32-bit unsigned word in a machine's native endian order.
00671 */
```

```
00672 static inline uint_fast32_t tagAsU32 (const char tag[static 4])
00673 {
00674     uint_fast32_t r = 0;
00675     r |= (tag[0] & 0xff) « 24;
00676     r |= (tag[1] & 0xff) « 16;
00677     r |= (tag[2] & 0xff) « 8;
00678     r |= (tag[3] & 0xff);
00679     return r;
00680 }
00681
00682 /**
00683 @brief Add a TrueType or OpenType table to the font.
00684
00685 This function adds a TrueType or OpenType table to a font.
00686 The 4-byte table tag is passed as an unsigned 32-bit integer
00687 in big-endian format.
00688
00689 @param[in,out] font The font to which a font table will be added.
00690 @param[in] tag The 4-byte table name.
00691 @param[in] content The table bytes to add, of type Buffer *.
00692 */
00693 void
00694 addTable (Font *font, const char tag[static 4], Buffer *content)
00695 {
00696     Table *table = getBufferSlot (font->tables, sizeof (Table));
00697     table->tag = tagAsU32 (tag);
00698     table->content = content;
00699 }
00700
00701 /**
00702 @brief  Sort tables according to OpenType recommendations.
00703
00704 The various tables in a font are sorted in an order recommended
00705 for TrueType font files.
00706
00707 @param[in,out] font The font in which to sort tables.
00708 @param[in] isCFF True iff Compact Font Format (CFF) is being used.
00709 */
00710 void
00711 organizeTables (Font *font, bool isCFF)
00712 {
00713     const char *const cffOrder[] = {"head","hhea","maxp","OS/2","name",
00714         "cmap","post","CFF ",NULL};
00715     const char *const truetypeOrder[] = {"head","hhea","maxp","OS/2",
00716         "hmtx","LTSH","VDMX","hdmx","cmap","fpgm","prep","cvt ","loca",
00717         "glyf","kern","name","post","gasp","PCLT","DSIG",NULL};
00718     const char *const *const order = isCFF ? cffOrder : truetypeOrder;
00719     Table *unordered = getBufferHead (font->tables);
00720     const Table *const tablesEnd = getBufferTail (font->tables);
00721     for (const char *const *p = order; *p; p++)
00722     {
00723         uint_fast32_t tag = tagAsU32 (*p);
00724         for (Table *t = unordered; t < tablesEnd; t++)
00725         {
00726             if (t->tag != tag)
00727                 continue;
00728             if (t != unordered)
00729             {
00730                 Table temp = *unordered;
00731                 *unordered = *t;
00732                 *t = temp;
00733             }
00734             unordered++;
00735             break;
00736         }
00737     }
00738 }
00739
00740 /**
00741 @brief Data structure for data associated with one OpenType table.
00742
00743 This data structure contains an OpenType table's tag, start within
00744 an OpenType font file, length in bytes, and checksum at the end of
00745 the table.
00746 */
00747 struct TableRecord
00748 {
00749     uint_least32_t tag, offset, length, checksum;
00750 };
00751
00752 /**
```

```
00753 @brief Compare tables by 4-byte unsigned table tag value.
00754
00755 This function takes two pointers to a TableRecord data structure
00756 and extracts the four-byte tag structure element for each.  The
00757 two 32-bit numbers are then compared.  If the first tag is greater
00758 than the first, then gt = 1 and lt = 0, and so 1 - 0 = 1 is
00759 returned.  If the first is less than the second, then gt = 0 and
00760 lt = 1, and so 0 - 1 = -1 is returned.
00761
00762 @param[in] a Pointer to the first TableRecord structure.
00763 @param[in] b Pointer to the second TableRecord structure.
00764 @return 1 if the tag in "a" is greater, -1 if less, 0 if equal.
00765 */
00766 int
00767 byTableTag (const void *a, const void *b)
00768 {
00769     const struct TableRecord *const ra = a, *const rb = b;
00770     int gt = ra->tag > rb->tag;
00771     int lt = ra->tag < rb->tag;
00772     return gt - lt;
00773 }
00774
00775 /**
00776 @brief Write OpenType font to output file.
00777
00778 This function writes the constructed OpenType font to the
00779 output file named "filename".
00780
00781 @param[in] font Pointer to the font, of type Font *.
00782 @param[in] isCFF Boolean indicating whether the font has CFF data.
00783 @param[in] filename The name of the font file to create.
00784 */
00785 void
00786 writeFont (Font *font, bool isCFF, const char *fileName)
00787 {
00788     FILE *file = fopen (fileName, "wb");
00789     if (!file)
00790         fail ("Failed to open file '%s'.", fileName);
00791     const Table *const tables = getBufferHead (font->tables);
00792     const Table *const tablesEnd = getBufferTail (font->tables);
00793     size_t tableCount = tablesEnd - tables;
00794     assert (0 < tableCount && tableCount <= U16MAX);
00795     size_t offset = 12 + 16 * tableCount;
00796     uint_fast32_t totalChecksum = 0;
00797     Buffer *tableRecords =
00798         newBuffer (sizeof (struct TableRecord) * tableCount);
00799     for (size_t i = 0; i < tableCount; i++)
00800     {
00801         struct TableRecord *record =
00802             getBufferSlot (tableRecords, sizeof *record);
00803         record->tag = tables[i].tag;
00804         size_t length = countBufferedBytes (tables[i].content);
00805 #if SIZE_MAX > U32MAX
00806             if (offset > U32MAX)
00807                 fail ("Table offset exceeded 4 GiB.");
00808             if (length > U32MAX)
00809                 fail ("Table size exceeded 4 GiB.");
00810 #endif
00811         record->length = length;
00812         record->checksum = 0;
00813         const byte *p = getBufferHead (tables[i].content);
00814         const byte *const end = getBufferTail (tables[i].content);
00815
00816 /// Add a byte shifted by 24, 16, 8, or 0 bits.
00817 #define addByte(shift) \
00818 if (p == end) \
00819 break; \
00820 record->checksum += (uint_fast32_t)*p++ « (shift);
00821
00822         for (;;)
00823         {
00824             addByte (24)
00825             addByte (16)
00826             addByte (8)
00827             addByte (0)
00828         }
00829 #undef addByte
00830         cacheZeros (tables[i].content, (~length + 1U) & 3U);
00831         record->offset = offset;
00832         offset += countBufferedBytes (tables[i].content);
00833         totalChecksum += record->checksum;
```

```
00834     }
00835     struct TableRecord *records = getBufferHead (tableRecords);
00836     qsort (records, tableCount, sizeof *records, byTableTag);
00837     // Offset Table
00838     uint_fast32_t sfntVersion = isCFF ? 0x4f54544f : 0x00010000;
00839     writeU32 (sfntVersion, file); // sfntVersion
00840     totalChecksum += sfntVersion;
00841     uint_fast16_t entrySelector = 0;
00842     for (size_t k = tableCount; k != 1; k »= 1)
00843         entrySelector++;
00844     uint_fast16_t searchRange = 1 « (entrySelector + 4);
00845     uint_fast16_t rangeShift = (tableCount - (1 « entrySelector)) « 4;
00846     writeU16 (tableCount, file); // numTables
00847     writeU16 (searchRange, file); // searchRange
00848     writeU16 (entrySelector, file); // entrySelector
00849     writeU16 (rangeShift, file); // rangeShift
00850     totalChecksum += (uint_fast32_t)tableCount « 16;
00851     totalChecksum += searchRange;
00852     totalChecksum += (uint_fast32_t)entrySelector « 16;
00853     totalChecksum += rangeShift;
00854     // Table Records (always sorted by table tags)
00855     for (size_t i = 0; i < tableCount; i++)
00856     {
00857         // Table Record
00858         writeU32 (records[i].tag, file); // tableTag
00859         writeU32 (records[i].checksum, file); // checkSum
00860         writeU32 (records[i].offset, file); // offset
00861         writeU32 (records[i].length, file); // length
00862         totalChecksum += records[i].tag;
00863         totalChecksum += records[i].checksum;
00864         totalChecksum += records[i].offset;
00865         totalChecksum += records[i].length;
00866     }
00867     freeBuffer (tableRecords);
00868     for (const Table *table = tables; table < tablesEnd; table++)
00869     {
00870         if (table->tag == 0x68656164) // 'head' table
00871         {
00872             byte *begin = getBufferHead (table->content);
00873             byte *end = getBufferTail (table->content);
00874             writeBytes (begin, 8, file);
00875             writeU32 (0xb1b0afbaU - totalChecksum, file); // checksumAdjustment
00876             writeBytes (begin + 12, end - (begin + 12), file);
00877             continue;
00878         }
00879         writeBuffer (table->content, file);
00880     }
00881     fclose (file);
00882 }
00883
00884 /**
00885 @brief Convert a hexadecimal digit character to a 4-bit number.
00886
00887 This function takes a character that contains one hexadecimal digit
00888 and returns the 4-bit value (as an unsigned 8-bit value) corresponding
00889 to the hexadecimal digit.
00890
00891 @param[in] nibble The character containing one hexadecimal digit.
00892 @return The hexadecimal digit value, 0 through 15, inclusive.
00893 */
00894 static inline byte
00895 nibbleValue (char nibble)
00896 {
00897     if (isdigit (nibble))
00898         return nibble - '0';
00899     nibble = toupper (nibble);
00900     return nibble - 'A' + 10;
00901 }
00902
00903 /**
00904 @brief Read up to 6 hexadecimal digits and a colon from file.
00905
00906 This function reads up to 6 hexadecimal digits followed by
00907 a colon from a file.
00908
00909 If the end of the file is reached, the function returns true.
00910 The file name is provided to include in an error message if
00911 the end of file was reached unexpectedly.
00912
00913 @param[out] codePoint The Unicode code point.
00914 @param[in] fileName The name of the input file.
```

```
00915 @param[in] file Pointer to the input file stream.
00916 @return true if at end of file, false otherwise.
00917 */
00918 bool
00919 readCodePoint (uint_fast32_t *codePoint, const char *fileName, FILE *file)
00920 {
00921     *codePoint = 0;
00922     uint_fast8_t digitCount = 0;
00923     for (;;)
00924     {
00925         int c = getc (file);
00926         if (isxdigit (c) && ++digitCount <= 6)
00927         {
00928             *codePoint = (*codePoint « 4) | nibbleValue (c);
00929             continue;
00930         }
00931         if (c == ':' && digitCount > 0)
00932             return false;
00933         if (c == EOF)
00934         {
00935             if (digitCount == 0)
00936                 return true;
00937             if (feof (file))
00938                 fail ("%s: Unexpected end of file.", fileName);
00939             else
00940                 fail ("%s: Read error.", fileName);
00941         }
00942         fail ("%s: Unexpected character: %#.2x.", fileName, (unsigned)c);
00943     }
00944 }
00945
00946 /**
00947 @brief Read glyph definitions from a Unifont .hex format file.
00948
00949 This function reads in the glyph bitmaps contained in a Unifont
00950 .hex format file.  These input files contain one glyph bitmap
00951 per line.  Each line is of the form
00952
00953 <hexadecimal code point> ':' <hexadecimal bitmap sequence>
00954
00955 The code point field typically consists of 4 hexadecimal digits
00956 for a code point in Unicode Plane 0, and 6 hexadecimal digits for
00957 code points above Plane 0.  The hexadecimal bitmap sequence is
00958 32 hexadecimal digits long for a glyph that is 8 pixels wide by
00959 16 pixels high, and 64 hexadecimal digits long for a glyph that
00960 is 16 pixels wide by 16 pixels high.
00961
00962 @param[in,out] font The font data structure to update with new glyphs.
00963 @param[in] fileName The name of the Unifont .hex format input file.
00964 */
00965 void
00966 readGlyphs (Font *font, const char *fileName)
00967 {
00968     FILE *file = fopen (fileName, "r");
00969     if (!file)
00970         fail ("Failed to open file '%s'.", fileName);
00971     uint_fast32_t glyphCount = 1; // for glyph 0
00972     uint_fast8_t maxByteCount = 0;
00973     { // Hard code the .notdef glyph.
00974         const byte bitmap[] = "\0\0\0~fZZzvv~vv~\0\0"; // same as U+FFFD
00975         const size_t byteCount = sizeof bitmap - 1;
00976         assert (byteCount <= GLYPH_MAX_BYTE_COUNT);
00977         assert (byteCount % GLYPH_HEIGHT == 0);
00978         Glyph *notdef = getBufferSlot (font->glyphs, sizeof (Glyph));
00979         memcpy (notdef->bitmap, bitmap, byteCount);
00980         notdef->byteCount = maxByteCount = byteCount;
00981         notdef->combining = false;
00982         notdef->pos = 0;
00983         notdef->lsb = 0;
00984     }
00985     for (;;)
00986     {
00987         uint_fast32_t codePoint;
00988         if (readCodePoint (&codePoint, fileName, file))
00989             break;
00990         if (++glyphCount > MAX_GLYPHS)
00991             fail ("OpenType does not support more than %lu glyphs.",
00992                 MAX_GLYPHS);
00993         Glyph *glyph = getBufferSlot (font->glyphs, sizeof (Glyph));
00994         glyph->codePoint = codePoint;
00995         glyph->byteCount = 0;
```

```
00996         glyph->combining = false;
00997         glyph->pos = 0;
00998         glyph->lsb = 0;
00999         for (byte *p = glyph->bitmap;; p++)
01000         {
01001             int h, l;
01002             if (isxdigit (h = getc (file)) && isxdigit (l = getc (file)))
01003             {
01004                 if (++glyph->byteCount > GLYPH_MAX_BYTE_COUNT)
01005                     fail ("Hex stream of "PRI_CP" is too long.", codePoint);
01006                 *p = nibbleValue (h) « 4 | nibbleValue (l);
01007             }
01008             else if (h == '\n' || (h == EOF && feof (file)))
01009                 break;
01010             else if (ferror (file))
01011                 fail ("%s: Read error.", fileName);
01012             else
01013                 fail ("Hex stream of "PRI_CP" is invalid.", codePoint);
01014         }
01015         if (glyph->byteCount % GLYPH_HEIGHT != 0)
01016             fail ("Hex length of "PRI_CP" is indivisible by glyph height %d.",
01017                 codePoint, GLYPH_HEIGHT);
01018         if (glyph->byteCount > maxByteCount)
01019             maxByteCount = glyph->byteCount;
01020     }
01021     if (glyphCount == 1)
01022         fail ("No glyph is specified.");
01023     font->glyphCount = glyphCount;
01024     font->maxWidth = PW (maxByteCount);
01025     fclose (file);
01026 }
01027
01028 /**
01029 @brief Compare two Unicode code points to determine which is greater.
01030
01031 This function compares the Unicode code points contained within
01032 two Glyph data structures.  The function returns 1 if the first
01033 code point is greater, and -1 if the second is greater.
01034
01035 @param[in] a A Glyph data structure containing the first code point.
01036 @param[in] b A Glyph data structure containing the second code point.
01037 @return 1 if the code point a is greater, -1 if less, 0 if equal.
01038 */
01039 int
01040 byCodePoint (const void *a, const void *b)
01041 {
01042     const Glyph *const ga = a, *const gb = b;
01043     int gt = ga->codePoint > gb->codePoint;
01044     int lt = ga->codePoint < gb->codePoint;
01045     return gt - lt;
01046 }
01047
01048 /**
01049 @brief Position a glyph within a 16-by-16 pixel bounding box.
01050
01051 Position a glyph within the 16-by-16 pixel drawing area and
01052 note whether or not the glyph is a combining character.
01053
01054 N.B.: Glyphs must be sorted by code point before calling this function.
01055
01056 @param[in,out] font Font data structure pointer to store glyphs.
01057 @param[in] fileName Name of glyph file to read.
01058 @param[in] xMin Minimum x-axis value (for left side bearing).
01059 */
01060 void
01061 positionGlyphs (Font *font, const char *fileName, pixels_t *xMin)
01062 {
01063     *xMin = 0;
01064     FILE *file = fopen (fileName, "r");
01065     if (!file)
01066         fail ("Failed to open file '%s'.", fileName);
01067     Glyph *glyphs = getBufferHead (font->glyphs);
01068     const Glyph *const endGlyph = glyphs + font->glyphCount;
01069     Glyph *nextGlyph = &glyphs[1]; // predict and avoid search
01070     for (;;)
01071     {
01072         uint_fast32_t codePoint;
01073         if (readCodePoint (&codePoint, fileName, file))
01074             break;
01075         Glyph *glyph = nextGlyph;
01076         if (glyph == endGlyph || glyph->codePoint != codePoint)
```

```
01077         {
01078             // Prediction failed. Search.
01079             const Glyph key = { .codePoint = codePoint };
01080             glyph = bsearch (&key, glyphs + 1, font->glyphCount - 1,
01081                 sizeof key, byCodePoint);
01082             if (!glyph)
01083                 fail ("Glyph "PRI_CP" is positioned but not defined.",
01084                     codePoint);
01085         }
01086         nextGlyph = glyph + 1;
01087         char s[8];
01088         if (!fgets (s, sizeof s, file))
01089             fail ("%s: Read error.", fileName);
01090         char *end;
01091         const long value = strtol (s, &end, 10);
01092         if (*end != '\n' && *end != '\0')
01093             fail ("Position of glyph "PRI_CP" is invalid.", codePoint);
01094         // Currently no glyph is moved to the right,
01095         // so positive position is considered out of range.
01096         // If this limit is to be lifted,
01097         // 'xMax' of bounding box in 'head' table shall also be updated.
01098         if (value < -GLYPH_MAX_WIDTH || value > 0)
01099             fail ("Position of glyph "PRI_CP" is out of range.", codePoint);
01100         glyph->combining = true;
01101         glyph->pos = value;
01102         glyph->lsb = value; // updated during outline generation
01103         if (value < *xMin)
01104             *xMin = value;
01105     }
01106     fclose (file);
01107 }
01108
01109 /**
01110 @brief Sort the glyphs in a font by Unicode code point.
01111
01112 This function reads in an array of glyphs and sorts them
01113 by Unicode code point.  If a duplicate code point is encountered,
01114 that will result in a fatal error with an error message to stderr.
01115
01116 @param[in,out] font Pointer to a Font structure with glyphs to sort.
01117 */
01118 void
01119 sortGlyphs (Font *font)
01120 {
01121     Glyph *glyphs = getBufferHead (font->glyphs);
01122     const Glyph *const glyphsEnd = getBufferTail (font->glyphs);
01123     glyphs++; // glyph 0 does not need sorting
01124     qsort (glyphs, glyphsEnd - glyphs, sizeof *glyphs, byCodePoint);
01125     for (const Glyph *glyph = glyphs; glyph < glyphsEnd - 1; glyph++)
01126     {
01127         if (glyph[0].codePoint == glyph[1].codePoint)
01128             fail ("Duplicate code point: "PRI_CP".", glyph[0].codePoint);
01129         assert (glyph[0].codePoint < glyph[1].codePoint);
01130     }
01131 }
01132
01133 /**
01134 @brief Specify the current contour drawing operation.
01135 */
01136 enum ContourOp {
01137     OP_CLOSE,    ///< Close the current contour path that was being drawn.
01138     OP_POINT     ///< Add one more (x,y) point to the contor being drawn.
01139 };
01140
01141 /**
01142 @brief Fill to the left side (CFF) or right side (TrueType) of a contour.
01143 */
01144 enum FillSide {
01145     FILL_LEFT,    ///< Draw outline counter-clockwise (CFF, PostScript).
01146     FILL_RIGHT    ///< Draw outline clockwise (TrueType).
01147 };
01148
01149 /**
01150 @brief Build a glyph outline.
01151
01152 This function builds a glyph outline from a Unifont glyph bitmap.
01153
01154 @param[out] result The resulting glyph outline.
01155 @param[in] bitmap A bitmap array.
01156 @param[in] byteCount the number of bytes in the input bitmap array.
01157 @param[in] fillSide Enumerated indicator to fill left or right side.
```

```
01158 */
01159 void
01160 buildOutline (Buffer *result, const byte bitmap[], const size_t byteCount,
01161     const enum FillSide fillSide)
01162 {
01163     enum Direction {RIGHT, LEFT, DOWN, UP}; // order is significant
01164
01165     // respective coordinate deltas
01166     const pixels_t dx[] = {1, -1, 0, 0}, dy[] = {0, 0, -1, 1};
01167
01168     assert (byteCount % GLYPH_HEIGHT == 0);
01169     const uint_fast8_t bytesPerRow = byteCount / GLYPH_HEIGHT;
01170     const pixels_t glyphWidth = bytesPerRow * 8;
01171     assert (glyphWidth <= GLYPH_MAX_WIDTH);
01172
01173 #if GLYPH_MAX_WIDTH < 32
01174         typedef uint_fast32_t row_t;
01175 #elif GLYPH_MAX_WIDTH < 64
01176         typedef uint_fast64_t row_t;
01177 #else
01178 #error GLYPH_MAX_WIDTH is too large.
01179 #endif
01180
01181     row_t pixels[GLYPH_HEIGHT + 2] = {0};
01182     for (pixels_t row = GLYPH_HEIGHT; row > 0; row--)
01183         for (pixels_t b = 0; b < bytesPerRow; b++)
01184             pixels[row] = pixels[row] « 8 | *bitmap++;
01185     typedef row_t graph_t[GLYPH_HEIGHT + 1];
01186     graph_t vectors[4];
01187     const row_t *lower = pixels, *upper = pixels + 1;
01188     for (pixels_t row = 0; row <= GLYPH_HEIGHT; row++)
01189     {
01190         const row_t m = (fillSide == FILL_RIGHT) - 1;
01191         vectors[RIGHT][row] = (m ^ (*lower « 1)) & (~m ^ (*upper « 1));
01192         vectors[LEFT ][row] = (m ^ (*upper     )) & (~m ^ (*lower     ));
01193         vectors[DOWN ][row] = (m ^ (*lower     )) & (~m ^ (*lower « 1));
01194         vectors[UP   ][row] = (m ^ (*upper « 1)) & (~m ^ (*upper     ));
01195         lower++;
01196         upper++;
01197     }
01198     graph_t selection = {0};
01199     const row_t x0 = (row_t)1 « glyphWidth;
01200
01201 /// Get the value of a given bit that is in a given row.
01202 #define getRowBit(rows, x, y)  ((rows)[(y)] &  x0 » (x))
01203
01204 /// Invert the value of a given bit that is in a given row.
01205 #define flipRowBit(rows, x, y) ((rows)[(y)] ^= x0 » (x))
01206
01207     for (pixels_t y = GLYPH_HEIGHT; y >= 0; y--)
01208     {
01209         for (pixels_t x = 0; x <= glyphWidth; x++)
01210         {
01211             assert (!getRowBit (vectors[LEFT], x, y));
01212             assert (!getRowBit (vectors[UP], x, y));
01213             enum Direction initial;
01214
01215             if (getRowBit (vectors[RIGHT], x, y))
01216                 initial = RIGHT;
01217             else if (getRowBit (vectors[DOWN], x, y))
01218                 initial = DOWN;
01219             else
01220                 continue;
01221
01222             static_assert ((GLYPH_MAX_WIDTH + 1) * (GLYPH_HEIGHT + 1) * 2 <=
01223                 U16MAX, "potential overflow");
01224
01225             uint_fast16_t lastPointCount = 0;
01226             for (bool converged = false;;)
01227             {
01228                 uint_fast16_t pointCount = 0;
01229                 enum Direction heading = initial;
01230                 for (pixels_t tx = x, ty = y;;)
01231                 {
01232                     if (converged)
01233                     {
01234                         storePixels (result, OP_POINT);
01235                         storePixels (result, tx);
01236                         storePixels (result, ty);
01237                     }
01238                     do
```

```
01239                   {
01240                       if (converged)
01241                           flipRowBit (vectors[heading], tx, ty);
01242                       tx += dx[heading];
01243                       ty += dy[heading];
01244                   } while (getRowBit (vectors[heading], tx, ty));
01245                   if (tx == x && ty == y)
01246                       break;
01247                   static_assert ((UP ^ DOWN) == 1 && (LEFT ^ RIGHT) == 1,
01248                       "wrong enums");
01249                   heading = (heading & 2) ^ 2;
01250                   heading |= !!getRowBit (selection, tx, ty);
01251                   heading ^= !getRowBit (vectors[heading], tx, ty);
01252                   assert (getRowBit (vectors[heading], tx, ty));
01253                   flipRowBit (selection, tx, ty);
01254                   pointCount++;
01255               }
01256               if (converged)
01257                   break;
01258               converged = pointCount == lastPointCount;
01259               lastPointCount = pointCount;
01260           }
01261
01262           storePixels (result, OP_CLOSE);
01263       }
01264   }
01265 #undef getRowBit
01266 #undef flipRowBit
01267 }
01268
01269 /**
01270 @brief Prepare 32-bit glyph offsets in a font table.
01271
01272 @param[in] sizes Array of glyph sizes, for offset calculations.
01273 */
01274 void
01275 prepareOffsets (size_t *sizes)
01276 {
01277     size_t *p = sizes;
01278     for (size_t *i = sizes + 1; *i; i++)
01279         *i += *p++;
01280     if (*p > 2147483647U) // offset not representable
01281         fail ("CFF table is too large.");
01282 }
01283
01284 /**
01285 @brief Prepare a font name string index.
01286
01287 @param[in] names List of name strings.
01288 @return Pointer to a Buffer struct containing the string names.
01289 */
01290 Buffer *
01291 prepareStringIndex (const NameStrings names)
01292 {
01293     Buffer *buf = newBuffer (256);
01294     assert (names[6]);
01295     const char *strings[] = {"Adobe", "Identity", names[6]};
01296 /// Get the number of elements in array char *strings[].
01297 #define stringCount (sizeof strings / sizeof *strings)
01298     static_assert (stringCount <= U16MAX, "too many strings");
01299     size_t offset = 1;
01300     size_t lengths[stringCount];
01301     for (size_t i = 0; i < stringCount; i++)
01302     {
01303         assert (strings[i]);
01304         lengths[i] = strlen (strings[i]);
01305         offset += lengths[i];
01306     }
01307     int offsetSize = 1 + (offset > 0xff)
01308                        + (offset > 0xffff)
01309                        + (offset > 0xffffff);
01310     cacheU16 (buf, stringCount); // count
01311     cacheU8 (buf, offsetSize); // offSize
01312     cacheU (buf, offset = 1, offsetSize); // offset[0]
01313     for (size_t i = 0; i < stringCount; i++)
01314         cacheU (buf, offset += lengths[i], offsetSize); // offset[i + 1]
01315     for (size_t i = 0; i < stringCount; i++)
01316         cacheBytes (buf, strings[i], lengths[i]);
01317 #undef stringCount
01318     return buf;
01319 }
```

```
01320
01321 /**
01322 @brief Add a CFF table to a font.
01323
01324 @param[in,out] font Pointer to a Font struct to contain the CFF table.
01325 @param[in] version Version of CFF table, with value 1 or 2.
01326 @param[in] names List of NameStrings.
01327 */
01328 void
01329 fillCFF (Font *font, int version, const NameStrings names)
01330 {
01331     // HACK: For convenience, CFF data structures are hard coded.
01332     assert (0 < version && version <= 2);
01333     Buffer *cff = newBuffer (65536);
01334     addTable (font, version == 1 ? "CFF " : "CFF2", cff);
01335
01336 /// Use fixed width integer for variables to simplify offset calculation.
01337 #define cacheCFF32(buf, x) (cacheU8 ((buf), 29), cacheU32 ((buf), (x)))
01338
01339     // In Unifont, 16px glyphs are more common. This is used by CFF1 only.
01340     const pixels_t defaultWidth = 16, nominalWidth = 8;
01341     if (version == 1)
01342     {
01343         Buffer *strings = prepareStringIndex (names);
01344         size_t stringsSize = countBufferedBytes (strings);
01345         const char *cffName = names[6];
01346         assert (cffName);
01347         size_t nameLength = strlen (cffName);
01348         size_t namesSize = nameLength + 5;
01349         // These sizes must be updated together with the data below.
01350         size_t offsets[] = {4, namesSize, 45, stringsSize, 2, 5, 8, 32, 4, 0};
01351         prepareOffsets (offsets);
01352         { // Header
01353             cacheU8 (cff, 1); // major
01354             cacheU8 (cff, 0); // minor
01355             cacheU8 (cff, 4); // hdrSize
01356             cacheU8 (cff, 1); // offSize
01357         }
01358         assert (countBufferedBytes (cff) == offsets[0]);
01359         { // Name INDEX (should not be used by OpenType readers)
01360             cacheU16 (cff, 1); // count
01361             cacheU8 (cff, 1); // offSize
01362             cacheU8 (cff, 1); // offset[0]
01363             if (nameLength + 1 > 255) // must be too long; spec limit is 63
01364                 fail ("PostScript name is too long.");
01365             cacheU8 (cff, nameLength + 1); // offset[1]
01366             cacheBytes (cff, cffName, nameLength);
01367         }
01368         assert (countBufferedBytes (cff) == offsets[1]);
01369         { // Top DICT INDEX
01370             cacheU16 (cff, 1); // count
01371             cacheU8 (cff, 1); // offSize
01372             cacheU8 (cff, 1); // offset[0]
01373             cacheU8 (cff, 41); // offset[1]
01374             cacheCFFOperand (cff, 391); // "Adobe"
01375             cacheCFFOperand (cff, 392); // "Identity"
01376             cacheCFFOperand (cff, 0);
01377             cacheBytes (cff, (byte[]){12, 30}, 2); // ROS
01378             cacheCFF32 (cff, font->glyphCount);
01379             cacheBytes (cff, (byte[]){12, 34}, 2); // CIDCount
01380             cacheCFF32 (cff, offsets[6]);
01381             cacheBytes (cff, (byte[]){12, 36}, 2); // FDArray
01382             cacheCFF32 (cff, offsets[5]);
01383             cacheBytes (cff, (byte[]){12, 37}, 2); // FDSelect
01384             cacheCFF32 (cff, offsets[4]);
01385             cacheU8 (cff, 15); // charset
01386             cacheCFF32 (cff, offsets[8]);
01387             cacheU8 (cff, 17); // CharStrings
01388         }
01389         assert (countBufferedBytes (cff) == offsets[2]);
01390         { // String INDEX
01391             cacheBuffer (cff, strings);
01392             freeBuffer (strings);
01393         }
01394         assert (countBufferedBytes (cff) == offsets[3]);
01395         cacheU16 (cff, 0); // Global Subr INDEX
01396         assert (countBufferedBytes (cff) == offsets[4]);
01397         { // Charsets
01398             cacheU8 (cff, 2); // format
01399             { // Range2[0]
01400                 cacheU16 (cff, 1); // first
```

```
01401             cacheU16 (cff, font->glyphCount - 2); // nLeft
01402          }
01403       }
01404       assert (countBufferedBytes (cff) == offsets[5]);
01405       { // FDSelect
01406          cacheU8 (cff, 3); // format
01407          cacheU16 (cff, 1); // nRanges
01408          cacheU16 (cff, 0); // first
01409          cacheU8 (cff, 0); // fd
01410          cacheU16 (cff, font->glyphCount); // sentinel
01411       }
01412       assert (countBufferedBytes (cff) == offsets[6]);
01413       { // FDArray
01414          cacheU16 (cff, 1); // count
01415          cacheU8 (cff, 1); // offSize
01416          cacheU8 (cff, 1); // offset[0]
01417          cacheU8 (cff, 28); // offset[1]
01418          cacheCFFOperand (cff, 393);
01419          cacheBytes (cff, (byte[]){12, 38}, 2); // FontName
01420          // Windows requires FontMatrix in Font DICT.
01421          const byte unit[] = {0x1e,0x15,0x62,0x5c,0x6f}; // 1/64 (0.015625)
01422          cacheBytes (cff, unit, sizeof unit);
01423          cacheCFFOperand (cff, 0);
01424          cacheCFFOperand (cff, 0);
01425          cacheBytes (cff, unit, sizeof unit);
01426          cacheCFFOperand (cff, 0);
01427          cacheCFFOperand (cff, 0);
01428          cacheBytes (cff, (byte[]){12, 7}, 2); // FontMatrix
01429          cacheCFFOperand (cff, offsets[8] - offsets[7]); // size
01430          cacheCFF32 (cff, offsets[7]); // offset
01431          cacheU8 (cff, 18); // Private
01432       }
01433       assert (countBufferedBytes (cff) == offsets[7]);
01434       { // Private
01435          cacheCFFOperand (cff, FU (defaultWidth));
01436          cacheU8 (cff, 20); // defaultWidthX
01437          cacheCFFOperand (cff, FU (nominalWidth));
01438          cacheU8 (cff, 21); // nominalWidthX
01439       }
01440       assert (countBufferedBytes (cff) == offsets[8]);
01441    }
01442    else
01443    {
01444       assert (version == 2);
01445       // These sizes must be updated together with the data below.
01446       size_t offsets[] = {5, 21, 4, 10, 0};
01447       prepareOffsets (offsets);
01448       { // Header
01449          cacheU8 (cff, 2); // majorVersion
01450          cacheU8 (cff, 0); // minorVersion
01451          cacheU8 (cff, 5); // headerSize
01452          cacheU16 (cff, offsets[1] - offsets[0]); // topDictLength
01453       }
01454       assert (countBufferedBytes (cff) == offsets[0]);
01455       { // Top DICT
01456          const byte unit[] = {0x1e,0x15,0x62,0x5c,0x6f}; // 1/64 (0.015625)
01457          cacheBytes (cff, unit, sizeof unit);
01458          cacheCFFOperand (cff, 0);
01459          cacheCFFOperand (cff, 0);
01460          cacheBytes (cff, unit, sizeof unit);
01461          cacheCFFOperand (cff, 0);
01462          cacheCFFOperand (cff, 0);
01463          cacheBytes (cff, (byte[]){12, 7}, 2); // FontMatrix
01464          cacheCFFOperand (cff, offsets[2]);
01465          cacheBytes (cff, (byte[]){12, 36}, 2); // FDArray
01466          cacheCFFOperand (cff, offsets[3]);
01467          cacheU8 (cff, 17); // CharStrings
01468       }
01469       assert (countBufferedBytes (cff) == offsets[1]);
01470       cacheU32 (cff, 0); // Global Subr INDEX
01471       assert (countBufferedBytes (cff) == offsets[2]);
01472       { // Font DICT INDEX
01473          cacheU32 (cff, 1); // count
01474          cacheU8 (cff, 1); // offSize
01475          cacheU8 (cff, 1); // offset[0]
01476          cacheU8 (cff, 4); // offset[1]
01477          cacheCFFOperand (cff, 0);
01478          cacheCFFOperand (cff, 0);
01479          cacheU8 (cff, 18); // Private
01480       }
01481       assert (countBufferedBytes (cff) == offsets[3]);
```

```
01482     }
01483     { // CharStrings INDEX
01484         Buffer *offsets = newBuffer (4096);
01485         Buffer *charstrings = newBuffer (4096);
01486         Buffer *outline = newBuffer (1024);
01487         const Glyph *glyph = getBufferHead (font->glyphs);
01488         const Glyph *const endGlyph = glyph + font->glyphCount;
01489         for (; glyph < endGlyph; glyph++)
01490         {
01491             // CFF offsets start at 1
01492             storeU32 (offsets, countBufferedBytes (charstrings) + 1);
01493 
01494             pixels_t rx = -glyph->pos;
01495             pixels_t ry = DESCENDER;
01496             resetBuffer (outline);
01497             buildOutline (outline, glyph->bitmap, glyph->byteCount, FILL_LEFT);
01498             enum CFFOp {rmoveto=21, hmoveto=22, vmoveto=4, hlineto=6,
01499                 vlineto=7, endchar=14};
01500             enum CFFOp pendingOp = 0;
01501             const int STACK_LIMIT = version == 1 ? 48 : 513;
01502             int stackSize = 0;
01503             bool isDrawing = false;
01504             pixels_t width = glyph->combining ? 0 : PW (glyph->byteCount);
01505             if (version == 1 && width != defaultWidth)
01506             {
01507                 cacheCFFOperand (charstrings, FU (width - nominalWidth));
01508                 stackSize++;
01509             }
01510             for (const pixels_t *p = getBufferHead (outline),
01511                  *const end = getBufferTail (outline); p < end;)
01512             {
01513                 int s = 0;
01514                 const enum ContourOp op = *p++;
01515                 if (op == OP_POINT)
01516                 {
01517                     const pixels_t x = *p++, y = *p++;
01518                     if (x != rx)
01519                     {
01520                         cacheCFFOperand (charstrings, FU (x - rx));
01521                         rx = x;
01522                         stackSize++;
01523                         s |= 1;
01524                     }
01525                     if (y != ry)
01526                     {
01527                         cacheCFFOperand (charstrings, FU (y - ry));
01528                         ry = y;
01529                         stackSize++;
01530                         s |= 2;
01531                     }
01532                     assert (!(isDrawing && s == 3));
01533                 }
01534                 if (s)
01535                 {
01536                     if (!isDrawing)
01537                     {
01538                         const enum CFFOp moves[] = {0, hmoveto, vmoveto,
01539                             rmoveto};
01540                         cacheU8 (charstrings, moves[s]);
01541                         stackSize = 0;
01542                     }
01543                     else if (!pendingOp)
01544                         pendingOp = (enum CFFOp[]){0, hlineto, vlineto}[s];
01545                 }
01546                 else if (!isDrawing)
01547                 {
01548                     // only when the first point happens to be (0, 0)
01549                     cacheCFFOperand (charstrings, FU (0));
01550                     cacheU8 (charstrings, hmoveto);
01551                     stackSize = 0;
01552                 }
01553                 if (op == OP_CLOSE || stackSize >= STACK_LIMIT)
01554                 {
01555                     assert (stackSize <= STACK_LIMIT);
01556                     cacheU8 (charstrings, pendingOp);
01557                     pendingOp = 0;
01558                     stackSize = 0;
01559                 }
01560                 isDrawing = op != OP_CLOSE;
01561             }
01562             if (version == 1)
```

```
01563                 cacheU8 (charstrings, endchar);
01564         }
01565         size_t lastOffset = countBufferedBytes (charstrings) + 1;
01566 #if SIZE_MAX > U32MAX
01567             if (lastOffset > U32MAX)
01568                 fail ("CFF data exceeded size limit.");
01569 #endif
01570         storeU32 (offsets, lastOffset);
01571         int offsetSize = 1 + (lastOffset > 0xff)
01572                            + (lastOffset > 0xffff)
01573                            + (lastOffset > 0xffffff);
01574         // count (must match 'numGlyphs' in 'maxp' table)
01575         cacheU (cff, font->glyphCount, version * 2);
01576         cacheU8 (cff, offsetSize); // offSize
01577         const uint_least32_t *p = getBufferHead (offsets);
01578         const uint_least32_t *const end = getBufferTail (offsets);
01579         for (; p < end; p++)
01580             cacheU (cff, *p, offsetSize); // offsets
01581         cacheBuffer (cff, charstrings); // data
01582         freeBuffer (offsets);
01583         freeBuffer (charstrings);
01584         freeBuffer (outline);
01585     }
01586 #undef cacheCFF32
01587 }
01588
01589 /**
01590 @brief Add a TrueType table to a font.
01591
01592 @param[in,out] font Pointer to a Font struct to contain the TrueType table.
01593 @param[in] format The TrueType "loca" table format, Offset16 or Offset32.
01594 @param[in] names List of NameStrings.
01595 */
01596 void
01597 fillTrueType (Font *font, enum LocaFormat *format,
01598     uint_fast16_t *maxPoints, uint_fast16_t *maxContours)
01599 {
01600     Buffer *glyf = newBuffer (65536);
01601     addTable (font, "glyf", glyf);
01602     Buffer *loca = newBuffer (4 * (font->glyphCount + 1));
01603     addTable (font, "loca", loca);
01604     *format = LOCA_OFFSET32;
01605     Buffer *endPoints = newBuffer (256);
01606     Buffer *flags = newBuffer (256);
01607     Buffer *xs = newBuffer (256);
01608     Buffer *ys = newBuffer (256);
01609     Buffer *outline = newBuffer (1024);
01610     Glyph *const glyphs = getBufferHead (font->glyphs);
01611     const Glyph *const glyphsEnd = getBufferTail (font->glyphs);
01612     for (Glyph *glyph = glyphs; glyph < glyphsEnd; glyph++)
01613     {
01614         cacheU32 (loca, countBufferedBytes (glyf));
01615         pixels_t rx = -glyph->pos;
01616         pixels_t ry = DESCENDER;
01617         pixels_t xMin = GLYPH_MAX_WIDTH, xMax = 0;
01618         pixels_t yMin = ASCENDER, yMax = -DESCENDER;
01619         resetBuffer (endPoints);
01620         resetBuffer (flags);
01621         resetBuffer (xs);
01622         resetBuffer (ys);
01623         resetBuffer (outline);
01624         buildOutline (outline, glyph->bitmap, glyph->byteCount, FILL_RIGHT);
01625         uint_fast32_t pointCount = 0, contourCount = 0;
01626         for (const pixels_t *p = getBufferHead (outline),
01627              *const end = getBufferTail (outline); p < end;)
01628         {
01629             const enum ContourOp op = *p++;
01630             if (op == OP_CLOSE)
01631             {
01632                 contourCount++;
01633                 assert (contourCount <= U16MAX);
01634                 cacheU16 (endPoints, pointCount - 1);
01635                 continue;
01636             }
01637             assert (op == OP_POINT);
01638             pointCount++;
01639             assert (pointCount <= U16MAX);
01640             const pixels_t x = *p++, y = *p++;
01641             uint_fast8_t pointFlags =
01642                 + B1 (0) // point is on curve
01643                 + BX (1, x != rx) // x coordinate is 1 byte instead of 2
```

```
01644               + BX (2, y != ry) // y coordinate is 1 byte instead of 2
01645               + B0 (3) // repeat
01646               + BX (4, x >= rx) // when x is 1 byte: x is positive;
01647                                 // when x is 2 bytes: x unchanged and omitted
01648               + BX (5, y >= ry) // when y is 1 byte: y is positive;
01649                                 // when y is 2 bytes: y unchanged and omitted
01650               + B1 (6) // contours may overlap
01651               + B0 (7) // reserved
01652           ;
01653           cacheU8 (flags, pointFlags);
01654           if (x != rx)
01655               cacheU8 (xs, FU (x > rx ? x - rx : rx - x));
01656           if (y != ry)
01657               cacheU8 (ys, FU (y > ry ? y - ry : ry - y));
01658           if (x < xMin) xMin = x;
01659           if (y < yMin) yMin = y;
01660           if (x > xMax) xMax = x;
01661           if (y > yMax) yMax = y;
01662           rx = x;
01663           ry = y;
01664       }
01665       if (contourCount == 0)
01666           continue; // blank glyph is indicated by the 'loca' table
01667       glyph->lsb = glyph->pos + xMin;
01668       cacheU16 (glyf, contourCount); // numberOfContours
01669       cacheU16 (glyf, FU (glyph->pos + xMin)); // xMin
01670       cacheU16 (glyf, FU (yMin)); // yMin
01671       cacheU16 (glyf, FU (glyph->pos + xMax)); // xMax
01672       cacheU16 (glyf, FU (yMax)); // yMax
01673       cacheBuffer (glyf, endPoints); // endPtsOfContours[]
01674       cacheU16 (glyf, 0); // instructionLength
01675       cacheBuffer (glyf, flags); // flags[]
01676       cacheBuffer (glyf, xs); // xCoordinates[]
01677       cacheBuffer (glyf, ys); // yCoordinates[]
01678       if (pointCount > *maxPoints)
01679           *maxPoints = pointCount;
01680       if (contourCount > *maxContours)
01681           *maxContours = contourCount;
01682   }
01683   cacheU32 (loca, countBufferedBytes (glyf));
01684   freeBuffer (endPoints);
01685   freeBuffer (flags);
01686   freeBuffer (xs);
01687   freeBuffer (ys);
01688   freeBuffer (outline);
01689 }
01690
01691 /**
01692 @brief Create a dummy blank outline in a font table.
01693
01694 @param[in,out] font Pointer to a Font struct to insert a blank outline.
01695 */
01696 void
01697 fillBlankOutline (Font *font)
01698 {
01699   Buffer *glyf = newBuffer (12);
01700   addTable (font, "glyf", glyf);
01701   // Empty table is not allowed, but an empty outline for glyph 0 suffices.
01702   cacheU16 (glyf, 0); // numberOfContours
01703   cacheU16 (glyf, FU (0)); // xMin
01704   cacheU16 (glyf, FU (0)); // yMin
01705   cacheU16 (glyf, FU (0)); // xMax
01706   cacheU16 (glyf, FU (0)); // yMax
01707   cacheU16 (glyf, 0); // instructionLength
01708   Buffer *loca = newBuffer (2 * (font->glyphCount + 1));
01709   addTable (font, "loca", loca);
01710   cacheU16 (loca, 0); // offsets[0]
01711   assert (countBufferedBytes (glyf) % 2 == 0);
01712   for (uint_fast32_t i = 1; i <= font->glyphCount; i++)
01713       cacheU16 (loca, countBufferedBytes (glyf) / 2); // offsets[i]
01714 }
01715
01716 /**
01717 @brief Fill OpenType bitmap data and location tables.
01718
01719 This function fills an Embedded Bitmap Data (EBDT) Table
01720 and an Embedded Bitmap Location (EBLC) Table with glyph
01721 bitmap information.  These tables enable embedding bitmaps
01722 in OpenType fonts.  No Embedded Bitmap Scaling (EBSC) table
01723 is used for the bitmap glyphs, only EBDT and EBLC.
01724
```

```
01725 @param[in,out] font Pointer to a Font struct in which to add bitmaps.
01726 */
01727 void
01728 fillBitmap (Font *font)
01729 {
01730     const Glyph *const glyphs = getBufferHead (font->glyphs);
01731     const Glyph *const glyphsEnd = getBufferTail (font->glyphs);
01732     size_t bitmapsSize = 0;
01733     for (const Glyph *glyph = glyphs; glyph < glyphsEnd; glyph++)
01734         bitmapsSize += glyph->byteCount;
01735     Buffer *ebdt = newBuffer (4 + bitmapsSize);
01736     addTable (font, "EBDT", ebdt);
01737     cacheU16 (ebdt, 2); // majorVersion
01738     cacheU16 (ebdt, 0); // minorVersion
01739     uint_fast8_t byteCount = 0; // unequal to any glyph
01740     pixels_t pos = 0;
01741     bool combining = false;
01742     Buffer *rangeHeads = newBuffer (32);
01743     Buffer *offsets = newBuffer (64);
01744     for (const Glyph *glyph = glyphs; glyph < glyphsEnd; glyph++)
01745     {
01746         if (glyph->byteCount != byteCount || glyph->pos != pos ||
01747             glyph->combining != combining)
01748         {
01749             storeU16 (rangeHeads, glyph - glyphs);
01750             storeU32 (offsets, countBufferedBytes (ebdt));
01751             byteCount = glyph->byteCount;
01752             pos = glyph->pos;
01753             combining = glyph->combining;
01754         }
01755         cacheBytes (ebdt, glyph->bitmap, byteCount);
01756     }
01757     const uint_least16_t *ranges = getBufferHead (rangeHeads);
01758     const uint_least16_t *rangesEnd = getBufferTail (rangeHeads);
01759     uint_fast32_t rangeCount = rangesEnd - ranges;
01760     storeU16 (rangeHeads, font->glyphCount);
01761     Buffer *eblc = newBuffer (4096);
01762     addTable (font, "EBLC", eblc);
01763     cacheU16 (eblc, 2); // majorVersion
01764     cacheU16 (eblc, 0); // minorVersion
01765     cacheU32 (eblc, 1); // numSizes
01766     { // bitmapSizes[0]
01767         cacheU32 (eblc, 56); // indexSubTableArrayOffset
01768         cacheU32 (eblc, (8 + 20) * rangeCount); // indexTablesSize
01769         cacheU32 (eblc, rangeCount); // numberOfIndexSubTables
01770         cacheU32 (eblc, 0); // colorRef
01771         { // hori
01772             cacheU8 (eblc, ASCENDER); // ascender
01773             cacheU8 (eblc, -DESCENDER); // descender
01774             cacheU8 (eblc, font->maxWidth); // widthMax
01775             cacheU8 (eblc, 1); // caretSlopeNumerator
01776             cacheU8 (eblc, 0); // caretSlopeDenominator
01777             cacheU8 (eblc, 0); // caretOffset
01778             cacheU8 (eblc, 0); // minOriginSB
01779             cacheU8 (eblc, 0); // minAdvanceSB
01780             cacheU8 (eblc, ASCENDER); // maxBeforeBL
01781             cacheU8 (eblc, -DESCENDER); // minAfterBL
01782             cacheU8 (eblc, 0); // pad1
01783             cacheU8 (eblc, 0); // pad2
01784         }
01785         { // vert
01786             cacheU8 (eblc, ASCENDER); // ascender
01787             cacheU8 (eblc, -DESCENDER); // descender
01788             cacheU8 (eblc, font->maxWidth); // widthMax
01789             cacheU8 (eblc, 1); // caretSlopeNumerator
01790             cacheU8 (eblc, 0); // caretSlopeDenominator
01791             cacheU8 (eblc, 0); // caretOffset
01792             cacheU8 (eblc, 0); // minOriginSB
01793             cacheU8 (eblc, 0); // minAdvanceSB
01794             cacheU8 (eblc, ASCENDER); // maxBeforeBL
01795             cacheU8 (eblc, -DESCENDER); // minAfterBL
01796             cacheU8 (eblc, 0); // pad1
01797             cacheU8 (eblc, 0); // pad2
01798         }
01799         cacheU16 (eblc, 0); // startGlyphIndex
01800         cacheU16 (eblc, font->glyphCount - 1); // endGlyphIndex
01801         cacheU8 (eblc, 16); // ppemX
01802         cacheU8 (eblc, 16); // ppemY
01803         cacheU8 (eblc, 1); // bitDepth
01804         cacheU8 (eblc, 1); // flags = Horizontal
01805     }
```

```
01806     { // IndexSubTableArray
01807         uint_fast32_t offset = rangeCount * 8;
01808         for (const uint_least16_t *p = ranges; p < rangesEnd; p++)
01809         {
01810             cacheU16 (eblc, *p); // firstGlyphIndex
01811             cacheU16 (eblc, p[1] - 1); // lastGlyphIndex
01812             cacheU32 (eblc, offset); // additionalOffsetToIndexSubtable
01813             offset += 20;
01814         }
01815     }
01816     { // IndexSubTables
01817         const uint_least32_t *offset = getBufferHead (offsets);
01818         for (const uint_least16_t *p = ranges; p < rangesEnd; p++)
01819         {
01820             const Glyph *glyph = &glyphs[*p];
01821             cacheU16 (eblc, 2); // indexFormat
01822             cacheU16 (eblc, 5); // imageFormat
01823             cacheU32 (eblc, *offset++); // imageDataOffset
01824             cacheU32 (eblc, glyph->byteCount); // imageSize
01825             { // bigMetrics
01826                 cacheU8 (eblc, GLYPH_HEIGHT); // height
01827                 const uint_fast8_t width = PW (glyph->byteCount);
01828                 cacheU8 (eblc, width); // width
01829                 cacheU8 (eblc, glyph->pos); // horiBearingX
01830                 cacheU8 (eblc, ASCENDER); // horiBearingY
01831                 cacheU8 (eblc, glyph->combining ? 0 : width); // horiAdvance
01832                 cacheU8 (eblc, 0); // vertBearingX
01833                 cacheU8 (eblc, 0); // vertBearingY
01834                 cacheU8 (eblc, GLYPH_HEIGHT); // vertAdvance
01835             }
01836         }
01837     }
01838     freeBuffer (rangeHeads);
01839     freeBuffer (offsets);
01840 }
01841
01842 /**
01843 @brief Fill a "head" font table.
01844
01845 The "head" table contains font header information common to the
01846 whole font.
01847
01848 @param[in,out] font The Font struct to which to add the table.
01849 @param[in] locaFormat The "loca" offset index location table.
01850 @param[in] xMin The minimum x-coordinate for a glyph.
01851 */
01852 void
01853 fillHeadTable (Font *font, enum LocaFormat locaFormat, pixels_t xMin)
01854 {
01855     Buffer *head = newBuffer (56);
01856     addTable (font, "head", head);
01857     cacheU16 (head, 1); // majorVersion
01858     cacheU16 (head, 0); // minorVersion
01859     cacheZeros (head, 4); // fontRevision (unused)
01860     // The 'checksumAdjustment' field is a checksum of the entire file.
01861     // It is later calculated and written directly in the 'writeFont' function.
01862     cacheU32 (head, 0); // checksumAdjustment (placeholder)
01863     cacheU32 (head, 0x5f0f3cf5); // magicNumber
01864     const uint_fast16_t flags =
01865         + B1 ( 0) // baseline at y=0
01866         + B1 ( 1) // LSB at x=0 (doubtful; probably should be LSB=xMin)
01867         + B0 ( 2) // instructions may depend on point size
01868         + B0 ( 3) // force internal ppem to integers
01869         + B0 ( 4) // instructions may alter advance width
01870         + B0 ( 5) // not used in OpenType
01871         + B0 ( 6) // not used in OpenType
01872         + B0 ( 7) // not used in OpenType
01873         + B0 ( 8) // not used in OpenType
01874         + B0 ( 9) // not used in OpenType
01875         + B0 (10) // not used in OpenType
01876         + B0 (11) // font transformed
01877         + B0 (12) // font converted
01878         + B0 (13) // font optimized for ClearType
01879         + B0 (14) // last resort font
01880         + B0 (15) // reserved
01881     ;
01882     cacheU16 (head, flags); // flags
01883     cacheU16 (head, FUPEM); // unitsPerEm
01884     cacheZeros (head, 8); // created (unused)
01885     cacheZeros (head, 8); // modified (unused)
01886     cacheU16 (head, FU (xMin)); // xMin
```

```
01887     cacheU16 (head, FU (-DESCENDER)); // yMin
01888     cacheU16 (head, FU (font->maxWidth)); // xMax
01889     cacheU16 (head, FU (ASCENDER)); // yMax
01890     // macStyle (must agree with 'fsSelection' in 'OS/2' table)
01891     const uint_fast16_t macStyle =
01892         + B0 (0) // bold
01893         + B0 (1) // italic
01894         + B0 (2) // underline
01895         + B0 (3) // outline
01896         + B0 (4) // shadow
01897         + B0 (5) // condensed
01898         + B0 (6) // extended
01899         //    7-15  reserved
01900     ;
01901     cacheU16 (head, macStyle);
01902     cacheU16 (head, GLYPH_HEIGHT); // lowestRecPPEM
01903     cacheU16 (head, 2); // fontDirectionHint
01904     cacheU16 (head, locaFormat); // indexToLocFormat
01905     cacheU16 (head, 0); // glyphDataFormat
01906 }
01907
01908 /**
01909 @brief Fill a "hhea" font table.
01910
01911 The "hhea" table contains horizontal header information,
01912 for example left and right side bearings.
01913
01914 @param[in,out] font The Font struct to which to add the table.
01915 @param[in] xMin The minimum x-coordinate for a glyph.
01916 */
01917 void
01918 fillHheaTable (Font *font, pixels_t xMin)
01919 {
01920     Buffer *hhea = newBuffer (36);
01921     addTable (font, "hhea", hhea);
01922     cacheU16 (hhea, 1); // majorVersion
01923     cacheU16 (hhea, 0); // minorVersion
01924     cacheU16 (hhea, FU (ASCENDER)); // ascender
01925     cacheU16 (hhea, FU (-DESCENDER)); // descender
01926     cacheU16 (hhea, FU (0)); // lineGap
01927     cacheU16 (hhea, FU (font->maxWidth)); // advanceWidthMax
01928     cacheU16 (hhea, FU (xMin)); // minLeftSideBearing
01929     cacheU16 (hhea, FU (0)); // minRightSideBearing (unused)
01930     cacheU16 (hhea, FU (font->maxWidth)); // xMaxExtent
01931     cacheU16 (hhea, 1); // caretSlopeRise
01932     cacheU16 (hhea, 0); // caretSlopeRun
01933     cacheU16 (hhea, 0); // caretOffset
01934     cacheU16 (hhea, 0); // reserved
01935     cacheU16 (hhea, 0); // reserved
01936     cacheU16 (hhea, 0); // reserved
01937     cacheU16 (hhea, 0); // reserved
01938     cacheU16 (hhea, 0); // metricDataFormat
01939     cacheU16 (hhea, font->glyphCount); // numberOfHMetrics
01940 }
01941
01942 /**
01943 @brief Fill a "maxp" font table.
01944
01945 The "maxp" table contains maximum profile information,
01946 such as the memory required to contain the font.
01947
01948 @param[in,out] font The Font struct to which to add the table.
01949 @param[in] isCFF true if a CFF font is included, false otherwise.
01950 @param[in] maxPoints Maximum points in a non-composite glyph.
01951 @param[in] maxContours Maximum contours in a non-composite glyph.
01952 */
01953 void
01954 fillMaxpTable (Font *font, bool isCFF, uint_fast16_t maxPoints,
01955     uint_fast16_t maxContours)
01956 {
01957     Buffer *maxp = newBuffer (32);
01958     addTable (font, "maxp", maxp);
01959     cacheU32 (maxp, isCFF ? 0x00005000 : 0x00010000); // version
01960     cacheU16 (maxp, font->glyphCount); // numGlyphs
01961     if (isCFF)
01962         return;
01963     cacheU16 (maxp, maxPoints); // maxPoints
01964     cacheU16 (maxp, maxContours); // maxContours
01965     cacheU16 (maxp, 0); // maxCompositePoints
01966     cacheU16 (maxp, 0); // maxCompositeContours
01967     cacheU16 (maxp, 0); // maxZones
```

```
01968     cacheU16 (maxp, 0); // maxTwilightPoints
01969     cacheU16 (maxp, 0); // maxStorage
01970     cacheU16 (maxp, 0); // maxFunctionDefs
01971     cacheU16 (maxp, 0); // maxInstructionDefs
01972     cacheU16 (maxp, 0); // maxStackElements
01973     cacheU16 (maxp, 0); // maxSizeOfInstructions
01974     cacheU16 (maxp, 0); // maxComponentElements
01975     cacheU16 (maxp, 0); // maxComponentDepth
01976 }
01977
01978 /**
01979 @brief Fill an "OS/2" font table.
01980
01981 The "OS/2" table contains OS/2 and Windows font metrics information.
01982
01983 @param[in,out] font The Font struct to which to add the table.
01984 */
01985 void
01986 fillOS2Table (Font *font)
01987 {
01988     Buffer *os2 = newBuffer (100);
01989     addTable (font, "OS/2", os2);
01990     cacheU16 (os2, 5); // version
01991     // HACK: Average glyph width is not actually calculated.
01992     cacheU16 (os2, FU (font->maxWidth)); // xAvgCharWidth
01993     cacheU16 (os2, 400); // usWeightClass = Normal
01994     cacheU16 (os2, 5); // usWidthClass = Medium
01995     const uint_fast16_t typeFlags =
01996         + B0 (0) // reserved
01997         // usage permissions, one of:
01998             // Default: Installable embedding
01999             + B0 (1) // Restricted License embedding
02000             + B0 (2) // Preview & Print embedding
02001             + B0 (3) // Editable embedding
02002         //    4-7   reserved
02003         + B0 (8) // no subsetting
02004         + B0 (9) // bitmap embedding only
02005         //    10-15 reserved
02006     ;
02007     cacheU16 (os2, typeFlags); // fsType
02008     cacheU16 (os2, FU (5)); // ySubscriptXSize
02009     cacheU16 (os2, FU (7)); // ySubscriptYSize
02010     cacheU16 (os2, FU (0)); // ySubscriptXOffset
02011     cacheU16 (os2, FU (1)); // ySubscriptYOffset
02012     cacheU16 (os2, FU (5)); // ySuperscriptXSize
02013     cacheU16 (os2, FU (7)); // ySuperscriptYSize
02014     cacheU16 (os2, FU (0)); // ySuperscriptXOffset
02015     cacheU16 (os2, FU (4)); // ySuperscriptYOffset
02016     cacheU16 (os2, FU (1)); // yStrikeoutSize
02017     cacheU16 (os2, FU (5)); // yStrikeoutPosition
02018     cacheU16 (os2, 0x080a); // sFamilyClass = Sans Serif, Matrix
02019     const byte panose[] =
02020     {
02021         2, // Family Kind = Latin Text
02022         11, // Serif Style = Normal Sans
02023         4, // Weight = Thin
02024         // Windows would render all glyphs to the same width,
02025         // if 'Proportion' is set to 'Monospaced' (as Unifont should be).
02026         // 'Condensed' is the best alternative according to metrics.
02027         6, // Proportion = Condensed
02028         2, // Contrast = None
02029         2, // Stroke = No Variation
02030         2, // Arm Style = Straight Arms
02031         8, // Letterform = Normal/Square
02032         2, // Midline = Standard/Trimmed
02033         4, // X-height = Constant/Large
02034     };
02035     cacheBytes (os2, panose, sizeof panose); // panose
02036     // HACK: All defined Unicode ranges are marked functional for convenience.
02037     cacheU32 (os2, 0xffffffff); // ulUnicodeRange1
02038     cacheU32 (os2, 0xffffffff); // ulUnicodeRange2
02039     cacheU32 (os2, 0xffffffff); // ulUnicodeRange3
02040     cacheU32 (os2, 0x0effffff); // ulUnicodeRange4
02041     cacheBytes (os2, "GNU ", 4); // achVendID
02042     // fsSelection (must agree with 'macStyle' in 'head' table)
02043     const uint_fast16_t selection =
02044         + B0 (0) // italic
02045         + B0 (1) // underscored
02046         + B0 (2) // negative
02047         + B0 (3) // outlined
02048         + B0 (4) // strikeout
```

```
02049         + B0 (5) // bold
02050         + B1 (6) // regular
02051         + B1 (7) // use sTypo* metrics in this table
02052         + B1 (8) // font name conforms to WWS model
02053         + B0 (9) // oblique
02054         //    10-15 reserved
02055     ;
02056     cacheU16 (os2, selection);
02057     const Glyph *glyphs = getBufferHead (font->glyphs);
02058     uint_fast32_t first = glyphs[1].codePoint;
02059     uint_fast32_t last = glyphs[font->glyphCount - 1].codePoint;
02060     cacheU16 (os2, first < U16MAX ? first : U16MAX); // usFirstCharIndex
02061     cacheU16 (os2, last  < U16MAX ? last  : U16MAX); // usLastCharIndex
02062     cacheU16 (os2, FU (ASCENDER)); // sTypoAscender
02063     cacheU16 (os2, FU (-DESCENDER)); // sTypoDescender
02064     cacheU16 (os2, FU (0)); // sTypoLineGap
02065     cacheU16 (os2, FU (ASCENDER)); // usWinAscent
02066     cacheU16 (os2, FU (DESCENDER)); // usWinDescent
02067     // HACK: All reasonable code pages are marked functional for convenience.
02068     cacheU32 (os2, 0x603f01ff); // ulCodePageRange1
02069     cacheU32 (os2, 0xffff0000); // ulCodePageRange2
02070     cacheU16 (os2, FU (8)); // sxHeight
02071     cacheU16 (os2, FU (10)); // sCapHeight
02072     cacheU16 (os2, 0); // usDefaultChar
02073     cacheU16 (os2, 0x20); // usBreakChar
02074     cacheU16 (os2, 0); // usMaxContext
02075     cacheU16 (os2, 0); // usLowerOpticalPointSize
02076     cacheU16 (os2, 0xffff); // usUpperOpticalPointSize
02077 }
02078
02079 /**
02080 @brief Fill an "hmtx" font table.
02081
02082 The "hmtx" table contains horizontal metrics information.
02083
02084 @param[in,out] font The Font struct to which to add the table.
02085 */
02086 void
02087 fillHmtxTable (Font *font)
02088 {
02089     Buffer *hmtx = newBuffer (4 * font->glyphCount);
02090     addTable (font, "hmtx", hmtx);
02091     const Glyph *const glyphs = getBufferHead (font->glyphs);
02092     const Glyph *const glyphsEnd = getBufferTail (font->glyphs);
02093     for (const Glyph *glyph = glyphs; glyph < glyphsEnd; glyph++)
02094     {
02095         int_fast16_t aw = glyph->combining ? 0 : PW (glyph->byteCount);
02096         cacheU16 (hmtx, FU (aw)); // advanceWidth
02097         cacheU16 (hmtx, FU (glyph->lsb)); // lsb
02098     }
02099 }
02100
02101 /**
02102 @brief Fill a "cmap" font table.
02103
02104 The "cmap" table contains character to glyph index mapping information.
02105
02106 @param[in,out] font The Font struct to which to add the table.
02107 */
02108 void
02109 fillCmapTable (Font *font)
02110 {
02111     Glyph *const glyphs = getBufferHead (font->glyphs);
02112     Buffer *rangeHeads = newBuffer (16);
02113     uint_fast32_t rangeCount = 0;
02114     uint_fast32_t bmpRangeCount = 1; // 1 for the last 0xffff-0xffff range
02115     glyphs[0].codePoint = glyphs[1].codePoint; // to start a range at glyph 1
02116     for (uint_fast16_t i = 1; i < font->glyphCount; i++)
02117     {
02118         if (glyphs[i].codePoint != glyphs[i - 1].codePoint + 1)
02119         {
02120             storeU16 (rangeHeads, i);
02121             rangeCount++;
02122             bmpRangeCount += glyphs[i].codePoint < 0xffff;
02123         }
02124     }
02125     Buffer *cmap = newBuffer (256);
02126     addTable (font, "cmap", cmap);
02127     // Format 4 table is always generated for compatibility.
02128     bool hasFormat12 = glyphs[font->glyphCount - 1].codePoint > 0xffff;
02129     cacheU16 (cmap, 0); // version
```

```
02130     cacheU16 (cmap, 1 + hasFormat12); // numTables
02131     { // encodingRecords[0]
02132         cacheU16 (cmap, 3); // platformID
02133         cacheU16 (cmap, 1); // encodingID
02134         cacheU32 (cmap, 12 + 8 * hasFormat12); // subtableOffset
02135     }
02136     if (hasFormat12) // encodingRecords[1]
02137     {
02138         cacheU16 (cmap, 3); // platformID
02139         cacheU16 (cmap, 10); // encodingID
02140         cacheU32 (cmap, 36 + 8 * bmpRangeCount); // subtableOffset
02141     }
02142     const uint_least16_t *ranges = getBufferHead (rangeHeads);
02143     const uint_least16_t *const rangesEnd = getBufferTail (rangeHeads);
02144     storeU16 (rangeHeads, font->glyphCount);
02145     { // format 4 table
02146         cacheU16 (cmap, 4); // format
02147         cacheU16 (cmap, 16 + 8 * bmpRangeCount); // length
02148         cacheU16 (cmap, 0); // language
02149         if (bmpRangeCount * 2 > U16MAX)
02150             fail ("Too many ranges in 'cmap' table.");
02151         cacheU16 (cmap, bmpRangeCount * 2); // segCountX2
02152         uint_fast16_t searchRange = 1, entrySelector = -1;
02153         while (searchRange <= bmpRangeCount)
02154         {
02155             searchRange «= 1;
02156             entrySelector++;
02157         }
02158         cacheU16 (cmap, searchRange); // searchRange
02159         cacheU16 (cmap, entrySelector); // entrySelector
02160         cacheU16 (cmap, bmpRangeCount * 2 - searchRange); // rangeShift
02161         { // endCode[]
02162             const uint_least16_t *p = ranges;
02163             for (p++; p < rangesEnd && glyphs[*p].codePoint < 0xffff; p++)
02164                 cacheU16 (cmap, glyphs[*p - 1].codePoint);
02165             uint_fast32_t cp = glyphs[*p - 1].codePoint;
02166             if (cp > 0xfffe)
02167                 cp = 0xfffe;
02168             cacheU16 (cmap, cp);
02169             cacheU16 (cmap, 0xffff);
02170         }
02171         cacheU16 (cmap, 0); // reservedPad
02172         { // startCode[]
02173             for (uint_fast32_t i = 0; i < bmpRangeCount - 1; i++)
02174                 cacheU16 (cmap, glyphs[ranges[i]].codePoint);
02175             cacheU16 (cmap, 0xffff);
02176         }
02177         { // idDelta[]
02178             const uint_least16_t *p = ranges;
02179             for (; p < rangesEnd && glyphs[*p].codePoint < 0xffff; p++)
02180                 cacheU16 (cmap, *p - glyphs[*p].codePoint);
02181             uint_fast16_t delta = 1;
02182             if (p < rangesEnd && *p == 0xffff)
02183                 delta = *p - glyphs[*p].codePoint;
02184             cacheU16 (cmap, delta);
02185         }
02186         { // idRangeOffsets[]
02187             for (uint_least16_t i = 0; i < bmpRangeCount; i++)
02188                 cacheU16 (cmap, 0);
02189         }
02190     }
02191     if (hasFormat12) // format 12 table
02192     {
02193         cacheU16 (cmap, 12); // format
02194         cacheU16 (cmap, 0); // reserved
02195         cacheU32 (cmap, 16 + 12 * rangeCount); // length
02196         cacheU32 (cmap, 0); // language
02197         cacheU32 (cmap, rangeCount); // numGroups
02198
02199         // groups[]
02200         for (const uint_least16_t *p = ranges; p < rangesEnd; p++)
02201         {
02202             cacheU32 (cmap, glyphs[*p].codePoint); // startCharCode
02203             cacheU32 (cmap, glyphs[p[1] - 1].codePoint); // endCharCode
02204             cacheU32 (cmap, *p); // startGlyphID
02205         }
02206     }
02207     freeBuffer (rangeHeads);
02208 }
02209
02210 /**
```

```
02211 @brief Fill a "post" font table.
02212
02213 The "post" table contains information for PostScript printers.
02214
02215 @param[in,out] font The Font struct to which to add the table.
02216 */
02217 void
02218 fillPostTable (Font *font)
02219 {
02220     Buffer *post = newBuffer (32);
02221     addTable (font, "post", post);
02222     cacheU32 (post, 0x00030000); // version = 3.0
02223     cacheU32 (post, 0); // italicAngle
02224     cacheU16 (post, 0); // underlinePosition
02225     cacheU16 (post, 1); // underlineThickness
02226     cacheU32 (post, 1); // isFixedPitch
02227     cacheU32 (post, 0); // minMemType42
02228     cacheU32 (post, 0); // maxMemType42
02229     cacheU32 (post, 0); // minMemType1
02230     cacheU32 (post, 0); // maxMemType1
02231 }
02232
02233 /**
02234 @brief Fill a "GPOS" font table.
02235
02236 The "GPOS" table contains information for glyph positioning.
02237
02238 @param[in,out] font The Font struct to which to add the table.
02239 */
02240 void
02241 fillGposTable (Font *font)
02242 {
02243     Buffer *gpos = newBuffer (16);
02244     addTable (font, "GPOS", gpos);
02245     cacheU16 (gpos, 1); // majorVersion
02246     cacheU16 (gpos, 0); // minorVersion
02247     cacheU16 (gpos, 10); // scriptListOffset
02248     cacheU16 (gpos, 12); // featureListOffset
02249     cacheU16 (gpos, 14); // lookupListOffset
02250     { // ScriptList table
02251         cacheU16 (gpos, 0); // scriptCount
02252     }
02253     { // Feature List table
02254         cacheU16 (gpos, 0); // featureCount
02255     }
02256     { // Lookup List Table
02257         cacheU16 (gpos, 0); // lookupCount
02258     }
02259 }
02260
02261 /**
02262 @brief Fill a "GSUB" font table.
02263
02264 The "GSUB" table contains information for glyph substitution.
02265
02266 @param[in,out] font The Font struct to which to add the table.
02267 */
02268 void
02269 fillGsubTable (Font *font)
02270 {
02271     Buffer *gsub = newBuffer (38);
02272     addTable (font, "GSUB", gsub);
02273     cacheU16 (gsub, 1); // majorVersion
02274     cacheU16 (gsub, 0); // minorVersion
02275     cacheU16 (gsub, 10); // scriptListOffset
02276     cacheU16 (gsub, 34); // featureListOffset
02277     cacheU16 (gsub, 36); // lookupListOffset
02278     { // ScriptList table
02279         cacheU16 (gsub, 2); // scriptCount
02280         { // scriptRecords[0]
02281             cacheBytes (gsub, "DFLT", 4); // scriptTag
02282             cacheU16 (gsub, 14); // scriptOffset
02283         }
02284         { // scriptRecords[1]
02285             cacheBytes (gsub, "thai", 4); // scriptTag
02286             cacheU16 (gsub, 14); // scriptOffset
02287         }
02288         { // Script table
02289             cacheU16 (gsub, 4); // defaultLangSysOffset
02290             cacheU16 (gsub, 0); // langSysCount
02291             { // Default Language System table
```

```
02292                 cacheU16 (gsub, 0); // lookupOrderOffset
02293                 cacheU16 (gsub, 0); // requiredFeatureIndex
02294                 cacheU16 (gsub, 0); // featureIndexCount
02295             }
02296         }
02297     }
02298     { // Feature List table
02299         cacheU16 (gsub, 0); // featureCount
02300     }
02301     { // Lookup List Table
02302         cacheU16 (gsub, 0); // lookupCount
02303     }
02304 }
02305
02306 /**
02307 @brief Cache a string as a big-ending UTF-16 surrogate pair.
02308
02309 This function encodes a UTF-8 string as a big-endian UTF-16
02310 surrogate pair.
02311
02312 @param[in,out] buf Pointer to a Buffer struct to update.
02313 @param[in] str The character array to encode.
02314 */
02315 void
02316 cacheStringAsUTF16BE (Buffer *buf, const char *str)
02317 {
02318     for (const char *p = str; *p; p++)
02319     {
02320         byte c = *p;
02321         if (c < 0x80)
02322         {
02323             cacheU16 (buf, c);
02324             continue;
02325         }
02326         int length = 1;
02327         byte mask = 0x40;
02328         for (; c & mask; mask »= 1)
02329             length++;
02330         if (length == 1 || length > 4)
02331             fail ("Ill-formed UTF-8 sequence.");
02332         uint_fast32_t codePoint = c & (mask - 1);
02333         for (int i = 1; i < length; i++)
02334         {
02335             c = *++p;
02336             if ((c & 0xc0) != 0x80) // NUL checked here
02337                 fail ("Ill-formed UTF-8 sequence.");
02338             codePoint = (codePoint « 6) | (c & 0x3f);
02339         }
02340         const int lowerBits = length==2 ? 7 : length==3 ? 11 : 16;
02341         if (codePoint » lowerBits == 0)
02342             fail ("Ill-formed UTF-8 sequence."); // sequence should be shorter
02343         if (codePoint >= 0xd800 && codePoint <= 0xdfff)
02344             fail ("Ill-formed UTF-8 sequence.");
02345         if (codePoint > 0x10ffff)
02346             fail ("Ill-formed UTF-8 sequence.");
02347         if (codePoint > 0xffff)
02348         {
02349             cacheU16 (buf, 0xd800 | (codePoint - 0x10000) » 10);
02350             cacheU16 (buf, 0xdc00 | (codePoint & 0x3ff));
02351         }
02352         else
02353             cacheU16 (buf, codePoint);
02354     }
02355 }
02356
02357 /**
02358 @brief Fill a "name" font table.
02359
02360 The "name" table contains name information, for example for Name IDs.
02361
02362 @param[in,out] font The Font struct to which to add the table.
02363 @param[in] names List of NameStrings.
02364 */
02365 void
02366 fillNameTable (Font *font, NameStrings nameStrings)
02367 {
02368     Buffer *name = newBuffer (2048);
02369     addTable (font, "name", name);
02370     size_t nameStringCount = 0;
02371     for (size_t i = 0; i < MAX_NAME_IDS; i++)
02372         nameStringCount += !!nameStrings[i];
```

```
02373     cacheU16 (name, 0); // version
02374     cacheU16 (name, nameStringCount); // count
02375     cacheU16 (name, 2 * 3 + 12 * nameStringCount); // storageOffset
02376     Buffer *stringData = newBuffer (1024);
02377     // nameRecord[]
02378     for (size_t i = 0; i < MAX_NAME_IDS; i++)
02379     {
02380         if (!nameStrings[i])
02381             continue;
02382         size_t offset = countBufferedBytes (stringData);
02383         cacheStringAsUTF16BE (stringData, nameStrings[i]);
02384         size_t length = countBufferedBytes (stringData) - offset;
02385         if (offset > U16MAX || length > U16MAX)
02386             fail ("Name strings are too long.");
02387         // Platform ID 0 (Unicode) is not well supported.
02388         // ID 3 (Windows) seems to be the best for compatibility.
02389         cacheU16 (name, 3); // platformID = Windows
02390         cacheU16 (name, 1); // encodingID = Unicode BMP
02391         cacheU16 (name, 0x0409); // languageID = en-US
02392         cacheU16 (name, i); // nameID
02393         cacheU16 (name, length); // length
02394         cacheU16 (name, offset); // stringOffset
02395     }
02396     cacheBuffer (name, stringData);
02397     freeBuffer (stringData);
02398 }
02399
02400 /**
02401 @brief Print program version string on stdout.
02402
02403 Print program version if invoked with the "--version" option,
02404 and then exit successfully.
02405 */
02406 void
02407 printVersion () {
02408     printf ("hex2otf (GNU Unifont) %s\n", VERSION);
02409     printf ("Copyright \u00A9 2022 \u4F55\u5FD7\u7FD4 (He Zhixiang)\n");
02410     printf ("License GPLv2+: GNU GPL version 2 or later\n");
02411     printf ("<https://gnu.org/licenses/gpl.html>\n");
02412     printf ("This is free software: you are free to change and\n");
02413     printf ("redistribute it.  There is NO WARRANTY, to the extent\n");
02414     printf ("permitted by law.\n");
02415
02416     exit (EXIT_SUCCESS);
02417 }
02418
02419 /**
02420 @brief Print help message to stdout and then exit.
02421
02422 Print help message if invoked with the "--help" option,
02423 and then exit successfully.
02424 */
02425 void
02426 printHelp () {
02427     printf ("Synopsis: hex2otf <options>:\n\n");
02428     printf ("    hex=<filename>        Specify Unifont .hex input file.\n");
02429     printf ("    pos=<filename>        Specify combining file. (Optional)\n");
02430     printf ("    out=<filename>        Specify output font file.\n");
02431     printf ("    format=<f1>,<f2>,...  Specify font format(s); values:\n");
02432     printf ("                          cff\n");
02433     printf ("                          cff2\n");
02434     printf ("                          truetype\n");
02435     printf ("                          blank\n");
02436     printf ("                          bitmap\n");
02437     printf ("                          gpos\n");
02438     printf ("                          gsub\n");
02439     printf ("\nExample:\n\n");
02440     printf ("    hex2otf hex=Myfont.hex out=Myfont.otf format=cff\n\n");
02441     printf ("For more information, consult the hex2otf(1) man page.\n\n");
02442
02443     exit (EXIT_SUCCESS);
02444 }
02445
02446 /**
02447 @brief Data structure to hold options for OpenType font output.
02448
02449 This data structure holds the status of options that can be
02450 specified as command line arguments for creating the output
02451 OpenType font file.
02452 */
02453 typedef struct Options
```

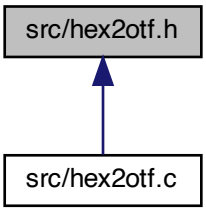
```
02454 {
02455     bool truetype, blankOutline, bitmap, gpos, gsub;
02456     int cff; // 0 = no CFF outline; 1 = use 'CFF' table; 2 = use 'CFF2' table
02457     const char *hex, *pos, *out; // file names
02458     NameStrings nameStrings; // indexed directly by Name IDs
02459 } Options;
02460
02461 /**
02462 @brief Match a command line option with its key for enabling.
02463
02464 @param[in] operand A pointer to the specified operand.
02465 @param[in] key Pointer to the option structure.
02466 @param[in] delimeter The delimiter to end searching.
02467 @return Pointer to the first character of the desired option.
02468 */
02469 const char *
02470 matchToken (const char *operand, const char *key, char delimiter)
02471 {
02472     while (*key)
02473         if (*operand++ != *key++)
02474             return NULL;
02475     if (!*operand || *operand++ == delimiter)
02476         return operand;
02477     return NULL;
02478 }
02479
02480 /**
02481 @brief Parse command line options.
02482
02483 Option          Data Type       Description
02484 ------          ---------       -----------
02485 truetype        bool            Generate TrueType outlines
02486 blankOutline    bool            Generate blank outlines
02487 bitmap          bool            Generate embedded bitmap
02488 gpos            bool            Generate a dummy GPOS table
02489 gsub            bool            Generate a dummy GSUB table
02490 cff             int             Generate CFF 1 or CFF 2 outlines
02491 hex             const char *    Name of Unifont .hex file
02492 pos             const char *    Name of Unifont combining data file
02493 out             const char *    Name of output font file
02494 nameStrings     NameStrings     Array of TrueType font Name IDs
02495
02496 @param[in] argv Pointer to array of command line options.
02497 @return Data structure to hold requested command line options.
02498 */
02499 Options
02500 parseOptions (char *const argv[const])
02501 {
02502     Options opt = {0}; // all options default to 0, false and NULL
02503     const char *format = NULL;
02504     struct StringArg
02505     {
02506         const char *const key;
02507         const char **const value;
02508     } strArgs[] =
02509     {
02510         {"hex", &opt.hex},
02511         {"pos", &opt.pos},
02512         {"out", &opt.out},
02513         {"format", &format},
02514         {NULL, NULL} // sentinel
02515     };
02516     for (char *const *argp = argv + 1; *argp; argp++)
02517     {
02518         const char *const arg = *argp;
02519         struct StringArg *p;
02520         const char *value = NULL;
02521         if (strcmp (arg, "--help") == 0)
02522             printHelp ();
02523         if (strcmp (arg, "--version") == 0)
02524             printVersion ();
02525         for (p = strArgs; p->key; p++)
02526             if ((value = matchToken (arg, p->key, '=')))
02527                 break;
02528         if (p->key)
02529         {
02530             if (!*value)
02531                 fail ("Empty argument: '%s'.", p->key);
02532             if (*p->value)
02533                 fail ("Duplicate argument: '%s'.", p->key);
02534             *p->value = value;
```

```
02535         }
02536         else // shall be a name string
02537         {
02538             char *endptr;
02539             unsigned long id = strtoul (arg, &endptr, 10);
02540             if (endptr == arg || id >= MAX_NAME_IDS || *endptr != '=')
02541                 fail ("Invalid argument: '%s'.", arg);
02542             endptr++; // skip '='
02543             if (opt.nameStrings[id])
02544                 fail ("Duplicate name ID: %lu.", id);
02545             opt.nameStrings[id] = endptr;
02546         }
02547     }
02548     if (!opt.hex)
02549         fail ("Hex file is not specified.");
02550     if (opt.pos && opt.pos[0] == '\0')
02551         opt.pos = NULL; // Position file is optional. Empty path means none.
02552     if (!opt.out)
02553         fail ("Output file is not specified.");
02554     if (!format)
02555         fail ("Format is not specified.");
02556     for (const NamePair *p = defaultNames; p->str; p++)
02557         if (!opt.nameStrings[p->id])
02558             opt.nameStrings[p->id] = p->str;
02559     bool cff = false, cff2 = false;
02560     struct Symbol
02561     {
02562         const char *const key;
02563         bool *const found;
02564     } symbols[] =
02565     {
02566         {"cff", &cff},
02567         {"cff2", &cff2},
02568         {"truetype", &opt.truetype},
02569         {"blank", &opt.blankOutline},
02570         {"bitmap", &opt.bitmap},
02571         {"gpos", &opt.gpos},
02572         {"gsub", &opt.gsub},
02573         {NULL, NULL} // sentinel
02574     };
02575     while (*format)
02576     {
02577         const struct Symbol *p;
02578         const char *next = NULL;
02579         for (p = symbols; p->key; p++)
02580             if ((next = matchToken (format, p->key, ',')))
02581                 break;
02582         if (!p->key)
02583             fail ("Invalid format.");
02584         *p->found = true;
02585         format = next;
02586     }
02587     if (cff + cff2 + opt.truetype + opt.blankOutline > 1)
02588         fail ("At most one outline format can be accepted.");
02589     if (!(cff || cff2 || opt.truetype || opt.bitmap))
02590         fail ("Invalid format.");
02591     opt.cff = cff + cff2 * 2;
02592     return opt;
02593 }
02594
02595 /**
02596 @brief The main function.
02597
02598 @param[in] argc The number of command-line arguments.
02599 @param[in] argv The array of command-line arguments.
02600 @return EXIT_FAILURE upon fatal error, EXIT_SUCCESS otherwise.
02601 */
02602 int
02603 main (int argc, char *argv[])
02604 {
02605     initBuffers (16);
02606     atexit (cleanBuffers);
02607     Options opt = parseOptions (argv);
02608     Font font;
02609     font.tables = newBuffer (sizeof (Table) * 16);
02610     font.glyphs = newBuffer (sizeof (Glyph) * MAX_GLYPHS);
02611     readGlyphs (&font, opt.hex);
02612     sortGlyphs (&font);
02613     enum LocaFormat loca = LOCA_OFFSET16;
02614     uint_fast16_t maxPoints = 0, maxContours = 0;
02615     pixels_t xMin = 0;
```

```
02616     if (opt.pos)
02617         positionGlyphs (&font, opt.pos, &xMin);
02618     if (opt.gpos)
02619         fillGposTable (&font);
02620     if (opt.gsub)
02621         fillGsubTable (&font);
02622     if (opt.cff)
02623         fillCFF (&font, opt.cff, opt.nameStrings);
02624     if (opt.truetype)
02625         fillTrueType (&font, &loca, &maxPoints, &maxContours);
02626     if (opt.blankOutline)
02627         fillBlankOutline (&font);
02628     if (opt.bitmap)
02629         fillBitmap (&font);
02630     fillHeadTable (&font, loca, xMin);
02631     fillHheaTable (&font, xMin);
02632     fillMaxpTable (&font, opt.cff, maxPoints, maxContours);
02633     fillOS2Table (&font);
02634     fillNameTable (&font, opt.nameStrings);
02635     fillHmtxTable (&font);
02636     fillCmapTable (&font);
02637     fillPostTable (&font);
02638     organizeTables (&font, opt.cff);
02639     writeFont (&font, opt.cff, opt.out);
02640     return EXIT_SUCCESS;
02641 }
```

5.5 src/hex2otf.h File Reference

hex2otf.h - Header file for hex2otf.c
This graph shows which files directly or indirectly include this file:



Data Structures

- struct NamePair

  Data structure for a font ID number and name character string.

Macros

- #define UNIFONT_VERSION "16.0.04"

  Current Unifont version.
- #define DEFAULT_ID0 "Copyright © 1998-2022 Roman Czyborra, Paul Hardy, \Qianqian Fang, Andrew Miller, Johnnie Weaver, David Corbett, \Nils Moskopp, Rebecca Bettencourt, et al."
- #define DEFAULT_ID1 "Unifont"

  Default NameID 1 string (Font Family)
- #define DEFAULT_ID2 "Regular"

Default NameID 2 string (Font Subfamily)

- #define DEFAULT_ID5 "Version "UNIFONT_VERSION

  Default NameID 5 string (Version of the Name Table)
- #define DEFAULT_ID11 "https://unifoundry.com/unifont/"

  Default NameID 11 string (Font Vendor URL)
- #define DEFAULT_ID13 "Dual license: SIL Open Font License version 1.1, \and GNU GPL version 2 or later with the GNU Font Embedding Exception."

  Default NameID 13 string (License Description)
- #define DEFAULT_ID14 "http://unifoundry.com/LICENSE.txt, \https://scripts.sil.org/OFL"

  Default NameID 14 string (License Information URLs)
- #define NAMEPAIR(n) {(n), DEFAULT_ID##n}

  Macro to initialize name identifier codes to default values defined above.

Typedefs

- typedef struct NamePair NamePair

  Data structure for a font ID number and name character string.

Variables

- const NamePair defaultNames []

  Allocate array of NameID codes with default values.

5.5.1 Detailed Description

hex2otf.h - Header file for hex2otf.c

Copyright

> Copyright © 2022 **何志翔** (He Zhixiang)

Author

> **何志翔** (He Zhixiang)

Definition in file hex2otf.h.

5.5.2 Macro Definition Documentation

5.5.2.1 DEFAULT_ID0

#define DEFAULT_ID0 "Copyright © 1998-2022 Roman Czyborra, Paul Hardy, \Qianqian Fang, Andrew Miller, Johnnie Weaver, David Corbett, \Nils Moskopp, Rebecca Bettencourt, et al."

Define default strings for some TrueType font NameID strings.

NameID	Description
0	Copyright Notice
1	Font Family
2	Font Subfamily
5	Version of the Name Table
11	URL of the Font Vendor
13	License Description
14	License Information URL

Default NameID 0 string (Copyright Notice)

Definition at line 53 of file hex2otf.h.

5.5.2.2 DEFAULT_ID1

#define DEFAULT_ID1 "Unifont"
Default NameID 1 string (Font Family)
Definition at line 57 of file hex2otf.h.

5.5.2.3 DEFAULT_ID11

#define DEFAULT_ID11 "https://unifoundry.com/unifont/"
Default NameID 11 string (Font Vendor URL)
Definition at line 64 of file hex2otf.h.

5.5.2.4 DEFAULT_ID13

#define DEFAULT_ID13 "Dual license: SIL Open Font License version 1.1, \and GNU GPL version 2 or later with the GNU Font Embedding Exception."
Default NameID 13 string (License Description)
Definition at line 67 of file hex2otf.h.

5.5.2.5 DEFAULT_ID14

#define DEFAULT_ID14 "http://unifoundry.com/LICENSE.txt, \https://scripts.sil.org/OFL"
Default NameID 14 string (License Information URLs)
Definition at line 71 of file hex2otf.h.

5.5.2.6 DEFAULT_ID2

#define DEFAULT_ID2 "Regular"
Default NameID 2 string (Font Subfamily)
Definition at line 58 of file hex2otf.h.

5.5.2.7 DEFAULT_ID5

#define DEFAULT_ID5 "Version "UNIFONT_VERSION
Default NameID 5 string (Version of the Name Table)
Definition at line 61 of file hex2otf.h.

5.5.2.8 NAMEPAIR

#define NAMEPAIR(
n) {(n), DEFAULT_ID##n}
Macro to initialize name identifier codes to default values defined above.
Definition at line 84 of file hex2otf.h.

5.5.2.9 UNIFONT_VERSION

#define UNIFONT_VERSION "16.0.04"
Current Unifont version.
Definition at line 36 of file hex2otf.h.

5.5.3 Variable Documentation

5.5.3.1 defaultNames

const NamePair defaultNames[]
Initial value:
=
{
  NAMEPAIR (0),
  NAMEPAIR (1),
  NAMEPAIR (2),
  NAMEPAIR (5),
  NAMEPAIR (11),
  NAMEPAIR (13),
  NAMEPAIR (14),
  {0, NULL}
}
Allocate array of NameID codes with default values.
This array contains the default values for several TrueType NameID strings, as defined above in this file. Strings are assigned using the NAMEPAIR macro defined above.
Definition at line 93 of file hex2otf.h.

5.6 hex2otf.h

Go to the documentation of this file.

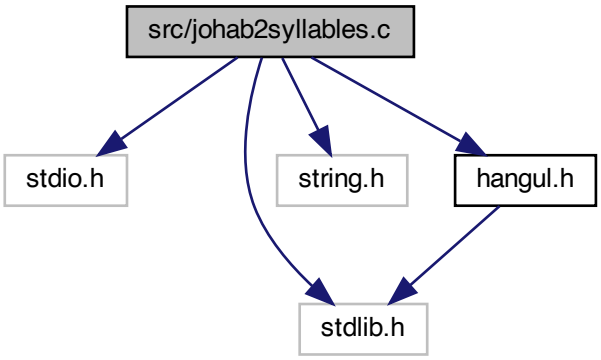
```
00001 /**
00002 @file hex2otf.h
00003
00004 @brief hex2otf.h - Header file for hex2otf.c
00005
00006 @copyright Copyright © 2022 何志翔 (He Zhixiang)
00007
00008 @author 何志翔 (He Zhixiang)
00009 */
00010
00011 /*
00012 LICENSE:
00013
00014 This program is free software; you can redistribute it and/or
00015 modify it under the terms of the GNU General Public License
00016 as published by the Free Software Foundation; either version 2
00017 of the License, or (at your option) any later version.
00018
00019 This program is distributed in the hope that it will be useful,
00020 but WITHOUT ANY WARRANTY; without even the implied warranty of
00021 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
00022 GNU General Public License for more details.
00023
00024 You should have received a copy of the GNU General Public License
00025 along with this program; if not, write to the Free Software
00026 Foundation, Inc., 51 Franklin Street, Fifth Floor, Boston, MA
00027 02110-1301, USA.
00028
00029 NOTE: It is a violation of the license terms of this software
00030 to delete license and copyright information below if creating
00031 a font derived from Unifont glyphs.
00032 */
00033 #ifndef _HEX2OTF_H_
00034 #define _HEX2OTF_H_
00035
00036 #define UNIFONT_VERSION "16.0.04"   ///< Current Unifont version.
00037
00038 /**
00039 Define default strings for some TrueType font NameID strings.
00040
00041 NameID   Description
00042 ------   -----------
00043 0     Copyright Notice
00044 1     Font Family
00045 2     Font Subfamily
00046 5     Version of the Name Table
00047 11     URL of the Font Vendor
```

```
00048 13     License Description
00049 14     License Information URL
00050
00051 Default NameID 0 string (Copyright Notice)
00052 */
00053 #define DEFAULT_ID0 "Copyright © 1998-2022 Roman Czyborra, Paul Hardy, \
00054 Qianqian Fang, Andrew Miller, Johnnie Weaver, David Corbett, \
00055 Nils Moskopp, Rebecca Bettencourt, et al."
00056
00057 #define DEFAULT_ID1 "Unifont"    ///< Default NameID 1 string (Font Family)
00058 #define DEFAULT_ID2 "Regular"    ///< Default NameID 2 string (Font Subfamily)
00059
00060 /// Default NameID 5 string (Version of the Name Table)
00061 #define DEFAULT_ID5 "Version "UNIFONT_VERSION
00062
00063 /// Default NameID 11 string (Font Vendor URL)
00064 #define DEFAULT_ID11 "https://unifoundry.com/unifont/"
00065
00066 /// Default NameID 13 string (License Description)
00067 #define DEFAULT_ID13 "Dual license: SIL Open Font License version 1.1, \
00068 and GNU GPL version 2 or later with the GNU Font Embedding Exception."
00069
00070 /// Default NameID 14 string (License Information URLs)
00071 #define DEFAULT_ID14 "http://unifoundry.com/LICENSE.txt, \
00072 https://scripts.sil.org/OFL"
00073
00074 /**
00075 @brief Data structure for a font ID number and name character string.
00076 */
00077 typedef struct NamePair
00078 {
00079     int id;
00080     const char *str;
00081 } NamePair;
00082
00083 /// Macro to initialize name identifier codes to default values defined above.
00084 #define NAMEPAIR(n) {(n), DEFAULT_ID##n}
00085
00086 /**
00087 @brief Allocate array of NameID codes with default values.
00088
00089 This array contains the default values for several TrueType NameID
00090 strings, as defined above in this file.  Strings are assigned using
00091 the NAMEPAIR macro defined above.
00092 */
00093 const NamePair defaultNames[] =
00094 {
00095     NAMEPAIR (0),  // Copyright notice; required (used in CFF)
00096     NAMEPAIR (1),  // Font family; required (used in CFF)
00097     NAMEPAIR (2),  // Font subfamily
00098     NAMEPAIR (5),  // Version of the name table
00099     NAMEPAIR (11), // URL of font vendor
00100     NAMEPAIR (13), // License description
00101     NAMEPAIR (14), // License information URL
00102     {0, NULL}      // Sentinel
00103 };
00104
00105 #undef NAMEPAIR
00106
00107 #endif
```

5.7 src/johab2syllables.c File Reference

Create the Unicode Hangul Syllables block from component letters.
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include "hangul.h"

Include dependency graph for johab2syllables.c:



Functions

- int main (int argc, char *argv[])
  The main function.
- void print_help ()
  Print a help message.

5.7.1 Detailed Description

Create the Unicode Hangul Syllables block from component letters.
This program reads in a "hangul-base.hex" file containing Hangul letters in Johab 6/3/1 format and outputs a Unifont .hex format file covering the Unicode Hangul Syllables range of U+AC00..U+D7A3.

Author

Paul Hardy

Copyright

Copyright © 2023 Paul Hardy

Definition in file johab2syllables.c.

5.7.2 Function Documentation

5.7.2.1 main()

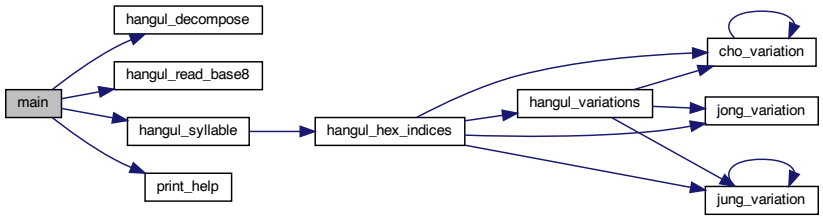
```
int main (
            int argc,
            char * argv[] )
```

The main function.
Definition at line 42 of file johab2syllables.c.

```
00042                           {
00043   int      i;          /* Loop variables     */
00044   int      arg_count;  /* index into *argv[] */
00045   unsigned codept;
00046   unsigned max_codept;
00047   unsigned char  hangul_base[MAX_GLYPHS][32];
00048   int      initial, medial, final;         /* Base glyphs for a syllable. */
00049   unsigned char  syllable[32];        /* Syllable glyph built for output. */
00050
00051   FILE *infp  = stdin;   /* Input Hangul Johab 6/3/1 file */
00052   FILE *outfp = stdout;  /* Output Hangul Syllables file  */
00053
00054   /* Print a help message */
00055   void print_help ();
00056
00057   /* Read the file containing Hangul base glyphs. */
00058   unsigned hangul_read_base8 (FILE *infp, unsigned char hangul_base[][32]);
00059
00060   /* Given a Hangul Syllables code point, determine component glyphs. */
00061   void hangul_decompose (unsigned codept, int *, int *, int *);
00062
00063   /* Given letters in a Hangul syllable, return a glyph. */
00064   void hangul_syllable (int choseong, int jungseong, int jongseong,
00065                         unsigned char hangul_base[][32],
00066                         unsigned char *syllable);
00067
00068
00069   /*
00070 If there are command line arguments, parse them.
00071 */
00072   arg_count = 1;
00073
00074   while (arg_count < argc) {
00075     /* If input file is specified, open it for read access. */
00076     if (strncmp (argv [arg_count], "-i", 2) == 0) {
00077       arg_count++;
00078       if (arg_count < argc) {
00079         infp = fopen (argv [arg_count], "r");
00080         if (infp == NULL) {
00081           fprintf (stderr, "\n*** ERROR: Cannot open %s for input.\n\n",
00082                    argv [arg_count]);
00083           exit (EXIT_FAILURE);
00084         }
00085       }
00086     }
00087     /* If output file is specified, open it for write access. */
00088     else if (strncmp (argv [arg_count], "-o", 2) == 0) {
00089       arg_count++;
00090       if (arg_count < argc) {
00091         outfp = fopen (argv [arg_count], "w");
00092         if (outfp == NULL) {
00093           fprintf (stderr, "\n*** ERROR: Cannot open %s for output.\n\n",
00094                    argv [arg_count]);
00095           exit (EXIT_FAILURE);
00096         }
00097       }
00098     }
00099     /* If help is requested, print help message and exit. */
00100     else if (strncmp (argv [arg_count], "-h",     2) == 0 ||
00101              strncmp (argv [arg_count], "--help", 6) == 0) {
00102       print_help ();
00103       exit (EXIT_SUCCESS);
00104     }
00105
00106     arg_count++;
00107   }
00108
00109
00110   /*
00111 Initialize entire glyph array to zeroes in case the input
00112 file skips over some code points.
00113 */
00114   for (codept = 0; codept < MAX_GLYPHS; codept++) {
00115     for (i = 0; i < 32; i++) hangul_base[codept][i] = 0;
00116   }
00117
00118   /*
00119 Read the entire "hangul-base.hex" file into an array
00120 organized as hangul_base [code_point][glyph_byte].
00121 The Hangul glyphs are 16 columns wide, which is
00122 two bytes, by 16 rows, for a total of 2 * 16 = 32 bytes.
```

```
00123 */
00124   max_codept = hangul_read_base8 (infp, hangul_base);
00125   if (max_codept > 0x8FF) {
00126     fprintf (stderr, "\nWARNING: Hangul glyph range exceeds PUA space.\n\n");
00127   }
00128
00129   /*
00130 For each glyph in the Unicode Hangul Syllables block,
00131 form a composite glyph of choseong + jungseong +
00132 optional jongseong and output it in Unifont .hex format.
00133 */
00134   for (codept = 0xAC00; codept < 0xAC00 + 19 * 21 * 28; codept++) {
00135     hangul_decompose (codept, &initial, &medial, &final);
00136
00137     hangul_syllable (initial, medial, final, hangul_base, syllable);
00138
00139     fprintf (outfp, "%04X:", codept);
00140
00141     for (i = 0; i < 32; i++) {
00142       fprintf (outfp, "%02X", syllable[i]);
00143     }
00144     fputc ('\n', outfp);
00145   }
00146
00147   exit (EXIT_SUCCESS);
00148 }
```

Here is the call graph for this function:



5.7.2.2 print_help()

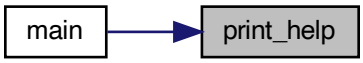
void print_help ( )

Print a help message.

Definition at line 155 of file johab2syllables.c.

```
00155             {
00156
00157   printf ("\ngen-hangul [options]\n\n");
00158   printf ("     Generates Hangul syllables from an input Unifont .hex file encoded\n");
00159   printf ("     in Johab 6/3/1 format.  The output is the Unicode Hangul Syllables\n");
00160   printf ("     range, U+AC00..U+D7A3.\n\n");
00161   printf ("     This program demonstrates forming Hangul syllables without shifting\n");
00162   printf ("     the final consonant (jongseong) when combined with a vowel having\n");
00163   printf ("     a long double vertical stroke.  For a program that demonstrtes\n");
00164   printf ("     shifting jongseong in those cases, see unigen-hangul, which is what\n");
00165   printf ("     creates the Unifont Hangul Syllables block.\n\n");
00166
00167   printf ("     This program may be invoked with the following command line options:\n\n");
00168
00169   printf ("     Option     Parameters     Function\n");
00170   printf ("     ------     ----------     --------\n");
00171   printf ("     -h, --help                Print this message and exit.\n\n");
00172   printf ("     -i         input_file     Unifont hangul-base.hex formatted input file.\n\n");
00173   printf ("     -o         output_file    Unifont .hex format output file.\n\n");
00174   printf ("      Example:\n\n");
00175   printf ("         johab2syllables -i hangul-base.hex -o hangul-syllables.hex\n\n");
00176
00177   return;
00178 }
```

Here is the caller graph for this function:



5.8 johab2syllables.c

Go to the documentation of this file.

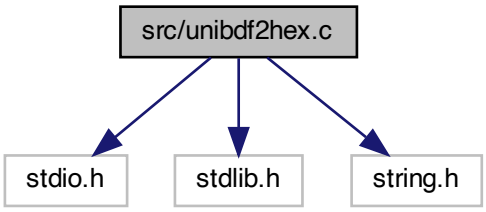
```
00001 /**
00002 @file johab2syllables.c
00003
00004 @brief Create the Unicode Hangul Syllables block from component letters.
00005
00006 This program reads in a "hangul-base.hex" file containing Hangul
00007 letters in Johab 6/3/1 format and outputs a Unifont .hex format
00008 file covering the Unicode Hangul Syllables range of U+AC00..U+D7A3.
00009
00010 @author Paul Hardy
00011
00012 @copyright Copyright © 2023 Paul Hardy
00013 */
00014 /*
00015 LICENSE:
00016
00017 This program is free software: you can redistribute it and/or modify
00018 it under the terms of the GNU General Public License as published by
00019 the Free Software Foundation, either version 2 of the License, or
00020 (at your option) any later version.
00021
00022 This program is distributed in the hope that it will be useful,
00023 but WITHOUT ANY WARRANTY; without even the implied warranty of
00024 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
00025 GNU General Public License for more details.
00026
00027 You should have received a copy of the GNU General Public License
00028 along with this program.  If not, see <http://www.gnu.org/licenses/>.
00029 */
00030
00031 #include <stdio.h>
00032 #include <stdlib.h>
00033 #include <string.h>
00034
00035 #include "hangul.h"
00036
00037
00038 /**
00039 @brief The main function.
00040 */
00041 int
00042 main (int argc, char *argv[]) {
00043   int      i;          /* Loop variables     */
00044   int      arg_count;  /* index into *argv[] */
00045   unsigned codept;
00046   unsigned max_codept;
00047   unsigned char  hangul_base[MAX_GLYPHS][32];
00048   int      initial, medial, final;         /* Base glyphs for a syllable. */
00049   unsigned char  syllable[32];        /* Syllable glyph built for output. */
00050
00051   FILE *infp  = stdin;   /* Input Hangul Johab 6/3/1 file */
00052   FILE *outfp = stdout;  /* Output Hangul Syllables file  */
00053
00054   /* Print a help message */
00055   void print_help ();
00056
00057   /* Read the file containing Hangul base glyphs. */
00058   unsigned hangul_read_base8 (FILE *infp, unsigned char hangul_base[][32]);
```

```
00059
00060   /* Given a Hangul Syllables code point, determine component glyphs. */
00061   void hangul_decompose (unsigned codept, int *, int *, int *);
00062
00063   /* Given letters in a Hangul syllable, return a glyph. */
00064   void hangul_syllable (int choseong, int jungseong, int jongseong,
00065                         unsigned char hangul_base[][32],
00066                         unsigned char *syllable);
00067
00068
00069   /*
00070 If there are command line arguments, parse them.
00071 */
00072   arg_count = 1;
00073
00074   while (arg_count < argc) {
00075     /* If input file is specified, open it for read access. */
00076     if (strncmp (argv [arg_count], "-i", 2) == 0) {
00077       arg_count++;
00078       if (arg_count < argc) {
00079         infp = fopen (argv [arg_count], "r");
00080         if (infp == NULL) {
00081           fprintf (stderr, "\n*** ERROR: Cannot open %s for input.\n\n",
00082                    argv [arg_count]);
00083           exit (EXIT_FAILURE);
00084         }
00085       }
00086     }
00087     /* If output file is specified, open it for write access. */
00088     else if (strncmp (argv [arg_count], "-o", 2) == 0) {
00089       arg_count++;
00090       if (arg_count < argc) {
00091         outfp = fopen (argv [arg_count], "w");
00092         if (outfp == NULL) {
00093           fprintf (stderr, "\n*** ERROR: Cannot open %s for output.\n\n",
00094                    argv [arg_count]);
00095           exit (EXIT_FAILURE);
00096         }
00097       }
00098     }
00099     /* If help is requested, print help message and exit. */
00100     else if (strncmp (argv [arg_count], "-h",     2) == 0 ||
00101              strncmp (argv [arg_count], "--help", 6) == 0) {
00102       print_help ();
00103       exit (EXIT_SUCCESS);
00104     }
00105
00106     arg_count++;
00107   }
00108
00109
00110   /*
00111 Initialize entire glyph array to zeroes in case the input
00112 file skips over some code points.
00113 */
00114   for (codept = 0; codept < MAX_GLYPHS; codept++) {
00115     for (i = 0; i < 32; i++) hangul_base[codept][i] = 0;
00116   }
00117
00118   /*
00119 Read the entire "hangul-base.hex" file into an array
00120 organized as hangul_base [code_point][glyph_byte].
00121 The Hangul glyphs are 16 columns wide, which is
00122 two bytes, by 16 rows, for a total of 2 * 16 = 32 bytes.
00123 */
00124   max_codept = hangul_read_base8 (infp, hangul_base);
00125   if (max_codept > 0x8FF) {
00126     fprintf (stderr, "\nWARNING: Hangul glyph range exceeds PUA space.\n\n");
00127   }
00128
00129   /*
00130 For each glyph in the Unicode Hangul Syllables block,
00131 form a composite glyph of choseong + jungseong +
00132 optional jongseong and output it in Unifont .hex format.
00133 */
00134   for (codept = 0xAC00; codept < 0xAC00 + 19 * 21 * 28; codept++) {
00135     hangul_decompose (codept, &initial, &medial, &final);
00136
00137     hangul_syllable (initial, medial, final, hangul_base, syllable);
00138
00139     fprintf (outfp, "%04X:", codept);
```

```
00140
00141       for (i = 0; i < 32; i++) {
00142         fprintf (outfp, "%02X", syllable[i]);
00143       }
00144       fputc ('\n', outfp);
00145     }
00146
00147     exit (EXIT_SUCCESS);
00148 }
00149
00150
00151 /**
00152 @brief Print a help message.
00153 */
00154 void
00155 print_help () {
00156
00157     printf ("\ngen-hangul [options]\n\n");
00158     printf ("     Generates Hangul syllables from an input Unifont .hex file encoded\n");
00159     printf ("     in Johab 6/3/1 format.  The output is the Unicode Hangul Syllables\n");
00160     printf ("     range, U+AC00..U+D7A3.\n\n");
00161     printf ("     This program demonstrates forming Hangul syllables without shifting\n");
00162     printf ("     the final consonant (jongseong) when combined with a vowel having\n");
00163     printf ("     a long double vertical stroke.  For a program that demonstrtes\n");
00164     printf ("     shifting jongseong in those cases, see unigen-hangul, which is what\n");
00165     printf ("     creates the Unifont Hangul Syllables block.\n\n");
00166
00167     printf ("     This program may be invoked with the following command line options:\n\n");
00168
00169     printf ("     Option     Parameters     Function\n");
00170     printf ("     ------     ----------     --------\n");
00171     printf ("     -h, --help                Print this message and exit.\n\n");
00172     printf ("     -i         input_file     Unifont hangul-base.hex formatted input file.\n\n");
00173     printf ("     -o         output_file    Unifont .hex format output file.\n\n");
00174     printf ("      Example:\n\n");
00175     printf ("        johab2syllables -i hangul-base.hex -o hangul-syllables.hex\n\n");
00176
00177     return;
00178 }
00179
```

5.9 src/unibdf2hex.c File Reference

unibdf2hex - Convert a BDF file into a unifont.hex file
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
Include dependency graph for unibdf2hex.c:



Macros

- #define UNISTART 0x3400

First Unicode code point to examine.

- #define UNISTOP 0x4DBF

  Last Unicode code point to examine.

- #define MAXBUF 256

  Maximum allowable input file line length - 1.

Functions

- int main ()

  The main function.

5.9.1 Detailed Description

unibdf2hex - Convert a BDF file into a unifont.hex file

Author

Paul Hardy, January 2008

Copyright

Copyright (C) 2008, 2013 Paul Hardy

Note: currently this has hard-coded code points for glyphs extracted from Wen Quan Yi to create the Unifont source file "wqy.hex".
Definition in file unibdf2hex.c.

5.9.2 Macro Definition Documentation

5.9.2.1 MAXBUF

#define MAXBUF 256
Maximum allowable input file line length - 1.
Definition at line 37 of file unibdf2hex.c.

5.9.2.2 UNISTART

#define UNISTART 0x3400
First Unicode code point to examine.
Definition at line 34 of file unibdf2hex.c.

5.9.2.3 UNISTOP

#define UNISTOP 0x4DBF
Last Unicode code point to examine.
Definition at line 35 of file unibdf2hex.c.

5.9.3 Function Documentation

5.9.3.1 main()

int main ( )
The main function.

Returns

Exit status is always 0 (successful termination).

Definition at line 46 of file unibdf2hex.c.

```
00047 {
00048   int i;
00049   int digitsout;  /* how many hex digits we output in a bitmap */
00050   int thispoint;
00051   char inbuf[MAXBUF];
00052   int bbxx, bbxy, bbxxoff, bbxyoff;
00053
00054   int descent=4; /* font descent wrt baseline */
00055   int startrow;  /* row to start glyph        */
00056   unsigned rowout;
00057
00058   while (fgets (inbuf, MAXBUF - 1, stdin) != NULL) {
00059     if (strncmp (inbuf, "ENCODING ", 9) == 0) {
00060       sscanf (&inbuf[9], "%d", &thispoint); /* get code point */
00061       /*
00062 If we want this code point, get the BBX (bounding box) and
00063 BITMAP information.
00064 */
00065       if ((thispoint >= 0x2E80 && thispoint <= 0x2EFF) || // CJK Radicals Supplement
00066           (thispoint >= 0x2F00 && thispoint <= 0x2FDF) || // Kangxi Radicals
00067           (thispoint >= 0x2FF0 && thispoint <= 0x2FFF) || // Ideographic Description Characters
00068           (thispoint >= 0x3001 && thispoint <= 0x303F) || // CJK Symbols and Punctuation (U+3000 is a space)
00069           (thispoint >= 0x3100 && thispoint <= 0x312F) || // Bopomofo
00070           (thispoint >= 0x31A0 && thispoint <= 0x31BF) || // Bopomofo extend
00071           (thispoint >= 0x31C0 && thispoint <= 0x31EF) || // CJK Strokes
00072           (thispoint >= 0x3400 && thispoint <= 0x4DBF) || // CJK Unified Ideographs Extension A
00073           (thispoint >= 0x4E00 && thispoint <= 0x9FCF) || // CJK Unified Ideographs
00074           (thispoint >= 0xF900 && thispoint <= 0xFAFF))   // CJK Compatibility Ideographs
00075         {
00076         while (fgets (inbuf, MAXBUF - 1, stdin) != NULL &&
00077                strncmp (inbuf, "BBX ", 4) != 0); /* find bounding box */
00078
00079         sscanf (&inbuf[4], "%d %d %d %d", &bbxx, &bbxy, &bbxxoff, &bbxyoff);
00080         while (fgets (inbuf, MAXBUF - 1, stdin) != NULL &&
00081                strncmp (inbuf, "BITMAP", 6) != 0); /* find bitmap start */
00082         fprintf (stdout, "%04X:", thispoint);
00083         digitsout = 0;
00084         /* Print initial blank rows */
00085         startrow = descent + bbxyoff + bbxy;
00086
00087         /* Force everything to 16 pixels wide */
00088         for (i = 16; i > startrow; i--) {
00089           fprintf (stdout,"0000");
00090           digitsout += 4;
00091         }
00092         while (fgets (inbuf, MAXBUF - 1, stdin) != NULL &&
00093                strncmp (inbuf, "END", 3) != 0) { /* copy bitmap until END */
00094           sscanf (inbuf, "%X", &rowout);
00095           /* Now force glyph to a 16x16 grid even if they'd fit in 8x16 */
00096           if (bbxx <= 8) rowout «= 8;  /* shift left for 16x16 glyph */
00097           rowout »= bbxxoff;
00098           fprintf (stdout, "%04X", rowout);
00099           digitsout += 4;
00100         }
00101
00102         /* Pad for 16x16 glyph */
00103         while (digitsout < 64) {
00104           fprintf (stdout,"0000");
00105           digitsout += 4;
00106         }
00107         fprintf (stdout,"\n");
00108       }
00109     }
00110   }
00111   exit (0);
00112 }
```

5.10 unibdf2hex.c

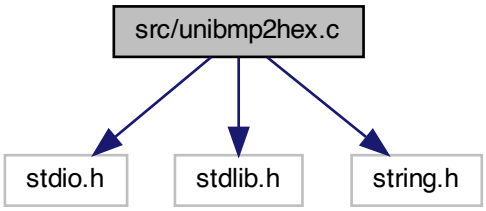
Go to the documentation of this file.

```
00001 /**
00002 @file unibdf2hex.c
00003
00004 @brief unibdf2hex - Convert a BDF file into a unifont.hex file
00005
00006 @author Paul Hardy, January 2008
00007
00008 @copyright Copyright (C) 2008, 2013 Paul Hardy
00009
00010 Note: currently this has hard-coded code points for glyphs extracted
00011 from Wen Quan Yi to create the Unifont source file "wqy.hex".
00012 */
00013 /*
00014 LICENSE:
00015
00016 This program is free software: you can redistribute it and/or modify
00017 it under the terms of the GNU General Public License as published by
00018 the Free Software Foundation, either version 2 of the License, or
00019 (at your option) any later version.
00020
00021 This program is distributed in the hope that it will be useful,
00022 but WITHOUT ANY WARRANTY; without even the implied warranty of
00023 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
00024 GNU General Public License for more details.
00025
00026 You should have received a copy of the GNU General Public License
00027 along with this program.  If not, see <http://www.gnu.org/licenses/>.
00028 */
00029
00030 #include <stdio.h>
00031 #include <stdlib.h>
00032 #include <string.h>
00033
00034 #define UNISTART 0x3400 ///< First Unicode code point to examine
00035 #define UNISTOP 0x4DBF  ///< Last Unicode code point to examine
00036
00037 #define MAXBUF 256  ///< Maximum allowable input file line length - 1
00038
00039
00040 /**
00041 @brief The main function.
00042
00043 @return Exit status is always 0 (successful termination).
00044 */
00045 int
00046 main()
00047 {
00048   int i;
00049   int digitsout;  /* how many hex digits we output in a bitmap */
00050   int thispoint;
00051   char inbuf[MAXBUF];
00052   int bbxx, bbxy, bbxxoff, bbxyoff;
00053
00054   int descent=4; /* font descent wrt baseline */
00055   int startrow;  /* row to start glyph        */
00056   unsigned rowout;
00057
00058   while (fgets (inbuf, MAXBUF - 1, stdin) != NULL) {
00059     if (strncmp (inbuf, "ENCODING ", 9) == 0) {
00060       sscanf (&inbuf[9], "%d", &thispoint); /* get code point */
00061       /*
00062 If we want this code point, get the BBX (bounding box) and
00063 BITMAP information.
00064 */
00065       if ((thispoint >= 0x2E80 && thispoint <= 0x2EFF) || // CJK Radicals Supplement
00066           (thispoint >= 0x2F00 && thispoint <= 0x2FDF) || // Kangxi Radicals
00067           (thispoint >= 0x2FF0 && thispoint <= 0x2FFF) || // Ideographic Description Characters
00068           (thispoint >= 0x3001 && thispoint <= 0x303F) || // CJK Symbols and Punctuation (U+3000 is a space)
00069           (thispoint >= 0x3100 && thispoint <= 0x312F) || // Bopomofo
00070           (thispoint >= 0x31A0 && thispoint <= 0x31BF) || // Bopomofo extend
00071           (thispoint >= 0x31C0 && thispoint <= 0x31EF) || // CJK Strokes
00072           (thispoint >= 0x3400 && thispoint <= 0x4DBF) || // CJK Unified Ideographs Extension A
00073           (thispoint >= 0x4E00 && thispoint <= 0x9FCF) || // CJK Unified Ideographs
00074           (thispoint >= 0xF900 && thispoint <= 0xFAFF))   // CJK Compatibility Ideographs
00075         {
00076         while (fgets (inbuf, MAXBUF - 1, stdin) != NULL &&
00077                strncmp (inbuf, "BBX ", 4) != 0); /* find bounding box */
```

```
00078
00079           sscanf (&inbuf[4], "%d %d %d %d", &bbxx, &bbxy, &bbxxoff, &bbxyoff);
00080           while (fgets (inbuf, MAXBUF - 1, stdin) != NULL &&
00081                  strncmp (inbuf, "BITMAP", 6) != 0); /* find bitmap start */
00082           fprintf (stdout, "%04X:", thispoint);
00083           digitsout = 0;
00084           /* Print initial blank rows */
00085           startrow = descent + bbxyoff + bbxy;
00086
00087           /* Force everything to 16 pixels wide */
00088           for (i = 16; i > startrow; i--) {
00089             fprintf (stdout,"0000");
00090             digitsout += 4;
00091           }
00092           while (fgets (inbuf, MAXBUF - 1, stdin) != NULL &&
00093                  strncmp (inbuf, "END", 3) != 0) { /* copy bitmap until END */
00094             sscanf (inbuf, "%X", &rowout);
00095             /* Now force glyph to a 16x16 grid even if they'd fit in 8x16 */
00096             if (bbxx <= 8) rowout «= 8;  /* shift left for 16x16 glyph */
00097             rowout »= bbxxoff;
00098             fprintf (stdout, "%04X", rowout);
00099             digitsout += 4;
00100           }
00101
00102           /* Pad for 16x16 glyph */
00103           while (digitsout < 64) {
00104             fprintf (stdout,"0000");
00105             digitsout += 4;
00106           }
00107           fprintf (stdout,"\n");
00108         }
00109       }
00110     }
00111     exit (0);
00112 }
```

5.11 src/unibmp2hex.c File Reference

unibmp2hex - Turn a .bmp or .wbmp glyph matrix into a GNU Unifont hex glyph set of 256 characters
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
Include dependency graph for unibmp2hex.c:



Macros

- #define MAXBUF 256

  Maximum input file line length - 1.

Functions

- int main (int argc, char *argv[])
  The main function.

Variables

- unsigned hexdigit [16][4]
  32 bit representation of 16x8 0..F bitmap
- unsigned uniplane =0
  Unicode plane number, 0..0xff ff ff.
- unsigned planeset =0
  =1: use plane specified with -p parameter
- unsigned flip =0
  =1 if we're transposing glyph matrix
- unsigned forcewide =0
  =1 to set each glyph to 16 pixels wide
- unsigned unidigit [6][4]
- struct {
  char filetype [2]
  int file_size
  int image_offset
  int info_size
  int width
  int height
  int nplanes
  int bits_per_pixel
  int compression
  int image_size
  int x_ppm
  int y_ppm
  int ncolors
  int important_colors
  } bmp_header
- unsigned char color_table [256][4]

5.11.1 Detailed Description

unibmp2hex - Turn a .bmp or .wbmp glyph matrix into a GNU Unifont hex glyph set of 256 characters

Author

Paul Hardy, unifoundry <at> unifoundry.com, December 2007

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Synopsis: unibmp2hex [-iin_file.bmp] [-oout_file.hex] [-phex_page_num] [-w]
Definition in file unibmp2hex.c.

5.11.2 Macro Definition Documentation

5.11.2.1 MAXBUF

#define MAXBUF 256
Maximum input file line length - 1.
Definition at line 116 of file unibmp2hex.c.

5.11.3 Function Documentation

5.11.3.1 main()

int main (
int argc,
char * argv[])
The main function.

Parameters

in	argc	The count of command line arguments.
in	argv	Pointer to array of command line arguments.

Returns

This program exits with status 0.

Definition at line 161 of file unibmp2hex.c.

```
00162 {
00163
00164   int i, j, k;              /* loop variables                    */
00165   unsigned char inchar;     /* temporary input character */
00166   char header[MAXBUF];      /* input buffer for bitmap file header */
00167   int wbmp=0; /* =0 for Windows Bitmap (.bmp); 1 for Wireless Bitmap (.wbmp) */
00168   int fatal; /* =1 if a fatal error occurred */
00169   int match; /* =1 if we're still matching a pattern, 0 if no match */
00170   int empty1, empty2; /* =1 if bytes tested are all zeroes */
00171   unsigned char thischar1[16], thischar2[16]; /* bytes of hex char */
00172   unsigned char thischar0[16], thischar3[16]; /* bytes for quadruple-width */
00173   int thisrow; /* index to point into thischar1[] and thischar2[] */
00174   int tmpsum;  /* temporary sum to see if a character is blank */
00175   unsigned this_pixel;  /* color of one pixel, if > 1 bit per pixel */
00176   unsigned next_pixels; /* pending group of 8 pixels being read */
00177   unsigned color_mask = 0x00;  /* to invert monochrome bitmap, set to 0xFF */
00178
00179   unsigned char bitmap[17*32][18*32/8]; /* final bitmap */
00180   /* For wide array:
00181 0 = don't force glyph to double-width;
00182 1 = force glyph to double-width;
00183 4 = force glyph to quadruple-width.
```

```
00184 */
00185   char wide[0x200000]={0x200000 * 0};
00186
00187   char *infile="", *outfile="";  /* names of input and output files */
00188   FILE *infp, *outfp;       /* file pointers of input and output files */
00189
00190   if (argc > 1) {
00191     for (i = 1; i < argc; i++) {
00192       if (argv[i][0] == '-') {  /* this is an option argument */
00193         switch (argv[i][1]) {
00194           case 'i':   /* name of input file */
00195             infile = &argv[i][2];
00196             break;
00197           case 'o':   /* name of output file */
00198             outfile = &argv[i][2];
00199             break;
00200           case 'p':   /* specify a Unicode plane */
00201             sscanf (&argv[i][2], "%x", &uniplane); /* Get Unicode plane */
00202             planeset = 1; /* Use specified range, not what's in bitmap */
00203             break;
00204           case 'w': /* force wide (16 pixels) for each glyph */
00205             forcewide = 1;
00206             break;
00207           default:    /* if unrecognized option, print list and exit */
00208             fprintf (stderr, "\nSyntax:\n\n");
00209             fprintf (stderr, "   %s -p<Unicode_Page> ", argv[0]);
00210             fprintf (stderr, "-i<Input_File> -o<Output_File> -w\n\n");
00211             fprintf (stderr, "   -w specifies .wbmp output instead of ");
00212             fprintf (stderr, "default Windows .bmp output.\n\n");
00213             fprintf (stderr, "   -p is followed by 1 to 6 ");
00214             fprintf (stderr, "Unicode plane hex digits ");
00215             fprintf (stderr, "(default is Page 0).\n\n");
00216             fprintf (stderr, "\nExample:\n\n");
00217             fprintf (stderr, "   %s -p83 -iunifont.hex -ou83.bmp\n\n\n",
00218                    argv[0]);
00219             exit (1);
00220         }
00221       }
00222     }
00223   }
00224   /*
00225 Make sure we can open any I/O files that were specified before
00226 doing anything else.
00227 */
00228   if (strlen (infile) > 0) {
00229     if ((infp = fopen (infile, "r")) == NULL) {
00230       fprintf (stderr, "Error: can't open %s for input.\n", infile);
00231       exit (1);
00232     }
00233   }
00234   else {
00235     infp = stdin;
00236   }
00237   if (strlen (outfile) > 0) {
00238     if ((outfp = fopen (outfile, "w")) == NULL) {
00239       fprintf (stderr, "Error: can't open %s for output.\n", outfile);
00240       exit (1);
00241     }
00242   }
00243   else {
00244     outfp = stdout;
00245   }
00246   /*
00247 Initialize selected code points for double width (16x16).
00248 Double-width is forced in cases where a glyph (usually a combining
00249 glyph) only occupies the left-hand side of a 16x16 grid, but must
00250 be rendered as double-width to appear properly with other glyphs
00251 in a given script.  If additions were made to a script after
00252 Unicode 5.0, the Unicode version is given in parentheses after
00253 the script name.
00254 */
00255   for (i = 0x0700; i <= 0x074F; i++) wide[i] = 1; /* Syriac              */
00256   for (i = 0x0800; i <= 0x083F; i++) wide[i] = 1; /* Samaritan (5.2)      */
00257   for (i = 0x0900; i <= 0x0DFF; i++) wide[i] = 1; /* Indic               */
00258   for (i = 0x1000; i <= 0x109F; i++) wide[i] = 1; /* Myanmar             */
00259   for (i = 0x1100; i <= 0x11FF; i++) wide[i] = 1; /* Hangul Jamo         */
00260   for (i = 0x1400; i <= 0x167F; i++) wide[i] = 1; /* Canadian Aboriginal */
00261   for (i = 0x1700; i <= 0x171F; i++) wide[i] = 1; /* Tagalog             */
00262   for (i = 0x1720; i <= 0x173F; i++) wide[i] = 1; /* Hanunoo             */
00263   for (i = 0x1740; i <= 0x175F; i++) wide[i] = 1; /* Buhid               */
00264   for (i = 0x1760; i <= 0x177F; i++) wide[i] = 1; /* Tagbanwa            */
```

```
00265   for (i = 0x1780; i <= 0x17FF; i++) wide[i] = 1; /* Khmer               */
00266   for (i = 0x18B0; i <= 0x18FF; i++) wide[i] = 1; /* Ext. Can. Aboriginal  */
00267   for (i = 0x1800; i <= 0x18AF; i++) wide[i] = 1; /* Mongolian           */
00268   for (i = 0x1900; i <= 0x194F; i++) wide[i] = 1; /* Limbu               */
00269 // for (i = 0x1980; i <= 0x19DF; i++) wide[i] = 1; /* New Tai Lue         */
00270   for (i = 0x1A00; i <= 0x1A1F; i++) wide[i] = 1; /* Buginese            */
00271   for (i = 0x1A20; i <= 0x1AAF; i++) wide[i] = 1; /* Tai Tham (5.2)      */
00272   for (i = 0x1B00; i <= 0x1B7F; i++) wide[i] = 1; /* Balinese            */
00273   for (i = 0x1B80; i <= 0x1BBF; i++) wide[i] = 1; /* Sundanese (5.1)     */
00274   for (i = 0x1BC0; i <= 0x1BFF; i++) wide[i] = 1; /* Batak (6.0)         */
00275   for (i = 0x1C00; i <= 0x1C4F; i++) wide[i] = 1; /* Lepcha (5.1)        */
00276   for (i = 0x1CC0; i <= 0x1CCF; i++) wide[i] = 1; /* Sundanese Supplement  */
00277   for (i = 0x1CD0; i <= 0x1CFF; i++) wide[i] = 1; /* Vedic Extensions (5.2) */
00278   wide[0x2329] = wide[0x232A] = 1; /* Left- & Right-pointing Angle Brackets */
00279   for (i = 0x2E80; i <= 0xA4CF; i++) wide[i] = 1; /* CJK                 */
00280 // for (i = 0x9FD8; i <= 0x9FE9; i++) wide[i] = 4; /* CJK quadruple-width   */
00281   for (i = 0xA900; i <= 0xA92F; i++) wide[i] = 1; /* Kayah Li (5.1)      */
00282   for (i = 0xA930; i <= 0xA95F; i++) wide[i] = 1; /* Rejang (5.1)        */
00283   for (i = 0xA960; i <= 0xA97F; i++) wide[i] = 1; /* Hangul Jamo Extended-A */
00284   for (i = 0xA980; i <= 0xA9DF; i++) wide[i] = 1; /* Javanese (5.2)      */
00285   for (i = 0xAA00; i <= 0xAA5F; i++) wide[i] = 1; /* Cham (5.1)          */
00286   for (i = 0xA9E0; i <= 0xA9FF; i++) wide[i] = 1; /* Myanmar Extended-B    */
00287   for (i = 0xAA00; i <= 0xAA5F; i++) wide[i] = 1; /* Cham                */
00288   for (i = 0xAA60; i <= 0xAA7F; i++) wide[i] = 1; /* Myanmar Extended-A    */
00289   for (i = 0xAAE0; i <= 0xAAFF; i++) wide[i] = 1; /* Meetei Mayek Ext (6.0) */
00290   for (i = 0xABC0; i <= 0xABFF; i++) wide[i] = 1; /* Meetei Mayek (5.2)    */
00291   for (i = 0xAC00; i <= 0xD7AF; i++) wide[i] = 1; /* Hangul Syllables      */
00292   for (i = 0xD7B0; i <= 0xD7FF; i++) wide[i] = 1; /* Hangul Jamo Extended-B */
00293   for (i = 0xF900; i <= 0xFAFF; i++) wide[i] = 1; /* CJK Compatibility     */
00294   for (i = 0xFE10; i <= 0xFE1F; i++) wide[i] = 1; /* Vertical Forms        */
00295   for (i = 0xFE30; i <= 0xFE60; i++) wide[i] = 1; /* CJK Compatibility Forms*/
00296   for (i = 0xFFE0; i <= 0xFFE6; i++) wide[i] = 1; /* CJK Compatibility Forms*/
00297
00298   wide[0x303F] = 0; /* CJK half-space fill */
00299
00300   /* Supplemental Multilingual Plane (Plane 01) */
00301   for (i = 0x0105C0; i <= 0x0105FF; i++) wide[i] = 1; /* Todhri           */
00302   for (i = 0x010A00; i <= 0x010A5F; i++) wide[i] = 1; /* Kharoshthi       */
00303   for (i = 0x011000; i <= 0x01107F; i++) wide[i] = 1; /* Brahmi           */
00304   for (i = 0x011080; i <= 0x0110CF; i++) wide[i] = 1; /* Kaithi           */
00305   for (i = 0x011100; i <= 0x01114F; i++) wide[i] = 1; /* Chakma           */
00306   for (i = 0x011180; i <= 0x0111DF; i++) wide[i] = 1; /* Sharada          */
00307   for (i = 0x011200; i <= 0x01124F; i++) wide[i] = 1; /* Khojki           */
00308   for (i = 0x0112B0; i <= 0x0112FF; i++) wide[i] = 1; /* Khudawadi        */
00309   for (i = 0x011300; i <= 0x01137F; i++) wide[i] = 1; /* Grantha          */
00310   for (i = 0x011380; i <= 0x0113FF; i++) wide[i] = 1; /* Tulu-Tigalari    */
00311   for (i = 0x011400; i <= 0x01147F; i++) wide[i] = 1; /* Newa             */
00312   for (i = 0x011480; i <= 0x0114DF; i++) wide[i] = 1; /* Tirhuta          */
00313   for (i = 0x011580; i <= 0x0115FF; i++) wide[i] = 1; /* Siddham          */
00314   for (i = 0x011600; i <= 0x01165F; i++) wide[i] = 1; /* Modi             */
00315   for (i = 0x011660; i <= 0x01167F; i++) wide[i] = 1; /* Mongolian Suppl.  */
00316   for (i = 0x011680; i <= 0x0116CF; i++) wide[i] = 1; /* Takri            */
00317   for (i = 0x0116D0; i <= 0x0116FF; i++) wide[i] = 1; /* Myanmar Extended-C */
00318   for (i = 0x011700; i <= 0x01173F; i++) wide[i] = 1; /* Ahom             */
00319   for (i = 0x011800; i <= 0x01184F; i++) wide[i] = 1; /* Dogra            */
00320   for (i = 0x011900; i <= 0x01195F; i++) wide[i] = 1; /* Dives Akuru      */
00321   for (i = 0x0119A0; i <= 0x0119FF; i++) wide[i] = 1; /* Nandinagari      */
00322   for (i = 0x011A00; i <= 0x011A4F; i++) wide[i] = 1; /* Zanabazar Square  */
00323   for (i = 0x011A50; i <= 0x011AAF; i++) wide[i] = 1; /* Soyombo          */
00324   for (i = 0x011B00; i <= 0x011B5F; i++) wide[i] = 1;/*Devanagari Extended-A*/
00325   for (i = 0x011F00; i <= 0x011F5F; i++) wide[i] = 1; /* Kawi             */
00326   for (i = 0x011C00; i <= 0x011C6F; i++) wide[i] = 1; /* Bhaiksuki        */
00327   for (i = 0x011C70; i <= 0x011CBF; i++) wide[i] = 1; /* Marchen          */
00328   for (i = 0x011D00; i <= 0x011D5F; i++) wide[i] = 1; /* Masaram Gondi    */
00329   for (i = 0x011EE0; i <= 0x011EFF; i++) wide[i] = 1; /* Makasar          */
00330   for (i = 0x011F00; i <= 0x011F5F; i++) wide[i] = 1; /* Kawi             */
00331   for (i = 0x012F90; i <= 0x012FFF; i++) wide[i] = 1; /* Cypro-Minoan     */
00332   /* Make Bassa Vah all single width or all double width */
00333   for (i = 0x016100; i <= 0x01613F; i++) wide[i] = 1; /* Gurung Khema     */
00334   for (i = 0x016AD0; i <= 0x016AFF; i++) wide[i] = 1; /* Bassa Vah        */
00335   for (i = 0x016B00; i <= 0x016B8F; i++) wide[i] = 1; /* Pahawh Hmong     */
00336   for (i = 0x016D40; i <= 0x016D7F; i++) wide[i] = 1; /* Kirat Rai        */
00337   for (i = 0x016F00; i <= 0x016F9F; i++) wide[i] = 1; /* Miao             */
00338   for (i = 0x016FE0; i <= 0x016FFF; i++) wide[i] = 1; /* Ideograph Sym/Punct*/
00339   for (i = 0x017000; i <= 0x0187FF; i++) wide[i] = 1; /* Tangut           */
00340   for (i = 0x018800; i <= 0x018AFF; i++) wide[i] = 1; /* Tangut Components */
00341   for (i = 0x018B00; i <= 0x018CFF; i++) wide[i] = 1; /* Khitan Small Script*/
00342   for (i = 0x01AFF0; i <= 0x01AFFF; i++) wide[i] = 1; /* Kana Extended-B   */
00343   for (i = 0x01B000; i <= 0x01B0FF; i++) wide[i] = 1; /* Kana Supplement   */
00344   for (i = 0x01B100; i <= 0x01B12F; i++) wide[i] = 1; /* Kana Extended-A   */
00345   for (i = 0x01B170; i <= 0x01B2FF; i++) wide[i] = 1; /* Nushu            */
```

```
00346     for (i = 0x01CF00; i <= 0x01CFCF; i++) wide[i] = 1; /* Znamenny Musical   */
00347     for (i = 0x01D800; i <= 0x01DAAF; i++) wide[i] = 1; /* Sutton SignWriting */
00348     for (i = 0x01E2C0; i <= 0x01E2FF; i++) wide[i] = 1; /* Wancho             */
00349     for (i = 0x01E500; i <= 0x01E5FF; i++) wide[i] = 1; /* Ol Onal            */
00350     for (i = 0x01E800; i <= 0x01E8DF; i++) wide[i] = 1; /* Mende Kikakui      */
00351     for (i = 0x01F200; i <= 0x01F2FF; i++) wide[i] = 1; /* Encl Ideograp Suppl*/
00352     wide[0x01F5E7] = 1;                                 /* Three Rays Right   */
00353
00354     /*
00355 Determine whether or not the file is a Microsoft Windows Bitmap file.
00356 If it starts with 'B', 'M', assume it's a Windows Bitmap file.
00357 Otherwise, assume it's a Wireless Bitmap file.
00358
00359 WARNING: There isn't much in the way of error checking here --
00360 if you give it a file that wasn't first created by hex2bmp.c,
00361 all bets are off.
00362 */
00363     fatal = 0;  /* assume everything is okay with reading input file */
00364     if ((header[0] = fgetc (infp)) != EOF) {
00365       if ((header[1] = fgetc (infp)) != EOF) {
00366         if (header[0] == 'B' && header[1] == 'M') {
00367           wbmp = 0; /* Not a Wireless Bitmap -- it's a Windows Bitmap */
00368         }
00369         else {
00370           wbmp = 1; /* Assume it's a Wireless Bitmap */
00371         }
00372       }
00373       else
00374         fatal = 1;
00375     }
00376     else
00377       fatal = 1;
00378
00379     if (fatal) {
00380       fprintf (stderr, "Fatal error; end of input file.\n\n");
00381       exit (1);
00382     }
00383     /*
00384 If this is a Wireless Bitmap (.wbmp) format file,
00385 skip the header and point to the start of the bitmap itself.
00386 */
00387     if (wbmp) {
00388       for (i=2; i<6; i++)
00389         header[i] = fgetc (infp);
00390       /*
00391 Now read the bitmap.
00392 */
00393       for (i=0; i < 32*17; i++) {
00394         for (j=0; j < 32*18/8; j++) {
00395           inchar = fgetc (infp);
00396           bitmap[i][j] = ~inchar;  /* invert bits for proper color */
00397         }
00398       }
00399     }
00400     /*
00401 Otherwise, treat this as a Windows Bitmap file, because we checked
00402 that it began with "BM".  Save the header contents for future use.
00403 Expect a 14 byte standard BITMAPFILEHEADER format header followed
00404 by a 40 byte standard BITMAPINFOHEADER Device Independent Bitmap
00405 header, with data stored in little-endian format.
00406 */
00407     else {
00408       for (i = 2; i < 54; i++)
00409         header[i] = fgetc (infp);
00410
00411       bmp_header.filetype[0] = 'B';
00412       bmp_header.filetype[1] = 'M';
00413
00414       bmp_header.file_size =
00415           (header[2] & 0xFF)       | ((header[3] & 0xFF) <<  8) |
00416         ((header[4] & 0xFF) << 16) | ((header[5] & 0xFF) << 24);
00417
00418       /* header bytes 6..9 are reserved */
00419
00420       bmp_header.image_offset =
00421           (header[10] & 0xFF)       | ((header[11] & 0xFF) <<  8) |
00422         ((header[12] & 0xFF) << 16) | ((header[13] & 0xFF) << 24);
00423
00424       bmp_header.info_size =
00425           (header[14] & 0xFF)       | ((header[15] & 0xFF) <<  8) |
00426         ((header[16] & 0xFF) << 16) | ((header[17] & 0xFF) << 24);
```

```
00427
00428       bmp_header.width =
00429          (header[18] & 0xFF)       | ((header[19] & 0xFF) «  8) |
00430         ((header[20] & 0xFF) « 16) | ((header[21] & 0xFF) « 24);
00431
00432       bmp_header.height =
00433          (header[22] & 0xFF)       | ((header[23] & 0xFF) «  8) |
00434         ((header[24] & 0xFF) « 16) | ((header[25] & 0xFF) « 24);
00435
00436       bmp_header.nplanes =
00437          (header[26] & 0xFF)       | ((header[27] & 0xFF) «  8);
00438
00439       bmp_header.bits_per_pixel =
00440          (header[28] & 0xFF)       | ((header[29] & 0xFF) «  8);
00441
00442       bmp_header.compression =
00443          (header[30] & 0xFF)       | ((header[31] & 0xFF) «  8) |
00444         ((header[32] & 0xFF) « 16) | ((header[33] & 0xFF) « 24);
00445
00446       bmp_header.image_size =
00447          (header[34] & 0xFF)       | ((header[35] & 0xFF) «  8) |
00448         ((header[36] & 0xFF) « 16) | ((header[37] & 0xFF) « 24);
00449
00450       bmp_header.x_ppm =
00451          (header[38] & 0xFF)       | ((header[39] & 0xFF) «  8) |
00452         ((header[40] & 0xFF) « 16) | ((header[41] & 0xFF) « 24);
00453
00454       bmp_header.y_ppm =
00455          (header[42] & 0xFF)       | ((header[43] & 0xFF) «  8) |
00456         ((header[44] & 0xFF) « 16) | ((header[45] & 0xFF) « 24);
00457
00458       bmp_header.ncolors =
00459          (header[46] & 0xFF)       | ((header[47] & 0xFF) «  8) |
00460         ((header[48] & 0xFF) « 16) | ((header[49] & 0xFF) « 24);
00461
00462       bmp_header.important_colors =
00463          (header[50] & 0xFF)       | ((header[51] & 0xFF) «  8) |
00464         ((header[52] & 0xFF) « 16) | ((header[53] & 0xFF) « 24);
00465
00466       if (bmp_header.ncolors == 0)
00467         bmp_header.ncolors = 1 « bmp_header.bits_per_pixel;
00468
00469       /* If a Color Table exists, read it */
00470       if (bmp_header.ncolors > 0 && bmp_header.bits_per_pixel <= 8) {
00471         for (i = 0; i < bmp_header.ncolors; i++) {
00472           color_table[i][0] = fgetc (infp);  /* Red   */
00473           color_table[i][1] = fgetc (infp);  /* Green */
00474           color_table[i][2] = fgetc (infp);  /* Blue  */
00475           color_table[i][3] = fgetc (infp);  /* Alpha */
00476         }
00477         /*
00478 Determine from the first color table entry whether we
00479 are inverting the resulting bitmap image.
00480 */
00481         if ( (color_table[0][0] + color_table[0][1] + color_table[0][2])
00482              < (3 * 128) ) {
00483           color_mask = 0xFF;
00484         }
00485       }
00486
00487 #ifdef DEBUG
00488
00489       /*
00490 Print header info for possibly adding support for
00491 additional file formats in the future, to determine
00492 how the bitmap is encoded.
00493 */
00494       fprintf (stderr, "Filetype: '%c%c'\n",
00495                bmp_header.filetype[0], bmp_header.filetype[1]);
00496       fprintf (stderr, "File Size: %d\n", bmp_header.file_size);
00497       fprintf (stderr, "Image Offset: %d\n", bmp_header.image_offset);
00498       fprintf (stderr, "Info Header Size: %d\n", bmp_header.info_size);
00499       fprintf (stderr, "Image Width: %d\n", bmp_header.width);
00500       fprintf (stderr, "Image Height: %d\n", bmp_header.height);
00501       fprintf (stderr, "Number of Planes: %d\n", bmp_header.nplanes);
00502       fprintf (stderr, "Bits per Pixel: %d\n", bmp_header.bits_per_pixel);
00503       fprintf (stderr, "Compression Method: %d\n", bmp_header.compression);
00504       fprintf (stderr, "Image Size: %d\n", bmp_header.image_size);
00505       fprintf (stderr, "X Pixels per Meter: %d\n", bmp_header.x_ppm);
00506       fprintf (stderr, "Y Pixels per Meter: %d\n", bmp_header.y_ppm);
00507       fprintf (stderr, "Number of Colors: %d\n", bmp_header.ncolors);
```

```
00508       fprintf (stderr, "Important Colors: %d\n", bmp_header.important_colors);
00509
00510 #endif
00511
00512       /*
00513 Now read the bitmap.
00514 */
00515       for (i = 32*17-1; i >= 0; i--) {
00516         for (j=0; j < 32*18/8; j++) {
00517           next_pixels = 0x00;  /* initialize next group of 8 pixels */
00518           /* Read a monochrome image -- the original case */
00519           if (bmp_header.bits_per_pixel == 1) {
00520             next_pixels = fgetc (infp);
00521           }
00522           /* Read a 32 bit per pixel RGB image; convert to monochrome */
00523           else if ( bmp_header.bits_per_pixel == 24 ||
00524                     bmp_header.bits_per_pixel == 32) {
00525             next_pixels = 0;
00526             for (k = 0; k < 8; k++) {  /* get next 8 pixels */
00527               this_pixel = (fgetc (infp) & 0xFF) +
00528                            (fgetc (infp) & 0xFF) +
00529                            (fgetc (infp) & 0xFF);
00530
00531               if (bmp_header.bits_per_pixel == 32) {
00532                 (void) fgetc (infp);  /* ignore alpha value */
00533               }
00534
00535               /* convert RGB color space to monochrome */
00536               if (this_pixel >= (128 * 3))
00537                 this_pixel = 0;
00538               else
00539                 this_pixel = 1;
00540
00541               /* shift next pixel color into place for 8 pixels total */
00542               next_pixels = (next_pixels « 1) | this_pixel;
00543             }
00544           }
00545           if (bmp_header.height < 0) {  /* Bitmap drawn top to bottom */
00546             bitmap [(32*17-1) - i] [j] = next_pixels;
00547           }
00548           else {  /* Bitmap drawn bottom to top */
00549             bitmap [i][j] = next_pixels;
00550           }
00551         }
00552       }
00553
00554       /*
00555 If any bits are set in color_mask, apply it to
00556 entire bitmap to invert black <--> white.
00557 */
00558       if (color_mask != 0x00) {
00559         for (i = 32*17-1; i >= 0; i--) {
00560           for (j=0; j < 32*18/8; j++) {
00561             bitmap [i][j] ^= color_mask;
00562           }
00563         }
00564       }
00565
00566     }
00567
00568     /*
00569 We've read the entire file.   Now close the input file pointer.
00570 */
00571     fclose (infp);
00572     /*
00573 We now have the header portion in the header[] array,
00574 and have the bitmap portion from top-to-bottom in the bitmap[] array.
00575 */
00576     /*
00577 If no Unicode range (U+nnnnnn00 through U+nnnnnnFF) was specified
00578 with a -p parameter, determine the range from the digits in the
00579 bitmap itself.
00580
00581 Store bitmaps for the hex digit patterns that this file uses.
00582 */
00583     if (!planeset) {  /* If Unicode range not specified with -p parameter */
00584       for (i = 0x0; i <= 0xF; i++) {  /* hex digit pattern we're storing */
00585         for (j = 0; j < 4; j++) {
00586           hexdigit[i][j]   =
00587             ((unsigned)bitmap[32 * (i+1) + 4 * j + 8    ][6] « 24 ) |
00588             ((unsigned)bitmap[32 * (i+1) + 4 * j + 8 + 1][6] « 16 ) |
```

```
00589             ((unsigned)bitmap[32 * (i+1) + 4 * j + 8 + 2][6] «  8 ) |
00590             ((unsigned)bitmap[32 * (i+1) + 4 * j + 8 + 3][6]       );
00591         }
00592       }
00593       /*
00594 Read the Unicode plane digits into arrays for comparison, to
00595 determine the upper four hex digits of the glyph addresses.
00596 */
00597       for (i = 0; i < 4; i++) {
00598         for (j = 0; j < 4; j++) {
00599           unidigit[i][j] =
00600             ((unsigned)bitmap[32 * 0 + 4 * j + 8 + 1][i + 3] « 24 ) |
00601             ((unsigned)bitmap[32 * 0 + 4 * j + 8 + 2][i + 3] « 16 ) |
00602             ((unsigned)bitmap[32 * 0 + 4 * j + 8 + 3][i + 3] «  8 ) |
00603             ((unsigned)bitmap[32 * 0 + 4 * j + 8 + 4][i + 3]       );
00604         }
00605       }
00606
00607       tmpsum = 0;
00608       for (i = 4; i < 6; i++) {
00609         for (j = 0; j < 4; j++) {
00610           unidigit[i][j] =
00611             ((unsigned)bitmap[32 * 1 + 4 * j + 8    ][i] « 24 ) |
00612             ((unsigned)bitmap[32 * 1 + 4 * j + 8 + 1][i] « 16 ) |
00613             ((unsigned)bitmap[32 * 1 + 4 * j + 8 + 2][i] «  8 ) |
00614             ((unsigned)bitmap[32 * 1 + 4 * j + 8 + 3][i]       );
00615           tmpsum |= unidigit[i][j];
00616         }
00617       }
00618       if (tmpsum == 0) {  /* the glyph matrix is transposed */
00619         flip = 1;  /* note transposed order for processing glyphs in matrix */
00620         /*
00621 Get 5th and 6th hex digits by shifting first column header left by
00622 1.5 columns, thereby shifting the hex digit right after the leading
00623 "U+nnnn" page number.
00624 */
00625         for (i = 0x08; i < 0x18; i++) {
00626           bitmap[i][7] = (bitmap[i][8] « 4) | ((bitmap[i][ 9] » 4) & 0xf);
00627           bitmap[i][8] = (bitmap[i][9] « 4) | ((bitmap[i][10] » 4) & 0xf);
00628         }
00629         for (i = 4; i < 6; i++) {
00630           for (j = 0; j < 4; j++) {
00631             unidigit[i][j] =
00632               ((unsigned)bitmap[4 * j + 8 + 1][i + 3] « 24 ) |
00633               ((unsigned)bitmap[4 * j + 8 + 2][i + 3] « 16 ) |
00634               ((unsigned)bitmap[4 * j + 8 + 3][i + 3] «  8 ) |
00635               ((unsigned)bitmap[4 * j + 8 + 4][i + 3]       );
00636           }
00637         }
00638       }
00639
00640       /*
00641 Now determine the Unicode plane by comparing unidigit[0..5] to
00642 the hexdigit[0x0..0xF] array.
00643 */
00644       uniplane = 0;
00645       for (i=0; i<6; i++) { /* go through one bitmap digit at a time */
00646         match = 0; /* haven't found pattern yet */
00647         for (j = 0x0; !match && j <= 0xF; j++) {
00648           if (unidigit[i][0] == hexdigit[j][0] &&
00649               unidigit[i][1] == hexdigit[j][1] &&
00650               unidigit[i][2] == hexdigit[j][2] &&
00651               unidigit[i][3] == hexdigit[j][3]) { /* we found the digit */
00652             uniplane |= j;
00653             match = 1;
00654           }
00655         }
00656         uniplane «= 4;
00657       }
00658       uniplane »= 4;
00659     }
00660     /*
00661 Now read each glyph and print it as hex.
00662 */
00663     for (i = 0x0; i <= 0xf; i++) {
00664       for (j = 0x0; j <= 0xf; j++) {
00665         for (k = 0; k < 16; k++) {
00666           if (flip) {  /* transpose glyph matrix */
00667             thischar0[k] = bitmap[32*(j+1) + k + 7][4 * (i+2)    ];
00668             thischar1[k] = bitmap[32*(j+1) + k + 7][4 * (i+2) + 1];
00669             thischar2[k] = bitmap[32*(j+1) + k + 7][4 * (i+2) + 2];
```

```
00670               thischar3[k] = bitmap[32*(j+1) + k + 7][4 * (i+2) + 3];
00671             }
00672             else {
00673               thischar0[k] = bitmap[32*(i+1) + k + 7][4 * (j+2)    ];
00674               thischar1[k] = bitmap[32*(i+1) + k + 7][4 * (j+2) + 1];
00675               thischar2[k] = bitmap[32*(i+1) + k + 7][4 * (j+2) + 2];
00676               thischar3[k] = bitmap[32*(i+1) + k + 7][4 * (j+2) + 3];
00677             }
00678           }
00679           /*
00680 If the second half of the 16*16 character is all zeroes, this
00681 character is only 8 bits wide, so print a half-width character.
00682 */
00683           empty1 = empty2 = 1;
00684           for (k=0; (empty1 || empty2) && k < 16; k++) {
00685             if (thischar1[k] != 0) empty1 = 0;
00686             if (thischar2[k] != 0) empty2 = 0;
00687             }
00688           /*
00689 Only print this glyph if it isn't blank.
00690 */
00691           if (!empty1 || !empty2) {
00692             /*
00693 If the second half is empty, this is a half-width character.
00694 Only print the first half.
00695 */
00696             /*
00697 Original GNU Unifont format is four hexadecimal digit character
00698 code followed by a colon followed by a hex string.  Add support
00699 for codes beyond the Basic Multilingual Plane.
00700
00701 Unicode ranges from U+0000 to U+10FFFF, so print either a
00702 4-digit or a 6-digit code point.  Note that this software
00703 should support up to an 8-digit code point, extending beyond
00704 the normal Unicode range, but this has not been fully tested.
00705 */
00706             if (uniplane > 0xff)
00707               fprintf (outfp, "%04X%X%X:", uniplane, i, j); // 6 digit code pt.
00708             else
00709               fprintf (outfp, "%02X%X%X:", uniplane, i, j); // 4 digit code pt.
00710             for (thisrow=0; thisrow<16; thisrow++) {
00711               /*
00712 If second half is empty and we're not forcing this
00713 code point to double width, print as single width.
00714 */
00715               if (!forcewide &&
00716                   empty2 && !wide[(uniplane « 8) | (i « 4) | j]) {
00717                 fprintf (outfp,
00718                          "%02X",
00719                          thischar1[thisrow]);
00720               }
00721               else if (wide[(uniplane « 8) | (i « 4) | j] == 4) {
00722                 /* quadruple-width; force 32nd pixel to zero */
00723                 fprintf (outfp,
00724                          "%02X%02X%02X%02X",
00725                          thischar0[thisrow], thischar1[thisrow],
00726                          thischar2[thisrow], thischar3[thisrow] & 0xFE);
00727               }
00728               else { /* treat as double-width */
00729                 fprintf (outfp,
00730                          "%02X%02X",
00731                          thischar1[thisrow], thischar2[thisrow]);
00732               }
00733             }
00734             fprintf (outfp, "\n");
00735           }
00736       }
00737     }
00738     exit (0);
00739 }
```

5.11.4 Variable Documentation

5.11.4.1 bits_per_pixel

int bits_per_pixel

Definition at line 139 of file unibmp2hex.c.

5.11.4.2

struct { ... } bmp_header
Bitmap Header parameters

5.11.4.3 color_table

unsigned char color_table[256][4]
Bitmap Color Table – maximum of 256 colors in a BMP file
Definition at line 149 of file unibmp2hex.c.

5.11.4.4 compression

int compression
Definition at line 140 of file unibmp2hex.c.

5.11.4.5 file_size

int file_size
Definition at line 133 of file unibmp2hex.c.

5.11.4.6 filetype

char filetype[2]
Definition at line 132 of file unibmp2hex.c.

5.11.4.7 flip

unsigned flip =0
=1 if we're transposing glyph matrix
Definition at line 123 of file unibmp2hex.c.

5.11.4.8 forcewide

unsigned forcewide =0
=1 to set each glyph to 16 pixels wide
Definition at line 124 of file unibmp2hex.c.

5.11.4.9 height

int height
Definition at line 137 of file unibmp2hex.c.

5.11.4.10 hexdigit

unsigned hexdigit[16][4]
32 bit representation of 16x8 0..F bitmap
Definition at line 119 of file unibmp2hex.c.

5.11.4.11 image_offset

int image_offset
Definition at line 134 of file unibmp2hex.c.

5.11.4.12 image_size

int image_size
Definition at line 141 of file unibmp2hex.c.

5.11.4.13 important_colors

int important_colors
Definition at line 145 of file unibmp2hex.c.

5.11.4.14 info_size

int info_size
Definition at line 135 of file unibmp2hex.c.

5.11.4.15 ncolors

int ncolors
Definition at line 144 of file unibmp2hex.c.

5.11.4.16 nplanes

int nplanes
Definition at line 138 of file unibmp2hex.c.

5.11.4.17 planeset

unsigned planeset =0
=1: use plane specified with -p parameter
Definition at line 122 of file unibmp2hex.c.

5.11.4.18 unidigit

unsigned unidigit[6][4]
The six Unicode plane digits, from left-most (0) to right-most (5)
Definition at line 127 of file unibmp2hex.c.

5.11.4.19 uniplane

unsigned uniplane =0
Unicode plane number, 0..0xff ff ff.
Definition at line 121 of file unibmp2hex.c.

5.11.4.20 width

int width
Definition at line 136 of file unibmp2hex.c.

5.11.4.21 x_ppm

int x_ppm
Definition at line 142 of file unibmp2hex.c.

5.11.4.22 y_ppm

int y_ppm
Definition at line 143 of file unibmp2hex.c.

5.12 unibmp2hex.c

Go to the documentation of this file.

```
00001 /**
00002 @file unibmp2hex.c
00003
00004 @brief unibmp2hex - Turn a .bmp or .wbmp glyph matrix into a
00005 GNU Unifont hex glyph set of 256 characters
00006
00007 @author Paul Hardy, unifoundry <at> unifoundry.com, December 2007
00008
00009 @copyright Copyright (C) 2007, 2008, 2013, 2017, 2019, 2022 Paul Hardy
00010
00011 Synopsis: unibmp2hex [-iin_file.bmp] [-oout_file.hex] [-phex_page_num] [-w]
00012 */
00013 /*
00014
00015 LICENSE:
00016
00017 This program is free software: you can redistribute it and/or modify
00018 it under the terms of the GNU General Public License as published by
00019 the Free Software Foundation, either version 2 of the License, or
00020 (at your option) any later version.
00021
00022 This program is distributed in the hope that it will be useful,
00023 but WITHOUT ANY WARRANTY; without even the implied warranty of
00024 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
00025 GNU General Public License for more details.
00026
00027 You should have received a copy of the GNU General Public License
00028 along with this program.  If not, see <http://www.gnu.org/licenses/>.
00029 */
00030
00031 /*
00032 2 September 2024 [Paul Hardy] - Set these scripts to double width:
00033 - U+10D40..U+10D8F (Garay)
00034 - U+11380..U+113FF (Tulu-Tigalari)
00035 - U+116D0..U+116FF (Myanmar Extended-C)
00036 - U+11F00..U+11F5F (Kawi)
00037 - U+16100..U+1613F (Gurung Khema)
00038 - U+16D40..U+16D7F (Kirat Rai)
00039 - U+18B00..U+18CFF (Khitan Small Script)
00040 - U+1E5D0..U+1E5FF (Ol Onal)
00041
00042 6 September 2021 [Paul Hardy]:
```

```
00043 - Set U+12F90..U+12FFF (Cypro-Minoan) to be double width.
00044 - Set U+1CF00..U+1CFCF (Znamenny Musical Notation) to be double width.
00045 - Set U+1AFF0..U+1AFFF (Kana Extended-B) to be double width.
00046
00047 20 June 2017 [Paul Hardy]:
00048 - Modify to allow hard-coding of quadruple-width hex glyphs.
00049 The 32nd column (rightmost column) is cleared to zero, because
00050 that column contains the vertical cell border.
00051 - Set U+9FD8..U+9FE9 (complex CJK) to be quadruple-width.
00052 - Set U+011A00..U+011A4F (Masaram Gondi, non-digits) to be wide.
00053 - Set U+011A50..U+011AAF (Soyombo) to be wide.
00054
00055 8 July 2017 [Paul Hardy]:
00056 - All CJK glyphs in the range U+4E00..u+9FFF are double width
00057 again; commented out the line that sets U+9FD8..U+9FE9 to be
00058 quadruple width.
00059
00060 6 August 2017 [Paul Hardy]:
00061 - Remove hard-coding of U+01D200..U+01D24F Ancient Greek Musical
00062 Notation to double-width; allow range to be dual-width.
00063
00064 12 August 2017 [Paul Hardy]:
00065 - Remove Miao script from list of wide scripts, so it can contain
00066 single-width glyphs.
00067
00068 26 December 2017 Paul Hardy:
00069 - Removed Tibetan from list of wide scripts, so it can contain
00070 single-width glyphs.
00071 - Added a number of scripts to be explicitly double-width in case
00072 they are redrawn.
00073 - Added Miao script back as wide, because combining glyphs are
00074 added back to font/plane01/plane01-combining.txt.
00075
00076 05 June 2018 Paul Hardy:
00077 - Made U+2329] and U+232A wide.
00078 - Added to wide settings for CJK Compatibility Forms over entire range.
00079 - Made Kayah Li script double-width.
00080 - Made U+232A (Right-pointing Angle Bracket) double-width.
00081 - Made U+01F5E7 (Three Rays Right) double-width.
00082
00083 July 2018 Paul Hardy:
00084 - Changed 2017 to 2018 in previous change entry.
00085 - Added Dogra (U+011800..U+01184F) as double width.
00086 - Added Makasar (U+011EE0..U+011EFF) as dobule width.
00087
00088 23 February 2019 [Paul Hardy]:
00089 - Set U+119A0..U+119FF (Nandinagari) to be wide.
00090 - Set U+1E2C0..U+1E2FF (Wancho) to be wide.
00091
00092 25 May 2019 [Paul Hardy]:
00093 - Added support for the case when the original .bmp monochrome
00094 file has been converted to a 32 bit per pixel RGB file.
00095 - Added support for bitmap images stored from either top to bottom
00096 or bottom to top.
00097 - Add DEBUG compile flag to print header information, to ease
00098 adding support for additional bitmap formats in the future.
00099
00100 13 March 2022 [Paul Hardy]:
00101 - Added support for 24 bits per pixel RGB file.
00102
00103 12 June 2022 [Paul Hardy]:
00104 - Set U+11B00..U+11B5F (Devanagari Extended-A) to be wide.
00105 - Set U+11F00..U+11F5F (Kawi) to be wide.
00106
00107 19 April 2025 [Paul Hardy]:
00108 - Remove hard-coding of U+1D100..U+1D1FF (Musical Symbols)
00109 to double-width; allow range to be dual-width.
00110 */
00111
00112 #include <stdio.h>
00113 #include <stdlib.h>
00114 #include <string.h>
00115
00116 #define MAXBUF 256  ///< Maximum input file line length - 1
00117
00118
00119 unsigned hexdigit[16][4]; ///< 32 bit representation of 16x8 0..F bitmap
00120
00121 unsigned uniplane=0;      ///< Unicode plane number, 0..0xff ff ff
00122 unsigned planeset=0;      ///< =1: use plane specified with -p parameter
00123 unsigned flip=0;          ///< =1 if we're transposing glyph matrix
```

```
00124 unsigned forcewide=0;     ///< =1 to set each glyph to 16 pixels wide
00125
00126 /** The six Unicode plane digits, from left-most (0) to right-most (5) */
00127 unsigned unidigit[6][4];
00128
00129
00130 /** Bitmap Header parameters */
00131 struct {
00132   char filetype[2];
00133   int file_size;
00134   int image_offset;
00135   int info_size;
00136   int width;
00137   int height;
00138   int nplanes;
00139   int bits_per_pixel;
00140   int compression;
00141   int image_size;
00142   int x_ppm;
00143   int y_ppm;
00144   int ncolors;
00145   int important_colors;
00146 } bmp_header;
00147
00148 /** Bitmap Color Table -- maximum of 256 colors in a BMP file */
00149 unsigned char color_table[256][4];  /* R, G, B, alpha for up to 256 colors */
00150
00151 // #define DEBUG
00152
00153 /**
00154 @brief The main function.
00155
00156 @param[in] argc The count of command line arguments.
00157 @param[in] argv Pointer to array of command line arguments.
00158 @return This program exits with status 0.
00159 */
00160 int
00161 main (int argc, char *argv[])
00162 {
00163
00164   int i, j, k;              /* loop variables                       */
00165   unsigned char inchar;     /* temporary input character */
00166   char header[MAXBUF];      /* input buffer for bitmap file header */
00167   int wbmp=0; /* =0 for Windows Bitmap (.bmp); 1 for Wireless Bitmap (.wbmp) */
00168   int fatal; /* =1 if a fatal error occurred */
00169   int match; /* =1 if we're still matching a pattern, 0 if no match */
00170   int empty1, empty2; /* =1 if bytes tested are all zeroes */
00171   unsigned char thischar1[16], thischar2[16]; /* bytes of hex char */
00172   unsigned char thischar0[16], thischar3[16]; /* bytes for quadruple-width */
00173   int thisrow; /* index to point into thischar1[] and thischar2[] */
00174   int tmpsum;  /* temporary sum to see if a character is blank */
00175   unsigned this_pixel;  /* color of one pixel, if > 1 bit per pixel */
00176   unsigned next_pixels; /* pending group of 8 pixels being read */
00177   unsigned color_mask = 0x00;  /* to invert monochrome bitmap, set to 0xFF */
00178
00179   unsigned char bitmap[17*32][18*32/8]; /* final bitmap */
00180   /* For wide array:
00181 0 = don't force glyph to double-width;
00182 1 = force glyph to double-width;
00183 4 = force glyph to quadruple-width.
00184 */
00185   char wide[0x200000]={0x200000 * 0};
00186
00187   char *infile="", *outfile="";  /* names of input and output files */
00188   FILE *infp, *outfp;      /* file pointers of input and output files */
00189
00190   if (argc > 1) {
00191     for (i = 1; i < argc; i++) {
00192       if (argv[i][0] == '-') {  /* this is an option argument */
00193         switch (argv[i][1]) {
00194           case 'i':  /* name of input file */
00195             infile = &argv[i][2];
00196             break;
00197           case 'o':  /* name of output file */
00198             outfile = &argv[i][2];
00199             break;
00200           case 'p':  /* specify a Unicode plane */
00201             sscanf (&argv[i][2], "%x", &uniplane); /* Get Unicode plane */
00202             planeset = 1; /* Use specified range, not what's in bitmap */
00203             break;
00204           case 'w': /* force wide (16 pixels) for each glyph */
```

```
00205                 forcewide = 1;
00206                 break;
00207               default:    /* if unrecognized option, print list and exit */
00208                 fprintf (stderr, "\nSyntax:\n\n");
00209                 fprintf (stderr, "   %s -p<Unicode_Page> ", argv[0]);
00210                 fprintf (stderr, "-i<Input_File> -o<Output_File> -w\n\n");
00211                 fprintf (stderr, "   -w specifies .wbmp output instead of ");
00212                 fprintf (stderr, "default Windows .bmp output.\n\n");
00213                 fprintf (stderr, "   -p is followed by 1 to 6 ");
00214                 fprintf (stderr, "Unicode plane hex digits ");
00215                 fprintf (stderr, "(default is Page 0).\n\n");
00216                 fprintf (stderr, "\nExample:\n\n");
00217                 fprintf (stderr, "   %s -p83 -iunifont.hex -ou83.bmp\n\n\n",
00218                       argv[0]);
00219                 exit (1);
00220             }
00221           }
00222       }
00223     }
00224     /*
00225 Make sure we can open any I/O files that were specified before
00226 doing anything else.
00227 */
00228     if (strlen (infile) > 0) {
00229       if ((infp = fopen (infile, "r")) == NULL) {
00230         fprintf (stderr, "Error: can't open %s for input.\n", infile);
00231         exit (1);
00232       }
00233     }
00234     else {
00235       infp = stdin;
00236     }
00237     if (strlen (outfile) > 0) {
00238       if ((outfp = fopen (outfile, "w")) == NULL) {
00239         fprintf (stderr, "Error: can't open %s for output.\n", outfile);
00240         exit (1);
00241       }
00242     }
00243     else {
00244       outfp = stdout;
00245     }
00246     /*
00247 Initialize selected code points for double width (16x16).
00248 Double-width is forced in cases where a glyph (usually a combining
00249 glyph) only occupies the left-hand side of a 16x16 grid, but must
00250 be rendered as double-width to appear properly with other glyphs
00251 in a given script.  If additions were made to a script after
00252 Unicode 5.0, the Unicode version is given in parentheses after
00253 the script name.
00254 */
00255     for (i = 0x0700; i <= 0x074F; i++) wide[i] = 1; /* Syriac               */
00256     for (i = 0x0800; i <= 0x083F; i++) wide[i] = 1; /* Samaritan (5.2)      */
00257     for (i = 0x0900; i <= 0x0DFF; i++) wide[i] = 1; /* Indic                */
00258     for (i = 0x1000; i <= 0x109F; i++) wide[i] = 1; /* Myanmar              */
00259     for (i = 0x1100; i <= 0x11FF; i++) wide[i] = 1; /* Hangul Jamo          */
00260     for (i = 0x1400; i <= 0x167F; i++) wide[i] = 1; /* Canadian Aboriginal  */
00261     for (i = 0x1700; i <= 0x171F; i++) wide[i] = 1; /* Tagalog              */
00262     for (i = 0x1720; i <= 0x173F; i++) wide[i] = 1; /* Hanunoo              */
00263     for (i = 0x1740; i <= 0x175F; i++) wide[i] = 1; /* Buhid                */
00264     for (i = 0x1760; i <= 0x177F; i++) wide[i] = 1; /* Tagbanwa             */
00265     for (i = 0x1780; i <= 0x17FF; i++) wide[i] = 1; /* Khmer               */
00266     for (i = 0x18B0; i <= 0x18FF; i++) wide[i] = 1; /* Ext. Can. Aboriginal */
00267     for (i = 0x1800; i <= 0x18AF; i++) wide[i] = 1; /* Mongolian            */
00268     for (i = 0x1900; i <= 0x194F; i++) wide[i] = 1; /* Limbu               */
00269 // for (i = 0x1980; i <= 0x19DF; i++) wide[i] = 1; /* New Tai Lue          */
00270     for (i = 0x1A00; i <= 0x1A1F; i++) wide[i] = 1; /* Buginese            */
00271     for (i = 0x1A20; i <= 0x1AAF; i++) wide[i] = 1; /* Tai Tham (5.2)      */
00272     for (i = 0x1B00; i <= 0x1B7F; i++) wide[i] = 1; /* Balinese            */
00273     for (i = 0x1B80; i <= 0x1BBF; i++) wide[i] = 1; /* Sundanese (5.1)     */
00274     for (i = 0x1BC0; i <= 0x1BFF; i++) wide[i] = 1; /* Batak (6.0)         */
00275     for (i = 0x1C00; i <= 0x1C4F; i++) wide[i] = 1; /* Lepcha (5.1)        */
00276     for (i = 0x1CC0; i <= 0x1CCF; i++) wide[i] = 1; /* Sundanese Supplement */
00277     for (i = 0x1CD0; i <= 0x1CFF; i++) wide[i] = 1; /* Vedic Extensions (5.2) */
00278     wide[0x2329] = wide[0x232A] = 1; /* Left- & Right-pointing Angle Brackets */
00279     for (i = 0x2E80; i <= 0xA4CF; i++) wide[i] = 1; /* CJK                 */
00280 // for (i = 0x9FD8; i <= 0x9FE9; i++) wide[i] = 4; /* CJK quadruple-width  */
00281     for (i = 0xA900; i <= 0xA92F; i++) wide[i] = 1; /* Kayah Li (5.1)      */
00282     for (i = 0xA930; i <= 0xA95F; i++) wide[i] = 1; /* Rejang (5.1)        */
00283     for (i = 0xA960; i <= 0xA97F; i++) wide[i] = 1; /* Hangul Jamo Extended-A */
00284     for (i = 0xA980; i <= 0xA9DF; i++) wide[i] = 1; /* Javanese (5.2)      */
00285     for (i = 0xAA00; i <= 0xAA5F; i++) wide[i] = 1; /* Cham (5.1)          */
```

```
00286   for (i = 0xA9E0; i <= 0xA9FF; i++) wide[i] = 1; /* Myanmar Extended-B     */
00287   for (i = 0xAA00; i <= 0xAA5F; i++) wide[i] = 1; /* Cham                   */
00288   for (i = 0xAA60; i <= 0xAA7F; i++) wide[i] = 1; /* Myanmar Extended-A     */
00289   for (i = 0xAAE0; i <= 0xAAFF; i++) wide[i] = 1; /* Meetei Mayek Ext (6.0) */
00290   for (i = 0xABC0; i <= 0xABFF; i++) wide[i] = 1; /* Meetei Mayek (5.2)     */
00291   for (i = 0xAC00; i <= 0xD7AF; i++) wide[i] = 1; /* Hangul Syllables       */
00292   for (i = 0xD7B0; i <= 0xD7FF; i++) wide[i] = 1; /* Hangul Jamo Extended-B */
00293   for (i = 0xF900; i <= 0xFAFF; i++) wide[i] = 1; /* CJK Compatibility      */
00294   for (i = 0xFE10; i <= 0xFE1F; i++) wide[i] = 1; /* Vertical Forms         */
00295   for (i = 0xFE30; i <= 0xFE60; i++) wide[i] = 1; /* CJK Compatibility Forms*/
00296   for (i = 0xFFE0; i <= 0xFFE6; i++) wide[i] = 1; /* CJK Compatibility Forms*/
00297
00298   wide[0x303F] = 0; /* CJK half-space fill */
00299
00300   /* Supplemental Multilingual Plane (Plane 01) */
00301   for (i = 0x0105C0; i <= 0x0105FF; i++) wide[i] = 1; /* Todhri            */
00302   for (i = 0x010A00; i <= 0x010A5F; i++) wide[i] = 1; /* Kharoshthi        */
00303   for (i = 0x011000; i <= 0x01107F; i++) wide[i] = 1; /* Brahmi            */
00304   for (i = 0x011080; i <= 0x0110CF; i++) wide[i] = 1; /* Kaithi            */
00305   for (i = 0x011100; i <= 0x01114F; i++) wide[i] = 1; /* Chakma            */
00306   for (i = 0x011180; i <= 0x0111DF; i++) wide[i] = 1; /* Sharada           */
00307   for (i = 0x011200; i <= 0x01124F; i++) wide[i] = 1; /* Khojki            */
00308   for (i = 0x0112B0; i <= 0x0112FF; i++) wide[i] = 1; /* Khudawadi         */
00309   for (i = 0x011300; i <= 0x01137F; i++) wide[i] = 1; /* Grantha           */
00310   for (i = 0x011380; i <= 0x0113FF; i++) wide[i] = 1; /* Tulu-Tigalari     */
00311   for (i = 0x011400; i <= 0x01147F; i++) wide[i] = 1; /* Newa              */
00312   for (i = 0x011480; i <= 0x0114DF; i++) wide[i] = 1; /* Tirhuta           */
00313   for (i = 0x011580; i <= 0x0115FF; i++) wide[i] = 1; /* Siddham           */
00314   for (i = 0x011600; i <= 0x01165F; i++) wide[i] = 1; /* Modi              */
00315   for (i = 0x011660; i <= 0x01167F; i++) wide[i] = 1; /* Mongolian Suppl.  */
00316   for (i = 0x011680; i <= 0x0116CF; i++) wide[i] = 1; /* Takri             */
00317   for (i = 0x0116D0; i <= 0x0116FF; i++) wide[i] = 1; /* Myanmar Extended-C */
00318   for (i = 0x011700; i <= 0x01173F; i++) wide[i] = 1; /* Ahom              */
00319   for (i = 0x011800; i <= 0x01184F; i++) wide[i] = 1; /* Dogra             */
00320   for (i = 0x011900; i <= 0x01195F; i++) wide[i] = 1; /* Dives Akuru       */
00321   for (i = 0x0119A0; i <= 0x0119FF; i++) wide[i] = 1; /* Nandinagari       */
00322   for (i = 0x011A00; i <= 0x011A4F; i++) wide[i] = 1; /* Zanabazar Square  */
00323   for (i = 0x011A50; i <= 0x011AAF; i++) wide[i] = 1; /* Soyombo           */
00324   for (i = 0x011B00; i <= 0x011B5F; i++) wide[i] = 1;/*Devanagari Extended-A*/
00325   for (i = 0x011F00; i <= 0x011F5F; i++) wide[i] = 1; /* Kawi              */
00326   for (i = 0x011C00; i <= 0x011C6F; i++) wide[i] = 1; /* Bhaiksuki         */
00327   for (i = 0x011C70; i <= 0x011CBF; i++) wide[i] = 1; /* Marchen           */
00328   for (i = 0x011D00; i <= 0x011D5F; i++) wide[i] = 1; /* Masaram Gondi     */
00329   for (i = 0x011EE0; i <= 0x011EFF; i++) wide[i] = 1; /* Makasar           */
00330   for (i = 0x011F00; i <= 0x011F5F; i++) wide[i] = 1; /* Kawi              */
00331   for (i = 0x012F90; i <= 0x012FFF; i++) wide[i] = 1; /* Cypro-Minoan      */
00332   /* Make Bassa Vah all single width or all double width */
00333   for (i = 0x016100; i <= 0x01613F; i++) wide[i] = 1; /* Gurung Khema      */
00334   for (i = 0x016AD0; i <= 0x016AFF; i++) wide[i] = 1; /* Bassa Vah         */
00335   for (i = 0x016B00; i <= 0x016B8F; i++) wide[i] = 1; /* Pahawh Hmong      */
00336   for (i = 0x016D40; i <= 0x016D7F; i++) wide[i] = 1; /* Kirat Rai         */
00337   for (i = 0x016F00; i <= 0x016F9F; i++) wide[i] = 1; /* Miao              */
00338   for (i = 0x016FE0; i <= 0x016FFF; i++) wide[i] = 1; /* Ideograph Sym/Punct*/
00339   for (i = 0x017000; i <= 0x0187FF; i++) wide[i] = 1; /* Tangut            */
00340   for (i = 0x018800; i <= 0x018AFF; i++) wide[i] = 1; /* Tangut Components */
00341   for (i = 0x018B00; i <= 0x018CFF; i++) wide[i] = 1; /* Khitan Small Script*/
00342   for (i = 0x01AFF0; i <= 0x01AFFF; i++) wide[i] = 1; /* Kana Extended-B   */
00343   for (i = 0x01B000; i <= 0x01B0FF; i++) wide[i] = 1; /* Kana Supplement   */
00344   for (i = 0x01B100; i <= 0x01B12F; i++) wide[i] = 1; /* Kana Extended-A   */
00345   for (i = 0x01B170; i <= 0x01B2FF; i++) wide[i] = 1; /* Nushu             */
00346   for (i = 0x01CF00; i <= 0x01CFCF; i++) wide[i] = 1; /* Znamenny Musical  */
00347   for (i = 0x01D800; i <= 0x01DAAF; i++) wide[i] = 1; /* Sutton SignWriting */
00348   for (i = 0x01E2C0; i <= 0x01E2FF; i++) wide[i] = 1; /* Wancho            */
00349   for (i = 0x01E500; i <= 0x01E5FF; i++) wide[i] = 1; /* Ol Onal           */
00350   for (i = 0x01E800; i <= 0x01E8DF; i++) wide[i] = 1; /* Mende Kikakui     */
00351   for (i = 0x01F200; i <= 0x01F2FF; i++) wide[i] = 1; /* Encl Ideograp Suppl*/
00352   wide[0x01F5E7] = 1;                                 /* Three Rays Right  */
00353
00354   /*
00355 Determine whether or not the file is a Microsoft Windows Bitmap file.
00356 If it starts with 'B', 'M', assume it's a Windows Bitmap file.
00357 Otherwise, assume it's a Wireless Bitmap file.
00358
00359 WARNING: There isn't much in the way of error checking here --
00360 if you give it a file that wasn't first created by hex2bmp.c,
00361 all bets are off.
00362 */
00363   fatal = 0;  /* assume everything is okay with reading input file */
00364   if ((header[0] = fgetc (infp)) != EOF) {
00365     if ((header[1] = fgetc (infp)) != EOF) {
00366       if (header[0] == 'B' && header[1] == 'M') {
```

```
00367             wbmp = 0; /* Not a Wireless Bitmap -- it's a Windows Bitmap */
00368           }
00369           else {
00370             wbmp = 1; /* Assume it's a Wireless Bitmap */
00371           }
00372         }
00373         else
00374           fatal = 1;
00375       }
00376       else
00377         fatal = 1;
00378
00379       if (fatal) {
00380         fprintf (stderr, "Fatal error; end of input file.\n\n");
00381         exit (1);
00382       }
00383       /*
00384 If this is a Wireless Bitmap (.wbmp) format file,
00385 skip the header and point to the start of the bitmap itself.
00386 */
00387       if (wbmp) {
00388         for (i=2; i<6; i++)
00389           header[i] = fgetc (infp);
00390         /*
00391 Now read the bitmap.
00392 */
00393         for (i=0; i < 32*17; i++) {
00394           for (j=0; j < 32*18/8; j++) {
00395             inchar = fgetc (infp);
00396             bitmap[i][j] = ~inchar;  /* invert bits for proper color */
00397           }
00398         }
00399       }
00400       /*
00401 Otherwise, treat this as a Windows Bitmap file, because we checked
00402 that it began with "BM".  Save the header contents for future use.
00403 Expect a 14 byte standard BITMAPFILEHEADER format header followed
00404 by a 40 byte standard BITMAPINFOHEADER Device Independent Bitmap
00405 header, with data stored in little-endian format.
00406 */
00407       else {
00408         for (i = 2; i < 54; i++)
00409           header[i] = fgetc (infp);
00410
00411         bmp_header.filetype[0] = 'B';
00412         bmp_header.filetype[1] = 'M';
00413
00414         bmp_header.file_size =
00415           (header[2] & 0xFF)       | ((header[3] & 0xFF) «  8) |
00416           ((header[4] & 0xFF) « 16) | ((header[5] & 0xFF) « 24);
00417
00418         /* header bytes 6..9 are reserved */
00419
00420         bmp_header.image_offset =
00421           (header[10] & 0xFF)       | ((header[11] & 0xFF) «  8) |
00422           ((header[12] & 0xFF) « 16) | ((header[13] & 0xFF) « 24);
00423
00424         bmp_header.info_size =
00425           (header[14] & 0xFF)       | ((header[15] & 0xFF) «  8) |
00426           ((header[16] & 0xFF) « 16) | ((header[17] & 0xFF) « 24);
00427
00428         bmp_header.width =
00429           (header[18] & 0xFF)       | ((header[19] & 0xFF) «  8) |
00430           ((header[20] & 0xFF) « 16) | ((header[21] & 0xFF) « 24);
00431
00432         bmp_header.height =
00433           (header[22] & 0xFF)       | ((header[23] & 0xFF) «  8) |
00434           ((header[24] & 0xFF) « 16) | ((header[25] & 0xFF) « 24);
00435
00436         bmp_header.nplanes =
00437           (header[26] & 0xFF)       | ((header[27] & 0xFF) «  8);
00438
00439         bmp_header.bits_per_pixel =
00440           (header[28] & 0xFF)       | ((header[29] & 0xFF) «  8);
00441
00442         bmp_header.compression =
00443           (header[30] & 0xFF)       | ((header[31] & 0xFF) «  8) |
00444           ((header[32] & 0xFF) « 16) | ((header[33] & 0xFF) « 24);
00445
00446         bmp_header.image_size =
00447           (header[34] & 0xFF)       | ((header[35] & 0xFF) «  8) |
```

```
00448         ((header[36] & 0xFF) « 16) | ((header[37] & 0xFF) « 24);
00449
00450       bmp_header.x_ppm =
00451          (header[38] & 0xFF)       | ((header[39] & 0xFF) «  8) |
00452         ((header[40] & 0xFF) « 16) | ((header[41] & 0xFF) « 24);
00453
00454       bmp_header.y_ppm =
00455          (header[42] & 0xFF)       | ((header[43] & 0xFF) «  8) |
00456         ((header[44] & 0xFF) « 16) | ((header[45] & 0xFF) « 24);
00457
00458       bmp_header.ncolors =
00459          (header[46] & 0xFF)       | ((header[47] & 0xFF) «  8) |
00460         ((header[48] & 0xFF) « 16) | ((header[49] & 0xFF) « 24);
00461
00462       bmp_header.important_colors =
00463          (header[50] & 0xFF)       | ((header[51] & 0xFF) «  8) |
00464         ((header[52] & 0xFF) « 16) | ((header[53] & 0xFF) « 24);
00465
00466       if (bmp_header.ncolors == 0)
00467         bmp_header.ncolors = 1 « bmp_header.bits_per_pixel;
00468
00469       /* If a Color Table exists, read it */
00470       if (bmp_header.ncolors > 0 && bmp_header.bits_per_pixel <= 8) {
00471         for (i = 0; i < bmp_header.ncolors; i++) {
00472           color_table[i][0] = fgetc (infp);  /* Red   */
00473           color_table[i][1] = fgetc (infp);  /* Green */
00474           color_table[i][2] = fgetc (infp);  /* Blue  */
00475           color_table[i][3] = fgetc (infp);  /* Alpha */
00476         }
00477         /*
00478 Determine from the first color table entry whether we
00479 are inverting the resulting bitmap image.
00480 */
00481         if ( (color_table[0][0] + color_table[0][1] + color_table[0][2])
00482             < (3 * 128) ) {
00483           color_mask = 0xFF;
00484         }
00485       }
00486
00487 #ifdef DEBUG
00488
00489       /*
00490 Print header info for possibly adding support for
00491 additional file formats in the future, to determine
00492 how the bitmap is encoded.
00493 */
00494       fprintf (stderr, "Filetype: '%c%c'\n",
00495                bmp_header.filetype[0], bmp_header.filetype[1]);
00496       fprintf (stderr, "File Size: %d\n", bmp_header.file_size);
00497       fprintf (stderr, "Image Offset: %d\n", bmp_header.image_offset);
00498       fprintf (stderr, "Info Header Size: %d\n", bmp_header.info_size);
00499       fprintf (stderr, "Image Width: %d\n", bmp_header.width);
00500       fprintf (stderr, "Image Height: %d\n", bmp_header.height);
00501       fprintf (stderr, "Number of Planes: %d\n", bmp_header.nplanes);
00502       fprintf (stderr, "Bits per Pixel: %d\n", bmp_header.bits_per_pixel);
00503       fprintf (stderr, "Compression Method: %d\n", bmp_header.compression);
00504       fprintf (stderr, "Image Size: %d\n", bmp_header.image_size);
00505       fprintf (stderr, "X Pixels per Meter: %d\n", bmp_header.x_ppm);
00506       fprintf (stderr, "Y Pixels per Meter: %d\n", bmp_header.y_ppm);
00507       fprintf (stderr, "Number of Colors: %d\n", bmp_header.ncolors);
00508       fprintf (stderr, "Important Colors: %d\n", bmp_header.important_colors);
00509
00510 #endif
00511
00512       /*
00513 Now read the bitmap.
00514 */
00515       for (i = 32*17-1; i >= 0; i--) {
00516         for (j=0; j < 32*18/8; j++) {
00517           next_pixels = 0x00;  /* initialize next group of 8 pixels */
00518           /* Read a monochrome image -- the original case */
00519           if (bmp_header.bits_per_pixel == 1) {
00520             next_pixels = fgetc (infp);
00521           }
00522           /* Read a 32 bit per pixel RGB image; convert to monochrome */
00523           else if ( bmp_header.bits_per_pixel == 24 ||
00524                     bmp_header.bits_per_pixel == 32) {
00525             next_pixels = 0;
00526             for (k = 0; k < 8; k++) {  /* get next 8 pixels */
00527               this_pixel = (fgetc (infp) & 0xFF) +
00528                            (fgetc (infp) & 0xFF) +
```

```
00529                           (fgetc (infp) & 0xFF);
00530
00531                   if (bmp_header.bits_per_pixel == 32) {
00532                     (void) fgetc (infp);  /* ignore alpha value */
00533                   }
00534
00535                   /* convert RGB color space to monochrome */
00536                   if (this_pixel >= (128 * 3))
00537                     this_pixel = 0;
00538                   else
00539                     this_pixel = 1;
00540
00541                   /* shift next pixel color into place for 8 pixels total */
00542                   next_pixels = (next_pixels « 1) | this_pixel;
00543                 }
00544               }
00545               if (bmp_header.height < 0) {  /* Bitmap drawn top to bottom */
00546                 bitmap [(32*17-1) - i] [j] = next_pixels;
00547               }
00548               else {  /* Bitmap drawn bottom to top */
00549                 bitmap [i][j] = next_pixels;
00550               }
00551             }
00552           }
00553
00554           /*
00555 If any bits are set in color_mask, apply it to
00556 entire bitmap to invert black <--> white.
00557 */
00558           if (color_mask != 0x00) {
00559             for (i = 32*17-1; i >= 0; i--) {
00560               for (j=0; j < 32*18/8; j++) {
00561                 bitmap [i][j] ^= color_mask;
00562               }
00563             }
00564           }
00565
00566         }
00567
00568         /*
00569 We've read the entire file.   Now close the input file pointer.
00570 */
00571         fclose (infp);
00572         /*
00573 We now have the header portion in the header[] array,
00574 and have the bitmap portion from top-to-bottom in the bitmap[] array.
00575 */
00576         /*
00577 If no Unicode range (U+nnnnnn00 through U+nnnnnnFF) was specified
00578 with a -p parameter, determine the range from the digits in the
00579 bitmap itself.
00580
00581 Store bitmaps for the hex digit patterns that this file uses.
00582 */
00583         if (!planeset) {  /* If Unicode range not specified with -p parameter */
00584           for (i = 0x0; i <= 0xF; i++) {  /* hex digit pattern we're storing */
00585             for (j = 0; j < 4; j++) {
00586               hexdigit[i][j]   =
00587                 ((unsigned)bitmap[32 * (i+1) + 4 * j + 8    ][6] « 24 ) |
00588                 ((unsigned)bitmap[32 * (i+1) + 4 * j + 8 + 1][6] « 16 ) |
00589                 ((unsigned)bitmap[32 * (i+1) + 4 * j + 8 + 2][6] «  8 ) |
00590                 ((unsigned)bitmap[32 * (i+1) + 4 * j + 8 + 3][6]       );
00591             }
00592           }
00593           /*
00594 Read the Unicode plane digits into arrays for comparison, to
00595 determine the upper four hex digits of the glyph addresses.
00596 */
00597           for (i = 0; i < 4; i++) {
00598             for (j = 0; j < 4; j++) {
00599               unidigit[i][j] =
00600                 ((unsigned)bitmap[32 * 0 + 4 * j + 8 + 1][i + 3] « 24 ) |
00601                 ((unsigned)bitmap[32 * 0 + 4 * j + 8 + 2][i + 3] « 16 ) |
00602                 ((unsigned)bitmap[32 * 0 + 4 * j + 8 + 3][i + 3] «  8 ) |
00603                 ((unsigned)bitmap[32 * 0 + 4 * j + 8 + 4][i + 3]       );
00604             }
00605           }
00606
00607           tmpsum = 0;
00608           for (i = 4; i < 6; i++) {
00609             for (j = 0; j < 4; j++) {
```

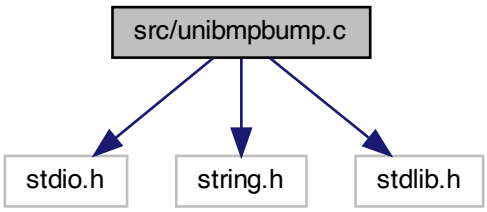
```
00610             unidigit[i][j] =
00611               ((unsigned)bitmap[32 * 1 + 4 * j + 8    ][i] « 24 ) |
00612               ((unsigned)bitmap[32 * 1 + 4 * j + 8 + 1][i] « 16 ) |
00613               ((unsigned)bitmap[32 * 1 + 4 * j + 8 + 2][i] «  8 ) |
00614               ((unsigned)bitmap[32 * 1 + 4 * j + 8 + 3][i]       );
00615             tmpsum |= unidigit[i][j];
00616           }
00617         }
00618         if (tmpsum == 0) {  /* the glyph matrix is transposed */
00619           flip = 1;  /* note transposed order for processing glyphs in matrix */
00620           /*
00621 Get 5th and 6th hex digits by shifting first column header left by
00622 1.5 columns, thereby shifting the hex digit right after the leading
00623 "U+nnnn" page number.
00624 */
00625           for (i = 0x08; i < 0x18; i++) {
00626             bitmap[i][7] = (bitmap[i][8] « 4) | ((bitmap[i][ 9] » 4) & 0xf);
00627             bitmap[i][8] = (bitmap[i][9] « 4) | ((bitmap[i][10] » 4) & 0xf);
00628           }
00629           for (i = 4; i < 6; i++) {
00630             for (j = 0; j < 4; j++) {
00631               unidigit[i][j] =
00632                 ((unsigned)bitmap[4 * j + 8 + 1][i + 3] « 24 ) |
00633                 ((unsigned)bitmap[4 * j + 8 + 2][i + 3] « 16 ) |
00634                 ((unsigned)bitmap[4 * j + 8 + 3][i + 3] «  8 ) |
00635                 ((unsigned)bitmap[4 * j + 8 + 4][i + 3]       );
00636             }
00637           }
00638         }
00639
00640         /*
00641 Now determine the Unicode plane by comparing unidigit[0..5] to
00642 the hexdigit[0x0..0xF] array.
00643 */
00644         uniplane = 0;
00645         for (i=0; i<6; i++) { /* go through one bitmap digit at a time */
00646           match = 0; /* haven't found pattern yet */
00647           for (j = 0x0; !match && j <= 0xF; j++) {
00648             if (unidigit[i][0] == hexdigit[j][0] &&
00649                 unidigit[i][1] == hexdigit[j][1] &&
00650                 unidigit[i][2] == hexdigit[j][2] &&
00651                 unidigit[i][3] == hexdigit[j][3]) { /* we found the digit */
00652               uniplane |= j;
00653               match = 1;
00654             }
00655           }
00656           uniplane «= 4;
00657         }
00658         uniplane »= 4;
00659       }
00660       /*
00661 Now read each glyph and print it as hex.
00662 */
00663       for (i = 0x0; i <= 0xf; i++) {
00664         for (j = 0x0; j <= 0xf; j++) {
00665           for (k = 0; k < 16; k++) {
00666             if (flip) {  /* transpose glyph matrix */
00667               thischar0[k] = bitmap[32*(j+1) + k + 7][4 * (i+2)    ];
00668               thischar1[k] = bitmap[32*(j+1) + k + 7][4 * (i+2) + 1];
00669               thischar2[k] = bitmap[32*(j+1) + k + 7][4 * (i+2) + 2];
00670               thischar3[k] = bitmap[32*(j+1) + k + 7][4 * (i+2) + 3];
00671             }
00672             else {
00673               thischar0[k] = bitmap[32*(i+1) + k + 7][4 * (j+2)    ];
00674               thischar1[k] = bitmap[32*(i+1) + k + 7][4 * (j+2) + 1];
00675               thischar2[k] = bitmap[32*(i+1) + k + 7][4 * (j+2) + 2];
00676               thischar3[k] = bitmap[32*(i+1) + k + 7][4 * (j+2) + 3];
00677             }
00678           }
00679           /*
00680 If the second half of the 16*16 character is all zeroes, this
00681 character is only 8 bits wide, so print a half-width character.
00682 */
00683           empty1 = empty2 = 1;
00684           for (k=0; (empty1 || empty2) && k < 16; k++) {
00685             if (thischar1[k] != 0) empty1 = 0;
00686             if (thischar2[k] != 0) empty2 = 0;
00687             }
00688           /*
00689 Only print this glyph if it isn't blank.
00690 */
```

```
00691         if (!empty1 || !empty2) {
00692           /*
00693 If the second half is empty, this is a half-width character.
00694 Only print the first half.
00695 */
00696           /*
00697 Original GNU Unifont format is four hexadecimal digit character
00698 code followed by a colon followed by a hex string.  Add support
00699 for codes beyond the Basic Multilingual Plane.
00700
00701 Unicode ranges from U+0000 to U+10FFFF, so print either a
00702 4-digit or a 6-digit code point.  Note that this software
00703 should support up to an 8-digit code point, extending beyond
00704 the normal Unicode range, but this has not been fully tested.
00705 */
00706           if (uniplane > 0xff)
00707             fprintf (outfp, "%04X%X%X:", uniplane, i, j); // 6 digit code pt.
00708           else
00709             fprintf (outfp, "%02X%X%X:", uniplane, i, j); // 4 digit code pt.
00710           for (thisrow=0; thisrow<16; thisrow++) {
00711             /*
00712 If second half is empty and we're not forcing this
00713 code point to double width, print as single width.
00714 */
00715             if (!forcewide &&
00716                 empty2 && !wide[(uniplane « 8) | (i « 4) | j]) {
00717               fprintf (outfp,
00718                        "%02X",
00719                        thischar1[thisrow]);
00720             }
00721             else if (wide[(uniplane « 8) | (i « 4) | j] == 4) {
00722               /* quadruple-width; force 32nd pixel to zero */
00723               fprintf (outfp,
00724                        "%02X%02X%02X%02X",
00725                        thischar0[thisrow], thischar1[thisrow],
00726                        thischar2[thisrow], thischar3[thisrow] & 0xFE);
00727             }
00728             else { /* treat as double-width */
00729               fprintf (outfp,
00730                        "%02X%02X",
00731                        thischar1[thisrow], thischar2[thisrow]);
00732             }
00733           }
00734           fprintf (outfp, "\n");
00735         }
00736       }
00737     }
00738     exit (0);
00739 }
```

5.13 src/unibmpbump.c File Reference

unibmpbump - Adjust a Microsoft bitmap (.bmp) file that was created by unihex2png but converted to .bmp
#include <stdio.h>
#include <string.h>
#include <stdlib.h>

Include dependency graph for unibmpbump.c:



Macros

- #define VERSION "1.0"

  Version of this program.
- #define MAX_COMPRESSION_METHOD 13

  Maximum supported compression method.

Functions

- int main (int argc, char *argv[])

  The main function.
- unsigned get_bytes (FILE *infp, int nbytes)

  Get from 1 to 4 bytes, inclusive, from input file.
- void regrid (unsigned *image_bytes)

  After reading in the image, shift it.

5.13.1 Detailed Description

unibmpbump - Adjust a Microsoft bitmap (.bmp) file that was created by unihex2png but converted to .bmp

Author

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Copyright

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This program shifts the glyphs in a bitmap file to adjust an original PNG file that was saved in BMP format. This is so the result matches the format of a unihex2bmp image. This conversion then lets unibmp2hex decode the result.
Synopsis: unibmpbump [-iin_file.bmp] [-oout_file.bmp]
Definition in file unibmpbump.c.

5.13.2 Macro Definition Documentation

5.13.2.1 MAX_COMPRESSION_METHOD

#define MAX_COMPRESSION_METHOD 13
Maximum supported compression method.
Definition at line 40 of file unibmpbump.c.

5.13.2.2 VERSION

#define VERSION "1.0"
Version of this program.
Definition at line 38 of file unibmpbump.c.

5.13.3 Function Documentation

5.13.3.1 get_bytes()

unsigned get_bytes (
FILE * infp,
int nbytes)
Get from 1 to 4 bytes, inclusive, from input file.

Parameters

in	infp	Pointer to input file.
in	nbytes	Number of bytes to read, from 1 to 4, inclusive.

Returns

The unsigned 1 to 4 bytes in machine native endian format.

Definition at line 487 of file unibmpbump.c.

```
00487                                   {
00488     int i;
00489     unsigned char inchar[4];
00490     unsigned inword;
00491
00492     for (i = 0; i < nbytes; i++) {
00493        if (fread (&inchar[i], 1, 1, infp) != 1) {
00494           inchar[i] = 0;
00495        }
00496     }
00497     for (i = nbytes; i < 4; i++) inchar[i] = 0;
00498
00499     inword = ((inchar[3] & 0xFF) « 24) | ((inchar[2] & 0xFF) « 16) |
00500              ((inchar[1] & 0xFF) «  8) |  (inchar[0] & 0xFF);
00501
00502     return inword;
```

```
00503 }
```

5.13.3.2 main()

```
int main (
                int argc,
                char * argv[] )
```

The main function.

Parameters

in	argc	The count of command line arguments.
in	argv	Pointer to array of command line arguments.

Returns

This program exits with status EXIT_SUCCESS.

Definition at line 50 of file unibmpbump.c.

```
00050                           {
00051
00052   /*
00053 Values preserved from file header (first 14 bytes).
00054 */
00055   char file_format[3];      /* "BM" for original Windows format          */
00056   unsigned filesize;        /* size of file in bytes                     */
00057   unsigned char rsvd_hdr[4]; /* 4 reserved bytes                         */
00058   unsigned image_start;     /* byte offset of image in file             */
00059
00060   /*
00061 Values preserved from Device Independent Bitmap (DIB) Header.
00062
00063 The DIB fields below are in the standard 40-byte header.  Version
00064 4 and version 5 headers have more information, mainly for color
00065 information.  That is skipped over, because a valid glyph image
00066 is just monochrome.
00067 */
00068   int dib_length;           /* in bytes, for parsing by header version   */
00069   int image_width = 0;      /* Signed image width                        */
00070   int image_height = 0;     /* Signed image height                       */
00071   int num_planes = 0;       /* number of planes; must be 1               */
00072   int bits_per_pixel = 0;   /* for palletized color maps (< 2^16 colors) */
00073   /*
00074 The following fields are not in the original spec, so initialize
00075 them to 0 so we can correctly parse an original file format.
00076 */
00077   int compression_method=0; /* 0 --> uncompressed RGB/monochrome         */
00078   int image_size = 0;       /* 0 is a valid size if no compression       */
00079   int hres = 0;             /* image horizontal resolution               */
00080   int vres = 0;             /* image vertical resolution                 */
```

```
00081   int num_colors = 0;       /* Number of colors for pallettized images    */
00082   int important_colors = 0; /* Number of significant colors (0 or 2)      */
00083
00084   int true_colors = 0;      /* interpret num_colors, which can equal 0    */
00085
00086   /*
00087 Color map.  This should be a monochrome file, so only two
00088 colors are stored.
00089 */
00090   unsigned char color_map[2][4]; /* two of R, G, B, and possibly alpha  */
00091
00092   /*
00093 The monochrome image bitmap, stored as a vector 544 rows by
00094 72*8 columns.
00095 */
00096   unsigned image_bytes[544*72];
00097
00098   /*
00099 Flags for conversion & I/O.
00100 */
00101   int verbose      = 0;     /* Whether to print file info on stderr     */
00102   unsigned image_xor = 0x00; /* Invert (= 0xFF) if color 0 is not black  */
00103
00104   /*
00105 Temporary variables.
00106 */
00107   int i, j, k;          /* loop variables */
00108
00109   /* Compression type, for parsing file */
00110   char *compression_type[MAX_COMPRESSION_METHOD + 1] = {
00111     "BI_RGB",           /*  0 */
00112     "BI_RLE8",          /*  1 */
00113     "BI_RLE4",          /*  2 */
00114     "BI_BITFIELDS",     /*  3 */
00115     "BI_JPEG",          /*  4 */
00116     "BI_PNG",           /*  5 */
00117     "BI_ALPHABITFIELDS", /*  6 */
00118     "", "", "", "",     /*  7 - 10 */
00119     "BI_CMYK",          /* 11 */
00120     "BI_CMYKRLE8",      /* 12 */
00121     "BI_CMYKRLE4",      /* 13 */
00122   };
00123
00124   /* Standard unihex2bmp.c header for BMP image */
00125   unsigned standard_header [62] = {
00126     /*  0 */ 0x42, 0x4d, 0x3e, 0x99, 0x00, 0x00, 0x00, 0x00,
00127     /*  8 */ 0x00, 0x00, 0x3e, 0x00, 0x00, 0x00, 0x28, 0x00,
00128     /* 16 */ 0x00, 0x00, 0x40, 0x02, 0x00, 0x00, 0x20, 0x02,
00129     /* 24 */ 0x00, 0x00, 0x01, 0x00, 0x01, 0x00, 0x00, 0x00,
00130     /* 32 */ 0x00, 0x00, 0x00, 0x99, 0x00, 0x00, 0xc4, 0x0e,
00131     /* 40 */ 0x00, 0x00, 0xc4, 0x0e, 0x00, 0x00, 0x00, 0x00,
00132     /* 48 */ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
00133     /* 56 */ 0x00, 0x00, 0xff, 0xff, 0xff, 0x00
00134   };
00135
00136   unsigned get_bytes (FILE *, int);
00137   void     regrid    (unsigned *);
00138
00139   char *infile="", *outfile="";  /* names of input and output files         */
00140   FILE *infp, *outfp;           /* file pointers of input and output files */
00141
00142   /*
00143 Process command line arguments.
00144 */
00145   if (argc > 1) {
00146     for (i = 1; i < argc; i++) {
00147       if (argv[i][0] == '-') {  /* this is an option argument */
00148         switch (argv[i][1]) {
00149           case 'i':  /* name of input file */
00150             infile = &argv[i][2];
00151             break;
00152           case 'o':  /* name of output file */
00153             outfile = &argv[i][2];
00154             break;
00155           case 'v':  /* verbose output */
00156             verbose = 1;
00157             break;
00158           case 'V':  /* print version & quit */
00159             fprintf (stderr, "unibmpbump version %s\n\n", VERSION);
00160             exit (EXIT_SUCCESS);
00161             break;
```

```
00162             case '-':   /* see if "--verbose" */
00163               if (strcmp (argv[i], "--verbose") == 0) {
00164                 verbose = 1;
00165               }
00166               else if (strcmp (argv[i], "--version") == 0) {
00167                 fprintf (stderr, "unibmpbump version %s\n\n", VERSION);
00168                 exit (EXIT_SUCCESS);
00169               }
00170               break;
00171             default:    /* if unrecognized option, print list and exit */
00172               fprintf (stderr, "\nSyntax:\n\n");
00173               fprintf (stderr, "    unibmpbump ");
00174               fprintf (stderr, "-i<Input_File> -o<Output_File>\n\n");
00175               fprintf (stderr, "-v or --verbose gives verbose output");
00176               fprintf (stderr, " on stderr\n\n");
00177               fprintf (stderr, "-V or --version prints version");
00178               fprintf (stderr, " on stderr and exits\n\n");
00179               fprintf (stderr, "\nExample:\n\n");
00180               fprintf (stderr, "    unibmpbump -iuni0101.bmp");
00181               fprintf (stderr, " -onew-uni0101.bmp\n\n");
00182               exit (EXIT_SUCCESS);
00183           }
00184         }
00185     }
00186   }
00187
00188   /*
00189 Make sure we can open any I/O files that were specified before
00190 doing anything else.
00191 */
00192   if (strlen (infile) > 0) {
00193     if ((infp = fopen (infile, "r")) == NULL) {
00194       fprintf (stderr, "Error: can't open %s for input.\n", infile);
00195       exit (EXIT_FAILURE);
00196     }
00197   }
00198   else {
00199     infp = stdin;
00200   }
00201   if (strlen (outfile) > 0) {
00202     if ((outfp = fopen (outfile, "w")) == NULL) {
00203       fprintf (stderr, "Error: can't open %s for output.\n", outfile);
00204       exit (EXIT_FAILURE);
00205     }
00206   }
00207   else {
00208     outfp = stdout;
00209   }
00210
00211
00212   /* Read bitmap file header */
00213   file_format[0] = get_bytes (infp, 1);
00214   file_format[1] = get_bytes (infp, 1);
00215   file_format[2] = '\0';  /* Terminate string with null */
00216
00217   /* Read file size */
00218   filesize = get_bytes (infp, 4);
00219
00220   /* Read Reserved bytes */
00221   rsvd_hdr[0] = get_bytes (infp, 1);
00222   rsvd_hdr[1] = get_bytes (infp, 1);
00223   rsvd_hdr[2] = get_bytes (infp, 1);
00224   rsvd_hdr[3] = get_bytes (infp, 1);
00225
00226   /* Read Image Offset Address within file */
00227   image_start = get_bytes (infp, 4);
00228
00229   /*
00230 See if this looks like a valid image file based on
00231 the file header first two bytes.
00232 */
00233   if (strncmp (file_format, "BM", 2) != 0) {
00234     fprintf (stderr, "\nInvalid file format: not file type \"BM\".\n\n");
00235     exit (EXIT_FAILURE);
00236   }
00237
00238   if (verbose) {
00239     fprintf (stderr, "\nFile Header:\n");
00240     fprintf (stderr, "    File Type:    \"%s\"\n", file_format);
00241     fprintf (stderr, "    File Size:    %d bytes\n", filesize);
00242     fprintf (stderr, "    Reserved:     ");
```

```
00243       for (i = 0; i < 4; i++) fprintf (stderr, " 0x%02X", rsvd_hdr[i]);
00244       fputc ('\n', stderr);
00245       fprintf (stderr, "   Image Start: %d. = 0x%02X = 0%05o\n\n",
00246               image_start, image_start, image_start);
00247     }  /* if (verbose) */
00248 
00249     /*
00250 Device Independent Bitmap (DIB) Header: bitmap information header
00251 ("BM" format file DIB Header is 12 bytes long).
00252 */
00253     dib_length = get_bytes (infp, 4);
00254 
00255     /*
00256 Parse one of three versions of Device Independent Bitmap (DIB) format:
00257 
00258 Length  Format
00259 ------  ------
00260 12   BITMAPCOREHEADER
00261 40   BITMAPINFOHEADER
00262 108   BITMAPV4HEADER
00263 124   BITMAPV5HEADER
00264 */
00265     if (dib_length == 12) { /* BITMAPCOREHEADER format -- UNTESTED */
00266       image_width     = get_bytes (infp, 2);
00267       image_height    = get_bytes (infp, 2);
00268       num_planes      = get_bytes (infp, 2);
00269       bits_per_pixel = get_bytes (infp, 2);
00270     }
00271     else if (dib_length >= 40) { /* BITMAPINFOHEADER format or later */
00272       image_width = get_bytes (infp, 4);
00273       image_height        = get_bytes (infp, 4);
00274       num_planes          = get_bytes (infp, 2);
00275       bits_per_pixel      = get_bytes (infp, 2);
00276       compression_method = get_bytes (infp, 4);  /* BI_BITFIELDS */
00277       image_size          = get_bytes (infp, 4);
00278       hres                = get_bytes (infp, 4);
00279       vres                = get_bytes (infp, 4);
00280       num_colors          = get_bytes (infp, 4);
00281       important_colors    = get_bytes (infp, 4);
00282 
00283       /* true_colors is true number of colors in image */
00284       if (num_colors == 0)
00285         true_colors = 1 « bits_per_pixel;
00286       else
00287         true_colors = num_colors;
00288 
00289       /*
00290 If dib_length > 40, the format is BITMAPV4HEADER or
00291 BITMAPV5HEADER.  As this program is only designed
00292 to handle a monochrome image, we can ignore the rest
00293 of the header but must read past the remaining bytes.
00294 */
00295       for (i = 40; i < dib_length; i++) (void)get_bytes (infp, 1);
00296     }
00297 
00298     if (verbose) {
00299       fprintf (stderr, "Device Independent Bitmap (DIB) Header:\n");
00300       fprintf (stderr, "   DIB Length:   %9d bytes (version = ", dib_length);
00301 
00302       if      (dib_length ==  12) fprintf (stderr, "\"BITMAPCOREHEADER\")\n");
00303       else if (dib_length ==  40) fprintf (stderr, "\"BITMAPINFOHEADER\")\n");
00304       else if (dib_length == 108) fprintf (stderr, "\"BITMAPV4HEADER\")\n");
00305       else if (dib_length == 124) fprintf (stderr, "\"BITMAPV5HEADER\")\n");
00306       else fprintf (stderr, "unknown)");
00307       fprintf (stderr, "   Bitmap Width:    %6d pixels\n", image_width);
00308       fprintf (stderr, "   Bitmap Height:   %6d pixels\n", image_height);
00309       fprintf (stderr, "   Color Planes:    %6d\n",         num_planes);
00310       fprintf (stderr, "   Bits per Pixel: %6d\n",          bits_per_pixel);
00311       fprintf (stderr, "   Compression Method: %2d --> ", compression_method);
00312       if (compression_method <= MAX_COMPRESSION_METHOD) {
00313         fprintf (stderr, "%s", compression_type [compression_method]);
00314       }
00315       /*
00316 Supported compression method values:
00317 0 --> uncompressed RGB
00318 11 --> uncompressed CMYK
00319 */
00320       if (compression_method == 0 || compression_method == 11) {
00321         fprintf (stderr, " (no compression)");
00322       }
00323       else {
```

```
00324         fprintf (stderr, "Image uses compression; this is unsupported.\n\n");
00325         exit (EXIT_FAILURE);
00326       }
00327       fprintf (stderr, "\n");
00328       fprintf (stderr, "   Image Size:                %5d bytes\n", image_size);
00329       fprintf (stderr, "   Horizontal Resolution: %5d pixels/meter\n", hres);
00330       fprintf (stderr, "   Vertical Resolution:   %5d pixels/meter\n", vres);
00331       fprintf (stderr, "   Number of Colors:          %5d", num_colors);
00332       if (num_colors != true_colors) {
00333         fprintf (stderr, " --> %d", true_colors);
00334       }
00335       fputc ('\n', stderr);
00336       fprintf (stderr, "   Important Colors:          %5d", important_colors);
00337       if (important_colors == 0)
00338         fprintf (stderr, " (all colors are important)");
00339       fprintf (stderr, "\n\n");
00340     }  /* if (verbose) */
00341
00342     /*
00343 Print Color Table information for images with pallettized colors.
00344 */
00345     if (bits_per_pixel <= 8) {
00346       for (i = 0; i < 2; i++) {
00347         color_map [i][0] = get_bytes (infp, 1);
00348         color_map [i][1] = get_bytes (infp, 1);
00349         color_map [i][2] = get_bytes (infp, 1);
00350         color_map [i][3] = get_bytes (infp, 1);
00351       }
00352       /* Skip remaining color table entries if more than 2 */
00353       while (i < true_colors) {
00354         (void) get_bytes (infp, 4);
00355         i++;
00356       }
00357
00358       if (color_map [0][0] >= 128) image_xor = 0xFF;  /* Invert colors */
00359     }
00360
00361     if (verbose) {
00362       fprintf (stderr, "Color Palette [R, G, B, %s] Values:\n",
00363                (dib_length <= 40) ? "reserved" : "Alpha");
00364       for (i = 0; i < 2; i++) {
00365         fprintf (stderr, "%7d: [", i);
00366         fprintf (stderr, "%3d,",   color_map [i][0] & 0xFF);
00367         fprintf (stderr, "%3d,",   color_map [i][1] & 0xFF);
00368         fprintf (stderr, "%3d,",   color_map [i][2] & 0xFF);
00369         fprintf (stderr, "%3d]\n", color_map [i][3] & 0xFF);
00370       }
00371       if (image_xor == 0xFF) fprintf (stderr, "Will Invert Colors.\n");
00372       fputc ('\n', stderr);
00373
00374     }  /* if (verbose) */
00375
00376
00377     /*
00378 Check format before writing output file.
00379 */
00380     if (image_width != 560 && image_width != 576) {
00381       fprintf (stderr, "\nUnsupported image width: %d\n", image_width);
00382       fprintf (stderr, "Width should be 560 or 576 pixels.\n\n");
00383       exit (EXIT_FAILURE);
00384     }
00385
00386     if (image_height != 544) {
00387       fprintf (stderr, "\nUnsupported image height: %d\n", image_height);
00388       fprintf (stderr, "Height should be 544 pixels.\n\n");
00389       exit (EXIT_FAILURE);
00390     }
00391
00392     if (num_planes != 1) {
00393       fprintf (stderr, "\nUnsupported number of planes: %d\n", num_planes);
00394       fprintf (stderr, "Number of planes should be 1.\n\n");
00395       exit (EXIT_FAILURE);
00396     }
00397
00398     if (bits_per_pixel != 1) {
00399       fprintf (stderr, "\nUnsupported number of bits per pixel: %d\n",
00400                bits_per_pixel);
00401       fprintf (stderr, "Bits per pixel should be 1.\n\n");
00402       exit (EXIT_FAILURE);
00403     }
00404
```

```
00405    if (compression_method != 0 && compression_method != 11) {
00406       fprintf (stderr, "\nUnsupported compression method: %d\n",
00407                compression_method);
00408       fprintf (stderr, "Compression method should be 1 or 11.\n\n");
00409       exit (EXIT_FAILURE);
00410    }
00411
00412    if (true_colors != 2) {
00413       fprintf (stderr, "\nUnsupported number of colors: %d\n", true_colors);
00414       fprintf (stderr, "Number of colors should be 2.\n\n");
00415       exit (EXIT_FAILURE);
00416    }
00417
00418
00419    /*
00420 If we made it this far, things look okay, so write out
00421 the standard header for image conversion.
00422 */
00423    for (i = 0; i < 62; i++) fputc (standard_header[i], outfp);
00424
00425
00426    /*
00427 Image Data.  Each row must be a multiple of 4 bytes, with
00428 padding at the end of each row if necessary.
00429 */
00430    k = 0;  /* byte number within the binary image */
00431    for (i = 0; i < 544; i++) {
00432       /*
00433 If original image is 560 pixels wide (not 576), add
00434 2 white bytes at beginning of row.
00435 */
00436       if (image_width == 560) {  /* Insert 2 white bytes */
00437          image_bytes[k++] = 0xFF;
00438          image_bytes[k++] = 0xFF;
00439       }
00440       for (j = 0; j < 70; j++) {  /* Copy next 70 bytes */
00441          image_bytes[k++] = (get_bytes (infp, 1) & 0xFF) ^ image_xor;
00442       }
00443       /*
00444 If original image is 560 pixels wide (not 576), skip
00445 2 padding bytes at end of row in file because we inserted
00446 2 white bytes at the beginning of the row.
00447 */
00448       if (image_width == 560) {
00449          (void) get_bytes (infp, 2);
00450       }
00451       else {  /* otherwise, next 2 bytes are part of the image so copy them */
00452          image_bytes[k++] = (get_bytes (infp, 1) & 0xFF) ^ image_xor;
00453          image_bytes[k++] = (get_bytes (infp, 1) & 0xFF) ^ image_xor;
00454       }
00455    }
00456
00457
00458    /*
00459 Change the image to match the unihex2bmp.c format if original wasn't
00460 */
00461    if (image_width == 560) {
00462       regrid (image_bytes);
00463    }
00464
00465    for (i = 0; i < 544 * 576 / 8; i++) {
00466       fputc (image_bytes[i], outfp);
00467    }
00468
00469
00470    /*
00471 Wrap up.
00472 */
00473    fclose (infp);
00474    fclose (outfp);
00475
00476    exit (EXIT_SUCCESS);
00477 }
```

5.13.3.3 regrid()

void regrid (

unsigned * image_bytes)

After reading in the image, shift it.

This function adjusts the input image from an original PNG file to match unihex2bmp.c format.

Parameters

in,out	image_bytes	The pixels in an image.

Definition at line 514 of file unibmpbump.c.

```
00514                                {
00515   int i, j, k;  /* loop variables */
00516   int offset;
00517   unsigned glyph_row; /* one grid row of 32 pixels */
00518   unsigned last_pixel; /* last pixel in a byte, to preserve */
00519
00520   /* To insert "00" after "U+" at top of image */
00521   char zero_pattern[16] = {
00522       0x00, 0x00, 0x00, 0x00, 0x18, 0x24, 0x42, 0x42,
00523       0x42, 0x42, 0x42, 0x42, 0x24, 0x18, 0x00, 0x00
00524   };
00525
00526   /* This is the horizontal grid pattern on glyph boundaries */
00527   unsigned hgrid[72] = {
00528     /*  0 */ 0xff, 0xff, 0xff, 0xff, 0xff, 0xff, 0xff, 0xfe,
00529     /*  8 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00530     /* 16 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00531     /* 24 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00532     /* 32 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00533     /* 40 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00534     /* 48 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00535     /* 56 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00536     /* 64 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00
00537   };
00538
00539
00540   /*
00541 First move "U+" left and insert "00" after it.
00542 */
00543   j = 15; /* rows are written bottom to top, so we'll decrement j */
00544   for (i = 543 - 8; i > 544 - 24; i--) {
00545     offset = 72 * i;
00546     image_bytes [offset + 0] = image_bytes [offset + 2];
00547     image_bytes [offset + 1] = image_bytes [offset + 3];
00548     image_bytes [offset + 2] = image_bytes [offset + 4];
00549     image_bytes [offset + 3] = image_bytes [offset + 4] =
00550       ~zero_pattern[15 - j--] & 0xFF;
00551   }
00552
00553   /*
00554 Now move glyph bitmaps to the right by 8 pixels.
00555 */
00556   for (i = 0; i < 16; i++) { /* for each glyph row */
00557     for (j = 0; j < 16; j++) { /* for each glyph column */
00558       /* set offset to lower left-hand byte of next glyph */
00559       offset = (32 * 72 * i) + (9 * 72) + (4 * j) + 8;
00560       for (k = 0; k < 16; k++) { /* for each glyph row */
00561         glyph_row = (image_bytes [offset + 0] « 24) |
00562                     (image_bytes [offset + 1] « 16) |
00563                     (image_bytes [offset + 2] «  8) |
00564                     (image_bytes [offset + 3]);
00565         last_pixel = glyph_row & 1;  /* preserve border */
00566         glyph_row »= 4;
00567         glyph_row &=  0x0FFFFFFE;
00568         /* Set left 4 pixels to white and preserve last pixel */
00569         glyph_row |=  0xF0000000 | last_pixel;
00570         image_bytes [offset + 3] = glyph_row & 0xFF;
00571         glyph_row »= 8;
00572         image_bytes [offset + 2] = glyph_row & 0xFF;
00573         glyph_row »= 8;
00574         image_bytes [offset + 1] = glyph_row & 0xFF;
00575         glyph_row »= 8;
00576         image_bytes [offset + 0] = glyph_row & 0xFF;
```

```
00577             offset += 72;  /* move up to next row in current glyph */
00578           }
00579       }
00580     }
00581
00582     /* Replace horizontal grid with unihex2bmp.c grid */
00583     for (i = 0; i <= 16; i++) {
00584       offset = 32 * 72 * i;
00585       for (j = 0; j < 72; j++) {
00586         image_bytes [offset + j] = hgrid [j];
00587       }
00588     }
00589
00590     return;
00591 }
```

5.14 unibmpbump.c

Go to the documentation of this file.

```
00001 /**
00002 @file unibmpbump.c
00003
00004 @brief unibmpbump - Adjust a Microsoft bitmap (.bmp) file that
00005 was created by unihex2png but converted to .bmp
00006
00007 @author Paul Hardy, unifoundry <at> unifoundry.com
00008
00009 @copyright Copyright (C) 2019 Paul Hardy
00010
00011 This program shifts the glyphs in a bitmap file to adjust an
00012 original PNG file that was saved in BMP format.  This is so the
00013 result matches the format of a unihex2bmp image.  This conversion
00014 then lets unibmp2hex decode the result.
00015
00016 Synopsis: unibmpbump [-iin_file.bmp] [-oout_file.bmp]
00017 */
00018 /*
00019 LICENSE:
00020
00021 This program is free software: you can redistribute it and/or modify
00022 it under the terms of the GNU General Public License as published by
00023 the Free Software Foundation, either version 2 of the License, or
00024 (at your option) any later version.
00025
00026 This program is distributed in the hope that it will be useful,
00027 but WITHOUT ANY WARRANTY; without even the implied warranty of
00028 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
00029 GNU General Public License for more details.
00030
00031 You should have received a copy of the GNU General Public License
00032 along with this program.  If not, see <http://www.gnu.org/licenses/>.
00033 */
00034 #include <stdio.h>
00035 #include <string.h>
00036 #include <stdlib.h>
00037
00038 #define VERSION "1.0"   ///< Version of this program
00039
00040 #define MAX_COMPRESSION_METHOD 13   ///< Maximum supported compression method
00041
00042
00043 /**
00044 @brief The main function.
00045
00046 @param[in] argc The count of command line arguments.
00047 @param[in] argv Pointer to array of command line arguments.
00048 @return This program exits with status EXIT_SUCCESS.
00049 */
00050 int main (int argc, char *argv[]) {
00051
00052   /*
00053 Values preserved from file header (first 14 bytes).
00054 */
00055   char file_format[3];       /* "BM" for original Windows format          */
00056   unsigned filesize;        /* size of file in bytes                     */
00057   unsigned char rsvd_hdr[4]; /* 4 reserved bytes                         */
00058   unsigned image_start;     /* byte offset of image in file             */
00059
```

```
00060   /*
00061 Values preserved from Device Independent Bitmap (DIB) Header.
00062
00063 The DIB fields below are in the standard 40-byte header.  Version
00064 4 and version 5 headers have more information, mainly for color
00065 information.  That is skipped over, because a valid glyph image
00066 is just monochrome.
00067 */
00068   int dib_length;           /* in bytes, for parsing by header version    */
00069   int image_width = 0;      /* Signed image width                         */
00070   int image_height = 0;     /* Signed image height                        */
00071   int num_planes = 0;       /* number of planes; must be 1                */
00072   int bits_per_pixel = 0;   /* for palletized color maps (< 2^16 colors)  */
00073   /*
00074 The following fields are not in the original spec, so initialize
00075 them to 0 so we can correctly parse an original file format.
00076 */
00077   int compression_method=0; /* 0 --> uncompressed RGB/monochrome          */
00078   int image_size = 0;       /* 0 is a valid size if no compression        */
00079   int hres = 0;             /* image horizontal resolution                */
00080   int vres = 0;             /* image vertical resolution                  */
00081   int num_colors = 0;       /* Number of colors for pallettized images    */
00082   int important_colors = 0; /* Number of significant colors (0 or 2)      */
00083
00084   int true_colors = 0;      /* interpret num_colors, which can equal 0    */
00085
00086   /*
00087 Color map.  This should be a monochrome file, so only two
00088 colors are stored.
00089 */
00090   unsigned char color_map[2][4]; /* two of R, G, B, and possibly alpha  */
00091
00092   /*
00093 The monochrome image bitmap, stored as a vector 544 rows by
00094 72*8 columns.
00095 */
00096   unsigned image_bytes[544*72];
00097
00098   /*
00099 Flags for conversion & I/O.
00100 */
00101   int verbose      = 0;     /* Whether to print file info on stderr     */
00102   unsigned image_xor = 0x00; /* Invert (= 0xFF) if color 0 is not black  */
00103
00104   /*
00105 Temporary variables.
00106 */
00107   int i, j, k;          /* loop variables */
00108
00109   /* Compression type, for parsing file */
00110   char *compression_type[MAX_COMPRESSION_METHOD + 1] = {
00111     "BI_RGB",           /*  0 */
00112     "BI_RLE8",          /*  1 */
00113     "BI_RLE4",          /*  2 */
00114     "BI_BITFIELDS",     /*  3 */
00115     "BI_JPEG",          /*  4 */
00116     "BI_PNG",           /*  5 */
00117     "BI_ALPHABITFIELDS", /*  6 */
00118     "", "", "", "",     /*  7 - 10 */
00119     "BI_CMYK",          /* 11 */
00120     "BI_CMYKRLE8",      /* 12 */
00121     "BI_CMYKRLE4",      /* 13 */
00122   };
00123
00124   /* Standard unihex2bmp.c header for BMP image */
00125   unsigned standard_header [62] = {
00126     /*  0 */ 0x42, 0x4d, 0x3e, 0x99, 0x00, 0x00, 0x00, 0x00,
00127     /*  8 */ 0x00, 0x00, 0x3e, 0x00, 0x00, 0x00, 0x28, 0x00,
00128     /* 16 */ 0x00, 0x00, 0x40, 0x02, 0x00, 0x00, 0x20, 0x02,
00129     /* 24 */ 0x00, 0x00, 0x01, 0x00, 0x01, 0x00, 0x00, 0x00,
00130     /* 32 */ 0x00, 0x00, 0x00, 0x99, 0x00, 0x00, 0xc4, 0x0e,
00131     /* 40 */ 0x00, 0x00, 0xc4, 0x0e, 0x00, 0x00, 0x00, 0x00,
00132     /* 48 */ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
00133     /* 56 */ 0x00, 0x00, 0xff, 0xff, 0xff, 0x00
00134   };
00135
00136   unsigned get_bytes (FILE *, int);
00137   void     regrid    (unsigned *);
00138
00139   char *infile="", *outfile="";  /* names of input and output files        */
00140   FILE *infp, *outfp;           /* file pointers of input and output files */
```

```
00141
00142   /*
00143 Process command line arguments.
00144 */
00145   if (argc > 1) {
00146     for (i = 1; i < argc; i++) {
00147       if (argv[i][0] == '-') {  /* this is an option argument */
00148         switch (argv[i][1]) {
00149           case 'i':  /* name of input file */
00150             infile = &argv[i][2];
00151             break;
00152           case 'o':  /* name of output file */
00153             outfile = &argv[i][2];
00154             break;
00155           case 'v':  /* verbose output */
00156             verbose = 1;
00157             break;
00158           case 'V':  /* print version & quit */
00159             fprintf (stderr, "unibmpbump version %s\n\n", VERSION);
00160             exit (EXIT_SUCCESS);
00161             break;
00162           case '-':  /* see if "--verbose" */
00163             if (strcmp (argv[i], "--verbose") == 0) {
00164               verbose = 1;
00165             }
00166             else if (strcmp (argv[i], "--version") == 0) {
00167               fprintf (stderr, "unibmpbump version %s\n\n", VERSION);
00168               exit (EXIT_SUCCESS);
00169             }
00170             break;
00171           default:    /* if unrecognized option, print list and exit */
00172             fprintf (stderr, "\nSyntax:\n\n");
00173             fprintf (stderr, "   unibmpbump ");
00174             fprintf (stderr, "-i<Input_File> -o<Output_File>\n\n");
00175             fprintf (stderr, "-v or --verbose gives verbose output");
00176             fprintf (stderr, " on stderr\n\n");
00177             fprintf (stderr, "-V or --version prints version");
00178             fprintf (stderr, " on stderr and exits\n\n");
00179             fprintf (stderr, "\nExample:\n\n");
00180             fprintf (stderr, "   unibmpbump -iuni0101.bmp");
00181             fprintf (stderr, " -onew-uni0101.bmp\n\n");
00182             exit (EXIT_SUCCESS);
00183         }
00184       }
00185     }
00186   }
00187
00188   /*
00189 Make sure we can open any I/O files that were specified before
00190 doing anything else.
00191 */
00192   if (strlen (infile) > 0) {
00193     if ((infp = fopen (infile, "r")) == NULL) {
00194       fprintf (stderr, "Error: can't open %s for input.\n", infile);
00195       exit (EXIT_FAILURE);
00196     }
00197   }
00198   else {
00199     infp = stdin;
00200   }
00201   if (strlen (outfile) > 0) {
00202     if ((outfp = fopen (outfile, "w")) == NULL) {
00203       fprintf (stderr, "Error: can't open %s for output.\n", outfile);
00204       exit (EXIT_FAILURE);
00205     }
00206   }
00207   else {
00208     outfp = stdout;
00209   }
00210
00211
00212   /* Read bitmap file header */
00213   file_format[0] = get_bytes (infp, 1);
00214   file_format[1] = get_bytes (infp, 1);
00215   file_format[2] = '\0';  /* Terminate string with null */
00216
00217   /* Read file size */
00218   filesize = get_bytes (infp, 4);
00219
00220   /* Read Reserved bytes */
00221   rsvd_hdr[0] = get_bytes (infp, 1);
```

```
00222    rsvd_hdr[1] = get_bytes (infp, 1);
00223    rsvd_hdr[2] = get_bytes (infp, 1);
00224    rsvd_hdr[3] = get_bytes (infp, 1);
00225
00226    /* Read Image Offset Address within file */
00227    image_start = get_bytes (infp, 4);
00228
00229    /*
00230 See if this looks like a valid image file based on
00231 the file header first two bytes.
00232 */
00233    if (strncmp (file_format, "BM", 2) != 0) {
00234       fprintf (stderr, "\nInvalid file format: not file type \"BM\".\n\n");
00235       exit (EXIT_FAILURE);
00236    }
00237
00238    if (verbose) {
00239       fprintf (stderr, "\nFile Header:\n");
00240       fprintf (stderr, "    File Type:    \"%s\"\n", file_format);
00241       fprintf (stderr, "    File Size:    %d bytes\n", filesize);
00242       fprintf (stderr, "    Reserved:     ");
00243       for (i = 0; i < 4; i++) fprintf (stderr, " 0x%02X", rsvd_hdr[i]);
00244       fputc ('\n', stderr);
00245       fprintf (stderr, "    Image Start: %d. = 0x%02X = 0%05o\n\n",
00246                image_start, image_start, image_start);
00247    }  /* if (verbose) */
00248
00249    /*
00250 Device Independent Bitmap (DIB) Header: bitmap information header
00251 ("BM" format file DIB Header is 12 bytes long).
00252 */
00253    dib_length = get_bytes (infp, 4);
00254
00255    /*
00256 Parse one of three versions of Device Independent Bitmap (DIB) format:
00257
00258 Length  Format
00259 ------  ------
00260 12   BITMAPCOREHEADER
00261 40   BITMAPINFOHEADER
00262 108   BITMAPV4HEADER
00263 124   BITMAPV5HEADER
00264 */
00265    if (dib_length == 12) { /* BITMAPCOREHEADER format -- UNTESTED */
00266       image_width     = get_bytes (infp, 2);
00267       image_height    = get_bytes (infp, 2);
00268       num_planes      = get_bytes (infp, 2);
00269       bits_per_pixel = get_bytes (infp, 2);
00270    }
00271    else if (dib_length >= 40) { /* BITMAPINFOHEADER format or later */
00272       image_width = get_bytes (infp, 4);
00273       image_height        = get_bytes (infp, 4);
00274       num_planes          = get_bytes (infp, 2);
00275       bits_per_pixel      = get_bytes (infp, 2);
00276       compression_method = get_bytes (infp, 4);  /* BI_BITFIELDS */
00277       image_size          = get_bytes (infp, 4);
00278       hres                = get_bytes (infp, 4);
00279       vres                = get_bytes (infp, 4);
00280       num_colors          = get_bytes (infp, 4);
00281       important_colors    = get_bytes (infp, 4);
00282
00283       /* true_colors is true number of colors in image */
00284       if (num_colors == 0)
00285          true_colors = 1 « bits_per_pixel;
00286       else
00287          true_colors = num_colors;
00288
00289       /*
00290 If dib_length > 40, the format is BITMAPV4HEADER or
00291 BITMAPV5HEADER.  As this program is only designed
00292 to handle a monochrome image, we can ignore the rest
00293 of the header but must read past the remaining bytes.
00294 */
00295       for (i = 40; i < dib_length; i++) (void)get_bytes (infp, 1);
00296    }
00297
00298    if (verbose) {
00299       fprintf (stderr, "Device Independent Bitmap (DIB) Header:\n");
00300       fprintf (stderr, "    DIB Length:   %9d bytes (version = ", dib_length);
00301
00302       if      (dib_length ==  12) fprintf (stderr, "\"BITMAPCOREHEADER\")\n");
```

```
00303       else if (dib_length ==  40) fprintf (stderr, "\"BITMAPINFOHEADER\")\n");
00304       else if (dib_length == 108) fprintf (stderr, "\"BITMAPV4HEADER\")\n");
00305       else if (dib_length == 124) fprintf (stderr, "\"BITMAPV5HEADER\")\n");
00306       else fprintf (stderr, "unknown)");
00307       fprintf (stderr, "   Bitmap Width:    %6d pixels\n", image_width);
00308       fprintf (stderr, "   Bitmap Height:   %6d pixels\n", image_height);
00309       fprintf (stderr, "   Color Planes:    %6d\n",        num_planes);
00310       fprintf (stderr, "   Bits per Pixel: %6d\n",         bits_per_pixel);
00311       fprintf (stderr, "   Compression Method: %2d --> ", compression_method);
00312       if (compression_method <= MAX_COMPRESSION_METHOD) {
00313         fprintf (stderr, "%s", compression_type [compression_method]);
00314       }
00315       /*
00316 Supported compression method values:
00317 0 --> uncompressed RGB
00318 11 --> uncompressed CMYK
00319 */
00320       if (compression_method == 0 || compression_method == 11) {
00321         fprintf (stderr, " (no compression)");
00322       }
00323       else {
00324         fprintf (stderr, "Image uses compression; this is unsupported.\n\n");
00325         exit (EXIT_FAILURE);
00326       }
00327       fprintf (stderr, "\n");
00328       fprintf (stderr, "   Image Size:                %5d bytes\n", image_size);
00329       fprintf (stderr, "   Horizontal Resolution: %5d pixels/meter\n", hres);
00330       fprintf (stderr, "   Vertical Resolution:    %5d pixels/meter\n", vres);
00331       fprintf (stderr, "   Number of Colors:         %5d", num_colors);
00332       if (num_colors != true_colors) {
00333         fprintf (stderr, " --> %d", true_colors);
00334       }
00335       fputc ('\n', stderr);
00336       fprintf (stderr, "   Important Colors:         %5d", important_colors);
00337       if (important_colors == 0)
00338         fprintf (stderr, " (all colors are important)");
00339       fprintf (stderr, "\n\n");
00340     }  /* if (verbose) */
00341
00342     /*
00343 Print Color Table information for images with pallettized colors.
00344 */
00345     if (bits_per_pixel <= 8) {
00346       for (i = 0; i < 2; i++) {
00347         color_map [i][0] = get_bytes (infp, 1);
00348         color_map [i][1] = get_bytes (infp, 1);
00349         color_map [i][2] = get_bytes (infp, 1);
00350         color_map [i][3] = get_bytes (infp, 1);
00351       }
00352       /* Skip remaining color table entries if more than 2 */
00353       while (i < true_colors) {
00354         (void) get_bytes (infp, 4);
00355         i++;
00356       }
00357
00358       if (color_map [0][0] >= 128) image_xor = 0xFF;  /* Invert colors */
00359     }
00360
00361     if (verbose) {
00362       fprintf (stderr, "Color Palette [R, G, B, %s] Values:\n",
00363                (dib_length <= 40) ? "reserved" : "Alpha");
00364       for (i = 0; i < 2; i++) {
00365         fprintf (stderr, "%7d: [", i);
00366         fprintf (stderr, "%3d,",   color_map [i][0] & 0xFF);
00367         fprintf (stderr, "%3d,",   color_map [i][1] & 0xFF);
00368         fprintf (stderr, "%3d,",   color_map [i][2] & 0xFF);
00369         fprintf (stderr, "%3d]\n", color_map [i][3] & 0xFF);
00370       }
00371       if (image_xor == 0xFF) fprintf (stderr, "Will Invert Colors.\n");
00372       fputc ('\n', stderr);
00373
00374     }  /* if (verbose) */
00375
00376
00377     /*
00378 Check format before writing output file.
00379 */
00380     if (image_width != 560 && image_width != 576) {
00381       fprintf (stderr, "\nUnsupported image width: %d\n", image_width);
00382       fprintf (stderr, "Width should be 560 or 576 pixels.\n\n");
00383       exit (EXIT_FAILURE);
```

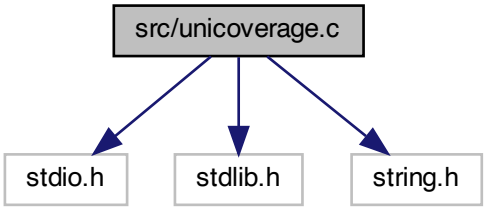
```
00384   }
00385
00386   if (image_height != 544) {
00387     fprintf (stderr, "\nUnsupported image height: %d\n", image_height);
00388     fprintf (stderr, "Height should be 544 pixels.\n\n");
00389     exit (EXIT_FAILURE);
00390   }
00391
00392   if (num_planes != 1) {
00393     fprintf (stderr, "\nUnsupported number of planes: %d\n", num_planes);
00394     fprintf (stderr, "Number of planes should be 1.\n\n");
00395     exit (EXIT_FAILURE);
00396   }
00397
00398   if (bits_per_pixel != 1) {
00399     fprintf (stderr, "\nUnsupported number of bits per pixel: %d\n",
00400             bits_per_pixel);
00401     fprintf (stderr, "Bits per pixel should be 1.\n\n");
00402     exit (EXIT_FAILURE);
00403   }
00404
00405   if (compression_method != 0 && compression_method != 11) {
00406     fprintf (stderr, "\nUnsupported compression method: %d\n",
00407             compression_method);
00408     fprintf (stderr, "Compression method should be 1 or 11.\n\n");
00409     exit (EXIT_FAILURE);
00410   }
00411
00412   if (true_colors != 2) {
00413     fprintf (stderr, "\nUnsupported number of colors: %d\n", true_colors);
00414     fprintf (stderr, "Number of colors should be 2.\n\n");
00415     exit (EXIT_FAILURE);
00416   }
00417
00418
00419   /*
00420 If we made it this far, things look okay, so write out
00421 the standard header for image conversion.
00422 */
00423   for (i = 0; i < 62; i++) fputc (standard_header[i], outfp);
00424
00425
00426   /*
00427 Image Data.  Each row must be a multiple of 4 bytes, with
00428 padding at the end of each row if necessary.
00429 */
00430   k = 0;  /* byte number within the binary image */
00431   for (i = 0; i < 544; i++) {
00432     /*
00433 If original image is 560 pixels wide (not 576), add
00434 2 white bytes at beginning of row.
00435 */
00436     if (image_width == 560) {  /* Insert 2 white bytes */
00437       image_bytes[k++] = 0xFF;
00438       image_bytes[k++] = 0xFF;
00439     }
00440     for (j = 0; j < 70; j++) {  /* Copy next 70 bytes */
00441       image_bytes[k++] = (get_bytes (infp, 1) & 0xFF) ^ image_xor;
00442     }
00443     /*
00444 If original image is 560 pixels wide (not 576), skip
00445 2 padding bytes at end of row in file because we inserted
00446 2 white bytes at the beginning of the row.
00447 */
00448     if (image_width == 560) {
00449       (void) get_bytes (infp, 2);
00450     }
00451     else {  /* otherwise, next 2 bytes are part of the image so copy them */
00452       image_bytes[k++] = (get_bytes (infp, 1) & 0xFF) ^ image_xor;
00453       image_bytes[k++] = (get_bytes (infp, 1) & 0xFF) ^ image_xor;
00454     }
00455   }
00456
00457
00458   /*
00459 Change the image to match the unihex2bmp.c format if original wasn't
00460 */
00461   if (image_width == 560) {
00462     regrid (image_bytes);
00463   }
00464
```

```
00465    for (i = 0; i < 544 * 576 / 8; i++) {
00466       fputc (image_bytes[i], outfp);
00467    }
00468
00469
00470    /*
00471 Wrap up.
00472 */
00473    fclose (infp);
00474    fclose (outfp);
00475
00476    exit (EXIT_SUCCESS);
00477 }
00478
00479
00480 /**
00481 @brief Get from 1 to 4 bytes, inclusive, from input file.
00482
00483 @param[in] infp Pointer to input file.
00484 @param[in] nbytes Number of bytes to read, from 1 to 4, inclusive.
00485 @return The unsigned 1 to 4 bytes in machine native endian format.
00486 */
00487 unsigned get_bytes (FILE *infp, int nbytes) {
00488    int i;
00489    unsigned char inchar[4];
00490    unsigned inword;
00491
00492    for (i = 0; i < nbytes; i++) {
00493       if (fread (&inchar[i], 1, 1, infp) != 1) {
00494          inchar[i] = 0;
00495       }
00496    }
00497    for (i = nbytes; i < 4; i++) inchar[i] = 0;
00498
00499    inword = ((inchar[3] & 0xFF) « 24) | ((inchar[2] & 0xFF) « 16) |
00500             ((inchar[1] & 0xFF) «  8) |  (inchar[0] & 0xFF);
00501
00502    return inword;
00503 }
00504
00505
00506 /**
00507 @brief After reading in the image, shift it.
00508
00509 This function adjusts the input image from an original PNG file
00510 to match unihex2bmp.c format.
00511
00512 @param[in,out] image_bytes The pixels in an image.
00513 */
00514 void regrid (unsigned *image_bytes) {
00515    int i, j, k;  /* loop variables */
00516    int offset;
00517    unsigned glyph_row; /* one grid row of 32 pixels */
00518    unsigned last_pixel; /* last pixel in a byte, to preserve */
00519
00520    /* To insert "00" after "U+" at top of image */
00521    char zero_pattern[16] = {
00522        0x00, 0x00, 0x00, 0x00, 0x18, 0x24, 0x42, 0x42,
00523        0x42, 0x42, 0x42, 0x42, 0x24, 0x18, 0x00, 0x00
00524    };
00525
00526    /* This is the horizontal grid pattern on glyph boundaries */
00527    unsigned hgrid[72] = {
00528       /*  0 */ 0xff, 0xff, 0xff, 0xff, 0xff, 0xff, 0xff, 0xfe,
00529       /*  8 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00530       /* 16 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00531       /* 24 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00532       /* 32 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00533       /* 40 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00534       /* 48 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00535       /* 56 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00536       /* 64 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00
00537    };
00538
00539
00540    /*
00541 First move "U+" left and insert "00" after it.
00542 */
00543    j = 15; /* rows are written bottom to top, so we'll decrement j */
00544    for (i = 543 - 8; i > 544 - 24; i--) {
00545       offset = 72 * i;
```

```
00546       image_bytes [offset + 0] = image_bytes [offset + 2];
00547       image_bytes [offset + 1] = image_bytes [offset + 3];
00548       image_bytes [offset + 2] = image_bytes [offset + 4];
00549       image_bytes [offset + 3] = image_bytes [offset + 4] =
00550         ~zero_pattern[15 - j--] & 0xFF;
00551     }
00552
00553     /*
00554 Now move glyph bitmaps to the right by 8 pixels.
00555 */
00556     for (i = 0; i < 16; i++) { /* for each glyph row */
00557       for (j = 0; j < 16; j++) { /* for each glyph column */
00558         /* set offset to lower left-hand byte of next glyph */
00559         offset = (32 * 72 * i) + (9 * 72) + (4 * j) + 8;
00560         for (k = 0; k < 16; k++) { /* for each glyph row */
00561           glyph_row = (image_bytes [offset + 0] « 24) |
00562                       (image_bytes [offset + 1] « 16) |
00563                       (image_bytes [offset + 2] «  8) |
00564                       (image_bytes [offset + 3]);
00565           last_pixel = glyph_row & 1;  /* preserve border */
00566           glyph_row »= 4;
00567           glyph_row &=  0x0FFFFFFE;
00568           /* Set left 4 pixels to white and preserve last pixel */
00569           glyph_row |=  0xF0000000 | last_pixel;
00570           image_bytes [offset + 3] = glyph_row & 0xFF;
00571           glyph_row »= 8;
00572           image_bytes [offset + 2] = glyph_row & 0xFF;
00573           glyph_row »= 8;
00574           image_bytes [offset + 1] = glyph_row & 0xFF;
00575           glyph_row »= 8;
00576           image_bytes [offset + 0] = glyph_row & 0xFF;
00577           offset += 72;  /* move up to next row in current glyph */
00578         }
00579       }
00580     }
00581
00582     /* Replace horizontal grid with unihex2bmp.c grid */
00583     for (i = 0; i <= 16; i++) {
00584       offset = 32 * 72 * i;
00585       for (j = 0; j < 72; j++) {
00586         image_bytes [offset + j] = hgrid [j];
00587       }
00588     }
00589
00590     return;
00591 }
```

5.15 src/unicoverage.c File Reference

unicoverage - Show the coverage of Unicode plane scripts for a GNU Unifont hex glyph file
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
Include dependency graph for unicoverage.c:



Macros

- #define MAXBUF 256
  Maximum input line length - 1.

Functions

- int main (int argc, char *argv[])
  The main function.
- int nextrange (FILE *coveragefp, int *cstart, int *cend, char *coverstring)
  Get next Unicode range.
- void print_subtotal (FILE *outfp, int print_n, int nglyphs, int cstart, int cend, char *coverstring)
  Print the subtotal for one Unicode script range.

5.15.1 Detailed Description

unicoverage - Show the coverage of Unicode plane scripts for a GNU Unifont hex glyph file

Author

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Copyright

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Synopsis: unicoverage [-ifont_file.hex] [-ocoverage_file.txt]
This program requires the file "coverage.dat" to be present in the directory from which it is run.
Definition in file unicoverage.c.

5.15.2 Macro Definition Documentation

5.15.2.1 MAXBUF

#define MAXBUF 256
Maximum input line length - 1.
Definition at line 60 of file unicoverage.c.

5.15.3 Function Documentation

5.15.3.1 main()

```
int main (
            int argc,
            char * argv[] )
```

The main function.

Parameters

in	argc	The count of command line arguments.
in	argv	Pointer to array of command line arguments.

Returns

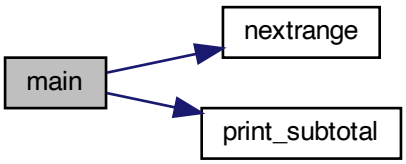
This program exits with status 0.

Definition at line 71 of file unicoverage.c.

```
00072 {
00073
00074   int      print_n=0;       /* print # of glyphs, not percentage   */
00075   unsigned i;               /* loop variable                       */
00076   unsigned slen;            /* string length of coverage file line */
00077   char     inbuf[256];      /* input buffer                        */
00078   unsigned thischar;        /* the current character               */
00079
00080   char *infile="", *outfile="";  /* names of input and output files       */
00081   FILE *infp, *outfp;       /* file pointers of input and output files   */
00082   FILE *coveragefp;         /* file pointer to coverage.dat file         */
00083   int cstart, cend;         /* current coverage start and end code points */
00084   char coverstring[MAXBUF];  /* description of current coverage range     */
00085   int nglyphs;              /* number of glyphs in this section          */
00086
00087   /* to get next range & name of Unicode glyphs */
00088   int nextrange (FILE *coveragefp, int *cstart, int *cend, char *coverstring);
00089
00090   void print_subtotal (FILE *outfp, int print_n, int nglyphs,
00091                        int cstart, int cend, char *coverstring);
00092
00093   if ((coveragefp = fopen ("coverage.dat", "r")) == NULL) {
00094     fprintf (stderr, "\nError: data file \"coverage.dat\" not found.\n\n");
00095     exit (0);
00096   }
00097
00098   if (argc > 1) {
00099     for (i = 1; i < argc; i++) {
00100       if (argv[i][0] == '-') {  /* this is an option argument */
00101         switch (argv[i][1]) {
00102           case 'i':  /* name of input file */
00103             infile = &argv[i][2];
00104             break;
00105           case 'n':  /* print number of glyphs instead of percentage */
00106             print_n = 1;
00107           case 'o':  /* name of output file */
00108             outfile = &argv[i][2];
00109             break;
00110           default:    /* if unrecognized option, print list and exit */
00111             fprintf (stderr, "\nSyntax:\n\n");
00112             fprintf (stderr, "   %s -p<Unicode_Page> ", argv[0]);
00113             fprintf (stderr, "-i<Input_File> -o<Output_File> -w\n\n");
00114             exit (1);
00115         }
00116       }
00117     }
```

```
00118   }
00119   /*
00120 Make sure we can open any I/O files that were specified before
00121 doing anything else.
00122 */
00123   if (strlen (infile) > 0) {
00124     if ((infp = fopen (infile, "r")) == NULL) {
00125       fprintf (stderr, "Error: can't open %s for input.\n", infile);
00126       exit (1);
00127     }
00128   }
00129   else {
00130     infp = stdin;
00131   }
00132   if (strlen (outfile) > 0) {
00133     if ((outfp = fopen (outfile, "w")) == NULL) {
00134       fprintf (stderr, "Error: can't open %s for output.\n", outfile);
00135       exit (1);
00136     }
00137   }
00138   else {
00139     outfp = stdout;
00140   }
00141
00142   /*
00143 Print header row.
00144 */
00145   if (print_n) {
00146     fprintf (outfp, "# Glyphs      Range        Script\n");
00147     fprintf (outfp, "--------      -----        ------\n");
00148   }
00149   else {
00150     fprintf (outfp, "Covered      Range        Script\n");
00151     fprintf (outfp, "-------      -----        ------\n\n");
00152   }
00153
00154   slen = nextrange (coveragefp, &cstart, &cend, coverstring);
00155   nglyphs = 0;
00156
00157   /*
00158 Read in the glyphs in the file
00159 */
00160   while (slen != 0 && fgets (inbuf, MAXBUF-1, infp) != NULL) {
00161     sscanf (inbuf, "%x", &thischar);
00162
00163     /* Read a character beyond end of current script. */
00164     while (cend < thischar && slen != 0) {
00165       print_subtotal (outfp, print_n, nglyphs, cstart, cend, coverstring);
00166
00167       /* start new range total */
00168       slen = nextrange (coveragefp, &cstart, &cend, coverstring);
00169       nglyphs = 0;
00170     }
00171     nglyphs++;
00172   }
00173
00174   print_subtotal (outfp, print_n, nglyphs, cstart, cend, coverstring);
00175
00176   exit (0);
00177 }
```

Here is the call graph for this function:



5.15.3.2 nextrange()

```
int nextrange (
                FILE * coveragefp,
                int * cstart,
                int * cend,
                char * coverstring )
```

Get next Unicode range.
This function reads the next Unicode script range to count its glyph coverage.

Parameters

in	coveragefp	File pointer to Unicode script range data file.
in	cstart	Starting code point in current Unicode script range.

Parameters

in	cend	Ending code point in current Unicode script range.
out	coverstring	String containing <cstart>-<cend> substring.

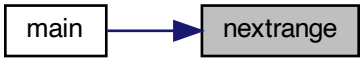
Returns

Length of the last string read, or 0 for end of file.

Definition at line 192 of file unicoverage.c.

```
00195 {
00196    int i;
00197    static char inbuf[MAXBUF];
00198    int retval;          /* the return value */
00199
00200    retval = 0;
00201
00202    do {
00203       if (fgets (inbuf, MAXBUF-1, coveragefp) != NULL) {
00204          retval = strlen (inbuf);
00205          if ((inbuf[0] >= '0' && inbuf[0] <= '9') ||
00206              (inbuf[0] >= 'A' && inbuf[0] <= 'F') ||
00207              (inbuf[0] >= 'a' && inbuf[0] <= 'f')) {
00208             sscanf (inbuf, "%x-%x", cstart, cend);
00209             i = 0;
00210             while (inbuf[i] != ' ') i++;  /* find first blank */
00211             while (inbuf[i] == ' ') i++;  /* find next non-blank */
00212             strncpy (coverstring, &inbuf[i], MAXBUF);
00213          }
00214          else retval = 0;
00215       }
00216       else retval = 0;
00217    } while (retval == 0 && !feof (coveragefp));
00218
00219    return (retval);
00220 }
```

Here is the caller graph for this function:



5.15.3.3 print_subtotal()

```
void print_subtotal (
            FILE * outfp,
            int print_n,
            int nglyphs,
            int cstart,
            int cend,
            char * coverstring )
```

Print the subtotal for one Unicode script range.

Parameters

in	outfp	Pointer to output file.
in	print_n	1 = print number of glyphs, 0 = print percentage.
in	nglyphs	Number of glyphs in current range.
in	cstart	Starting code point for current range.
in	cend	Ending code point for current range.

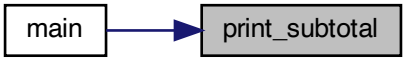
Parameters

in	coverstring	Character string of "<cstart>-<cend>".

Definition at line 233 of file unicoverage.c.

```
00234                                                {
00235
00236    /* print old range total */
00237    if (print_n) {  /* Print number of glyphs, not percentage */
00238       fprintf (outfp, " %6d ", nglyphs);
00239    }
00240    else {
00241       fprintf (outfp, " %5.1f%%", 100.0*nglyphs/(1+cend-cstart));
00242    }
00243
00244    if (cend < 0x10000)
00245       fprintf (outfp, "  U+%04X..U+%04X   %s",
00246             cstart, cend, coverstring);
00247    else
00248       fprintf (outfp, " U+%05X..U+%05X  %s",
00249             cstart, cend, coverstring);
00250
00251    return;
00252 }
```

Here is the caller graph for this function:



5.16 unicoverage.c

Go to the documentation of this file.

```
00001 /**
00002 @file unicoverage.c
00003
00004 @brief unicoverage - Show the coverage of Unicode plane scripts
00005 for a GNU Unifont hex glyph file
00006
00007 @author Paul Hardy, unifoundry <at> unifoundry.com, 6 January 2008
00008
00009 @copyright Copyright (C) 2008, 2013 Paul Hardy
00010
00011 Synopsis: unicoverage [-ifont_file.hex] [-ocoverage_file.txt]
00012
00013 This program requires the file "coverage.dat" to be present
00014 in the directory from which it is run.
00015 */
00016 /*
00017 LICENSE:
00018
00019 This program is free software: you can redistribute it and/or modify
00020 it under the terms of the GNU General Public License as published by
00021 the Free Software Foundation, either version 2 of the License, or
00022 (at your option) any later version.
00023
00024 This program is distributed in the hope that it will be useful,
00025 but WITHOUT ANY WARRANTY; without even the implied warranty of
```

```
00026 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
00027 GNU General Public License for more details.
00028
00029 You should have received a copy of the GNU General Public License
00030 along with this program.  If not, see <http://www.gnu.org/licenses/>.
00031 */
00032
00033 /*
00034 2016 (Paul Hardy): Modified in Unifont 9.0.01 release to remove non-existent
00035 "-p" option and empty example from help printout.
00036
00037 2018 (Paul Hardy): Modified to cover entire Unicode range, not just Plane 0.
00038
00039 11 May 2019: [Paul Hardy] changed strcpy function call to strlcpy
00040 for better error handling.
00041
00042 31 May 2019: [Paul Hardy] replaced strlcpy call with strncpy
00043 for compilation on more systems.
00044
00045 4 June 2022: [Paul Hardy] Adjusted column spacing for better alignment
00046 of Unicode Plane 1-15 scripts.  Added "-n" option to print number of
00047 glyphs in each range instead of percent coverage.
00048
00049 18 September 2022: [Paul Hardy] in nextrange function, initialize retval.
00050
00051 21 October 2023: [Paul Hardy]
00052 Added full function prototype for nextrange function in main function.
00053 */
00054
00055 #include <stdio.h>
00056 #include <stdlib.h>
00057 #include <string.h>
00058
00059
00060 #define MAXBUF 256   ///< Maximum input line length - 1
00061
00062
00063 /**
00064 @brief The main function.
00065
00066 @param[in] argc The count of command line arguments.
00067 @param[in] argv Pointer to array of command line arguments.
00068 @return This program exits with status 0.
00069 */
00070 int
00071 main (int argc, char *argv[])
00072 {
00073
00074   int      print_n=0;       /* print # of glyphs, not percentage   */
00075   unsigned i;               /* loop variable                       */
00076   unsigned slen;            /* string length of coverage file line */
00077   char     inbuf[256];      /* input buffer                        */
00078   unsigned thischar;        /* the current character               */
00079
00080   char *infile="", *outfile="";  /* names of input and output files       */
00081   FILE *infp, *outfp;       /* file pointers of input and output files   */
00082   FILE *coveragefp;         /* file pointer to coverage.dat file         */
00083   int cstart, cend;         /* current coverage start and end code points */
00084   char coverstring[MAXBUF];  /* description of current coverage range     */
00085   int nglyphs;              /* number of glyphs in this section          */
00086
00087   /* to get next range & name of Unicode glyphs */
00088   int nextrange (FILE *coveragefp, int *cstart, int *cend, char *coverstring);
00089
00090   void print_subtotal (FILE *outfp, int print_n, int nglyphs,
00091                        int cstart, int cend, char *coverstring);
00092
00093   if ((coveragefp = fopen ("coverage.dat", "r")) == NULL) {
00094     fprintf (stderr, "\nError: data file \"coverage.dat\" not found.\n\n");
00095     exit (0);
00096   }
00097
00098   if (argc > 1) {
00099     for (i = 1; i < argc; i++) {
00100       if (argv[i][0] == '-') {  /* this is an option argument */
00101         switch (argv[i][1]) {
00102           case 'i':  /* name of input file */
00103             infile = &argv[i][2];
00104             break;
00105           case 'n':  /* print number of glyphs instead of percentage */
00106             print_n = 1;
```

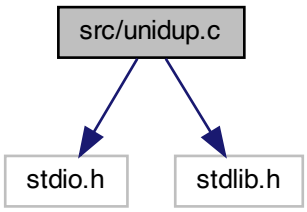
```
00107             case 'o':  /* name of output file */
00108               outfile = &argv[i][2];
00109               break;
00110             default:   /* if unrecognized option, print list and exit */
00111               fprintf (stderr, "\nSyntax:\n\n");
00112               fprintf (stderr, "   %s -p<Unicode_Page> ", argv[0]);
00113               fprintf (stderr, "-i<Input_File> -o<Output_File> -w\n\n");
00114               exit (1);
00115           }
00116         }
00117     }
00118   }
00119   /*
00120 Make sure we can open any I/O files that were specified before
00121 doing anything else.
00122 */
00123   if (strlen (infile) > 0) {
00124     if ((infp = fopen (infile, "r")) == NULL) {
00125       fprintf (stderr, "Error: can't open %s for input.\n", infile);
00126       exit (1);
00127     }
00128   }
00129   else {
00130     infp = stdin;
00131   }
00132   if (strlen (outfile) > 0) {
00133     if ((outfp = fopen (outfile, "w")) == NULL) {
00134       fprintf (stderr, "Error: can't open %s for output.\n", outfile);
00135       exit (1);
00136     }
00137   }
00138   else {
00139     outfp = stdout;
00140   }
00141
00142   /*
00143 Print header row.
00144 */
00145   if (print_n) {
00146     fprintf (outfp, "# Glyphs      Range         Script\n");
00147     fprintf (outfp, "--------      -----         ------\n");
00148   }
00149   else {
00150     fprintf (outfp, "Covered       Range         Script\n");
00151     fprintf (outfp, "-------       -----         ------\n\n");
00152   }
00153
00154   slen = nextrange (coveragefp, &cstart, &cend, coverstring);
00155   nglyphs = 0;
00156
00157   /*
00158 Read in the glyphs in the file
00159 */
00160   while (slen != 0 && fgets (inbuf, MAXBUF-1, infp) != NULL) {
00161     sscanf (inbuf, "%x", &thischar);
00162
00163     /* Read a character beyond end of current script. */
00164     while (cend < thischar && slen != 0) {
00165       print_subtotal (outfp, print_n, nglyphs, cstart, cend, coverstring);
00166
00167       /* start new range total */
00168       slen = nextrange (coveragefp, &cstart, &cend, coverstring);
00169       nglyphs = 0;
00170     }
00171     nglyphs++;
00172   }
00173
00174   print_subtotal (outfp, print_n, nglyphs, cstart, cend, coverstring);
00175
00176   exit (0);
00177 }
00178
00179 /**
00180 @brief Get next Unicode range.
00181
00182 This function reads the next Unicode script range to count its
00183 glyph coverage.
00184
00185 @param[in] coveragefp File pointer to Unicode script range data file.
00186 @param[in] cstart Starting code point in current Unicode script range.
00187 @param[in] cend Ending code point in current Unicode script range.
```

```
00188 @param[out] coverstring String containing <cstart>-<cend> substring.
00189 @return Length of the last string read, or 0 for end of file.
00190 */
00191 int
00192 nextrange (FILE *coveragefp,
00193              int *cstart, int *cend,
00194              char *coverstring)
00195 {
00196    int i;
00197    static char inbuf[MAXBUF];
00198    int retval;          /* the return value */
00199
00200    retval = 0;
00201
00202    do {
00203       if (fgets (inbuf, MAXBUF-1, coveragefp) != NULL) {
00204          retval = strlen (inbuf);
00205          if ((inbuf[0] >= '0' && inbuf[0] <= '9') ||
00206              (inbuf[0] >= 'A' && inbuf[0] <= 'F') ||
00207              (inbuf[0] >= 'a' && inbuf[0] <= 'f')) {
00208             sscanf (inbuf, "%x-%x", cstart, cend);
00209             i = 0;
00210             while (inbuf[i] != ' ') i++;  /* find first blank */
00211             while (inbuf[i] == ' ') i++;  /* find next non-blank */
00212             strncpy (coverstring, &inbuf[i], MAXBUF);
00213          }
00214          else retval = 0;
00215       }
00216       else retval = 0;
00217    } while (retval == 0 && !feof (coveragefp));
00218
00219    return (retval);
00220 }
00221
00222
00223 /**
00224 @brief Print the subtotal for one Unicode script range.
00225
00226 @param[in] outfp Pointer to output file.
00227 @param[in] print_n 1 = print number of glyphs, 0 = print percentage.
00228 @param[in] nglyphs Number of glyphs in current range.
00229 @param[in] cstart Starting code point for current range.
00230 @param[in] cend Ending code point for current range.
00231 @param[in] coverstring Character string of "<cstart>-<cend>".
00232 */
00233 void print_subtotal (FILE *outfp, int print_n, int nglyphs,
00234                      int cstart, int cend, char *coverstring) {
00235
00236    /* print old range total */
00237    if (print_n) {  /* Print number of glyphs, not percentage */
00238       fprintf (outfp, " %6d ", nglyphs);
00239    }
00240    else {
00241       fprintf (outfp, " %5.1f%%", 100.0*nglyphs/(1+cend-cstart));
00242    }
00243
00244    if (cend < 0x10000)
00245       fprintf (outfp, "  U+%04X..U+%04X   %s",
00246                cstart, cend, coverstring);
00247    else
00248       fprintf (outfp, " U+%05X..U+%05X  %s",
00249                cstart, cend, coverstring);
00250
00251    return;
00252 }
```

5.17 src/unidup.c File Reference

unidup - Check for duplicate code points in sorted unifont.hex file
#include <stdio.h>
#include <stdlib.h>

Include dependency graph for unidup.c:



Macros

- #define MAXBUF 256

  Maximum input line length - 1.

Functions

- int main (int argc, char **argv)

  The main function.

5.17.1 Detailed Description

unidup - Check for duplicate code points in sorted unifont.hex file

Author

Paul Hardy, unifoundry <at> unifoundry.com, December 2007

Copyright

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This program reads a sorted list of glyphs in Unifont .hex format and prints duplicate code points on stderr if any were detected.
Synopsis: unidup < unifont_file.hex

[Hopefully there won't be any output!]

Definition in file unidup.c.

5.17.2 Macro Definition Documentation

5.17.2.1 MAXBUF

#define MAXBUF 256
Maximum input line length - 1.
Definition at line 37 of file unidup.c.

5.17.3 Function Documentation

5.17.3.1 main()

int main (
int argc,
char ** argv)

The main function.

Parameters

in	argc	The count of command line arguments.
in	argv	Pointer to array of command line arguments.

Returns

This program exits with status 0.

Definition at line 48 of file unidup.c.

```
00049 {
00050
00051    int ix, iy;
00052    char inbuf[MAXBUF];
00053    char *infile;   /* the input file name */
00054    FILE *infilefp; /* file pointer to input file */
00055
00056    if (argc > 1) {
00057       infile = argv[1];
00058       if ((infilefp = fopen (infile, "r")) == NULL) {
00059          fprintf (stderr, "\nERROR: Can't open file %s\n\n", infile);
00060          exit (EXIT_FAILURE);
00061       }
00062    }
00063    else {
00064       infilefp = stdin;
00065    }
00066
00067    ix = -1;
00068
00069    while (fgets (inbuf, MAXBUF-1, infilefp) != NULL) {
00070       sscanf (inbuf, "%X", &iy);
00071       if (ix == iy) fprintf (stderr, "Duplicate code point: %04X\n", ix);
00072       else ix = iy;
00073    }
00074    exit (0);
00075 }
```

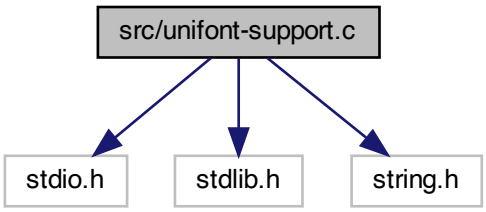
5.18 unidup.c

Go to the documentation of this file.

```
00001 /**
00002 @file unidup.c
00003
00004 @brief unidup - Check for duplicate code points in sorted unifont.hex file
00005
00006 @author Paul Hardy, unifoundry <at> unifoundry.com, December 2007
00007
00008 @copyright Copyright (C) 2007, 2008, 2013 Paul Hardy
00009
00010 This program reads a sorted list of glyphs in Unifont .hex format
00011 and prints duplicate code points on stderr if any were detected.
00012
00013 Synopsis: unidup < unifont_file.hex
00014
00015 [Hopefully there won't be any output!]
00016 */
00017 /*
00018 LICENSE:
00019
00020 This program is free software: you can redistribute it and/or modify
00021 it under the terms of the GNU General Public License as published by
00022 the Free Software Foundation, either version 2 of the License, or
00023 (at your option) any later version.
00024
00025 This program is distributed in the hope that it will be useful,
00026 but WITHOUT ANY WARRANTY; without even the implied warranty of
00027 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
00028 GNU General Public License for more details.
00029
00030 You should have received a copy of the GNU General Public License
00031 along with this program.  If not, see <http://www.gnu.org/licenses/>.
00032 */
00033
00034 #include <stdio.h>
00035 #include <stdlib.h>
00036
00037 #define MAXBUF 256   ///< Maximum input line length - 1
00038
00039
00040 /**
00041 @brief The main function.
00042
00043 @param[in] argc The count of command line arguments.
00044 @param[in] argv Pointer to array of command line arguments.
00045 @return This program exits with status 0.
00046 */
00047 int
00048 main (int argc, char **argv)
00049 {
00050
00051   int ix, iy;
00052   char inbuf[MAXBUF];
00053   char *infile;   /* the input file name */
00054   FILE *infilefp; /* file pointer to input file */
00055
00056   if (argc > 1) {
00057     infile = argv[1];
00058     if ((infilefp = fopen (infile, "r")) == NULL) {
00059       fprintf (stderr, "\nERROR: Can't open file %s\n\n", infile);
00060       exit (EXIT_FAILURE);
00061     }
00062   }
00063   else {
00064     infilefp = stdin;
00065   }
00066
00067   ix = -1;
00068
00069   while (fgets (inbuf, MAXBUF-1, infilefp) != NULL) {
00070     sscanf (inbuf, "%X", &iy);
00071     if (ix == iy) fprintf (stderr, "Duplicate code point: %04X\n", ix);
00072     else ix = iy;
00073   }
00074   exit (0);
00075 }
```

5.19 src/unifont-support.c File Reference

: Support functions for Unifont .hex files.
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
Include dependency graph for unifont-support.c:



Functions

- void parse_hex (char *hexstring, int *width, unsigned *codept, unsigned char glyph[16][2])
  Decode a Unifont .hex file into Uniocde code point and glyph.
- void glyph2bits (int width, unsigned char glyph[16][2], unsigned char glyphbits[16][16])
  Convert a Unifont binary glyph into a binary glyph array of bits.
- void hexpose (int width, unsigned char glyphbits[16][16], unsigned char transpose[2][16])
  Transpose a Unifont .hex format glyph into 2 column-major sub-arrays.
- void glyph2string (int width, unsigned codept, unsigned char glyph[16][2], char *outstring)
  Convert a glyph code point and byte array into a Unifont .hex string.
- void xglyph2string (int width, unsigned codept, unsigned char transpose[2][16], char *outstring)
  Convert a code point and transposed glyph into a Unifont .hex string.

5.19.1 Detailed Description

: Support functions for Unifont .hex files.

Author

Paul Hardy

Copyright

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Definition in file unifont-support.c.

5.19.2 Function Documentation

5.19.2.1 glyph2bits()

```
void glyph2bits (
                int width,
                unsigned char glyph[16][2],
                unsigned char glyphbits[16][16] )
```

Convert a Unifont binary glyph into a binary glyph array of bits.
This function takes a Unifont 16-row by 1- or 2-byte wide binary glyph and returns an array of 16 rows by 16 columns. For each output array element, a 1 indicates the corresponding bit was set in the binary glyph, and a 0 indicates the corresponding bit was not set.

Parameters

in	width	The number of columns in the glyph.
in	glyph	The binary glyph, as a 16-row by 2-byte array.
out	glyphbits	The converted glyph, as a 16-row, 16-column array.

Definition at line 91 of file unifont-support.c.

```
00093                                       {
00094
00095     unsigned char tmp_byte;
00096     unsigned char mask;
00097     int row, column;
00098
00099     for (row = 0; row < 16; row++) {
00100       tmp_byte = glyph [row][0];
00101       mask = 0x80;
00102       for (column = 0; column < 8; column++) {
00103         glyphbits [row][column] = tmp_byte & mask ? 1 : 0;
00104         mask »= 1;
00105       }
00106
00107       if (width > 8)
00108         tmp_byte = glyph [row][1];
00109       else
00110         tmp_byte = 0x00;
00111
00112       mask = 0x80;
00113       for (column = 8; column < 16; column++) {
```

```
00114           glyphbits [row][column] = tmp_byte & mask ? 1 : 0;
00115           mask »= 1;
00116       }
00117   }
00118
00119
00120   return;
00121 }
```

5.19.2.2 glyph2string()

```
void glyph2string (
                int width,
                unsigned codept,
                unsigned char glyph[16][2],
                char * outstring )
```

Convert a glyph code point and byte array into a Unifont .hex string.
This function takes a code point and a 16-row by 1- or 2-byte binary glyph, and converts it into a Unifont .hex format character array.

Parameters

in	width	The number of columns in the glyph.
in	codept	The code point to appear in the output .hex string.
in	glyph	The glyph, with each of 16 rows 1 or 2 bytes wide.

Parameters

out	outstring	The output string, in Unifont .hex format.

Definition at line 221 of file unifont-support.c.

```
00223                                {
00224
00225    int i;           /* index into outstring array */
00226    int row;
00227
00228    if (codept <= 0xFFFF) {
00229       sprintf (outstring, "%04X:", codept);
00230       i = 5;
00231    }
00232    else {
00233       sprintf (outstring, "%06X:", codept);
00234       i = 7;
00235    }
00236
00237    for (row = 0; row < 16; row++) {
00238       sprintf (&outstring[i], "%02X", glyph [row][0]);
00239       i += 2;
00240
00241       if (width > 8) {
00242          sprintf (&outstring[i], "%02X", glyph [row][1]);
00243          i += 2;
00244       }
00245    }
00246
00247    outstring[i] = '\0';  /* terminate output string */
00248
00249
00250    return;
00251 }
```

5.19.2.3 hexpose()

```
void hexpose (
                int width,
                unsigned char glyphbits[16][16],
                unsigned char transpose[2][16] )
```

Transpose a Unifont .hex format glyph into 2 column-major sub-arrays.

This function takes a 16-by-16 cell bit array made from a Unifont glyph (as created by the glyph2bits function) and outputs a transposed array of 2 sets of 8 or 16 columns, depending on the glyph width. This format simplifies outputting these bit patterns on a graphics display with a controller chip designed to output a column of 8 pixels at a time.

For a line of text with Unifont output, first all glyphs can have their first 8 rows of pixels displayed on a line. Then the second 8 rows of all glyphs on the line can be displayed. This simplifies code for such controller chips that are designed to automatically increment input bytes of column data by one column at a time for each successive byte.

The glyphbits array contains a '1' in each cell where the corresponding non-transposed glyph has a pixel set, and 0 in each cell where a pixel is not set.

Parameters

in	width	The number of columns in the glyph.
in	glyphbits	The 16-by-16 pixel glyph bits.
out	transpose	The array of 2 sets of 8 ot 16 columns of 8 pixels.

Definition at line 150 of file unifont-support.c.

```
00152                                   {
00153
00154   int column;
00155
00156
00157   for (column = 0; column < 8; column++) {
00158     transpose [0][column] =
00159             (glyphbits [ 0][column] « 7) |
00160             (glyphbits [ 1][column] « 6) |
00161             (glyphbits [ 2][column] « 5) |
00162             (glyphbits [ 3][column] « 4) |
00163             (glyphbits [ 4][column] « 3) |
00164             (glyphbits [ 5][column] « 2) |
00165             (glyphbits [ 6][column] « 1) |
00166             (glyphbits [ 7][column]      );
00167     transpose [1][column] =
00168             (glyphbits [ 8][column] « 7) |
00169             (glyphbits [ 9][column] « 6) |
00170             (glyphbits [10][column] « 5) |
00171             (glyphbits [11][column] « 4) |
00172             (glyphbits [12][column] « 3) |
00173             (glyphbits [13][column] « 2) |
00174             (glyphbits [14][column] « 1) |
00175             (glyphbits [15][column]      );
00176   }
00177   if (width > 8) {
00178     for (column = 8; column < width; column++) {
00179       transpose [0][column] =
00180               (glyphbits [0][column] « 7) |
00181               (glyphbits [1][column] « 6) |
00182               (glyphbits [2][column] « 5) |
00183               (glyphbits [3][column] « 4) |
00184               (glyphbits [4][column] « 3) |
00185               (glyphbits [5][column] « 2) |
00186               (glyphbits [6][column] « 1) |
00187               (glyphbits [7][column]      );
00188       transpose [1][column] =
00189               (glyphbits [ 8][column] « 7) |
00190               (glyphbits [ 9][column] « 6) |
00191               (glyphbits [10][column] « 5) |
00192               (glyphbits [11][column] « 4) |
00193               (glyphbits [12][column] « 3) |
00194               (glyphbits [13][column] « 2) |
00195               (glyphbits [14][column] « 1) |
00196               (glyphbits [15][column]      );
```

```
00197       }
00198    }
00199    else {
00200       for (column = 8; column < width; column++)
00201          transpose [0][column] = transpose [1][column] = 0x00;
00202    }
00203
00204
00205    return;
00206 }
```

5.19.2.4 parse_hex()

```
void parse_hex (
                char * hexstring,
                int * width,
                unsigned * codept,
                unsigned char glyph[16][2] )
```

Decode a Unifont .hex file into Uniocde code point and glyph.

This function takes one line from a Unifont .hex file and decodes it into a code point followed by a 16-row glyph array. The glyph array can be one byte (8 columns) or two bytes (16 columns).

Parameters

in	hexstring	The Unicode .hex string for one code point.
out	width	The number of columns in a glyph with 16 rows.
out	codept	The code point, contained in the first .hex file field.

Parameters

out	glyph	The Unifont glyph, as 16 rows by 1 or 2 bytes wide.

Definition at line 44 of file unifont-support.c.

```
00047                                   {
00048
00049     int i;
00050     int row;
00051     int length;
00052
00053     sscanf (hexstring, "%X", codept);
00054     length = strlen (hexstring);
00055     for (i = length - 1; i > 0 && hexstring[i] != '\n'; i--);
00056     hexstring[i] = '\0';
00057     for (i = 0; i < 9 && hexstring[i] != ':'; i++);
00058     i++;  /* Skip over ':' */
00059     *width = (length - i) * 4 / 16;  /* 16 rows per glyphbits */
00060
00061     for (row = 0; row < 16; row++) {
00062       sscanf (&hexstring[i], "%2hhX", &glyph [row][0]);
00063       i += 2;
00064       if (*width > 8) {
00065         sscanf (&hexstring[i], "%2hhX", &glyph [row][1]);
00066         i += 2;
00067       }
00068       else {
00069         glyph [row][1] = 0x00;
00070       }
00071     }
00072
00073
00074     return;
00075 }
```

5.19.2.5 xglyph2string()

```
void xglyph2string (
                int width,
                unsigned codept,
                unsigned char transpose[2][16],
                char * outstring )
```

Convert a code point and transposed glyph into a Unifont .hex string.

This function takes a code point and a transposed Unifont glyph of 2 rows of 8 pixels in a column, and converts it into a Unifont .hex format character array.

Parameters

in	width	The number of columns in the glyph.

Parameters

in	codept	The code point to appear in the output .hex string.
in	transpose	The transposed glyph, with 2 sets of 8-row data.
out	outstring	The output string, in Unifont .hex format.

Definition at line 267 of file unifont-support.c.

```
00269                                {
00270
00271    int i;           /* index into outstring array */
00272    int  column;
00273
00274    if (codept <= 0xFFFF) {
00275       sprintf (outstring, "%04X:", codept);
00276       i = 5;
00277    }
00278    else {
00279       sprintf (outstring, "%06X:", codept);
00280       i = 7;
00281    }
00282
00283    for (column = 0; column < 8; column++) {
00284       sprintf (&outstring[i], "%02X", transpose [0][column]);
00285       i += 2;
00286    }
00287    if (width > 8) {
00288       for (column = 8; column < 16; column++) {
00289          sprintf (&outstring[i], "%02X", transpose [0][column]);
00290          i += 2;
00291       }
00292    }
00293    for (column = 0; column < 8; column++) {
00294       sprintf (&outstring[i], "%02X", transpose [1][column]);
00295       i += 2;
00296    }
00297    if (width > 8) {
00298       for (column = 8; column < 16; column++) {
00299          sprintf (&outstring[i], "%02X", transpose [1][column]);
00300          i += 2;
00301       }
```

```
00302   }
00303
00304   outstring[i] = '\0';  /* terminate output string */
00305
00306
00307   return;
00308 }
```

5.20 unifont-support.c

Go to the documentation of this file.

```
00001 /**
00002 @file: unifont-support.c
00003
00004 @brief: Support functions for Unifont .hex files.
00005
00006 @author Paul Hardy
00007
00008 @copyright Copyright © 2023 Paul Hardy
00009 */
00010 /*
00011 LICENSE:
00012
00013 This program is free software: you can redistribute it and/or modify
00014 it under the terms of the GNU General Public License as published by
00015 the Free Software Foundation, either version 2 of the License, or
00016 (at your option) any later version.
00017
00018 This program is distributed in the hope that it will be useful,
00019 but WITHOUT ANY WARRANTY; without even the implied warranty of
00020 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
00021 GNU General Public License for more details.
00022
00023 You should have received a copy of the GNU General Public License
00024 along with this program.  If not, see <http://www.gnu.org/licenses/>.
00025 */
00026 #include <stdio.h>
00027 #include <stdlib.h>
00028 #include <string.h>
00029
00030
00031 /**
00032 @brief Decode a Unifont .hex file into Uniocde code point and glyph.
00033
00034 This function takes one line from a Unifont .hex file and decodes
00035 it into a code point followed by a 16-row glyph array.  The glyph
00036 array can be one byte (8 columns) or two bytes (16 columns).
00037
00038 @param[in] hexstring The Unicode .hex string for one code point.
00039 @param[out] width The number of columns in a glyph with 16 rows.
00040 @param[out] codept The code point, contained in the first .hex file field.
00041 @param[out] glyph The Unifont glyph, as 16 rows by 1 or 2 bytes wide.
00042 */
00043 void
00044 parse_hex (char *hexstring,
00045           int *width,
00046           unsigned *codept,
00047           unsigned char glyph[16][2]) {
00048
00049   int i;
00050   int row;
00051   int length;
00052
00053   sscanf (hexstring, "%X", codept);
00054   length = strlen (hexstring);
00055   for (i = length - 1; i > 0 && hexstring[i] != '\n'; i--);
00056   hexstring[i] = '\0';
00057   for (i = 0; i < 9 && hexstring[i] != ':'; i++);
00058   i++;  /* Skip over ':' */
00059   *width = (length - i) * 4 / 16;  /* 16 rows per glyphbits */
00060
00061   for (row = 0; row < 16; row++) {
00062     sscanf (&hexstring[i], "%2hhX", &glyph [row][0]);
00063     i += 2;
00064     if (*width > 8) {
00065       sscanf (&hexstring[i], "%2hhX", &glyph [row][1]);
00066       i += 2;
00067     }
```

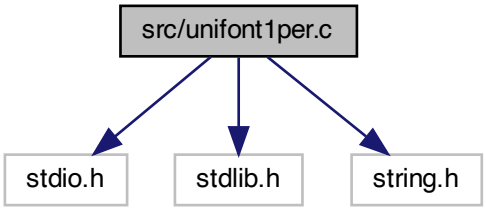
```
00068       else {
00069         glyph [row][1] = 0x00;
00070       }
00071     }
00072 
00073 
00074     return;
00075 }
00076 
00077 
00078 /**
00079 @brief Convert a Unifont binary glyph into a binary glyph array of bits.
00080 
00081 This function takes a Unifont 16-row by 1- or 2-byte wide binary glyph
00082 and returns an array of 16 rows by 16 columns.  For each output array
00083 element, a 1 indicates the corresponding bit was set in the binary
00084 glyph, and a 0 indicates the corresponding bit was not set.
00085 
00086 @param[in] width The number of columns in the glyph.
00087 @param[in] glyph The binary glyph, as a 16-row by 2-byte array.
00088 @param[out] glyphbits The converted glyph, as a 16-row, 16-column array.
00089 */
00090 void
00091 glyph2bits (int width,
00092             unsigned char glyph[16][2],
00093             unsigned char glyphbits [16][16]) {
00094 
00095     unsigned char tmp_byte;
00096     unsigned char mask;
00097     int row, column;
00098 
00099     for (row = 0; row < 16; row++) {
00100       tmp_byte = glyph [row][0];
00101       mask = 0x80;
00102       for (column = 0; column < 8; column++) {
00103         glyphbits [row][column] = tmp_byte & mask ? 1 : 0;
00104         mask »= 1;
00105       }
00106 
00107       if (width > 8)
00108         tmp_byte = glyph [row][1];
00109       else
00110         tmp_byte = 0x00;
00111 
00112       mask = 0x80;
00113       for (column = 8; column < 16; column++) {
00114         glyphbits [row][column] = tmp_byte & mask ? 1 : 0;
00115         mask »= 1;
00116       }
00117     }
00118 
00119 
00120     return;
00121 }
00122 
00123 
00124 /**
00125 @brief Transpose a Unifont .hex format glyph into 2 column-major sub-arrays.
00126 
00127 This function takes a 16-by-16 cell bit array made from a Unifont
00128 glyph (as created by the glyph2bits function) and outputs a transposed
00129 array of 2 sets of 8 or 16 columns, depending on the glyph width.
00130 This format simplifies outputting these bit patterns on a graphics
00131 display with a controller chip designed to output a column of 8 pixels
00132 at a time.
00133 
00134 For a line of text with Unifont output, first all glyphs can have
00135 their first 8 rows of pixels displayed on a line.  Then the second
00136 8 rows of all glyphs on the line can be displayed.  This simplifies
00137 code for such controller chips that are designed to automatically
00138 increment input bytes of column data by one column at a time for
00139 each successive byte.
00140 
00141 The glyphbits array contains a '1' in each cell where the corresponding
00142 non-transposed glyph has a pixel set, and 0 in each cell where a pixel
00143 is not set.
00144 
00145 @param[in] width The number of columns in the glyph.
00146 @param[in] glyphbits The 16-by-16 pixel glyph bits.
00147 @param[out] transpose The array of 2 sets of 8 ot 16 columns of 8 pixels.
00148 */
```

```
00149 void
00150 hexpose (int width,
00151         unsigned char glyphbits [16][16],
00152         unsigned char transpose [2][16]) {
00153
00154   int column;
00155
00156
00157   for (column = 0; column < 8; column++) {
00158     transpose [0][column] =
00159             (glyphbits [ 0][column] « 7) |
00160             (glyphbits [ 1][column] « 6) |
00161             (glyphbits [ 2][column] « 5) |
00162             (glyphbits [ 3][column] « 4) |
00163             (glyphbits [ 4][column] « 3) |
00164             (glyphbits [ 5][column] « 2) |
00165             (glyphbits [ 6][column] « 1) |
00166             (glyphbits [ 7][column]     );
00167     transpose [1][column] =
00168             (glyphbits [ 8][column] « 7) |
00169             (glyphbits [ 9][column] « 6) |
00170             (glyphbits [10][column] « 5) |
00171             (glyphbits [11][column] « 4) |
00172             (glyphbits [12][column] « 3) |
00173             (glyphbits [13][column] « 2) |
00174             (glyphbits [14][column] « 1) |
00175             (glyphbits [15][column]     );
00176   }
00177   if (width > 8) {
00178     for (column = 8; column < width; column++) {
00179       transpose [0][column] =
00180               (glyphbits [0][column] « 7) |
00181               (glyphbits [1][column] « 6) |
00182               (glyphbits [2][column] « 5) |
00183               (glyphbits [3][column] « 4) |
00184               (glyphbits [4][column] « 3) |
00185               (glyphbits [5][column] « 2) |
00186               (glyphbits [6][column] « 1) |
00187               (glyphbits [7][column]     );
00188       transpose [1][column] =
00189               (glyphbits [ 8][column] « 7) |
00190               (glyphbits [ 9][column] « 6) |
00191               (glyphbits [10][column] « 5) |
00192               (glyphbits [11][column] « 4) |
00193               (glyphbits [12][column] « 3) |
00194               (glyphbits [13][column] « 2) |
00195               (glyphbits [14][column] « 1) |
00196               (glyphbits [15][column]     );
00197     }
00198   }
00199   else {
00200     for (column = 8; column < width; column++)
00201       transpose [0][column] = transpose [1][column] = 0x00;
00202   }
00203
00204
00205   return;
00206 }
00207
00208
00209 /**
00210 @brief Convert a glyph code point and byte array into a Unifont .hex string.
00211
00212 This function takes a code point and a 16-row by 1- or 2-byte binary
00213 glyph, and converts it into a Unifont .hex format character array.
00214
00215 @param[in] width The number of columns in the glyph.
00216 @param[in] codept The code point to appear in the output .hex string.
00217 @param[in] glyph The glyph, with each of 16 rows 1 or 2 bytes wide.
00218 @param[out] outstring The output string, in Unifont .hex format.
00219 */
00220 void
00221 glyph2string (int width, unsigned codept,
00222               unsigned char glyph [16][2],
00223               char *outstring) {
00224
00225   int i;            /* index into outstring array */
00226   int row;
00227
00228   if (codept <= 0xFFFF) {
00229     sprintf (outstring, "%04X:", codept);
```

```
00230       i = 5;
00231    }
00232    else {
00233       sprintf (outstring, "%06X:", codept);
00234       i = 7;
00235    }
00236
00237    for (row = 0; row < 16; row++) {
00238       sprintf (&outstring[i], "%02X", glyph [row][0]);
00239       i += 2;
00240
00241       if (width > 8) {
00242          sprintf (&outstring[i], "%02X", glyph [row][1]);
00243          i += 2;
00244       }
00245    }
00246
00247    outstring[i] = '\0';  /* terminate output string */
00248
00249
00250    return;
00251 }
00252
00253
00254 /**
00255 @brief Convert a code point and transposed glyph into a Unifont .hex string.
00256
00257 This function takes a code point and a transposed Unifont glyph
00258 of 2 rows of 8 pixels in a column, and converts it into a Unifont
00259 .hex format character array.
00260
00261 @param[in] width The number of columns in the glyph.
00262 @param[in] codept The code point to appear in the output .hex string.
00263 @param[in] transpose The transposed glyph, with 2 sets of 8-row data.
00264 @param[out] outstring The output string, in Unifont .hex format.
00265 */
00266 void
00267 xglyph2string (int width, unsigned codept,
00268                unsigned char transpose [2][16],
00269                char *outstring) {
00270
00271    int i;            /* index into outstring array */
00272    int  column;
00273
00274    if (codept <= 0xFFFF) {
00275       sprintf (outstring, "%04X:", codept);
00276       i = 5;
00277    }
00278    else {
00279       sprintf (outstring, "%06X:", codept);
00280       i = 7;
00281    }
00282
00283    for (column = 0; column < 8; column++) {
00284       sprintf (&outstring[i], "%02X", transpose [0][column]);
00285       i += 2;
00286    }
00287    if (width > 8) {
00288       for (column = 8; column < 16; column++) {
00289          sprintf (&outstring[i], "%02X", transpose [0][column]);
00290          i += 2;
00291       }
00292    }
00293    for (column = 0; column < 8; column++) {
00294       sprintf (&outstring[i], "%02X", transpose [1][column]);
00295       i += 2;
00296    }
00297    if (width > 8) {
00298       for (column = 8; column < 16; column++) {
00299          sprintf (&outstring[i], "%02X", transpose [1][column]);
00300          i += 2;
00301       }
00302    }
00303
00304    outstring[i] = '\0';  /* terminate output string */
00305
00306
00307    return;
00308 }
00309
```

5.21 src/unifont1per.c File Reference

unifont1per - Read a Unifont .hex file from standard input and produce one glyph per ".bmp" bitmap file as output
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
Include dependency graph for unifont1per.c:



Macros

- #define MAXSTRING 266
- #define MAXFILENAME 20

Functions

- int main ()

  The main function.

5.21.1 Detailed Description

unifont1per - Read a Unifont .hex file from standard input and produce one glyph per ".bmp" bitmap file as output

Author

Paul Hardy, unifoundry <at> unifoundry.com, December 2016

Copyright

Copyright (C) 2016, 2017 Paul Hardy

Each glyph is 16 pixels tall, and can be 8, 16, 24, or 32 pixels wide. The width of each output graphic file is determined automatically by the width of each Unifont hex representation.
This program creates files of the form "U+<codepoint>.bmp", 1 per glyph.
Synopsis: unifont1per < unifont.hex
Definition in file unifont1per.c.

5.21.2 Macro Definition Documentation

5.21.2.1 MAXFILENAME

#define MAXFILENAME 20
Maximum size of a filename of the form "U+%06X.bmp".
Definition at line 60 of file unifont1per.c.

5.21.2.2 MAXSTRING

#define MAXSTRING 266
Maximum size of an input line in a Unifont .hex file - 1.
Definition at line 57 of file unifont1per.c.

5.21.3 Function Documentation

5.21.3.1 main()

int main ( )
The main function.

Returns

This program exits with status EXIT_SUCCESS.

Definition at line 69 of file unifont1per.c.

```
00069         {
00070
00071     int i; /* loop variable */
00072
00073     /*
00074 Define bitmap header bytes
00075 */
00076     unsigned char header [62] = {
00077       /*
00078 Bitmap File Header -- 14 bytes
00079 */
00080       'B', 'M',       /* Signature          */
00081       0x7E, 0, 0, 0,  /* File Size          */
00082         0, 0, 0, 0,   /* Reserved           */
00083       0x3E, 0, 0, 0,  /* Pixel Array Offset */
00084
00085       /*
00086 Device Independent Bitmap Header -- 40 bytes
00087
00088 Image Width and Image Height are assigned final values
00089 based on the dimensions of each glyph.
00090 */
00091       0x28,    0,    0,    0,  /* DIB Header Size                */
00092       0x10,    0,    0,    0,  /* Image Width = 16 pixels        */
00093       0xF0, 0xFF, 0xFF, 0xFF,  /* Image Height = -16 pixels      */
00094       0x01,    0,             /* Planes                         */
00095       0x01,    0,             /* Bits Per Pixel                 */
00096         0,    0,    0,    0,  /* Compression                    */
00097       0x40,    0,    0,    0,  /* Image Size                     */
00098       0x14, 0x0B,    0,    0,  /* X Pixels Per Meter = 72 dpi    */
00099       0x14, 0x0B,    0,    0,  /* Y Pixels Per Meter = 72 dpi    */
00100       0x02,    0,    0,    0,  /* Colors In Color Table          */
00101         0,    0,    0,    0,  /* Important Colors               */
00102
00103       /*
00104 Color Palette -- 8 bytes
00105 */
00106       0xFF, 0xFF, 0xFF, 0,  /* White */
00107         0,    0,    0, 0   /* Black */
00108     };
00109
00110     char instring[MAXSTRING]; /* input string                    */
00111     int  code_point;          /* current Unicode code point      */
00112     char glyph[MAXSTRING];    /* bitmap string for this glyph    */
00113     int  glyph_height=16;     /* for now, fixed at 16 pixels high */
```

```
00114    int  glyph_width;          /* 8, 16, 24, or 32 pixels wide        */
00115    char filename[MAXFILENAME];/* name of current output file        */
00116    FILE *outfp;               /* file pointer to current output file */
00117
00118    int string_index;  /* pointer into hexadecimal glyph string */
00119    int nextbyte;      /* next set of 8 bits to print out       */
00120
00121    /* Repeat for each line in the input stream */
00122    while (fgets (instring, MAXSTRING - 1, stdin) != NULL) {
00123       /* Read next Unifont ASCII hexadecimal format glyph description */
00124       sscanf (instring, "%X:%s", &code_point, glyph);
00125       /* Calculate width of a glyph in pixels; 4 bits per ASCII hex digit */
00126       glyph_width = strlen (glyph) / (glyph_height / 4);
00127       snprintf (filename, MAXFILENAME, "U+%06X.bmp", code_point);
00128       header [18] =  glyph_width;  /* bitmap width */
00129       header [22] = -glyph_height; /* negative height --> draw top to bottom */
00130       if ((outfp = fopen (filename, "w")) != NULL) {
00131          for (i = 0; i < 62; i++) fputc (header[i], outfp);
00132          /*
00133 Bitmap, with each row padded with zeroes if necessary
00134 so each row is four bytes wide.  (Each row must end
00135 on a four-byte boundary, and four bytes is the maximum
00136 possible row length for up to 32 pixels in a row.)
00137 */
00138          string_index = 0;
00139          for (i = 0; i < glyph_height; i++) {
00140             /* Read 2 ASCII hexadecimal digits (1 byte of output pixels) */
00141             sscanf (&glyph[string_index], "%2X", &nextbyte);
00142             string_index += 2;
00143             fputc (nextbyte, outfp);  /* write out the 8 pixels    */
00144             if (glyph_width <= 8) {   /* pad row with 3 zero bytes */
00145                fputc (0x00, outfp); fputc (0x00, outfp); fputc (0x00, outfp);
00146             }
00147             else { /* get 8 more pixels */
00148                sscanf (&glyph[string_index], "%2X", &nextbyte);
00149                string_index += 2;
00150                fputc (nextbyte, outfp);  /* write out the 8 pixels    */
00151                if (glyph_width <= 16) {  /* pad row with 2 zero bytes */
00152                   fputc (0x00, outfp); fputc (0x00, outfp);
00153                }
00154                else { /* get 8 more pixels */
00155                   sscanf (&glyph[string_index], "%2X", &nextbyte);
00156                   string_index += 2;
00157                   fputc (nextbyte, outfp);  /* write out the 8 pixels   */
00158                   if (glyph_width <= 24) {  /* pad row with 1 zero byte */
00159                      fputc (0x00, outfp);
00160                   }
00161                   else { /* get 8 more pixels */
00162                      sscanf (&glyph[string_index], "%2X", &nextbyte);
00163                      string_index += 2;
00164                      fputc (nextbyte, outfp); /* write out the 8 pixels */
00165                   }  /* glyph is 32 pixels wide */
00166                }  /* glyph is 24 pixels wide */
00167             }  /* glyph is 16 pixels wide */
00168          }  /* glyph is 8 pixels wide */
00169
00170          fclose (outfp);
00171       }
00172    }
00173
00174    exit (EXIT_SUCCESS);
00175 }
```

5.22 unifont1per.c

Go to the documentation of this file.

```
00001 /**
00002 @file unifont1per.c
00003
00004 @brief unifont1per - Read a Unifont .hex file from standard input and
00005 produce one glyph per ".bmp" bitmap file as output
00006
00007 @author Paul Hardy, unifoundry <at> unifoundry.com, December 2016
00008
00009 @copyright Copyright (C) 2016, 2017 Paul Hardy
00010
00011 Each glyph is 16 pixels tall, and can be 8, 16, 24,
00012 or 32 pixels wide.  The width of each output graphic
```

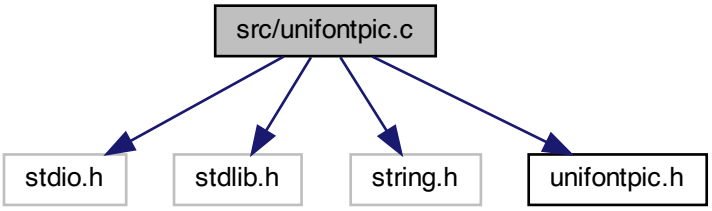
```
00013 file is determined automatically by the width of each
00014 Unifont hex representation.
00015
00016 This program creates files of the form "U+<codepoint>.bmp", 1 per glyph.
00017
00018 Synopsis: unifont1per < unifont.hex
00019 */
00020 /*
00021 LICENSE:
00022
00023 This program is free software: you can redistribute it and/or modify
00024 it under the terms of the GNU General Public License as published by
00025 the Free Software Foundation, either version 2 of the License, or
00026 (at your option) any later version.
00027
00028 This program is distributed in the hope that it will be useful,
00029 but WITHOUT ANY WARRANTY; without even the implied warranty of
00030 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
00031 GNU General Public License for more details.
00032
00033 You should have received a copy of the GNU General Public License
00034 along with this program.  If not, see <http://www.gnu.org/licenses/>.
00035
00036 Example:
00037
00038 mkdir my-bmp
00039 cd my-bmp
00040 unifont1per < ../glyphs.hex
00041
00042 */
00043
00044 /*
00045 11 May 2019 [Paul Hardy]:
00046 - Changed sprintf function call to snprintf for writing
00047 "filename" character string.
00048 - Defined MAXFILENAME to hold size of "filename" array
00049 for snprintf function call.
00050 */
00051
00052 #include <stdio.h>
00053 #include <stdlib.h>
00054 #include <string.h>
00055
00056 /** Maximum size of an input line in a Unifont .hex file - 1. */
00057 #define MAXSTRING 266
00058
00059 /** Maximum size of a filename of the form "U+%06X.bmp". */
00060 #define MAXFILENAME 20
00061
00062
00063 /**
00064 @brief The main function.
00065
00066 @return This program exits with status EXIT_SUCCESS.
00067 */
00068 int
00069 main () {
00070
00071   int i; /* loop variable */
00072
00073   /*
00074 Define bitmap header bytes
00075 */
00076   unsigned char header [62] = {
00077     /*
00078 Bitmap File Header -- 14 bytes
00079 */
00080     'B', 'M',       /* Signature         */
00081     0x7E, 0, 0, 0,  /* File Size         */
00082        0, 0, 0, 0,  /* Reserved          */
00083     0x3E, 0, 0, 0,  /* Pixel Array Offset */
00084
00085     /*
00086 Device Independent Bitmap Header -- 40 bytes
00087
00088 Image Width and Image Height are assigned final values
00089 based on the dimensions of each glyph.
00090 */
00091     0x28,    0,    0,    0,  /* DIB Header Size                */
00092     0x10,    0,    0,    0,  /* Image Width = 16 pixels        */
00093     0xF0, 0xFF, 0xFF, 0xFF,  /* Image Height = -16 pixels      */
```

```
00094       0x01,    0,             /* Planes                          */
00095       0x01,    0,             /* Bits Per Pixel                  */
00096          0,    0,    0,    0,  /* Compression                     */
00097       0x40,    0,    0,    0,  /* Image Size                      */
00098       0x14, 0x0B,    0,    0,  /* X Pixels Per Meter = 72 dpi     */
00099       0x14, 0x0B,    0,    0,  /* Y Pixels Per Meter = 72 dpi     */
00100       0x02,    0,    0,    0,  /* Colors In Color Table           */
00101          0,    0,    0,    0,  /* Important Colors                */
00102
00103       /*
00104 Color Palette -- 8 bytes
00105 */
00106       0xFF, 0xFF, 0xFF, 0,  /* White */
00107          0,    0,    0, 0   /* Black */
00108    };
00109
00110    char instring[MAXSTRING]; /* input string                        */
00111    int  code_point;          /* current Unicode code point          */
00112    char glyph[MAXSTRING];    /* bitmap string for this glyph        */
00113    int  glyph_height=16;     /* for now, fixed at 16 pixels high    */
00114    int  glyph_width;         /* 8, 16, 24, or 32 pixels wide        */
00115    char filename[MAXFILENAME];/* name of current output file        */
00116    FILE *outfp;              /* file pointer to current output file */
00117
00118    int string_index;  /* pointer into hexadecimal glyph string */
00119    int nextbyte;      /* next set of 8 bits to print out       */
00120
00121    /* Repeat for each line in the input stream */
00122    while (fgets (instring, MAXSTRING - 1, stdin) != NULL) {
00123       /* Read next Unifont ASCII hexadecimal format glyph description */
00124       sscanf (instring, "%X:%s", &code_point, glyph);
00125       /* Calculate width of a glyph in pixels; 4 bits per ASCII hex digit */
00126       glyph_width = strlen (glyph) / (glyph_height / 4);
00127       snprintf (filename, MAXFILENAME, "U+%06X.bmp", code_point);
00128       header [18] =  glyph_width;  /* bitmap width */
00129       header [22] = -glyph_height; /* negative height --> draw top to bottom */
00130       if ((outfp = fopen (filename, "w")) != NULL) {
00131          for (i = 0; i < 62; i++) fputc (header[i], outfp);
00132          /*
00133 Bitmap, with each row padded with zeroes if necessary
00134 so each row is four bytes wide.  (Each row must end
00135 on a four-byte boundary, and four bytes is the maximum
00136 possible row length for up to 32 pixels in a row.)
00137 */
00138          string_index = 0;
00139          for (i = 0; i < glyph_height; i++) {
00140             /* Read 2 ASCII hexadecimal digits (1 byte of output pixels) */
00141             sscanf (&glyph[string_index], "%2X", &nextbyte);
00142             string_index += 2;
00143             fputc (nextbyte, outfp);  /* write out the 8 pixels    */
00144             if (glyph_width <= 8) {   /* pad row with 3 zero bytes */
00145                fputc (0x00, outfp); fputc (0x00, outfp); fputc (0x00, outfp);
00146             }
00147             else { /* get 8 more pixels */
00148                sscanf (&glyph[string_index], "%2X", &nextbyte);
00149                string_index += 2;
00150                fputc (nextbyte, outfp);  /* write out the 8 pixels    */
00151                if (glyph_width <= 16) {  /* pad row with 2 zero bytes */
00152                   fputc (0x00, outfp); fputc (0x00, outfp);
00153                }
00154                else { /* get 8 more pixels */
00155                   sscanf (&glyph[string_index], "%2X", &nextbyte);
00156                   string_index += 2;
00157                   fputc (nextbyte, outfp);  /* write out the 8 pixels   */
00158                   if (glyph_width <= 24) {  /* pad row with 1 zero byte */
00159                      fputc (0x00, outfp);
00160                   }
00161                   else { /* get 8 more pixels */
00162                      sscanf (&glyph[string_index], "%2X", &nextbyte);
00163                      string_index += 2;
00164                      fputc (nextbyte, outfp); /* write out the 8 pixels */
00165                   }  /* glyph is 32 pixels wide */
00166                }  /* glyph is 24 pixels wide */
00167             }  /* glyph is 16 pixels wide */
00168          }  /* glyph is 8 pixels wide */
00169
00170          fclose (outfp);
00171       }
00172    }
00173
00174    exit (EXIT_SUCCESS);
```

00175 }

5.23 src/unifontpic.c File Reference

unifontpic - See the "Big Picture": the entire Unifont in one BMP bitmap
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include "unifontpic.h"
Include dependency graph for unifontpic.c:



Macros

- #define HDR_LEN 33

Functions

- int main (int argc, char **argv)

  The main function.
- void output4 (int thisword)

  Output a 4-byte integer in little-endian order.
- void output2 (int thisword)

  Output a 2-byte integer in little-endian order.
- void gethex (char *instring, int plane_array[0x10000][16], int plane)

  Read a Unifont .hex-format input file from stdin.
- void genlongbmp (int plane_array[0x10000][16], int dpi, int tinynum, int plane)

  Generate the BMP output file in long format.
- void genwidebmp (int plane_array[0x10000][16], int dpi, int tinynum, int plane)

  Generate the BMP output file in wide format.

5.23.1 Detailed Description

unifontpic - See the "Big Picture": the entire Unifont in one BMP bitmap

Author

Paul Hardy, 2013

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Definition in file unifontpic.c.

5.23.2 Macro Definition Documentation

5.23.2.1 HDR_LEN

#define HDR_LEN 33
Define length of header string for top of chart.
Definition at line 73 of file unifontpic.c.

5.23.3 Function Documentation

5.23.3.1 genlongbmp()

void genlongbmp (
int plane_array[0x10000][16],
int dpi,
int tinynum,
int plane)
Generate the BMP output file in long format.
This function generates the BMP output file from a bitmap parameter. This is a long bitmap, 16 glyphs wide by 4,096 glyphs tall.

Parameters

in	plane_array	The array of glyph bitmaps for a plane.
in	dpi	Dots per inch, for encoding in the BMP output file header.

Parameters

in	tinynum	Whether to generate tiny numbers in wide grid (unused).
in	plane	The Unicode plane, 0..17.

Definition at line 303 of file unifontpic.c.

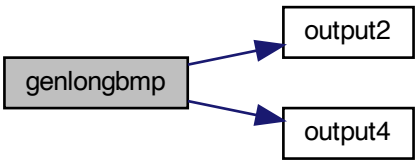
```
00304 {
00305
00306    char header_string[HDR_LEN]; /* centered header             */
00307    char raw_header[HDR_LEN];    /* left-aligned header         */
00308    int header[16][16];      /* header row, for chart title */
00309    int hdrlen;             /* length of HEADER_STRING     */
00310    int startcol;           /* column to start printing header, for centering */
00311
00312    unsigned leftcol[0x1000][16]; /* code point legend on left side of chart */
00313    int d1, d2, d3, d4;           /* digits for filling leftcol[][] legend   */
00314    int codept;                  /* current starting code point for legend  */
00315    int thisrow;                 /* glyph row currently being rendered      */
00316    unsigned toprow[16][16];     /* code point legend on top of chart       */
00317    int digitrow;       /* row we're in (0..4) for the above hexdigit digits */
00318
00319    /*
00320 DataOffset = BMP Header bytes + InfoHeader bytes + ColorTable bytes.
00321 */
00322    int DataOffset = 14 + 40 + 8; /* fixed size for monochrome BMP */
00323    int ImageSize;
00324    int FileSize;
00325    int Width, Height; /* bitmap image width and height in pixels */
00326    int ppm;     /* integer pixels per meter */
00327
00328    int i, j, k;
00329
00330    unsigned bytesout;
00331
00332    void output4(int), output2(int);
00333
00334    /*
00335 Image width and height, in pixels.
00336
00337 N.B.: Width must be an even multiple of 32 pixels, or 4 bytes.
00338 */
00339    Width  =   18 * 16;  /* (2 legend +   16 glyphs) * 16 pixels/glyph */
00340    Height = 4099 * 16;  /* (1 header + 4096 glyphs) * 16 rows/glyph   */
00341
00342    ImageSize = Height * (Width / 8); /* in bytes, calculated from pixels */
00343
00344    FileSize = DataOffset + ImageSize;
00345
00346    /* convert dots/inch to pixels/meter */
00347    if (dpi == 0) dpi = 96;
00348    ppm = (int)((double)dpi * 100.0 / 2.54 + 0.5);
00349
00350    /*
00351 Generate the BMP Header
00352 */
```

```
00353    putchar ('B');
00354    putchar ('M');
00355
00356    /*
00357 Calculate file size:
00358
00359 BMP Header + InfoHeader + Color Table + Raster Data
00360 */
00361    output4 (FileSize);  /* FileSize */
00362    output4 (0x0000); /* reserved */
00363
00364    /* Calculate DataOffset */
00365    output4 (DataOffset);
00366
00367    /*
00368 InfoHeader
00369 */
00370    output4 (40);          /* Size of InfoHeader                    */
00371    output4 (Width);       /* Width of bitmap in pixels             */
00372    output4 (Height);      /* Height of bitmap in pixels            */
00373    output2 (1);           /* Planes (1 plane)                      */
00374    output2 (1);           /* BitCount (1 = monochrome)             */
00375    output4 (0);           /* Compression (0 = none)                */
00376    output4 (ImageSize);   /* ImageSize, in bytes                   */
00377    output4 (ppm);         /* XpixelsPerM (96 dpi = 3780 pixels/meter) */
00378    output4 (ppm);         /* YpixelsPerM (96 dpi = 3780 pixels/meter) */
00379    output4 (2);           /* ColorsUsed (= 2)                      */
00380    output4 (2);           /* ColorsImportant (= 2)                 */
00381    output4 (0x00000000); /* black (reserved, B, G, R)              */
00382    output4 (0x00FFFFFF); /* white (reserved, B, G, R)              */
00383
00384    /*
00385 Create header row bits.
00386 */
00387    snprintf (raw_header, HDR_LEN, "%s Plane %d", HEADER_STRING, plane);
00388    memset ((void *)header, 0, 16 * 16 * sizeof (int)); /* fill with white */
00389    memset ((void *)header_string, ' ', 32 * sizeof (char)); /* 32 spaces */
00390    header_string[32] = '\0';  /* null-terminated */
00391
00392    hdrlen = strlen (raw_header);
00393    if (hdrlen > 32) hdrlen = 32;        /* only 32 columns to print header */
00394    startcol = 16 - ((hdrlen + 1) » 1); /* to center header                */
00395    /* center up to 32 chars */
00396    memcpy (&header_string[startcol], raw_header, hdrlen);
00397
00398    /* Copy each letter's bitmap from the plane_array[][] we constructed. */
00399    /* Each glyph must be single-width, to fit two glyphs in 16 pixels */
00400    for (j = 0; j < 16; j++) {
00401       for (i = 0; i < 16; i++) {
00402          header[i][j] =
00403             (ascii_bits[header_string[j+j  ] & 0x7F][i] & 0xFF00) |
00404             (ascii_bits[header_string[j+j+1] & 0x7F][i] » 8);
00405       }
00406    }
00407
00408    /*
00409 Create the left column legend.
00410 */
00411    memset ((void *)leftcol, 0, 4096 * 16 * sizeof (unsigned));
00412
00413    for (codept = 0x0000; codept < 0x10000; codept += 0x10) {
00414       d1 = (codept » 12) & 0xF; /* most significant hex digit */
00415       d2 = (codept »  8) & 0xF;
00416       d3 = (codept »  4) & 0xF;
00417
00418       thisrow = codept » 4; /* rows of 16 glyphs */
00419
00420       /* fill in first and second digits */
00421       for (digitrow = 0; digitrow < 5; digitrow++) {
00422          leftcol[thisrow][2 + digitrow] =
00423             (hexdigit[d1][digitrow] « 10) |
00424             (hexdigit[d2][digitrow] «  4);
00425       }
00426
00427       /* fill in third digit */
00428       for (digitrow = 0; digitrow < 5; digitrow++) {
00429          leftcol[thisrow][9 + digitrow] = hexdigit[d3][digitrow] « 10;
00430       }
00431       leftcol[thisrow][9 + 4] |= 0xF « 4; /* underscore as 4th digit */
00432
00433       for (i = 0; i < 15; i ++) {
```

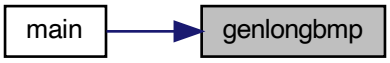
```
00434           leftcol[thisrow][i] |= 0x00000002;      /* right border */
00435       }
00436
00437       leftcol[thisrow][15] = 0x0000FFFE;        /* bottom border */
00438
00439       if (d3 == 0xF) {                      /* 256-point boundary */
00440           leftcol[thisrow][15] |= 0x00FF0000;  /* longer tic mark */
00441       }
00442
00443       if ((thisrow % 0x40) == 0x3F) {     /* 1024-point boundary */
00444           leftcol[thisrow][15] |= 0xFFFF0000; /* longest tic mark */
00445       }
00446   }
00447
00448   /*
00449 Create the top row legend.
00450 */
00451   memset ((void *)toprow, 0, 16 * 16 * sizeof (unsigned));
00452
00453   for (codept = 0x0; codept <= 0xF; codept++) {
00454       d1 = (codept » 12) & 0xF; /* most significant hex digit */
00455       d2 = (codept »  8) & 0xF;
00456       d3 = (codept »  4) & 0xF;
00457       d4 =  codept       & 0xF; /* least significant hex digit */
00458
00459       /* fill in last digit */
00460       for (digitrow = 0; digitrow < 5; digitrow++) {
00461           toprow[6 + digitrow][codept] = hexdigit[d4][digitrow] « 6;
00462       }
00463   }
00464
00465   for (j = 0; j < 16; j++) {
00466       /* force bottom pixel row to be white, for separation from glyphs */
00467       toprow[15][j] = 0x0000;
00468   }
00469
00470   /* 1 pixel row with left-hand legend line */
00471   for (j = 0; j < 16; j++) {
00472       toprow[14][j] |= 0xFFFF;
00473   }
00474
00475   /* 14 rows with line on left to fill out this character row */
00476   for (i = 13; i >= 0; i--) {
00477       for (j = 0; j < 16; j++) {
00478           toprow[i][j] |= 0x0001;
00479       }
00480   }
00481
00482   /*
00483 Now write the raster image.
00484
00485 XOR each byte with 0xFF because black = 0, white = 1 in BMP.
00486 */
00487
00488   /* Write the glyphs, bottom-up, left-to-right, in rows of 16 (i.e., 0x10) */
00489   for (i = 0xFFF0; i >= 0; i -= 0x10) {
00490       thisrow = i » 4; /* 16 glyphs per row */
00491       for (j = 15; j >= 0; j--) {
00492           /* left-hand legend */
00493           putchar ((~leftcol[thisrow][j] » 24) & 0xFF);
00494           putchar ((~leftcol[thisrow][j] » 16) & 0xFF);
00495           putchar ((~leftcol[thisrow][j] »  8) & 0xFF);
00496           putchar ( ~leftcol[thisrow][j]       & 0xFF);
00497           /* Unifont glyph */
00498           for (k = 0; k < 16; k++) {
00499               bytesout = ~plane_array[i+k][j] & 0xFFFF;
00500               putchar ((bytesout » 8) & 0xFF);
00501               putchar ( bytesout      & 0xFF);
00502           }
00503       }
00504   }
00505
00506   /*
00507 Write the top legend.
00508 */
00509   /* i == 15: bottom pixel row of header is output here */
00510   /* left-hand legend: solid black line except for right-most pixel */
00511   putchar (0x00);
00512   putchar (0x00);
00513   putchar (0x00);
00514   putchar (0x01);
```

```
00515    for (j = 0; j < 16; j++) {
00516       putchar ((~toprow[15][j] » 8) & 0xFF);
00517       putchar ( ~toprow[15][j]       & 0xFF);
00518    }
00519
00520    putchar (0xFF);
00521    putchar (0xFF);
00522    putchar (0xFF);
00523    putchar (0xFC);
00524    for (j = 0; j < 16; j++) {
00525       putchar ((~toprow[14][j] » 8) & 0xFF);
00526       putchar ( ~toprow[14][j]       & 0xFF);
00527    }
00528
00529    for (i = 13; i >= 0; i--) {
00530       putchar (0xFF);
00531       putchar (0xFF);
00532       putchar (0xFF);
00533       putchar (0xFD);
00534       for (j = 0; j < 16; j++) {
00535          putchar ((~toprow[i][j] » 8) & 0xFF);
00536          putchar ( ~toprow[i][j]       & 0xFF);
00537       }
00538    }
00539
00540    /*
00541 Write the header.
00542 */
00543
00544    /* 7 completely white rows */
00545    for (i = 7; i >= 0; i--) {
00546       for (j = 0; j < 18; j++) {
00547          putchar (0xFF);
00548          putchar (0xFF);
00549       }
00550    }
00551
00552    for (i = 15; i >= 0; i--) {
00553       /* left-hand legend */
00554       putchar (0xFF);
00555       putchar (0xFF);
00556       putchar (0xFF);
00557       putchar (0xFF);
00558       /* header glyph */
00559       for (j = 0; j < 16; j++) {
00560          bytesout = ~header[i][j] & 0xFFFF;
00561          putchar ((bytesout » 8) & 0xFF);
00562          putchar ( bytesout       & 0xFF);
00563       }
00564    }
00565
00566    /* 8 completely white rows at very top */
00567    for (i = 7; i >= 0; i--) {
00568       for (j = 0; j < 18; j++) {
00569       putchar (0xFF);
00570       putchar (0xFF);
00571       }
00572    }
00573
00574    return;
00575 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.23.3.2 genwidebmp()

```
void genwidebmp (
            int plane_array[0x10000][16],
            int dpi,
            int tinynum,
            int plane )
```

Generate the BMP output file in wide format.
This function generates the BMP output file from a bitmap parameter. This is a wide bitmap, 256 glyphs wide by 256 glyphs tall.

Parameters

in	plane_array	The array of glyph bitmaps for a plane.

Parameters

in	dpi	Dots per inch, for encoding in the BMP output file header.
in	tinynum	Whether to generate tiny numbers in 256x256 grid.
in	plane	The Unicode plane, 0..17.

Definition at line 590 of file unifontpic.c.

```
00591 {
00592
00593   char header_string[257];
00594   char raw_header[HDR_LEN];
00595   int header[16][256]; /* header row, for chart title */
00596   int hdrlen;          /* length of HEADER_STRING */
00597   int startcol;        /* column to start printing header, for centering */
00598
00599   unsigned leftcol[0x100][16]; /* code point legend on left side of chart */
00600   int d1, d2, d3, d4;          /* digits for filling leftcol[][] legend   */
00601   int codept;                  /* current starting code point for legend  */
00602   int thisrow;                 /* glyph row currently being rendered      */
00603   unsigned toprow[32][256];    /* code point legend on top of chart       */
00604   int digitrow;       /* row we're in (0..4) for the above hexdigit digits */
00605   int hexalpha1, hexalpha2;    /* to convert hex digits to ASCII          */
00606
00607   /*
00608 DataOffset = BMP Header bytes + InfoHeader bytes + ColorTable bytes.
00609 */
00610   int DataOffset = 14 + 40 + 8; /* fixed size for monochrome BMP */
00611   int ImageSize;
00612   int FileSize;
00613   int Width, Height; /* bitmap image width and height in pixels */
00614   int ppm;     /* integer pixels per meter */
00615
00616   int i, j, k;
00617
00618   unsigned bytesout;
00619
00620   void output4(int), output2(int);
00621
00622   /*
00623 Image width and height, in pixels.
00624
```

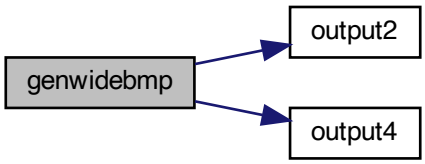
```
00625 N.B.: Width must be an even multiple of 32 pixels, or 4 bytes.
00626 */
00627    Width  = 258 * 16;  /* (          2 legend + 256 glyphs) * 16 pixels/glyph */
00628    Height = 260 * 16;  /* (2 header + 2 legend + 256 glyphs) * 16 rows/glyph   */
00629
00630    ImageSize = Height * (Width / 8); /* in bytes, calculated from pixels */
00631
00632    FileSize = DataOffset + ImageSize;
00633
00634    /* convert dots/inch to pixels/meter */
00635    if (dpi == 0) dpi = 96;
00636    ppm = (int)((double)dpi * 100.0 / 2.54 + 0.5);
00637
00638    /*
00639 Generate the BMP Header
00640 */
00641    putchar ('B');
00642    putchar ('M');
00643    /*
00644 Calculate file size:
00645
00646 BMP Header + InfoHeader + Color Table + Raster Data
00647 */
00648    output4 (FileSize);  /* FileSize */
00649    output4 (0x0000); /* reserved */
00650    /* Calculate DataOffset */
00651    output4 (DataOffset);
00652
00653    /*
00654 InfoHeader
00655 */
00656    output4 (40);         /* Size of InfoHeader                    */
00657    output4 (Width);      /* Width of bitmap in pixels             */
00658    output4 (Height);     /* Height of bitmap in pixels            */
00659    output2 (1);          /* Planes (1 plane)                      */
00660    output2 (1);          /* BitCount (1 = monochrome)             */
00661    output4 (0);          /* Compression (0 = none)                */
00662    output4 (ImageSize);  /* ImageSize, in bytes                   */
00663    output4 (ppm);        /* XpixelsPerM (96 dpi = 3780 pixels/meter) */
00664    output4 (ppm);        /* YpixelsPerM (96 dpi = 3780 pixels/meter) */
00665    output4 (2);          /* ColorsUsed (= 2)                      */
00666    output4 (2);          /* ColorsImportant (= 2)                 */
00667    output4 (0x00000000); /* black (reserved, B, G, R)             */
00668    output4 (0x00FFFFFF); /* white (reserved, B, G, R)             */
00669
00670    /*
00671 Create header row bits.
00672 */
00673    snprintf (raw_header, HDR_LEN, "%s Plane %d", HEADER_STRING, plane);
00674    memset ((void *)header, 0, 256 * 16 * sizeof (int)); /* fill with white */
00675    memset ((void *)header_string, ' ', 256 * sizeof (char)); /* 256 spaces */
00676    header_string[256] = '\0';  /* null-terminated */
00677
00678    hdrlen = strlen (raw_header);
00679    /* Wide bitmap can print 256 columns, but limit to 32 columns for long bitmap. */
00680    if (hdrlen > 32) hdrlen = 32;
00681    startcol = 127 - ((hdrlen - 1) » 1);  /* to center header */
00682    /* center up to 32 chars */
00683    memcpy (&header_string[startcol], raw_header, hdrlen);
00684
00685    /* Copy each letter's bitmap from the plane_array[][] we constructed. */
00686    for (j = 0; j < 256; j++) {
00687       for (i = 0; i < 16; i++) {
00688          header[i][j] = ascii_bits[header_string[j] & 0x7F][i];
00689       }
00690    }
00691
00692    /*
00693 Create the left column legend.
00694 */
00695    memset ((void *)leftcol, 0, 256 * 16 * sizeof (unsigned));
00696
00697    for (codept = 0x0000; codept < 0x10000; codept += 0x100) {
00698       d1 = (codept » 12) & 0xF; /* most significant hex digit */
00699       d2 = (codept »  8) & 0xF;
00700
00701       thisrow = codept » 8; /* rows of 256 glyphs */
00702
00703       /* fill in first and second digits */
00704
00705       if (tinynum) { /* use 4x5 pixel glyphs */
```

```
00706         for (digitrow = 0; digitrow < 5; digitrow++) {
00707           leftcol[thisrow][6 + digitrow] =
00708             (hexdigit[d1][digitrow] << 10) |
00709             (hexdigit[d2][digitrow] <<  4);
00710         }
00711       }
00712       else { /* bigger numbers -- use glyphs from Unifont itself */
00713         /* convert hexadecimal digits to ASCII equivalent */
00714         hexalpha1 = d1 < 0xA ? '0' + d1 : 'A' + d1 - 0xA;
00715         hexalpha2 = d2 < 0xA ? '0' + d2 : 'A' + d2 - 0xA;
00716
00717         for (i = 0 ; i < 16; i++) {
00718           leftcol[thisrow][i] =
00719             (ascii_bits[hexalpha1][i] << 2) |
00720             (ascii_bits[hexalpha2][i] >> 6);
00721         }
00722       }
00723
00724       for (i = 0; i < 15; i ++) {
00725         leftcol[thisrow][i] |= 0x00000002;      /* right border */
00726       }
00727
00728       leftcol[thisrow][15] = 0x0000FFFE;        /* bottom border */
00729
00730       if (d2 == 0xF) {                          /* 4096-point boundary */
00731         leftcol[thisrow][15] |= 0x00FF0000;  /* longer tic mark */
00732       }
00733
00734       if ((thisrow % 0x40) == 0x3F) {     /* 16,384-point boundary */
00735         leftcol[thisrow][15] |= 0xFFFF0000; /* longest tic mark */
00736       }
00737     }
00738
00739     /*
00740   Create the top row legend.
00741   */
00742     memset ((void *)toprow, 0, 32 * 256 * sizeof (unsigned));
00743
00744     for (codept = 0x00; codept <= 0xFF; codept++) {
00745       d3 = (codept >>  4) & 0xF;
00746       d4 =  codept        & 0xF; /* least significant hex digit */
00747
00748       if (tinynum) {
00749         for (digitrow = 0; digitrow < 5; digitrow++) {
00750           toprow[16 + 6 + digitrow][codept] =
00751             (hexdigit[d3][digitrow] << 10) |
00752             (hexdigit[d4][digitrow] <<  4);
00753         }
00754       }
00755       else {
00756         /* convert hexadecimal digits to ASCII equivalent */
00757         hexalpha1 = d3 < 0xA ? '0' + d3 : 'A' + d3 - 0xA;
00758         hexalpha2 = d4 < 0xA ? '0' + d4 : 'A' + d4 - 0xA;
00759         for (i = 0 ; i < 16; i++) {
00760           toprow[14 + i][codept] =
00761             (ascii_bits[hexalpha1][i]     ) |
00762             (ascii_bits[hexalpha2][i] >> 7);
00763         }
00764       }
00765     }
00766
00767     for (j = 0; j < 256; j++) {
00768       /* force bottom pixel row to be white, for separation from glyphs */
00769       toprow[16 + 15][j] = 0x0000;
00770     }
00771
00772     /* 1 pixel row with left-hand legend line */
00773     for (j = 0; j < 256; j++) {
00774       toprow[16 + 14][j] |= 0xFFFF;
00775     }
00776
00777     /* 14 rows with line on left to fill out this character row */
00778     for (i = 13; i >= 0; i--) {
00779       for (j = 0; j < 256; j++) {
00780         toprow[16 + i][j] |= 0x0001;
00781       }
00782     }
00783
00784     /* Form the longer tic marks in top legend */
00785     for (i = 8; i < 16; i++) {
00786       for (j = 0x0F; j < 0x100; j += 0x10) {
```

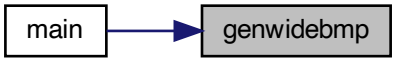
```
00787         toprow[i][j] |= 0x0001;
00788       }
00789     }
00790
00791     /*
00792 Now write the raster image.
00793
00794 XOR each byte with 0xFF because black = 0, white = 1 in BMP.
00795 */
00796
00797     /* Write the glyphs, bottom-up, left-to-right, in rows of 16 (i.e., 0x10) */
00798     for (i = 0xFF00; i >= 0; i -= 0x100) {
00799       thisrow = i » 8; /* 256 glyphs per row */
00800       for (j = 15; j >= 0; j--) {
00801         /* left-hand legend */
00802         putchar ((~leftcol[thisrow][j] » 24) & 0xFF);
00803         putchar ((~leftcol[thisrow][j] » 16) & 0xFF);
00804         putchar ((~leftcol[thisrow][j] »  8) & 0xFF);
00805         putchar ( ~leftcol[thisrow][j]       & 0xFF);
00806         /* Unifont glyph */
00807         for (k = 0x00; k < 0x100; k++) {
00808           bytesout = ~plane_array[i+k][j] & 0xFFFF;
00809           putchar ((bytesout » 8) & 0xFF);
00810           putchar ( bytesout      & 0xFF);
00811         }
00812       }
00813     }
00814
00815     /*
00816 Write the top legend.
00817 */
00818     /* i == 15: bottom pixel row of header is output here */
00819     /* left-hand legend: solid black line except for right-most pixel */
00820     putchar (0x00);
00821     putchar (0x00);
00822     putchar (0x00);
00823     putchar (0x01);
00824     for (j = 0; j < 256; j++) {
00825       putchar ((~toprow[16 + 15][j] » 8) & 0xFF);
00826       putchar ( ~toprow[16 + 15][j]      & 0xFF);
00827     }
00828
00829     putchar (0xFF);
00830     putchar (0xFF);
00831     putchar (0xFF);
00832     putchar (0xFC);
00833     for (j = 0; j < 256; j++) {
00834       putchar ((~toprow[16 + 14][j] » 8) & 0xFF);
00835       putchar ( ~toprow[16 + 14][j]      & 0xFF);
00836     }
00837
00838     for (i = 16 + 13; i >= 0; i--) {
00839       if (i >= 8) { /* make vertical stroke on right */
00840         putchar (0xFF);
00841         putchar (0xFF);
00842         putchar (0xFF);
00843         putchar (0xFD);
00844       }
00845       else { /* all white */
00846         putchar (0xFF);
00847         putchar (0xFF);
00848         putchar (0xFF);
00849         putchar (0xFF);
00850       }
00851       for (j = 0; j < 256; j++) {
00852         putchar ((~toprow[i][j] » 8) & 0xFF);
00853         putchar ( ~toprow[i][j]      & 0xFF);
00854       }
00855     }
00856
00857     /*
00858 Write the header.
00859 */
00860
00861     /* 8 completely white rows */
00862     for (i = 7; i >= 0; i--) {
00863       for (j = 0; j < 258; j++) {
00864         putchar (0xFF);
00865         putchar (0xFF);
00866       }
00867     }
```

```
00868
00869    for (i = 15; i >= 0; i--) {
00870       /* left-hand legend */
00871       putchar (0xFF);
00872       putchar (0xFF);
00873       putchar (0xFF);
00874       putchar (0xFF);
00875       /* header glyph */
00876       for (j = 0; j < 256; j++) {
00877          bytesout = ~header[i][j] & 0xFFFF;
00878          putchar ((bytesout » 8) & 0xFF);
00879          putchar ( bytesout      & 0xFF);
00880       }
00881    }
00882
00883    /* 8 completely white rows at very top */
00884    for (i = 7; i >= 0; i--) {
00885       for (j = 0; j < 258; j++) {
00886       putchar (0xFF);
00887       putchar (0xFF);
00888       }
00889    }
00890
00891    return;
00892 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.23.3.3 gethex()

```
void gethex (
                char * instring,
                int plane_array[0x10000][16],
                int plane )
```

Read a Unifont .hex-format input file from stdin.
Each glyph can be 2, 4, 6, or 8 ASCII hexadecimal digits wide. Glyph height is fixed at 16 pixels.

Parameters

in	instring	One line from a Unifont .hex-format file.
in,out	plane_array	Bitmap for this plane, one bitmap row per element.
in	plane	The Unicode plane, 0..17.

Definition at line 224 of file unifontpic.c.

```
00225 {
00226    char *bitstring;  /* pointer into instring for glyph bitmap */
00227    int i;       /* loop variable                                */
00228    int codept;  /* the Unicode code point of the current glyph */
00229    int glyph_plane; /* Unicode plane of current glyph           */
00230    int ndigits; /* number of ASCII hexadecimal digits in glyph */
00231    int bytespl; /* bytes per line of pixels in a glyph          */
00232    int temprow; /* 1 row of a quadruple-width glyph             */
00233    int newrow;  /* 1 row of double-width output pixels          */
00234    unsigned bitmask; /* to mask off 2 bits of long width glyph */
00235
00236    /*
00237 Read each input line and place its glyph into the bit array.
00238 */
00239    sscanf (instring, "%X", &codept);
00240    glyph_plane = codept » 16;
00241    if (glyph_plane == plane) {
00242       codept &= 0xFFFF;  /* array index will only have 16 bit address */
00243       /* find the colon separator */
00244       for (i = 0; (i < 9) && (instring[i] != ':'); i++);
00245       i++; /* position past it */
00246       bitstring = &instring[i];
00247       ndigits = strlen (bitstring);
00248       /* don't count '\n' at end of line if present */
00249       if (bitstring[ndigits - 1] == '\n') ndigits--;
00250       bytespl = ndigits » 5;  /* 16 rows per line, 2 digits per byte */
00251
00252       if (bytespl >= 1 && bytespl <= 4) {
00253          for (i = 0; i < 16; i++) { /* 16 rows per glyph */
00254             /* Read correct number of hexadecimal digits given glyph width */
00255             switch (bytespl) {
00256                case 1: sscanf (bitstring, "%2X", &temprow);
00257                        bitstring += 2;
00258                        temprow «= 8; /* left-justify single-width glyph */
00259                        break;
00260                case 2: sscanf (bitstring, "%4X", &temprow);
00261                        bitstring += 4;
00262                        break;
00263             /* cases 3 and 4 widths will be compressed by 50% (see below) */
00264                case 3: sscanf (bitstring, "%6X", &temprow);
00265                        bitstring += 6;
```

```
00266                     temprow «= 8; /* left-justify */
00267                     break;
00268                 case 4: sscanf (bitstring, "%8X", &temprow);
00269                     bitstring += 8;
00270                     break;
00271             }  /* switch on number of bytes per row */
00272             /* compress glyph width by 50% if greater than double-width */
00273             if (bytespl > 2) {
00274               newrow = 0x0000;
00275               /* mask off 2 bits at a time to convert each pair to 1 bit out */
00276               for (bitmask = 0xC0000000; bitmask != 0; bitmask »= 2) {
00277                 newrow «= 1;
00278                 if ((temprow & bitmask) != 0) newrow |= 1;
00279               }
00280               temprow = newrow;
00281             }  /* done conditioning glyphs beyond double-width */
00282             plane_array[codept][i] = temprow;  /* store glyph bitmap for output */
00283           }  /* for each row */
00284         }  /* if 1 to 4 bytes per row/line */
00285       }  /* if this is the plane we are seeking */
00286
00287     return;
00288 }
```

Here is the caller graph for this function:

5.23.3.4 main()

```
int main (
                int argc,
                char ** argv )
```

The main function.

Parameters

in	argc	The count of command line arguments.
in	argv	Pointer to array of command line arguments.

Returns

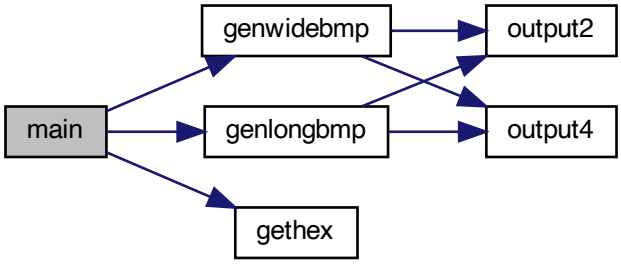
This program exits with status EXIT_SUCCESS.

Definition at line 93 of file unifontpic.c.

```
00094 {
00095   /* Input line buffer */
00096   char instring[MAXSTRING];
00097
00098   /* long and dpi are set from command-line options */
00099   int wide=1; /* =1 for a 256x256 grid, =0 for a 16x4096 grid */
00100   int dpi=96; /* change for 256x256 grid to fit paper if desired */
00101   int tinynum=0; /* whether to use tiny labels for 256x256 grid */
00102
00103   int i, j; /* loop variables */
00104
00105   int plane=0;      /* Unicode plane, 0..17; Plane 0 is default */
00106   /* 16 pixel rows for each of 65,536 glyphs in a Unicode plane */
00107   int plane_array[0x10000][16];
00108
00109   void gethex     (char *instring, int plane_array[0x10000][16], int plane);
00110   void genlongbmp (int plane_array[0x10000][16], int dpi, int tinynum,
00111                    int plane);
00112   void genwidebmp (int plane_array[0x10000][16], int dpi, int tinynum,
00113                    int plane);
00114
00115   if (argc > 1) {
00116     for (i = 1; i < argc; i++) {
00117       if (strncmp (argv[i],"-l",2) == 0) { /* long display */
00118         wide = 0;
00119       }
00120       else if (strncmp (argv[i],"-d",2) == 0) {
00121         dpi = atoi (&argv[i][2]); /* dots/inch specified on command line */
00122       }
00123       else if (strncmp (argv[i],"-t",2) == 0) {
00124         tinynum = 1;
00125       }
00126       else if (strncmp (argv[i],"-P",2) == 0) {
00127         /* Get Unicode plane */
00128         for (j = 2; argv[i][j] != '\0'; j++) {
00129           if (argv[i][j] < '0' || argv[i][j] > '9') {
00130             fprintf (stderr,
00131                      "ERROR: Specify Unicode plane as decimal number.\n\n");
00132             exit (EXIT_FAILURE);
00133           }
00134         }
00135         plane = atoi (&argv[i][2]); /* Unicode plane, 0..17 */
00136         if (plane < 0 || plane > 17) {
00137           fprintf (stderr,
00138                    "ERROR: Plane out of Unicode range [0,17].\n\n");
00139           exit (EXIT_FAILURE);
00140         }
00141       }
00142     }
00143   }
00144
00145
00146   /*
00147 Initialize the ASCII bitmap array for chart titles
00148 */
00149   for (i = 0; i < 128; i++) {
00150     /* convert Unifont hexadecimal string to bitmap */
00151     gethex ((char *)ascii_hex[i], plane_array, 0);
00152     for (j = 0; j < 16; j++) ascii_bits[i][j] = plane_array[i][j];
00153   }
00154
00155
00156   /*
00157 Read in the Unifont hex file to render from standard input
00158 */
00159   memset ((void *)plane_array, 0, 0x10000 * 16 * sizeof (int));
00160   while (fgets (instring, MAXSTRING, stdin) != NULL) {
00161     gethex (instring, plane_array, plane); /* read .hex input file and fill plane_array with glyph data */
00162   }  /* while not EOF */
00163
00164
00165   /*
00166 Write plane_array glyph data to BMP file as wide or long bitmap.
00167 */
00168   if (wide) {
00169     genwidebmp (plane_array, dpi, tinynum, plane);
```

```
00170    }
00171    else {
00172       genlongbmp (plane_array, dpi, tinynum, plane);
00173    }
00174
00175    exit (EXIT_SUCCESS);
00176 }
```

Here is the call graph for this function:



5.23.3.5 output2()

```
void output2 (
                int thisword )
```

Output a 2-byte integer in little-endian order.

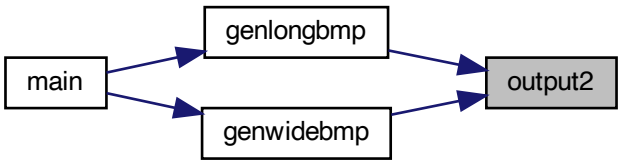
Parameters

in	thisword	The 2-byte integer to output as binary data.

Definition at line 203 of file unifontpic.c.

```
00204 {
00205
00206    putchar ( thisword      & 0xFF);
00207    putchar ((thisword » 8) & 0xFF);
00208
00209    return;
00210 }
```

Here is the caller graph for this function:



5.23.3.6 output4()

```
void output4 (
                int thisword )
```

Output a 4-byte integer in little-endian order.

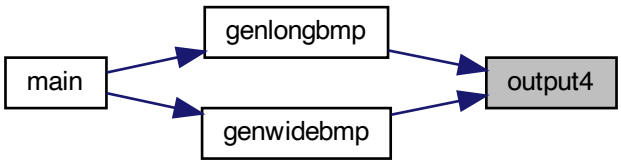
Parameters

in	thisword	The 4-byte integer to output as binary data.

Definition at line 185 of file unifontpic.c.

```
00186 {
00187
00188    putchar ( thisword       & 0xFF);
00189    putchar ((thisword »  8) & 0xFF);
00190    putchar ((thisword » 16) & 0xFF);
00191    putchar ((thisword » 24) & 0xFF);
00192
00193    return;
00194 }
```

Here is the caller graph for this function:



5.24 unifontpic.c

Go to the documentation of this file.

```
00001 /**
00002 @file unifontpic.c
00003
00004 @brief unifontpic - See the "Big Picture": the entire Unifont
00005 in one BMP bitmap
00006
00007 @author Paul Hardy, 2013
00008
00009 @copyright Copyright (C) 2013, 2017 Paul Hardy
00010 */
00011 /*
00012 LICENSE:
00013
00014 This program is free software: you can redistribute it and/or modify
00015 it under the terms of the GNU General Public License as published by
00016 the Free Software Foundation, either version 2 of the License, or
00017 (at your option) any later version.
00018
00019 This program is distributed in the hope that it will be useful,
00020 but WITHOUT ANY WARRANTY; without even the implied warranty of
00021 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
00022 GNU General Public License for more details.
00023
00024 You should have received a copy of the GNU General Public License
00025 along with this program.  If not, see <http://www.gnu.org/licenses/>.
00026 */
00027
00028 /*
00029 11 June 2017 [Paul Hardy]:
00030 -  Modified to take glyphs that are 24 or 32 pixels wide and
00031 compress them horizontally by 50%.
00032
00033 8 July 2017 [Paul Hardy]:
00034 - Modified to print Unifont charts above Unicode Plane 0.
00035 - Adds "-P" option to specify Unicode plane in decimal,
00036 as "-P0" through "-P17".  Omitting this argument uses
00037 plane 0 as the default.
00038 - Appends Unicode plane number to chart title.
00039 - Reads in "unifontpic.h", which was added mainly to
00040 store ASCII chart title glyphs in an embedded array
00041 rather than requiring these ASCII glyphs to be in
00042 the ".hex" file that is read in for the chart body
00043 (which was the case previously, when all that was
00044 able to print was Unicode place 0).
00045 - Fixes truncated header in long bitmap format, making
00046 the long chart title glyphs single-spaced.  This leaves
00047 room for the Unicode plane to appear even in the narrow
00048 chart title of the "long" format chart.  The wide chart
00049 title still has double-spaced ASCII glyphs.
00050 - Adjusts centering of title on long and wide charts.
00051
00052 11 May 2019 [Paul Hardy]:
00053 - Changed strncpy calls to memcpy.
```

```
00054 - Added "HDR_LEN" to define length of header string
00055 for use in snprintf function call.
00056 - Changed sprintf function calls to snprintf function
00057 calls for writing chart header string.
00058
00059 21 October 2023 [Paul Hardy]:
00060 - Added full function prototypes in main function for
00061 functions gethex, genlongbmp, and genwidebmp.
00062 - Typecast ascii_hex[i] to char * in gethex function call
00063 to avoid warning about const char * conversion.
00064 */
00065
00066
00067 #include <stdio.h>
00068 #include <stdlib.h>
00069 #include <string.h>
00070 #include "unifontpic.h"
00071
00072 /** Define length of header string for top of chart. */
00073 #define HDR_LEN 33
00074
00075
00076 /*
00077 Stylistic Note:
00078
00079 Many variables in this program use multiple words scrunched
00080 together, with each word starting with an upper-case letter.
00081 This is only done to match the canonical field names in the
00082 Windows Bitmap Graphics spec.
00083 */
00084
00085 /**
00086 @brief The main function.
00087
00088 @param[in] argc The count of command line arguments.
00089 @param[in] argv Pointer to array of command line arguments.
00090 @return This program exits with status EXIT_SUCCESS.
00091 */
00092 int
00093 main (int argc, char **argv)
00094 {
00095   /* Input line buffer */
00096   char instring[MAXSTRING];
00097
00098   /* long and dpi are set from command-line options */
00099   int wide=1; /* =1 for a 256x256 grid, =0 for a 16x4096 grid */
00100   int dpi=96; /* change for 256x256 grid to fit paper if desired */
00101   int tinynum=0; /* whether to use tiny labels for 256x256 grid */
00102
00103   int i, j; /* loop variables */
00104
00105   int plane=0;      /* Unicode plane, 0..17; Plane 0 is default */
00106   /* 16 pixel rows for each of 65,536 glyphs in a Unicode plane */
00107   int plane_array[0x10000][16];
00108
00109   void gethex     (char *instring, int plane_array[0x10000][16], int plane);
00110   void genlongbmp (int plane_array[0x10000][16], int dpi, int tinynum,
00111                    int plane);
00112   void genwidebmp (int plane_array[0x10000][16], int dpi, int tinynum,
00113                    int plane);
00114
00115   if (argc > 1) {
00116     for (i = 1; i < argc; i++) {
00117       if (strncmp (argv[i],"-l",2) == 0) { /* long display */
00118         wide = 0;
00119       }
00120       else if (strncmp (argv[i],"-d",2) == 0) {
00121         dpi = atoi (&argv[i][2]); /* dots/inch specified on command line */
00122       }
00123       else if (strncmp (argv[i],"-t",2) == 0) {
00124         tinynum = 1;
00125       }
00126       else if (strncmp (argv[i],"-P",2) == 0) {
00127         /* Get Unicode plane */
00128         for (j = 2; argv[i][j] != '\0'; j++) {
00129           if (argv[i][j] < '0' || argv[i][j] > '9') {
00130             fprintf (stderr,
00131                      "ERROR: Specify Unicode plane as decimal number.\n\n");
00132             exit (EXIT_FAILURE);
00133           }
00134         }
```

```
00135             plane = atoi (&argv[i][2]); /* Unicode plane, 0..17 */
00136             if (plane < 0 || plane > 17) {
00137                fprintf (stderr,
00138                         "ERROR: Plane out of Unicode range [0,17].\n\n");
00139                exit (EXIT_FAILURE);
00140             }
00141          }
00142       }
00143    }
00144
00145
00146    /*
00147 Initialize the ASCII bitmap array for chart titles
00148 */
00149    for (i = 0; i < 128; i++) {
00150       /* convert Unifont hexadecimal string to bitmap */
00151       gethex ((char *)ascii_hex[i], plane_array, 0);
00152       for (j = 0; j < 16; j++) ascii_bits[i][j] = plane_array[i][j];
00153    }
00154
00155
00156    /*
00157 Read in the Unifont hex file to render from standard input
00158 */
00159    memset ((void *)plane_array, 0, 0x10000 * 16 * sizeof (int));
00160    while (fgets (instring, MAXSTRING, stdin) != NULL) {
00161       gethex (instring, plane_array, plane); /* read .hex input file and fill plane_array with glyph data */
00162    }  /* while not EOF */
00163
00164
00165    /*
00166 Write plane_array glyph data to BMP file as wide or long bitmap.
00167 */
00168    if (wide) {
00169       genwidebmp (plane_array, dpi, tinynum, plane);
00170    }
00171    else {
00172       genlongbmp (plane_array, dpi, tinynum, plane);
00173    }
00174
00175    exit (EXIT_SUCCESS);
00176 }
00177
00178
00179 /**
00180 @brief Output a 4-byte integer in little-endian order.
00181
00182 @param[in] thisword The 4-byte integer to output as binary data.
00183 */
00184 void
00185 output4 (int thisword)
00186 {
00187
00188    putchar ( thisword        & 0xFF);
00189    putchar ((thisword »  8) & 0xFF);
00190    putchar ((thisword » 16) & 0xFF);
00191    putchar ((thisword » 24) & 0xFF);
00192
00193    return;
00194 }
00195
00196
00197 /**
00198 @brief Output a 2-byte integer in little-endian order.
00199
00200 @param[in] thisword The 2-byte integer to output as binary data.
00201 */
00202 void
00203 output2 (int thisword)
00204 {
00205
00206    putchar ( thisword       & 0xFF);
00207    putchar ((thisword » 8) & 0xFF);
00208
00209    return;
00210 }
00211
00212
00213 /**
00214 @brief Read a Unifont .hex-format input file from stdin.
00215
```

```
00216 Each glyph can be 2, 4, 6, or 8 ASCII hexadecimal digits wide.
00217 Glyph height is fixed at 16 pixels.
00218
00219 @param[in] instring One line from a Unifont .hex-format file.
00220 @param[in,out] plane_array Bitmap for this plane, one bitmap row per element.
00221 @param[in] plane The Unicode plane, 0..17.
00222 */
00223 void
00224 gethex (char *instring, int plane_array[0x10000][16], int plane)
00225 {
00226   char *bitstring;  /* pointer into instring for glyph bitmap */
00227   int i;       /* loop variable                                 */
00228   int codept;  /* the Unicode code point of the current glyph */
00229   int glyph_plane; /* Unicode plane of current glyph           */
00230   int ndigits; /* number of ASCII hexadecimal digits in glyph */
00231   int bytespl; /* bytes per line of pixels in a glyph         */
00232   int temprow; /* 1 row of a quadruple-width glyph            */
00233   int newrow;  /* 1 row of double-width output pixels         */
00234   unsigned bitmask; /* to mask off 2 bits of long width glyph */
00235
00236   /*
00237 Read each input line and place its glyph into the bit array.
00238 */
00239   sscanf (instring, "%X", &codept);
00240   glyph_plane = codept » 16;
00241   if (glyph_plane == plane) {
00242     codept &= 0xFFFF;  /* array index will only have 16 bit address */
00243     /* find the colon separator */
00244     for (i = 0; (i < 9) && (instring[i] != ':'); i++);
00245     i++; /* position past it */
00246     bitstring = &instring[i];
00247     ndigits = strlen (bitstring);
00248     /* don't count '\n' at end of line if present */
00249     if (bitstring[ndigits - 1] == '\n') ndigits--;
00250     bytespl = ndigits » 5;  /* 16 rows per line, 2 digits per byte */
00251
00252     if (bytespl >= 1 && bytespl <= 4) {
00253       for (i = 0; i < 16; i++) { /* 16 rows per glyph */
00254         /* Read correct number of hexadecimal digits given glyph width */
00255         switch (bytespl) {
00256           case 1: sscanf (bitstring, "%2X", &temprow);
00257                   bitstring += 2;
00258                   temprow «= 8; /* left-justify single-width glyph */
00259                   break;
00260           case 2: sscanf (bitstring, "%4X", &temprow);
00261                   bitstring += 4;
00262                   break;
00263           /* cases 3 and 4 widths will be compressed by 50% (see below) */
00264           case 3: sscanf (bitstring, "%6X", &temprow);
00265                   bitstring += 6;
00266                   temprow «= 8; /* left-justify */
00267                   break;
00268           case 4: sscanf (bitstring, "%8X", &temprow);
00269                   bitstring += 8;
00270                   break;
00271         }  /* switch on number of bytes per row */
00272         /* compress glyph width by 50% if greater than double-width */
00273         if (bytespl > 2) {
00274           newrow = 0x0000;
00275           /* mask off 2 bits at a time to convert each pair to 1 bit out */
00276           for (bitmask = 0xC0000000; bitmask != 0; bitmask »= 2) {
00277             newrow «= 1;
00278             if ((temprow & bitmask) != 0) newrow |= 1;
00279           }
00280           temprow = newrow;
00281         }  /* done conditioning glyphs beyond double-width */
00282         plane_array[codept][i] = temprow;  /* store glyph bitmap for output */
00283       }  /* for each row */
00284     }  /* if 1 to 4 bytes per row/line */
00285   }  /* if this is the plane we are seeking */
00286
00287   return;
00288 }
00289
00290
00291 /**
00292 @brief Generate the BMP output file in long format.
00293
00294 This function generates the BMP output file from a bitmap parameter.
00295 This is a long bitmap, 16 glyphs wide by 4,096 glyphs tall.
00296
```

```
00297 @param[in] plane_array The array of glyph bitmaps for a plane.
00298 @param[in] dpi Dots per inch, for encoding in the BMP output file header.
00299 @param[in] tinynum Whether to generate tiny numbers in wide grid (unused).
00300 @param[in] plane The Unicode plane, 0..17.
00301 */
00302 void
00303 genlongbmp (int plane_array[0x10000][16], int dpi, int tinynum, int plane)
00304 {
00305
00306   char header_string[HDR_LEN]; /* centered header            */
00307   char raw_header[HDR_LEN];    /* left-aligned header        */
00308   int header[16][16];      /* header row, for chart title */
00309   int hdrlen;              /* length of HEADER_STRING     */
00310   int startcol;            /* column to start printing header, for centering */
00311
00312   unsigned leftcol[0x1000][16]; /* code point legend on left side of chart */
00313   int d1, d2, d3, d4;           /* digits for filling leftcol[][] legend   */
00314   int codept;                   /* current starting code point for legend  */
00315   int thisrow;                  /* glyph row currently being rendered      */
00316   unsigned toprow[16][16];      /* code point legend on top of chart       */
00317   int digitrow;        /* row we're in (0..4) for the above hexdigit digits */
00318
00319   /*
00320 DataOffset = BMP Header bytes + InfoHeader bytes + ColorTable bytes.
00321 */
00322   int DataOffset = 14 + 40 + 8; /* fixed size for monochrome BMP */
00323   int ImageSize;
00324   int FileSize;
00325   int Width, Height; /* bitmap image width and height in pixels */
00326   int ppm;     /* integer pixels per meter */
00327
00328   int i, j, k;
00329
00330   unsigned bytesout;
00331
00332   void output4(int), output2(int);
00333
00334   /*
00335 Image width and height, in pixels.
00336
00337 N.B.: Width must be an even multiple of 32 pixels, or 4 bytes.
00338 */
00339   Width  =   18 * 16;  /* (2 legend +   16 glyphs) * 16 pixels/glyph */
00340   Height = 4099 * 16;  /* (1 header + 4096 glyphs) * 16 rows/glyph   */
00341
00342   ImageSize = Height * (Width / 8); /* in bytes, calculated from pixels */
00343
00344   FileSize = DataOffset + ImageSize;
00345
00346   /* convert dots/inch to pixels/meter */
00347   if (dpi == 0) dpi = 96;
00348   ppm = (int)((double)dpi * 100.0 / 2.54 + 0.5);
00349
00350   /*
00351 Generate the BMP Header
00352 */
00353   putchar ('B');
00354   putchar ('M');
00355
00356   /*
00357 Calculate file size:
00358
00359 BMP Header + InfoHeader + Color Table + Raster Data
00360 */
00361   output4 (FileSize);  /* FileSize */
00362   output4 (0x0000); /* reserved */
00363
00364   /* Calculate DataOffset */
00365   output4 (DataOffset);
00366
00367   /*
00368 InfoHeader
00369 */
00370   output4 (40);         /* Size of InfoHeader                    */
00371   output4 (Width);      /* Width of bitmap in pixels             */
00372   output4 (Height);     /* Height of bitmap in pixels            */
00373   output2 (1);          /* Planes (1 plane)                      */
00374   output2 (1);          /* BitCount (1 = monochrome)             */
00375   output4 (0);          /* Compression (0 = none)                */
00376   output4 (ImageSize);  /* ImageSize, in bytes                   */
00377   output4 (ppm);        /* XpixelsPerM (96 dpi = 3780 pixels/meter) */
```

```
00378    output4 (ppm);        /* YpixelsPerM (96 dpi = 3780 pixels/meter) */
00379    output4 (2);          /* ColorsUsed (= 2)                         */
00380    output4 (2);          /* ColorsImportant (= 2)                    */
00381    output4 (0x00000000); /* black (reserved, B, G, R)                */
00382    output4 (0x00FFFFFF); /* white (reserved, B, G, R)                */
00383
00384    /*
00385  Create header row bits.
00386  */
00387    snprintf (raw_header, HDR_LEN, "%s Plane %d", HEADER_STRING, plane);
00388    memset ((void *)header, 0, 16 * 16 * sizeof (int)); /* fill with white */
00389    memset ((void *)header_string, ' ', 32 * sizeof (char)); /* 32 spaces */
00390    header_string[32] = '\0';  /* null-terminated */
00391
00392    hdrlen = strlen (raw_header);
00393    if (hdrlen > 32) hdrlen = 32;        /* only 32 columns to print header */
00394    startcol = 16 - ((hdrlen + 1) » 1); /* to center header                 */
00395    /* center up to 32 chars */
00396    memcpy (&header_string[startcol], raw_header, hdrlen);
00397
00398    /* Copy each letter's bitmap from the plane_array[][] we constructed. */
00399    /* Each glyph must be single-width, to fit two glyphs in 16 pixels */
00400    for (j = 0; j < 16; j++) {
00401      for (i = 0; i < 16; i++) {
00402        header[i][j] =
00403          (ascii_bits[header_string[j+j  ] & 0x7F][i] & 0xFF00) |
00404          (ascii_bits[header_string[j+j+1] & 0x7F][i] » 8);
00405      }
00406    }
00407
00408    /*
00409  Create the left column legend.
00410  */
00411    memset ((void *)leftcol, 0, 4096 * 16 * sizeof (unsigned));
00412
00413    for (codept = 0x0000; codept < 0x10000; codept += 0x10) {
00414      d1 = (codept » 12) & 0xF; /* most significant hex digit */
00415      d2 = (codept »  8) & 0xF;
00416      d3 = (codept »  4) & 0xF;
00417
00418      thisrow = codept » 4; /* rows of 16 glyphs */
00419
00420      /* fill in first and second digits */
00421      for (digitrow = 0; digitrow < 5; digitrow++) {
00422        leftcol[thisrow][2 + digitrow] =
00423          (hexdigit[d1][digitrow] « 10) |
00424          (hexdigit[d2][digitrow] «  4);
00425      }
00426
00427      /* fill in third digit */
00428      for (digitrow = 0; digitrow < 5; digitrow++) {
00429        leftcol[thisrow][9 + digitrow] = hexdigit[d3][digitrow] « 10;
00430      }
00431      leftcol[thisrow][9 + 4] |= 0xF « 4; /* underscore as 4th digit */
00432
00433      for (i = 0; i < 15; i ++) {
00434        leftcol[thisrow][i] |= 0x00000002;      /* right border */
00435      }
00436
00437      leftcol[thisrow][15] = 0x0000FFFE;        /* bottom border */
00438
00439      if (d3 == 0xF) {                      /* 256-point boundary */
00440        leftcol[thisrow][15] |= 0x00FF0000;  /* longer tic mark */
00441      }
00442
00443      if ((thisrow % 0x40) == 0x3F) {     /* 1024-point boundary */
00444        leftcol[thisrow][15] |= 0xFFFF0000; /* longest tic mark */
00445      }
00446    }
00447
00448    /*
00449  Create the top row legend.
00450  */
00451    memset ((void *)toprow, 0, 16 * 16 * sizeof (unsigned));
00452
00453    for (codept = 0x0; codept <= 0xF; codept++) {
00454      d1 = (codept » 12) & 0xF; /* most significant hex digit */
00455      d2 = (codept »  8) & 0xF;
00456      d3 = (codept »  4) & 0xF;
00457      d4 =  codept       & 0xF; /* least significant hex digit */
00458
```

```
00459       /* fill in last digit */
00460       for (digitrow = 0; digitrow < 5; digitrow++) {
00461          toprow[6 + digitrow][codept] = hexdigit[d4][digitrow] « 6;
00462       }
00463    }
00464
00465    for (j = 0; j < 16; j++) {
00466       /* force bottom pixel row to be white, for separation from glyphs */
00467       toprow[15][j] = 0x0000;
00468    }
00469
00470    /* 1 pixel row with left-hand legend line */
00471    for (j = 0; j < 16; j++) {
00472       toprow[14][j] |= 0xFFFF;
00473    }
00474
00475    /* 14 rows with line on left to fill out this character row */
00476    for (i = 13; i >= 0; i--) {
00477       for (j = 0; j < 16; j++) {
00478          toprow[i][j] |= 0x0001;
00479       }
00480    }
00481
00482    /*
00483 Now write the raster image.
00484
00485 XOR each byte with 0xFF because black = 0, white = 1 in BMP.
00486 */
00487
00488    /* Write the glyphs, bottom-up, left-to-right, in rows of 16 (i.e., 0x10) */
00489    for (i = 0xFFF0; i >= 0; i -= 0x10) {
00490       thisrow = i » 4; /* 16 glyphs per row */
00491       for (j = 15; j >= 0; j--) {
00492          /* left-hand legend */
00493          putchar ((~leftcol[thisrow][j] » 24) & 0xFF);
00494          putchar ((~leftcol[thisrow][j] » 16) & 0xFF);
00495          putchar ((~leftcol[thisrow][j] »  8) & 0xFF);
00496          putchar ( ~leftcol[thisrow][j]       & 0xFF);
00497          /* Unifont glyph */
00498          for (k = 0; k < 16; k++) {
00499             bytesout = ~plane_array[i+k][j] & 0xFFFF;
00500             putchar ((bytesout » 8) & 0xFF);
00501             putchar ( bytesout      & 0xFF);
00502          }
00503       }
00504    }
00505
00506    /*
00507 Write the top legend.
00508 */
00509    /* i == 15: bottom pixel row of header is output here */
00510    /* left-hand legend: solid black line except for right-most pixel */
00511    putchar (0x00);
00512    putchar (0x00);
00513    putchar (0x00);
00514    putchar (0x01);
00515    for (j = 0; j < 16; j++) {
00516       putchar ((~toprow[15][j] » 8) & 0xFF);
00517       putchar ( ~toprow[15][j]      & 0xFF);
00518    }
00519
00520    putchar (0xFF);
00521    putchar (0xFF);
00522    putchar (0xFF);
00523    putchar (0xFC);
00524    for (j = 0; j < 16; j++) {
00525       putchar ((~toprow[14][j] » 8) & 0xFF);
00526       putchar ( ~toprow[14][j]      & 0xFF);
00527    }
00528
00529    for (i = 13; i >= 0; i--) {
00530       putchar (0xFF);
00531       putchar (0xFF);
00532       putchar (0xFF);
00533       putchar (0xFD);
00534       for (j = 0; j < 16; j++) {
00535          putchar ((~toprow[i][j] » 8) & 0xFF);
00536          putchar ( ~toprow[i][j]      & 0xFF);
00537       }
00538    }
00539
```

```
00540   /*
00541 Write the header.
00542 */
00543
00544   /* 7 completely white rows */
00545   for (i = 7; i >= 0; i--) {
00546     for (j = 0; j < 18; j++) {
00547       putchar (0xFF);
00548       putchar (0xFF);
00549     }
00550   }
00551
00552   for (i = 15; i >= 0; i--) {
00553     /* left-hand legend */
00554     putchar (0xFF);
00555     putchar (0xFF);
00556     putchar (0xFF);
00557     putchar (0xFF);
00558     /* header glyph */
00559     for (j = 0; j < 16; j++) {
00560       bytesout = ~header[i][j] & 0xFFFF;
00561       putchar ((bytesout » 8) & 0xFF);
00562       putchar ( bytesout      & 0xFF);
00563     }
00564   }
00565
00566   /* 8 completely white rows at very top */
00567   for (i = 7; i >= 0; i--) {
00568     for (j = 0; j < 18; j++) {
00569     putchar (0xFF);
00570     putchar (0xFF);
00571     }
00572   }
00573
00574   return;
00575 }
00576
00577
00578 /**
00579 @brief Generate the BMP output file in wide format.
00580
00581 This function generates the BMP output file from a bitmap parameter.
00582 This is a wide bitmap, 256 glyphs wide by 256 glyphs tall.
00583
00584 @param[in] plane_array The array of glyph bitmaps for a plane.
00585 @param[in] dpi Dots per inch, for encoding in the BMP output file header.
00586 @param[in] tinynum Whether to generate tiny numbers in 256x256 grid.
00587 @param[in] plane The Unicode plane, 0..17.
00588 */
00589 void
00590 genwidebmp (int plane_array[0x10000][16], int dpi, int tinynum, int plane)
00591 {
00592
00593   char header_string[257];
00594   char raw_header[HDR_LEN];
00595   int header[16][256]; /* header row, for chart title */
00596   int hdrlen;          /* length of HEADER_STRING */
00597   int startcol;        /* column to start printing header, for centering */
00598
00599   unsigned leftcol[0x100][16]; /* code point legend on left side of chart */
00600   int d1, d2, d3, d4;          /* digits for filling leftcol[][] legend   */
00601   int codept;                  /* current starting code point for legend  */
00602   int thisrow;                 /* glyph row currently being rendered      */
00603   unsigned toprow[32][256];    /* code point legend on top of chart       */
00604   int digitrow;       /* row we're in (0..4) for the above hexdigit digits */
00605   int hexalpha1, hexalpha2;    /* to convert hex digits to ASCII          */
00606
00607   /*
00608 DataOffset = BMP Header bytes + InfoHeader bytes + ColorTable bytes.
00609 */
00610   int DataOffset = 14 + 40 + 8; /* fixed size for monochrome BMP */
00611   int ImageSize;
00612   int FileSize;
00613   int Width, Height; /* bitmap image width and height in pixels */
00614   int ppm;     /* integer pixels per meter */
00615
00616   int i, j, k;
00617
00618   unsigned bytesout;
00619
00620   void output4(int), output2(int);
```

```
00621
00622   /*
00623 Image width and height, in pixels.
00624
00625 N.B.: Width must be an even multiple of 32 pixels, or 4 bytes.
00626 */
00627   Width  = 258 * 16;  /* (          2 legend + 256 glyphs) * 16 pixels/glyph */
00628   Height = 260 * 16;  /* (2 header + 2 legend + 256 glyphs) * 16 rows/glyph   */
00629
00630   ImageSize = Height * (Width / 8); /* in bytes, calculated from pixels */
00631
00632   FileSize = DataOffset + ImageSize;
00633
00634   /* convert dots/inch to pixels/meter */
00635   if (dpi == 0) dpi = 96;
00636   ppm = (int)((double)dpi * 100.0 / 2.54 + 0.5);
00637
00638   /*
00639 Generate the BMP Header
00640 */
00641   putchar ('B');
00642   putchar ('M');
00643   /*
00644 Calculate file size:
00645
00646 BMP Header + InfoHeader + Color Table + Raster Data
00647 */
00648   output4 (FileSize);  /* FileSize */
00649   output4 (0x0000); /* reserved */
00650   /* Calculate DataOffset */
00651   output4 (DataOffset);
00652
00653   /*
00654 InfoHeader
00655 */
00656   output4 (40);         /* Size of InfoHeader                    */
00657   output4 (Width);      /* Width of bitmap in pixels             */
00658   output4 (Height);     /* Height of bitmap in pixels            */
00659   output2 (1);          /* Planes (1 plane)                      */
00660   output2 (1);          /* BitCount (1 = monochrome)             */
00661   output4 (0);          /* Compression (0 = none)                */
00662   output4 (ImageSize);  /* ImageSize, in bytes                   */
00663   output4 (ppm);        /* XpixelsPerM (96 dpi = 3780 pixels/meter) */
00664   output4 (ppm);        /* YpixelsPerM (96 dpi = 3780 pixels/meter) */
00665   output4 (2);          /* ColorsUsed (= 2)                      */
00666   output4 (2);          /* ColorsImportant (= 2)                 */
00667   output4 (0x00000000); /* black (reserved, B, G, R)             */
00668   output4 (0x00FFFFFF); /* white (reserved, B, G, R)             */
00669
00670   /*
00671 Create header row bits.
00672 */
00673   snprintf (raw_header, HDR_LEN, "%s Plane %d", HEADER_STRING, plane);
00674   memset ((void *)header, 0, 256 * 16 * sizeof (int)); /* fill with white */
00675   memset ((void *)header_string, ' ', 256 * sizeof (char)); /* 256 spaces */
00676   header_string[256] = '\0';  /* null-terminated */
00677
00678   hdrlen = strlen (raw_header);
00679   /* Wide bitmap can print 256 columns, but limit to 32 columns for long bitmap. */
00680   if (hdrlen > 32) hdrlen = 32;
00681   startcol = 127 - ((hdrlen - 1) » 1);  /* to center header */
00682   /* center up to 32 chars */
00683   memcpy (&header_string[startcol], raw_header, hdrlen);
00684
00685   /* Copy each letter's bitmap from the plane_array[][] we constructed. */
00686   for (j = 0; j < 256; j++) {
00687     for (i = 0; i < 16; i++) {
00688       header[i][j] = ascii_bits[header_string[j] & 0x7F][i];
00689     }
00690   }
00691
00692   /*
00693 Create the left column legend.
00694 */
00695   memset ((void *)leftcol, 0, 256 * 16 * sizeof (unsigned));
00696
00697   for (codept = 0x0000; codept < 0x10000; codept += 0x100) {
00698     d1 = (codept » 12) & 0xF; /* most significant hex digit */
00699     d2 = (codept »  8) & 0xF;
00700
00701     thisrow = codept » 8; /* rows of 256 glyphs */
```

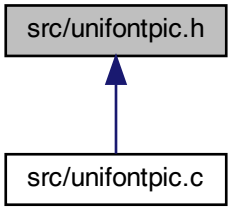
```
00702
00703       /* fill in first and second digits */
00704
00705       if (tinynum) { /* use 4x5 pixel glyphs */
00706         for (digitrow = 0; digitrow < 5; digitrow++) {
00707           leftcol[thisrow][6 + digitrow] =
00708             (hexdigit[d1][digitrow] << 10) |
00709             (hexdigit[d2][digitrow] <<  4);
00710         }
00711       }
00712       else { /* bigger numbers -- use glyphs from Unifont itself */
00713         /* convert hexadecimal digits to ASCII equivalent */
00714         hexalpha1 = d1 < 0xA ? '0' + d1 : 'A' + d1 - 0xA;
00715         hexalpha2 = d2 < 0xA ? '0' + d2 : 'A' + d2 - 0xA;
00716
00717         for (i = 0 ; i < 16; i++) {
00718           leftcol[thisrow][i] =
00719             (ascii_bits[hexalpha1][i] << 2) |
00720             (ascii_bits[hexalpha2][i] >> 6);
00721         }
00722       }
00723
00724       for (i = 0; i < 15; i ++) {
00725         leftcol[thisrow][i] |= 0x00000002;      /* right border */
00726       }
00727
00728       leftcol[thisrow][15] = 0x0000FFFE;        /* bottom border */
00729
00730       if (d2 == 0xF) {                      /* 4096-point boundary */
00731         leftcol[thisrow][15] |= 0x00FF0000;  /* longer tic mark */
00732       }
00733
00734       if ((thisrow % 0x40) == 0x3F) {    /* 16,384-point boundary */
00735         leftcol[thisrow][15] |= 0xFFFF0000; /* longest tic mark */
00736       }
00737     }
00738
00739     /*
00740   Create the top row legend.
00741   */
00742     memset ((void *)toprow, 0, 32 * 256 * sizeof (unsigned));
00743
00744     for (codept = 0x00; codept <= 0xFF; codept++) {
00745       d3 = (codept >>  4) & 0xF;
00746       d4 =  codept        & 0xF; /* least significant hex digit */
00747
00748       if (tinynum) {
00749         for (digitrow = 0; digitrow < 5; digitrow++) {
00750           toprow[16 + 6 + digitrow][codept] =
00751             (hexdigit[d3][digitrow] << 10) |
00752             (hexdigit[d4][digitrow] <<  4);
00753         }
00754       }
00755       else {
00756         /* convert hexadecimal digits to ASCII equivalent */
00757         hexalpha1 = d3 < 0xA ? '0' + d3 : 'A' + d3 - 0xA;
00758         hexalpha2 = d4 < 0xA ? '0' + d4 : 'A' + d4 - 0xA;
00759         for (i = 0 ; i < 16; i++) {
00760           toprow[14 + i][codept] =
00761             (ascii_bits[hexalpha1][i]     ) |
00762             (ascii_bits[hexalpha2][i] >> 7);
00763         }
00764       }
00765     }
00766
00767     for (j = 0; j < 256; j++) {
00768       /* force bottom pixel row to be white, for separation from glyphs */
00769       toprow[16 + 15][j] = 0x0000;
00770     }
00771
00772     /* 1 pixel row with left-hand legend line */
00773     for (j = 0; j < 256; j++) {
00774       toprow[16 + 14][j] |= 0xFFFF;
00775     }
00776
00777     /* 14 rows with line on left to fill out this character row */
00778     for (i = 13; i >= 0; i--) {
00779       for (j = 0; j < 256; j++) {
00780         toprow[16 + i][j] |= 0x0001;
00781       }
00782     }
```

```
00783
00784    /* Form the longer tic marks in top legend */
00785    for (i = 8; i < 16; i++) {
00786       for (j = 0x0F; j < 0x100; j += 0x10) {
00787          toprow[i][j] |= 0x0001;
00788       }
00789    }
00790
00791    /*
00792 Now write the raster image.
00793
00794 XOR each byte with 0xFF because black = 0, white = 1 in BMP.
00795 */
00796
00797    /* Write the glyphs, bottom-up, left-to-right, in rows of 16 (i.e., 0x10) */
00798    for (i = 0xFF00; i >= 0; i -= 0x100) {
00799       thisrow = i » 8; /* 256 glyphs per row */
00800       for (j = 15; j >= 0; j--) {
00801          /* left-hand legend */
00802          putchar ((~leftcol[thisrow][j] » 24) & 0xFF);
00803          putchar ((~leftcol[thisrow][j] » 16) & 0xFF);
00804          putchar ((~leftcol[thisrow][j] »  8) & 0xFF);
00805          putchar ( ~leftcol[thisrow][j]       & 0xFF);
00806          /* Unifont glyph */
00807          for (k = 0x00; k < 0x100; k++) {
00808             bytesout = ~plane_array[i+k][j] & 0xFFFF;
00809             putchar ((bytesout » 8) & 0xFF);
00810             putchar ( bytesout      & 0xFF);
00811          }
00812       }
00813    }
00814
00815    /*
00816 Write the top legend.
00817 */
00818    /* i == 15: bottom pixel row of header is output here */
00819    /* left-hand legend: solid black line except for right-most pixel */
00820    putchar (0x00);
00821    putchar (0x00);
00822    putchar (0x00);
00823    putchar (0x01);
00824    for (j = 0; j < 256; j++) {
00825       putchar ((~toprow[16 + 15][j] » 8) & 0xFF);
00826       putchar ( ~toprow[16 + 15][j]      & 0xFF);
00827    }
00828
00829    putchar (0xFF);
00830    putchar (0xFF);
00831    putchar (0xFF);
00832    putchar (0xFC);
00833    for (j = 0; j < 256; j++) {
00834       putchar ((~toprow[16 + 14][j] » 8) & 0xFF);
00835       putchar ( ~toprow[16 + 14][j]      & 0xFF);
00836    }
00837
00838    for (i = 16 + 13; i >= 0; i--) {
00839       if (i >= 8) { /* make vertical stroke on right */
00840          putchar (0xFF);
00841          putchar (0xFF);
00842          putchar (0xFF);
00843          putchar (0xFD);
00844       }
00845       else { /* all white */
00846          putchar (0xFF);
00847          putchar (0xFF);
00848          putchar (0xFF);
00849          putchar (0xFF);
00850       }
00851       for (j = 0; j < 256; j++) {
00852          putchar ((~toprow[i][j] » 8) & 0xFF);
00853          putchar ( ~toprow[i][j]      & 0xFF);
00854       }
00855    }
00856
00857    /*
00858 Write the header.
00859 */
00860
00861    /* 8 completely white rows */
00862    for (i = 7; i >= 0; i--) {
00863       for (j = 0; j < 258; j++) {
```

```
00864         putchar (0xFF);
00865         putchar (0xFF);
00866       }
00867     }
00868
00869     for (i = 15; i >= 0; i--) {
00870       /* left-hand legend */
00871       putchar (0xFF);
00872       putchar (0xFF);
00873       putchar (0xFF);
00874       putchar (0xFF);
00875       /* header glyph */
00876       for (j = 0; j < 256; j++) {
00877         bytesout = ~header[i][j] & 0xFFFF;
00878         putchar ((bytesout » 8) & 0xFF);
00879         putchar ( bytesout      & 0xFF);
00880       }
00881     }
00882
00883     /* 8 completely white rows at very top */
00884     for (i = 7; i >= 0; i--) {
00885       for (j = 0; j < 258; j++) {
00886       putchar (0xFF);
00887       putchar (0xFF);
00888       }
00889     }
00890
00891     return;
00892 }
00893
```

5.25 src/unifontpic.h File Reference

unifontpic.h - Header file for unifontpic.c
This graph shows which files directly or indirectly include this file:



Macros

- #define MAXSTRING 256

  Maximum input string allowed.
- #define HEADER_STRING "GNU Unifont 16.0.04"

  To be printed as chart title.

Variables

- const char * ascii_hex [128]

  Array of Unifont ASCII glyphs for chart row & column headings.
- int ascii_bits [128][16]

Array to hold ASCII bitmaps for chart title.

- char hexdigit [16][5]

  Array of 4x5 hexadecimal digits for legend.

5.25.1 Detailed Description

unifontpic.h - Header file for unifontpic.c

Author

Paul Hardy, July 2017

Copyright

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Definition in file unifontpic.h.

5.25.2 Macro Definition Documentation

5.25.2.1 HEADER_STRING

#define HEADER_STRING "GNU Unifont 16.0.04"
To be printed as chart title.
Definition at line 32 of file unifontpic.h.

5.25.2.2 MAXSTRING

#define MAXSTRING 256
Maximum input string allowed.
Definition at line 30 of file unifontpic.h.

5.25.3 Variable Documentation

5.25.3.1 ascii_bits

int ascii_bits[128][16]
Array to hold ASCII bitmaps for chart title.
This array will be created from the strings in ascii_hex[] above.
Definition at line 179 of file unifontpic.h.

5.25.3.2 ascii_hex

const char* ascii_hex[128]
Array of Unifont ASCII glyphs for chart row & column headings.
Define the array of Unifont ASCII glyphs, code points 0 through 127. This allows using unifontpic to print charts of glyphs above Unicode Plane 0. These were copied from font/plane00/unifont-base.hex, plus U+0020 (ASCII space character).
Definition at line 42 of file unifontpic.h.

5.25.3.3 hexdigit

char hexdigit[16][5]
Initial value:
```
= {
  {0x6,0x9,0x9,0x9,0x6},
  {0x2,0x6,0x2,0x2,0x7},
  {0xF,0x1,0xF,0x8,0xF},
  {0xE,0x1,0x7,0x1,0xE},
  {0x9,0x9,0xF,0x1,0x1},
  {0xF,0x8,0xF,0x1,0xF},
  {0x6,0x8,0xE,0x9,0x6},
  {0xF,0x1,0x2,0x4,0x4},
  {0x6,0x9,0x6,0x9,0x6},
  {0x6,0x9,0x7,0x1,0x6},
  {0xF,0x9,0xF,0x9,0x9},
  {0xE,0x9,0xE,0x9,0xE},
  {0x7,0x8,0x8,0x8,0x7},
  {0xE,0x9,0x9,0x9,0xE},
  {0xF,0x8,0xE,0x8,0xF},
  {0xF,0x8,0xE,0x8,0x8}
}
```
Array of 4x5 hexadecimal digits for legend.
hexdigit contains 4x5 pixel arrays of tiny digits for the legend. See unihexgen.c for a more detailed description in the comments.
Definition at line 188 of file unifontpic.h.

5.26 unifontpic.h

Go to the documentation of this file.

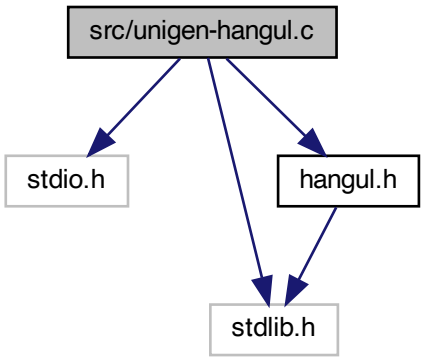
```
00001 /**
00002 @file unifontpic.h
00003
00004 @brief unifontpic.h - Header file for unifontpic.c
00005
00006 @author Paul Hardy, July 2017
00007
00008 @copyright Copyright (C) 2017 Paul Hardy
00009 */
00010 /*
00011 LICENSE:
00012
00013 This program is free software: you can redistribute it and/or modify
00014 it under the terms of the GNU General Public License as published by
00015 the Free Software Foundation, either version 2 of the License, or
00016 (at your option) any later version.
00017
00018 This program is distributed in the hope that it will be useful,
00019 but WITHOUT ANY WARRANTY; without even the implied warranty of
00020 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
00021 GNU General Public License for more details.
00022
00023 You should have received a copy of the GNU General Public License
00024 along with this program.  If not, see <http://www.gnu.org/licenses/>.
00025 */
00026
00027 #ifndef _UNIFONTPIC_H_
00028 #define _UNIFONTPIC_H_
00029
00030 #define MAXSTRING 256  ///< Maximum input string allowed.
00031
00032 #define HEADER_STRING "GNU Unifont 16.0.04" ///< To be printed as chart title.
00033
00034 /**
00035 @brief Array of Unifont ASCII glyphs for chart row & column headings.
00036
00037 Define the array of Unifont ASCII glyphs, code points 0 through 127.
00038 This allows using unifontpic to print charts of glyphs above Unicode
00039 Plane 0.  These were copied from font/plane00/unifont-base.hex, plus
00040 U+0020 (ASCII space character).
00041 */
00042 const char *ascii_hex [128] = {
00043   "0000:AAAA00018000000180004A51EA505A51C99E000180000001800000180005555",
00044   "0001:AAAA00018000000180003993C252325F8A5271938000000180000001800055555",
00045   "0002:AAAA00018000000180003BA5C124311989247125800000018000001800055555",
```

```
00046 "0003:AAAA000180000000180007BA5C1247919C1247925800000018000000180005555",
00047 "0004:AAAA000180000001800079BFC2487A49C2487989800000018000000180005555",
00048 "0005:AAAA000180000001800074A4DC2527B53C2D67A4F8000000180000000180005555",
00049 "0006:AAAA000180000001800031A5CA287A31CA2849A5800000018000000180005555",
00050 "0007:AAAA000180000001800073D1CA1073D1CA1073DF8000000180000000180005555",
00051 "0008:AAAA000180000000180001E3991401E3191081E7180000001800000180005555",
00052 "0009:AAAA000180000001800022F9A2203E21A22022218000000180000000180005555",
00053 "000A:AAAA000180000001800020F9A08020F9A0803E818000000180000000180005555",
00054 "000B:AAAA000180000001800022F9A22022219420082180000001800000180005555",
00055 "000C:AAAA000180000000180003EF9A0803EF9A0802081800000018000000180005555",
00056 "000D:AAAA000180000000180001EF1A08820F1A0901E898000000180000000180005555",
00057 "000E:AAAA000180000000180001E71A0881C8982883C7180000001800000000180005555",
00058 "000F:AAAA000180000000180001EF9A0201C2182203CF980000001800000000180005555",
00059 "0010:AAAA000180000001800391DA510251DA51039DD800000018000000180005555",
00060 "0011:AAAA000180000000180007189CA184A09CA08719D800000018000000180005555",
00061 "0012:AAAA000180000000180007199CA044A09CA10719D800000018000000180005555",
00062 "0013:AAAA000180000000180007199CA044A19CA047199800000018000000180005555",
00063 "0014:AAAA000180000000180007185CA0C4A15CA1C7185800000018000000180005555",
00064 "0015:AAAA000180000001800004993EA546A59DBD44A538000000180000000180005555",
00065 "0016:AAAA000180000000180003453C29A31178912711380000001800000180005555",
00066 "0017:AAAA000180000000180007BB9C1247939C1247939800000018000000180005555",
00067 "0018:AAAA000180000000180003325C4B447ADC4A434A580000001800000180005555",
00068 "0019:AAAA000180000000180003E89A0D83EA9A0883E898000000180000000180005555",
00069 "001A:AAAA000180000000180003A5DC252325D8A52719D800000018000000180005555",
00070 "001B:AAAA000180000001800079CFC2107991C0507B8F800000018000000180005555",
00071 "001C:AAAA000180000000180001E7190801E61901010E180000001800000180005555",
00072 "001D:AAAA000180000000180000E719080166192100EE180000001800000180005555",
00073 "001E:AAAA000180000000180001C7192801C61941012E180000001800000180005555",
00074 "001F:AAAA0001800000018000127192801261921 00CE180000001800000180005555",
00075 "0020:00000000000000000000000000000000",
00076 "0021:000000000808080808080808008080000",
00077 "0022:000022222222200000000000000000000",
00078 "0023:000000001212127E24247E4848480000",
00079 "0024:00000000083E4948380E09493E080000",
00080 "0025:00000000314A4A340808162929460000",
00081 "0026:000000001C2222141829454246390000",
00082 "0027:000008080808000000000000000000000",
00083 "0028:000000040808101010101008080400",
00084 "0029:000000201010080808080810102000",
00085 "002A:0000000000008492A1C2A4908000000",
00086 "002B:000000000000808087F080808000000",
00087 "002C:00000000000000000000018080810",
00088 "002D:000000000000000003C000000000000",
00089 "002E:00000000000000000000000018180000",
00090 "002F:000000000202040808101020404000000",
00091 "0030:00000000182442464A52624224180000",
00092 "0031:000000000818280808080808083E0000",
00093 "0032:000000003C4242020C102040407E0000",
00094 "0033:000000003C4242021C020242423C0000",
00095 "0034:00000000040C142444447E0404040000",
00096 "0035:000000007E4040407C020202423C0000",
00097 "0036:000000001C2040407C424242423C0000",
00098 "0037:000000007E020204040408080808000",
00099 "0038:000000003C4242423C424242423C0000",
00100 "0039:000000003C4242423E02020204380000",
00101 "003A:000000000000181800000001818000000",
00102 "003B:000000000000181800000001808081000",
00103 "003C:000000000002040810201008040200000",
00104 "003D:000000000000007E0000007E00000000",
00105 "003E:000000000040201008040810204000000",
00106 "003F:000000003C4242020408080080800000",
00107 "0040:000000001C224A565252524E201E0000",
00108 "0041:000000001824244242 7E424242420000",
00109 "0042:000000007C4242427C424242427C0000",
00110 "0043:000000003C42424040404242 3C0000",
00111 "0044:00000000784442424242424244780000",
00112 "0045:000000007E4040407C404040407E0000",
00113 "0046:000000007E4040407C40404040400000",
00114 "0047:000000003C424240404E4242463A0000",
00115 "0048:0000000424242427E42424242420000",
00116 "0049:000000003E08080808080808 3E0000",
00117 "004A:000000001F040404040404444380000",
00118 "004B:000000042444850606050484442 0000",
00119 "004C:000000040404040404040407E0000",
00120 "004D:00000000424266665A5A424242420000",
00121 "004E:0000000042626252524A4A4646420000",
00122 "004F:000000003C42424242424242 3C0000",
00123 "0050:000000007C4242427C40404040400000",
00124 "0051:000000003C4242424242425A663C0300",
00125 "0052:000000007C4242427C48444442420000",
00126 "0053:000000003C424240300C0242423C0000",
```

```
00127   "0054:000000007F080808080808080080000",
00128   "0055:00000000424242424242424242423C0000",
00129   "0056:000000004141412222221414080800000",
00130   "0057:00000000424242425A5A666642420000",
00131   "0058:000000004242242418182424424200000",
00132   "0059:000000004141222214080808080800000",
00133   "005A:000000007E02020408102040407E0000",
00134   "005B:0000000E0808080808080808080E00",
00135   "005C:000000004040201010080804020200000",
00136   "005D:000000701010101010101010101107000",
00137   "005E:000018244200000000000000000000000",
00138   "005F:00000000000000000000000000007F00",
00139   "0060:002010080000000000000000000000000",
00140   "0061:0000000000003C42023E4242463A0000",
00141   "0062:0000004040405C6242424242625C0000",
00142   "0063:0000000000003C4240404040423C0000",
00143   "0064:0000000202023A4642424242463A0000",
00144   "0065:0000000000003C42427E4040423C0000",
00145   "0066:0000000C1010107C1010101010100000",
00146   "0067:0000000000023A44444438203C42423C",
00147   "0068:0000004040405C6242424242420000",
00148   "0069:0000000808001808080808083E0000",
00149   "006A:0000000404000C0404040404044830",
00150   "006B:000000404040444850606504844420000",
00151   "006C:000000180808080808080808083E0000",
00152   "006D:0000000000007649494949494490000",
00153   "006E:0000000000005C624242424242420000",
00154   "006F:0000000000003C4242424242423C0000",
00155   "0070:0000000000005C6242424242625C4040",
00156   "0071:0000000000003A4642424242463A0202",
00157   "0072:0000000000005C6242404040400000",
00158   "0073:0000000000003C4240300C02423C0000",
00159   "0074:000000001010107C10101010100C0000",
00160   "0075:0000000000004242424242463A0000",
00161   "0076:0000000000004242422424218180000",
00162   "0077:0000000000041494949494949360000",
00163   "0078:0000000000004242241818244242000",
00164   "0079:0000000000004242424242261A02023C",
00165   "007A:0000000000007E0204081020407E0000",
00166   "007B:0000000C10100808102010080810100C",
00167   "007C:000008080808080808080808080808",
00168   "007D:000000300808101008040810100808300",
00169   "007E:000000314946000000000000000000000",
00170   "007F:AAAA000180000001800073D1CA104BD1CA1073DF8000000180000001800005555"
00171 };
00172
00173
00174 /**
00175 @brief Array to hold ASCII bitmaps for chart title.
00176
00177 This array will be created from the strings in ascii_hex[] above.
00178 */
00179 int ascii_bits[128][16];
00180
00181
00182 /**
00183 @brief Array of 4x5 hexadecimal digits for legend.
00184
00185 hexdigit contains 4x5 pixel arrays of tiny digits for the legend.
00186 See unihexgen.c for a more detailed description in the comments.
00187 */
00188 char hexdigit[16][5] = {
00189   {0x6,0x9,0x9,0x9,0x6},  /* 0x0 */
00190   {0x2,0x6,0x2,0x2,0x7},  /* 0x1 */
00191   {0xF,0x1,0xF,0x8,0xF},  /* 0x2 */
00192   {0xE,0x1,0x7,0x1,0xE},  /* 0x3 */
00193   {0x9,0x9,0xF,0x1,0x1},  /* 0x4 */
00194   {0xF,0x8,0xF,0x1,0xF},  /* 0x5 */
00195   {0x6,0x8,0xE,0x9,0x6},  /* 0x6 */
00196   {0xF,0x1,0x2,0x4,0x4},  /* 0x7 */
00197   {0x6,0x9,0x6,0x9,0x6},  /* 0x8 */
00198   {0x6,0x9,0x7,0x1,0x6},  /* 0x9 */
00199   {0xF,0x9,0xF,0x9,0x9},  /* 0xA */
00200   {0xE,0x9,0xE,0x9,0xE},  /* 0xB */
00201   {0x7,0x8,0x8,0x8,0x7},  /* 0xC */
00202   {0xE,0x9,0x9,0x9,0xE},  /* 0xD */
00203   {0xF,0x8,0xE,0x8,0xF},  /* 0xE */
00204   {0xF,0x8,0xE,0x8,0x8}   /* 0xF */
00205 };
00206
00207 #endif
```

5.27 src/unigen-hangul.c File Reference

Generate arbitrary hangul syllables.
#include <stdio.h>
#include <stdlib.h>
#include "hangul.h"
Include dependency graph for unigen-hangul.c:



Data Structures

- struct PARAMS

Functions

- int main (int argc, char *argv[])

  Program entry point.
- void parse_args (int argc, char *argv[], struct PARAMS *params)

  Parse command line arguments.
- void get_hex_range (char *instring, unsigned *start, unsigned *end)

  Scan a hexadecimal range from a character string.

5.27.1 Detailed Description

Generate arbitrary hangul syllables.
Input is a Unifont .hex file such as the "hangul-base.hex" file that is included in the Unifont package.
The default program parameters will generate the Unicode Hangul Syllables range of U+AC00..U+D7A3.
The syllables will appear in this order:

```
For each modern choseong {
  For each modern jungseong {
    Output syllable of choseong and jungseong
    For each modern jongseong {
      Output syllable of choseong + jungseong + jongseong
    }
  }
}
```

By starting the jongseong code point at one before the first valid jongseong, the first inner loop iteration will add a blank glyph for the jongseong portion of the syllable, so only the current choseong and jungseong will be output first.

Author

Paul Hardy

Copyright

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Definition in file unigen-hangul.c.

5.27.2 Function Documentation

5.27.2.1 get_hex_range()

```
void get_hex_range (
                char * instring,
                unsigned * start,
                unsigned * end )
```

Scan a hexadecimal range from a character string.

Definition at line 354 of file unigen-hangul.c.

```
00354                                                   {
00355
00356     int i;  /* String index variable. */
00357
00358     /* Get first number in range. */
00359     sscanf (instring, "%X", start);
00360     for (i = 0;
00361          instring [i] != '\0' && instring [i] != '-';
00362          i++);
00363     /* Get last number in range. */
00364     if (instring [i] == '-') {
00365        i++;
00366        sscanf (&instring [i], "%X", end);
00367     }
00368     else {
00369        *end = *start;
00370     }
00371
00372     return;
00373 }
```

Here is the caller graph for this function:

5.27.2.2 main()

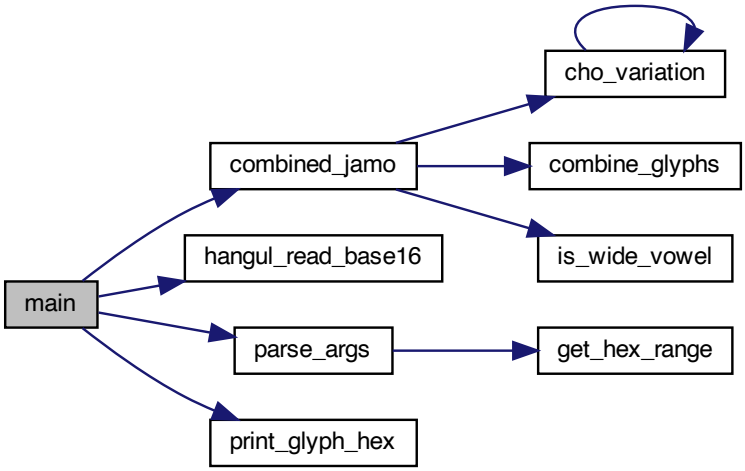
```
int main (
                int argc,
                char * argv[] )
```

Program entry point.
Default parameters for Hangul syllable generation.
Definition at line 69 of file unigen-hangul.c.

```
00069                           {
00070
00071   int i;  /* loop variable */
00072   unsigned codept;
00073   unsigned max_codept;
00074   unsigned glyph[MAX_GLYPHS][16];
00075   unsigned tmp_glyph [16];  /* To build one combined glyph at a time. */
00076   int cho, jung, jong;      /* The 3 components in a Hangul syllable. */
00077
00078 /// Default parameters for Hangul syllable generation.
00079   struct PARAMS params = { 0xAC00,  /* Starting output Unicode code point */
00080                            0x1100,  /* First modern choseong             */
00081                            0x1112,  /* Last modern choseong              */
00082                            0x1161,  /* First modern jungseong            */
00083                            0x1175,  /* Last modern jungseong             */
00084                            0x11A7,  /* One before first modern jongseong  */
00085                            0x11C2,  /* Last modern jongseong             */
00086                            stdin,   /* Default input file pointer        */
00087                            stdout   /* Default output file pointer       */
00088                          };
00089
00090   void parse_args (int argc, char *argv[], struct PARAMS *params);
00091
00092   unsigned hangul_read_base16 (FILE *infp, unsigned glyph[][16]);
00093
00094   void print_glyph_hex (FILE *fp, unsigned codept, unsigned *this_glyph);
00095
00096   void combined_jamo (unsigned glyph [MAX_GLYPHS][16],
00097                       unsigned cho, unsigned jung, unsigned jong,
00098                       unsigned *combined_glyph);
00099
00100
00101   if (argc > 1) {
00102     parse_args (argc, argv, &params);
00103
00104 #ifdef DEBUG
00105     fprintf (stderr,
00106              "Range: (U+%04X, U+%04X, U+%04X) to (U+%04X, U+%04X, U+%04X)\n",
00107              params.cho_start, params.jung_start, params.jong_start,
00108              params.cho_end,   params.jung_end,   params.jong_end);
00109 #endif
00110   }
00111
00112   /*
00113 Initialize glyph array to all zeroes.
00114 */
00115   for (codept = 0; codept < MAX_GLYPHS; codept++) {
00116     for (i = 0; i < 16; i++) glyph[codept][i] = 0x0000;
00117   }
00118
00119   /*
00120 Read Hangul base glyph file.
00121 */
00122   max_codept = hangul_read_base16 (params.infp, glyph);
00123   if (max_codept > 0x8FF) {
00124     fprintf (stderr, "\nWARNING: Hangul glyph range exceeds PUA space.\n\n");
00125   }
00126
00127   codept = params.starting_codept;  /* First code point to output */
00128
00129   for (cho = params.cho_start; cho <= params.cho_end; cho++) {
00130     for (jung = params.jung_start; jung <= params.jung_end; jung++) {
00131       for (jong = params.jong_start; jong <= params.jong_end; jong++) {
00132
00133 #ifdef DEBUG
00134         fprintf (params.outfp,
00135                  "(U+%04X, U+%04X, U+%04X)\n",
00136                  cho, jung, jong);
00137 #endif
00138         combined_jamo (glyph, cho, jung, jong, tmp_glyph);
```

```
00139             print_glyph_hex (params.outfp, codept, tmp_glyph);
00140             codept++;
00141             if (jong == JONG_UNICODE_END)
00142               jong = JONG_EXTB_UNICODE_START - 1; /* Start Extended-B range */
00143           }
00144         if (jung == JUNG_UNICODE_END)
00145           jung = JUNG_EXTB_UNICODE_START - 1;  /* Start Extended-B range */
00146       }
00147     if (cho == CHO_UNICODE_END)
00148       cho = CHO_EXTA_UNICODE_START - 1;  /* Start Extended-A range */
00149   }
00150
00151   if (params.infp  != stdin)  fclose (params.infp);
00152   if (params.outfp != stdout) fclose (params.outfp);
00153
00154   exit (EXIT_SUCCESS);
00155 }
```

Here is the call graph for this function:



5.27.2.3 parse_args()

```
void parse_args (
                int argc,
                char * argv[],
                struct PARAMS * params )
```

Parse command line arguments.

Definition at line 163 of file unigen-hangul.c.

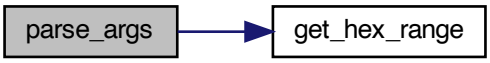
```
00163                                                   {
00164   int arg_count;  /* Current index into argv[]. */
00165
00166   void get_hex_range (char *instring, unsigned *start, unsigned *end);
00167
00168   int strncmp (const char *s1, const char *s2, size_t n);
00169
00170
00171   arg_count = 1;
00172
00173   while (arg_count < argc) {
00174     /* If all 600,000+ Hangul syllables are requested. */
00175     if (strncmp (argv [arg_count], "-all", 4) == 0) {
```

```
00176         params->starting_codept = 0x0001;
00177         params->cho_start  = CHO_UNICODE_START;      /*          First modern choseong  */
00178         params->cho_end    = CHO_EXTA_UNICODE_END;  /*           Last ancient choseong  */
00179         params->jung_start = JUNG_UNICODE_START;    /*          First modern jungseong */
00180         params->jung_end   = JUNG_EXTB_UNICODE_END; /*           Last ancient jungseong */
00181         params->jong_start = JONG_UNICODE_START - 1; /* One before first modern jongseong */
00182         params->jong_end   = JONG_EXTB_UNICODE_END; /*           Last andient jongseong */
00183       }
00184       /* If starting code point for output Unifont hex file is specified. */
00185       else if (strncmp (argv [arg_count], "-c", 2) == 0) {
00186         arg_count++;
00187         if (arg_count < argc) {
00188           sscanf (argv [arg_count], "%X", &params->starting_codept);
00189         }
00190       }
00191       /* If initial consonant (choseong) range, "jamo 1", get range.  */
00192       else if (strncmp (argv [arg_count], "-j1", 3) == 0) {
00193         arg_count++;
00194         if (arg_count < argc) {
00195           get_hex_range (argv [arg_count],
00196                          &params->cho_start, &params->cho_end);
00197           /*
00198 Allow one initial blank glyph at start of a loop, none at end.
00199 */
00200           if (params->cho_start < CHO_UNICODE_START) {
00201             params->cho_start = CHO_UNICODE_START - 1;
00202           }
00203           else if (params->cho_start > CHO_UNICODE_END &&
00204                    params->cho_start < CHO_EXTA_UNICODE_START) {
00205             params->cho_start = CHO_EXTA_UNICODE_START - 1;
00206           }
00207           /*
00208 Do not go past desired Hangul choseong range,
00209 Hangul Jamo or Hangul Jamo Extended-A choseong.
00210 */
00211           if (params->cho_end > CHO_EXTA_UNICODE_END) {
00212             params->cho_end = CHO_EXTA_UNICODE_END;
00213           }
00214           else if (params->cho_end > CHO_UNICODE_END &&
00215                    params->cho_end < CHO_EXTA_UNICODE_START) {
00216             params->cho_end = CHO_UNICODE_END;
00217           }
00218         }
00219       }
00220       /* If medial vowel (jungseong) range, "jamo 2", get range.  */
00221       else if (strncmp (argv [arg_count], "-j2", 3) == 0) {
00222         arg_count++;
00223         if (arg_count < argc) {
00224           get_hex_range (argv [arg_count],
00225                          &params->jung_start, &params->jung_end);
00226           /*
00227 Allow one initial blank glyph at start of a loop, none at end.
00228 */
00229           if (params->jung_start < JUNG_UNICODE_START) {
00230             params->jung_start = JUNG_UNICODE_START - 1;
00231           }
00232           else if (params->jung_start > JUNG_UNICODE_END &&
00233                    params->jung_start < JUNG_EXTB_UNICODE_START) {
00234             params->jung_start = JUNG_EXTB_UNICODE_START - 1;
00235           }
00236           /*
00237 Do not go past desired Hangul jungseong range,
00238 Hangul Jamo or Hangul Jamo Extended-B jungseong.
00239 */
00240           if (params->jung_end > JUNG_EXTB_UNICODE_END) {
00241             params->jung_end = JUNG_EXTB_UNICODE_END;
00242           }
00243           else if (params->jung_end > JUNG_UNICODE_END &&
00244                    params->jung_end < JUNG_EXTB_UNICODE_START) {
00245             params->jung_end = JUNG_UNICODE_END;
00246           }
00247         }
00248       }
00249       /* If final consonant (jongseong) range, "jamo 3", get range.  */
00250       else if (strncmp (argv [arg_count], "-j3", 3) == 0) {
00251         arg_count++;
00252         if (arg_count < argc) {
00253           get_hex_range (argv [arg_count],
00254                          &params->jong_start, &params->jong_end);
00255           /*
00256 Allow one initial blank glyph at start of a loop, none at end.
```

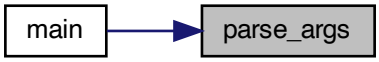
```
00257 */
00258           if (params->jong_start < JONG_UNICODE_START) {
00259             params->jong_start = JONG_UNICODE_START - 1;
00260           }
00261           else if (params->jong_start > JONG_UNICODE_END &&
00262                    params->jong_start < JONG_EXTB_UNICODE_START) {
00263             params->jong_start = JONG_EXTB_UNICODE_START - 1;
00264           }
00265           /*
00266 Do not go past desired Hangul jongseong range,
00267 Hangul Jamo or Hangul Jamo Extended-B jongseong.
00268 */
00269           if (params->jong_end > JONG_EXTB_UNICODE_END) {
00270             params->jong_end = JONG_EXTB_UNICODE_END;
00271           }
00272           else if (params->jong_end > JONG_UNICODE_END &&
00273                    params->jong_end < JONG_EXTB_UNICODE_START) {
00274             params->jong_end = JONG_UNICODE_END;
00275           }
00276         }
00277       }
00278       /* If input file is specified, open it for read access. */
00279       else if (strncmp (argv [arg_count], "-i", 2) == 0) {
00280         arg_count++;
00281         if (arg_count < argc) {
00282           params->infp = fopen (argv [arg_count], "r");
00283           if (params->infp == NULL) {
00284             fprintf (stderr, "\n*** ERROR: Cannot open %s for input.\n\n",
00285                      argv [arg_count]);
00286             exit (EXIT_FAILURE);
00287           }
00288         }
00289       }
00290       /* If output file is specified, open it for write access. */
00291       else if (strncmp (argv [arg_count], "-o", 2) == 0) {
00292         arg_count++;
00293         if (arg_count < argc) {
00294           params->outfp = fopen (argv [arg_count], "w");
00295           if (params->outfp == NULL) {
00296             fprintf (stderr, "\n*** ERROR: Cannot open %s for output.\n\n",
00297                      argv [arg_count]);
00298             exit (EXIT_FAILURE);
00299           }
00300         }
00301       }
00302       /* If help is requested, print help message and exit. */
00303       else if (strncmp (argv [arg_count], "-h",     2) == 0 ||
00304                strncmp (argv [arg_count], "--help", 6) == 0) {
00305         printf ("\nunigen-hangul [options]\n\n");
00306         printf ("     Generates Hangul syllables from an input Unifont .hex file encoded\n");
00307         printf ("     in Johab 6/3/1 format.  By default, the output is the Unicode Hangul\n");
00308         printf ("     Syllables range, U+AC00..U+D7A3.  Options allow the user to specify\n");
00309         printf ("     a starting code point for the output Unifont .hex file, and ranges\n");
00310         printf ("     in hexadecimal of the starting and ending Hangul Jamo code points:\n\n");
00311
00312         printf ("          * 1100-115E Initial consonants (choseong)\n");
00313         printf ("          * 1161-11A7 Medial vowels (jungseong)\n");
00314         printf ("          * 11A8-11FF Final consonants (jongseong).\n\n");
00315
00316         printf ("     A single code point or 0 to omit can be specified instead of a range.\n\n");
00317
00318         printf ("   Option    Parameters    Function\n");
00319         printf ("   ------    ----------    --------\n");
00320         printf ("   -h, --help              Print this message and exit.\n\n");
00321         printf ("   -all                    Generate all Hangul syllables, using all modern and\n");
00322         printf ("                           ancient Hangul in the Unicode range U+1100..U+11FF,\n");
00323         printf ("                           U+A960..U+A97C, and U+D7B0..U+D7FB.\n");
00324         printf ("                           WARNING: this will generate over 1,600,000 syllables\n");
00325         printf ("                           in a 115 megabyte Unifont .hex format file.  The\n");
00326         printf ("                           default is to only output modern Hangul syllables.\n\n");
00327         printf ("   -c        code_point    Starting code point in hexadecimal for output file.\n\n");
00328         printf ("   -j1       start-end     Choseong (jamo 1) start-end range in hexadecimal.\n\n");
00329         printf ("   -j2       start-end     Jungseong (jamo 2) start-end range in hexadecimal.\n\n");
00330         printf ("   -j3       start-end     Jongseong (jamo 3) start-end range in hexadecimal.\n\n");
00331         printf ("   -i        input_file    Unifont hangul-base.hex formatted input file.\n\n");
00332         printf ("   -o        output_file   Unifont .hex format output file.\n\n");
00333         printf ("     Example:\n\n");
00334         printf ("        unigen-hangul -c 1 -j3 11AB-11AB -i hangul-base.hex -o nieun-only.hex\n\n");
00335         printf ("     Generates Hangul syllables using all modern choseong and jungseong,\n");
00336         printf ("     and only the jongseong nieun (Unicode code point U+11AB).  The output\n");
00337         printf ("     Unifont .hex file will contain code points starting at 1.  Instead of\n");
```

```
00338           printf ("       specifying \"-j3 11AB-11AB\", simply using \"-j3 11AB\" will also suffice.\n\n");
00339
00340           exit (EXIT_SUCCESS);
00341         }
00342
00343       arg_count++;
00344     }
00345
00346   return;
00347 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.28 unigen-hangul.c

Go to the documentation of this file.

```
00001 /**
00002 @file unigen-hangul.c
00003
00004 @brief Generate arbitrary hangul syllables.
00005
00006 Input is a Unifont .hex file such as the "hangul-base.hex" file that
00007 is included in the Unifont package.
00008
00009 The default program parameters will generate the Unicode
00010 Hangul Syllables range of U+AC00..U+D7A3.  The syllables
00011 will appear in this order:
00012
00013 For each modern choseong {
00014 For each modern jungseong {
00015 Output syllable of choseong and jungseong
00016 For each modern jongseong {
00017 Output syllable of choseong + jungseong + jongseong
00018 }
00019 }
00020 }
00021
00022 By starting the jongseong code point at one before the first
00023 valid jongseong, the first inner loop iteration will add a
00024 blank glyph for the jongseong portion of the syllable, so
00025 only the current choseong and jungseong will be output first.
00026
00027 @author Paul Hardy
00028
00029 @copyright Copyright © 2023 Paul Hardy
```

```
00030 */
00031 /*
00032 LICENSE:
00033
00034 This program is free software: you can redistribute it and/or modify
00035 it under the terms of the GNU General Public License as published by
00036 the Free Software Foundation, either version 2 of the License, or
00037 (at your option) any later version.
00038
00039 This program is distributed in the hope that it will be useful,
00040 but WITHOUT ANY WARRANTY; without even the implied warranty of
00041 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
00042 GNU General Public License for more details.
00043
00044 You should have received a copy of the GNU General Public License
00045 along with this program.  If not, see <http://www.gnu.org/licenses/>.
00046 */
00047
00048 #include <stdio.h>
00049 #include <stdlib.h>
00050 #include "hangul.h"
00051
00052 // #define DEBUG
00053
00054
00055 struct PARAMS {
00056   unsigned starting_codept;      /* First output Unicode code point. */
00057   unsigned cho_start,  cho_end;  /* Choseong  start and end code points. */
00058   unsigned jung_start, jung_end; /* Jungseong start and end code points. */
00059   unsigned jong_start, jong_end; /* Jongseong start and end code points. */
00060   FILE *infp;
00061   FILE *outfp;
00062 };
00063
00064
00065 /**
00066 @brief Program entry point.
00067 */
00068 int
00069 main (int argc, char *argv[]) {
00070
00071   int i;  /* loop variable */
00072   unsigned codept;
00073   unsigned max_codept;
00074   unsigned glyph[MAX_GLYPHS][16];
00075   unsigned tmp_glyph [16];  /* To build one combined glyph at a time. */
00076   int cho, jung, jong;      /* The 3 components in a Hangul syllable. */
00077
00078 /// Default parameters for Hangul syllable generation.
00079   struct PARAMS params = { 0xAC00,  /* Starting output Unicode code point */
00080                            0x1100,  /* First modern choseong             */
00081                            0x1112,  /* Last modern choseong              */
00082                            0x1161,  /* First modern jungseong            */
00083                            0x1175,  /* Last modern jungseong             */
00084                            0x11A7,  /* One before first modern jongseong */
00085                            0x11C2,  /* Last modern jongseong             */
00086                            stdin,   /* Default input file pointer        */
00087                            stdout   /* Default output file pointer       */
00088                          };
00089
00090   void parse_args (int argc, char *argv[], struct PARAMS *params);
00091
00092   unsigned hangul_read_base16 (FILE *infp, unsigned glyph[][16]);
00093
00094   void print_glyph_hex (FILE *fp, unsigned codept, unsigned *this_glyph);
00095
00096   void combined_jamo (unsigned glyph [MAX_GLYPHS][16],
00097                       unsigned cho, unsigned jung, unsigned jong,
00098                       unsigned *combined_glyph);
00099
00100
00101   if (argc > 1) {
00102     parse_args (argc, argv, &params);
00103
00104 #ifdef DEBUG
00105     fprintf (stderr,
00106              "Range: (U+%04X, U+%04X, U+%04X) to (U+%04X, U+%04X, U+%04X)\n",
00107              params.cho_start, params.jung_start, params.jong_start,
00108              params.cho_end,   params.jung_end,   params.jong_end);
00109 #endif
00110   }
```

```
00111
00112   /*
00113 Initialize glyph array to all zeroes.
00114 */
00115   for (codept = 0; codept < MAX_GLYPHS; codept++) {
00116     for (i = 0; i < 16; i++) glyph[codept][i] = 0x0000;
00117   }
00118
00119   /*
00120 Read Hangul base glyph file.
00121 */
00122   max_codept = hangul_read_base16 (params.infp, glyph);
00123   if (max_codept > 0x8FF) {
00124     fprintf (stderr, "\nWARNING: Hangul glyph range exceeds PUA space.\n\n");
00125   }
00126
00127   codept = params.starting_codept;  /* First code point to output */
00128
00129   for (cho = params.cho_start; cho <= params.cho_end; cho++) {
00130     for (jung = params.jung_start; jung <= params.jung_end; jung++) {
00131       for (jong = params.jong_start; jong <= params.jong_end; jong++) {
00132
00133 #ifdef DEBUG
00134         fprintf (params.outfp,
00135                  "(U+%04X, U+%04X, U+%04X)\n",
00136                  cho, jung, jong);
00137 #endif
00138         combined_jamo (glyph, cho, jung, jong, tmp_glyph);
00139         print_glyph_hex (params.outfp, codept, tmp_glyph);
00140         codept++;
00141         if (jong == JONG_UNICODE_END)
00142           jong = JONG_EXTB_UNICODE_START - 1; /* Start Extended-B range */
00143       }
00144       if (jung == JUNG_UNICODE_END)
00145         jung = JUNG_EXTB_UNICODE_START - 1;  /* Start Extended-B range */
00146     }
00147     if (cho == CHO_UNICODE_END)
00148       cho = CHO_EXTA_UNICODE_START - 1;  /* Start Extended-A range */
00149   }
00150
00151   if (params.infp  != stdin)  fclose (params.infp);
00152   if (params.outfp != stdout) fclose (params.outfp);
00153
00154   exit (EXIT_SUCCESS);
00155 }
00156
00157
00158 /**
00159 @brief Parse command line arguments.
00160
00161 */
00162 void
00163 parse_args (int argc, char *argv[], struct PARAMS *params) {
00164   int arg_count;  /* Current index into argv[]. */
00165
00166   void get_hex_range (char *instring, unsigned *start, unsigned *end);
00167
00168   int strncmp (const char *s1, const char *s2, size_t n);
00169
00170
00171   arg_count = 1;
00172
00173   while (arg_count < argc) {
00174     /* If all 600,000+ Hangul syllables are requested. */
00175     if (strncmp (argv [arg_count], "-all", 4) == 0) {
00176       params->starting_codept = 0x0001;
00177       params->cho_start  = CHO_UNICODE_START;       /*          First modern choseong  */
00178       params->cho_end    = CHO_EXTA_UNICODE_END;    /*           Last ancient choseong  */
00179       params->jung_start = JUNG_UNICODE_START;      /*         First modern jungseong */
00180       params->jung_end   = JUNG_EXTB_UNICODE_END;   /*          Last ancient jungseong */
00181       params->jong_start = JONG_UNICODE_START - 1;  /* One before first modern jongseong */
00182       params->jong_end   = JONG_EXTB_UNICODE_END;   /*          Last andient jongseong */
00183     }
00184     /* If starting code point for output Unifont hex file is specified. */
00185     else if (strncmp (argv [arg_count], "-c", 2) == 0) {
00186       arg_count++;
00187       if (arg_count < argc) {
00188         sscanf (argv [arg_count], "%X", &params->starting_codept);
00189       }
00190     }
00191     /* If initial consonant (choseong) range, "jamo 1", get range.  */
```

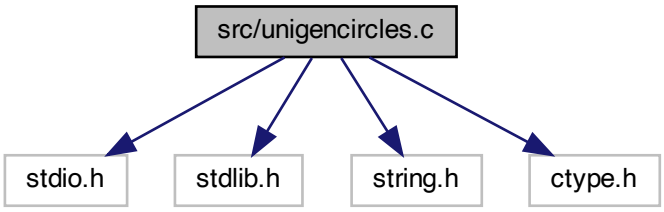
```
00192       else if (strncmp (argv [arg_count], "-j1", 3) == 0) {
00193         arg_count++;
00194         if (arg_count < argc) {
00195           get_hex_range (argv [arg_count],
00196                          &params->cho_start, &params->cho_end);
00197           /*
00198 Allow one initial blank glyph at start of a loop, none at end.
00199 */
00200           if (params->cho_start < CHO_UNICODE_START) {
00201             params->cho_start = CHO_UNICODE_START - 1;
00202           }
00203           else if (params->cho_start > CHO_UNICODE_END &&
00204                    params->cho_start < CHO_EXTA_UNICODE_START) {
00205             params->cho_start = CHO_EXTA_UNICODE_START - 1;
00206           }
00207           /*
00208 Do not go past desired Hangul choseong range,
00209 Hangul Jamo or Hangul Jamo Extended-A choseong.
00210 */
00211           if (params->cho_end > CHO_EXTA_UNICODE_END) {
00212             params->cho_end = CHO_EXTA_UNICODE_END;
00213           }
00214           else if (params->cho_end > CHO_UNICODE_END &&
00215                    params->cho_end < CHO_EXTA_UNICODE_START) {
00216             params->cho_end = CHO_UNICODE_END;
00217           }
00218         }
00219       }
00220       /* If medial vowel (jungseong) range, "jamo 2", get range.   */
00221       else if (strncmp (argv [arg_count], "-j2", 3) == 0) {
00222         arg_count++;
00223         if (arg_count < argc) {
00224           get_hex_range (argv [arg_count],
00225                          &params->jung_start, &params->jung_end);
00226           /*
00227 Allow one initial blank glyph at start of a loop, none at end.
00228 */
00229           if (params->jung_start < JUNG_UNICODE_START) {
00230             params->jung_start = JUNG_UNICODE_START - 1;
00231           }
00232           else if (params->jung_start > JUNG_UNICODE_END &&
00233                    params->jung_start < JUNG_EXTB_UNICODE_START) {
00234             params->jung_start = JUNG_EXTB_UNICODE_START - 1;
00235           }
00236           /*
00237 Do not go past desired Hangul jungseong range,
00238 Hangul Jamo or Hangul Jamo Extended-B jungseong.
00239 */
00240           if (params->jung_end > JUNG_EXTB_UNICODE_END) {
00241             params->jung_end = JUNG_EXTB_UNICODE_END;
00242           }
00243           else if (params->jung_end > JUNG_UNICODE_END &&
00244                    params->jung_end < JUNG_EXTB_UNICODE_START) {
00245             params->jung_end = JUNG_UNICODE_END;
00246           }
00247         }
00248       }
00249       /* If final consonant (jongseong) range, "jamo 3", get range.   */
00250       else if (strncmp (argv [arg_count], "-j3", 3) == 0) {
00251         arg_count++;
00252         if (arg_count < argc) {
00253           get_hex_range (argv [arg_count],
00254                          &params->jong_start, &params->jong_end);
00255           /*
00256 Allow one initial blank glyph at start of a loop, none at end.
00257 */
00258           if (params->jong_start < JONG_UNICODE_START) {
00259             params->jong_start = JONG_UNICODE_START - 1;
00260           }
00261           else if (params->jong_start > JONG_UNICODE_END &&
00262                    params->jong_start < JONG_EXTB_UNICODE_START) {
00263             params->jong_start = JONG_EXTB_UNICODE_START - 1;
00264           }
00265           /*
00266 Do not go past desired Hangul jongseong range,
00267 Hangul Jamo or Hangul Jamo Extended-B jongseong.
00268 */
00269           if (params->jong_end > JONG_EXTB_UNICODE_END) {
00270             params->jong_end = JONG_EXTB_UNICODE_END;
00271           }
00272           else if (params->jong_end > JONG_UNICODE_END &&
```

```
00273                 params->jong_end < JONG_EXTB_UNICODE_START) {
00274             params->jong_end = JONG_UNICODE_END;
00275           }
00276         }
00277       }
00278       /* If input file is specified, open it for read access. */
00279       else if (strncmp (argv [arg_count], "-i", 2) == 0) {
00280         arg_count++;
00281         if (arg_count < argc) {
00282           params->infp = fopen (argv [arg_count], "r");
00283           if (params->infp == NULL) {
00284             fprintf (stderr, "\n*** ERROR: Cannot open %s for input.\n\n",
00285                      argv [arg_count]);
00286             exit (EXIT_FAILURE);
00287           }
00288         }
00289       }
00290       /* If output file is specified, open it for write access. */
00291       else if (strncmp (argv [arg_count], "-o", 2) == 0) {
00292         arg_count++;
00293         if (arg_count < argc) {
00294           params->outfp = fopen (argv [arg_count], "w");
00295           if (params->outfp == NULL) {
00296             fprintf (stderr, "\n*** ERROR: Cannot open %s for output.\n\n",
00297                      argv [arg_count]);
00298             exit (EXIT_FAILURE);
00299           }
00300         }
00301       }
00302       /* If help is requested, print help message and exit. */
00303       else if (strncmp (argv [arg_count], "-h",     2) == 0 ||
00304                strncmp (argv [arg_count], "--help", 6) == 0) {
00305         printf ("\nunigen-hangul [options]\n\n");
00306         printf ("     Generates Hangul syllables from an input Unifont .hex file encoded\n");
00307         printf ("     in Johab 6/3/1 format.  By default, the output is the Unicode Hangul\n");
00308         printf ("     Syllables range, U+AC00..U+D7A3.  Options allow the user to specify\n");
00309         printf ("     a starting code point for the output Unifont .hex file, and ranges\n");
00310         printf ("     in hexadecimal of the starting and ending Hangul Jamo code points:\n\n");
00311
00312         printf ("          * 1100-115E Initial consonants (choseong)\n");
00313         printf ("          * 1161-11A7 Medial vowels (jungseong)\n");
00314         printf ("          * 11A8-11FF Final consonants (jongseong).\n\n");
00315
00316         printf ("     A single code point or 0 to omit can be specified instead of a range.\n\n");
00317
00318         printf ("   Option    Parameters    Function\n");
00319         printf ("   ------    ----------    --------\n");
00320         printf ("   -h, --help              Print this message and exit.\n\n");
00321         printf ("   -all                    Generate all Hangul syllables, using all modern and\n");
00322         printf ("                           ancient Hangul in the Unicode range U+1100..U+11FF,\n");
00323         printf ("                           U+A960..U+A97C, and U+D7B0..U+D7FB.\n");
00324         printf ("                           WARNING: this will generate over 1,600,000 syllables\n");
00325         printf ("                           in a 115 megabyte Unifont .hex format file.  The\n");
00326         printf ("                           default is to only output modern Hangul syllables.\n\n");
00327         printf ("   -c        code_point    Starting code point in hexadecimal for output file.\n\n");
00328         printf ("   -j1       start-end     Choseong (jamo 1) start-end range in hexadecimal.\n\n");
00329         printf ("   -j2       start-end     Jungseong (jamo 2) start-end range in hexadecimal.\n\n");
00330         printf ("   -j3       start-end     Jongseong (jamo 3) start-end range in hexadecimal.\n\n");
00331         printf ("   -i        input_file    Unifont hangul-base.hex formatted input file.\n\n");
00332         printf ("   -o        output_file   Unifont .hex format output file.\n\n");
00333         printf ("     Example:\n\n");
00334         printf ("        unigen-hangul -c 1 -j3 11AB-11AB -i hangul-base.hex -o nieun-only.hex\n\n");
00335         printf ("     Generates Hangul syllables using all modern choseong and jungseong,\n");
00336         printf ("     and only the jongseong nieun (Unicode code point U+11AB).  The output\n");
00337         printf ("     Unifont .hex file will contain code points starting at 1.  Instead of\n");
00338         printf ("     specifying \"-j3 11AB-11AB\", simply using \"-j3 11AB\" will also suffice.\n\n");
00339
00340         exit (EXIT_SUCCESS);
00341       }
00342
00343       arg_count++;
00344     }
00345
00346     return;
00347 }
00348
00349
00350 /**
00351 @brief Scan a hexadecimal range from a character string.
00352 */
00353 void
```

```
00354 get_hex_range (char *instring, unsigned *start, unsigned *end) {
00355
00356   int i;  /* String index variable. */
00357
00358   /* Get first number in range. */
00359   sscanf (instring, "%X", start);
00360   for (i = 0;
00361        instring [i] != '\0' && instring [i] != '-';
00362        i++);
00363   /* Get last number in range. */
00364   if (instring [i] == '-') {
00365     i++;
00366     sscanf (&instring [i], "%X", end);
00367   }
00368   else {
00369     *end = *start;
00370   }
00371
00372   return;
00373 }
```

5.29 src/unigencircles.c File Reference

unigencircles - Superimpose dashed combining circles on combining glyphs
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <ctype.h>
Include dependency graph for unigencircles.c:



Macros

- #define MAXSTRING 256

  Maximum input line length - 1.

Functions

- int main (int argc, char **argv)

  The main function.
- void add_single_circle (char *glyphstring)

  Superimpose a single-width dashed combining circle on a glyph bitmap.
- void add_double_circle (char *glyphstring, int offset)

  Superimpose a double-width dashed combining circle on a glyph bitmap.

5.29.1 Detailed Description

unigencircles - Superimpose dashed combining circles on combining glyphs

Author

Paul Hardy

Copyright

Copyright (C) 2013, Paul Hardy.

Definition in file unigencircles.c.

5.29.2 Macro Definition Documentation

5.29.2.1 MAXSTRING

#define MAXSTRING 256
Maximum input line length - 1.
Definition at line 62 of file unigencircles.c.

5.29.3 Function Documentation

5.29.3.1 add_double_circle()

void add_double_circle (
char * glyphstring,
int offset)
Superimpose a double-width dashed combining circle on a glyph bitmap.

Parameters

in,out	glyphstring	A double-width glyph, 16x16 pixels.

Definition at line 221 of file unigencircles.c.

```
00222 {
00223
00224   char newstring[256];
00225   /* Circle hex string pattern is "00000008000024004200240000000000" */
00226
00227   /* For double diacritical glyphs (offset = -8) */
00228   /* Combining circle is left-justified.          */
00229   char circle08[64]={0x0,0x0,0x0,0x0,  /* row  1 */
00230                      0x0,0x0,0x0,0x0,  /* row  2 */
00231                      0x0,0x0,0x0,0x0,  /* row  3 */
00232                      0x0,0x0,0x0,0x0,  /* row  4 */
00233                      0x0,0x0,0x0,0x0,  /* row  5 */
00234                      0x0,0x0,0x0,0x0,  /* row  6 */
00235                      0x2,0x4,0x0,0x0,  /* row  7 */
00236                      0x0,0x0,0x0,0x0,  /* row  8 */
00237                      0x4,0x2,0x0,0x0,  /* row  9 */
00238                      0x0,0x0,0x0,0x0,  /* row 10 */
```

```
00239                   0x2,0x4,0x0,0x0,  /* row 11 */
00240                   0x0,0x0,0x0,0x0,  /* row 12 */
00241                   0x0,0x0,0x0,0x0,  /* row 13 */
00242                   0x0,0x0,0x0,0x0,  /* row 14 */
00243                   0x0,0x0,0x0,0x0,  /* row 15 */
00244                   0x0,0x0,0x0,0x0}; /* row 16 */
00245
00246   /* For all other combining glyphs (offset = -16) */
00247   /* Combining circle is centered in 16 columns.    */
00248   char circle16[64]={0x0,0x0,0x0,0x0,  /* row  1 */
00249                   0x0,0x0,0x0,0x0,  /* row  2 */
00250                   0x0,0x0,0x0,0x0,  /* row  3 */
00251                   0x0,0x0,0x0,0x0,  /* row  4 */
00252                   0x0,0x0,0x0,0x0,  /* row  5 */
00253                   0x0,0x0,0x0,0x0,  /* row  6 */
00254                   0x0,0x2,0x4,0x0,  /* row  7 */
00255                   0x0,0x0,0x0,0x0,  /* row  8 */
00256                   0x0,0x4,0x2,0x0,  /* row  9 */
00257                   0x0,0x0,0x0,0x0,  /* row 10 */
00258                   0x0,0x2,0x4,0x0,  /* row 11 */
00259                   0x0,0x0,0x0,0x0,  /* row 12 */
00260                   0x0,0x0,0x0,0x0,  /* row 13 */
00261                   0x0,0x0,0x0,0x0,  /* row 14 */
00262                   0x0,0x0,0x0,0x0,  /* row 15 */
00263                   0x0,0x0,0x0,0x0}; /* row 16 */
00264
00265   char *circle; /* points into circle16 or circle08 */
00266
00267   int digit1, digit2; /* corresponding digits in each string */
00268
00269   int i; /* index variables */
00270
00271
00272   /*
00273 Determine if combining circle is left-justified (offset = -8)
00274 or centered (offset = -16).
00275 */
00276   circle = (offset >= -8) ? circle08 : circle16;
00277
00278   /* for each character position, OR the corresponding circle glyph value */
00279   for (i = 0; i < 64; i++) {
00280     glyphstring[i] = toupper (glyphstring[i]);
00281
00282     /* Convert ASCII character to a hexadecimal integer */
00283     digit1 = (glyphstring[i] <= '9') ?
00284           (glyphstring[i] - '0') : (glyphstring[i] - 'A' + 0xA);
00285
00286     /* Superimpose dashed circle */
00287     digit2 = digit1 | circle[i];
00288
00289     /* Convert hexadecimal integer to an ASCII character */
00290     newstring[i] = (digit2 <= 9) ?
00291                 ('0' + digit2) : ('A' + digit2 - 0xA);
00292   }
00293
00294   /* Terminate string for output */
00295   newstring[i++] = '\n';
00296   newstring[i++] = '\0';
00297
00298   memcpy (glyphstring, newstring, i);
00299
00300   return;
00301 }
```

Here is the caller graph for this function:

5.29.3.2 add_single_circle()

void add_single_circle (
char * glyphstring)

Superimpose a single-width dashed combining circle on a glyph bitmap.

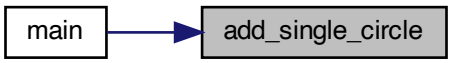
Parameters

in,out	glyphstring	A single-width glyph, 8x16 pixels.

Definition at line 163 of file unigencircles.c.

```
00164 {
00165
00166   char newstring[256];
00167   /* Circle hex string pattern is "00000008000024004200240000000000" */
00168   char circle[32]={0x0,0x0,  /* row  1 */
00169                    0x0,0x0,  /* row  2 */
00170                    0x0,0x0,  /* row  3 */
00171                    0x0,0x0,  /* row  4 */
00172                    0x0,0x0,  /* row  5 */
00173                    0x0,0x0,  /* row  6 */
00174                    0x2,0x4,  /* row  7 */
00175                    0x0,0x0,  /* row  8 */
00176                    0x4,0x2,  /* row  9 */
00177                    0x0,0x0,  /* row 10 */
00178                    0x2,0x4,  /* row 11 */
00179                    0x0,0x0,  /* row 12 */
00180                    0x0,0x0,  /* row 13 */
00181                    0x0,0x0,  /* row 14 */
00182                    0x0,0x0,  /* row 15 */
00183                    0x0,0x0}; /* row 16 */
00184
00185   int digit1, digit2; /* corresponding digits in each string */
00186
00187   int i; /* index variables */
00188
00189   /* for each character position, OR the corresponding circle glyph value */
00190   for (i = 0; i < 32; i++) {
00191     glyphstring[i] = toupper (glyphstring[i]);
00192
00193     /* Convert ASCII character to a hexadecimal integer */
00194     digit1 = (glyphstring[i] <= '9') ?
00195           (glyphstring[i] - '0') : (glyphstring[i] - 'A' + 0xA);
00196
00197     /* Superimpose dashed circle */
00198     digit2 = digit1 | circle[i];
00199
00200     /* Convert hexadecimal integer to an ASCII character */
00201     newstring[i] = (digit2 <= 9) ?
00202                  ('0' + digit2) : ('A' + digit2 - 0xA);
00203   }
00204
00205   /* Terminate string for output */
00206   newstring[i++] = '\n';
00207   newstring[i++] = '\0';
00208
00209   memcpy (glyphstring, newstring, i);
00210
00211   return;
00212 }
```

Here is the caller graph for this function:



5.29.3.3 main()

```
int main (
                int argc,
                char ** argv )
```

The main function.

Parameters

in	argc	The count of command line arguments.
in	argv	Pointer to array of command line arguments.

Returns

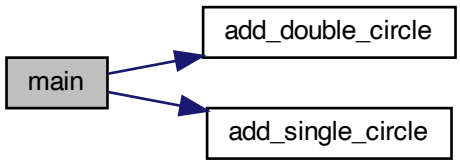
This program exits with status EXIT_SUCCESS.

Definition at line 73 of file unigencircles.c.

```
00074 {
00075
00076   char teststring[MAXSTRING];  /* current input line                    */
00077   int  loc;                   /* Unicode code point of current input line */
00078   int  offset;                /* offset value of a combining character    */
00079   char *gstart;                 /* glyph start, pointing into teststring    */
00080
00081   char combining[0x110000];    /* 1 --> combining glyph; 0 --> non-combining */
00082   char x_offset [0x110000];    /* second value in *combining.txt files       */
00083
00084   void add_single_circle(char *);      /* add a single-width dashed circle */
00085   void add_double_circle(char *, int); /* add a double-width dashed circle */
00086
00087   FILE *infilefp;
```

```
00088
00089    /*
00090 if (argc != 3) {
00091 fprintf (stderr,
00092 "\n\nUsage: %s combining.txt nonprinting.hex < unifont.hex > unifontfull.hex\n\n");
00093 exit (EXIT_FAILURE);
00094 }
00095 */
00096
00097    /*
00098 Read the combining characters list.
00099 */
00100    /* Start with no combining code points flagged */
00101    memset (combining, 0, 0x110000 * sizeof (char));
00102    memset (x_offset , 0, 0x110000 * sizeof (char));
00103
00104    if ((infilefp = fopen (argv[1],"r")) == NULL) {
00105       fprintf (stderr,"ERROR - combining characters file %s not found.\n\n",
00106             argv[1]);
00107       exit (EXIT_FAILURE);
00108    }
00109
00110    /* Flag list of combining characters to add a dashed circle. */
00111    while (fscanf (infilefp, "%X:%d", &loc, &offset) != EOF) {
00112       /*
00113 U+01107F and U+01D1A0 are not defined as combining characters
00114 in Unicode; they were added in a combining.txt file as the
00115 only way to make them look acceptable in proximity to other
00116 glyphs in their script.
00117 */
00118       if (loc != 0x01107F && loc != 0x01D1A0) {
00119          combining[loc] = 1;
00120          x_offset [loc] = offset;
00121       }
00122    }
00123    fclose (infilefp); /* all done reading combining.txt */
00124
00125    /* Now read the non-printing glyphs; they never have dashed circles */
00126    if ((infilefp = fopen (argv[2],"r")) == NULL) {
00127       fprintf (stderr,"ERROR - nonprinting characters file %s not found.\n\n",
00128             argv[1]);
00129       exit (EXIT_FAILURE);
00130    }
00131
00132    /* Reset list of nonprinting characters to avoid adding a dashed circle. */
00133    while (fscanf (infilefp, "%X:%*s", &loc) != EOF) combining[loc] = 0;
00134
00135    fclose (infilefp); /* all done reading nonprinting.hex */
00136
00137    /*
00138 Read the hex glyphs.
00139 */
00140    teststring[MAXSTRING - 1] = '\0';   /* so there's no chance we leave array  */
00141    while (fgets (teststring, MAXSTRING-1, stdin) != NULL) {
00142       sscanf (teststring, "%X", &loc);      /* loc == the Uniocde code point     */
00143       gstart = strchr (teststring,':') + 1; /* start of glyph bitmap             */
00144       if (combining[loc]) {                 /* if a combining character          */
00145          if (strlen (gstart) < 35)
00146             add_single_circle (gstart);                /* single-width */
00147          else
00148             add_double_circle (gstart, x_offset[loc]);  /* double-width */
00149       }
00150       printf ("%s", teststring); /* output the new character .hex string */
00151    }
00152
00153    exit (EXIT_SUCCESS);
00154 }
```

Here is the call graph for this function:



5.30 unigencircles.c

Go to the documentation of this file.

```
00001 /**
00002 @file unigencircles.c
00003
00004 @brief unigencircles - Superimpose dashed combining circles
00005 on combining glyphs
00006
00007 @author Paul Hardy
00008
00009 @copyright Copyright (C) 2013, Paul Hardy.
00010 */
00011 /*
00012 LICENSE:
00013
00014 This program is free software: you can redistribute it and/or modify
00015 it under the terms of the GNU General Public License as published by
00016 the Free Software Foundation, either version 2 of the License, or
00017 (at your option) any later version.
00018
00019 This program is distributed in the hope that it will be useful,
00020 but WITHOUT ANY WARRANTY; without even the implied warranty of
00021 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
00022 GNU General Public License for more details.
00023
00024 You should have received a copy of the GNU General Public License
00025 along with this program.  If not, see <http://www.gnu.org/licenses/>.
00026 */
00027
00028 /*
00029 8 July 2017 [Paul Hardy]:
00030 - Reads new second field that contains an x-axis offset for
00031 each combining character in "*combining.txt" files.
00032 - Uses the above x-axis offset value for a combining character
00033 to print combining circle in the left half of a double
00034 diacritic combining character grid, or in the center for
00035 other combining characters.
00036 - Adds exceptions for U+01107F (Brahmi number joiner) and
00037 U+01D1A0 (vertical stroke musical ornament); they are in
00038 a combining.txt file for positioning, but are not actually
00039 Unicode combining characters.
00040 - Typo fix: "single-width"-->"double-width" in comment for
00041 add_double_circle function.
00042
00043 12 August 2017 [Paul Hardy]:
00044 - Hard-code Miao vowels to show combining circles after
00045 removing them from font/plane01/plane01-combining.txt.
00046
00047 26 December 2017 [Paul Hardy]:
00048 - Remove Miao hard-coding; they are back in unibmp2hex.c and
00049 in font/plane01/plane01-combining.txt.
00050
00051 11 May 2019 [Paul Hardy]:
00052 - Changed strncpy calls to memcpy calls to avoid a compiler
00053 warning.
```

```
00054 */
00055
00056
00057 #include <stdio.h>
00058 #include <stdlib.h>
00059 #include <string.h>
00060 #include <ctype.h>
00061
00062 #define MAXSTRING   256   ///< Maximum input line length - 1.
00063
00064
00065 /**
00066 @brief The main function.
00067
00068 @param[in] argc The count of command line arguments.
00069 @param[in] argv Pointer to array of command line arguments.
00070 @return This program exits with status EXIT_SUCCESS.
00071 */
00072 int
00073 main (int argc, char **argv)
00074 {
00075
00076   char teststring[MAXSTRING];  /* current input line                    */
00077   int  loc;                    /* Unicode code point of current input line */
00078   int  offset;                 /* offset value of a combining character    */
00079   char *gstart;                  /* glyph start, pointing into teststring    */
00080
00081   char combining[0x110000];    /* 1 --> combining glyph; 0 --> non-combining */
00082   char x_offset [0x110000];    /* second value in *combining.txt files       */
00083
00084   void add_single_circle(char *);      /* add a single-width dashed circle */
00085   void add_double_circle(char *, int); /* add a double-width dashed circle */
00086
00087   FILE *infilefp;
00088
00089   /*
00090 if (argc != 3) {
00091 fprintf (stderr,
00092 "\n\nUsage: %s combining.txt nonprinting.hex < unifont.hex > unifontfull.hex\n\n");
00093 exit (EXIT_FAILURE);
00094 }
00095 */
00096
00097   /*
00098 Read the combining characters list.
00099 */
00100   /* Start with no combining code points flagged */
00101   memset (combining, 0, 0x110000 * sizeof (char));
00102   memset (x_offset , 0, 0x110000 * sizeof (char));
00103
00104   if ((infilefp = fopen (argv[1],"r")) == NULL) {
00105     fprintf (stderr,"ERROR - combining characters file %s not found.\n\n",
00106              argv[1]);
00107     exit (EXIT_FAILURE);
00108   }
00109
00110   /* Flag list of combining characters to add a dashed circle. */
00111   while (fscanf (infilefp, "%X:%d", &loc, &offset) != EOF) {
00112     /*
00113 U+01107F and U+01D1A0 are not defined as combining characters
00114 in Unicode; they were added in a combining.txt file as the
00115 only way to make them look acceptable in proximity to other
00116 glyphs in their script.
00117 */
00118     if (loc != 0x01107F && loc != 0x01D1A0) {
00119       combining[loc] = 1;
00120       x_offset [loc] = offset;
00121     }
00122   }
00123   fclose (infilefp); /* all done reading combining.txt */
00124
00125   /* Now read the non-printing glyphs; they never have dashed circles */
00126   if ((infilefp = fopen (argv[2],"r")) == NULL) {
00127     fprintf (stderr,"ERROR - nonprinting characters file %s not found.\n\n",
00128              argv[1]);
00129     exit (EXIT_FAILURE);
00130   }
00131
00132   /* Reset list of nonprinting characters to avoid adding a dashed circle. */
00133   while (fscanf (infilefp, "%X:%*s", &loc) != EOF) combining[loc] = 0;
00134
```

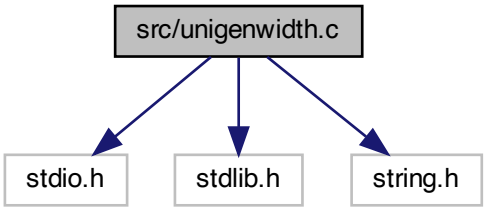
```
00135   fclose (infilefp); /* all done reading nonprinting.hex */
00136
00137   /*
00138 Read the hex glyphs.
00139 */
00140   teststring[MAXSTRING - 1] = '\0';   /* so there's no chance we leave array  */
00141   while (fgets (teststring, MAXSTRING-1, stdin) != NULL) {
00142     sscanf (teststring, "%X", &loc);     /* loc == the Uniocde code point    */
00143     gstart = strchr (teststring,':') + 1; /* start of glyph bitmap            */
00144     if (combining[loc]) {                /* if a combining character         */
00145       if (strlen (gstart) < 35)
00146         add_single_circle (gstart);                /* single-width */
00147       else
00148         add_double_circle (gstart, x_offset[loc]);  /* double-width */
00149     }
00150     printf ("%s", teststring); /* output the new character .hex string */
00151   }
00152
00153   exit (EXIT_SUCCESS);
00154 }
00155
00156
00157 /**
00158 @brief Superimpose a single-width dashed combining circle on a glyph bitmap.
00159
00160 @param[in,out] glyphstring A single-width glyph, 8x16 pixels.
00161 */
00162 void
00163 add_single_circle (char *glyphstring)
00164 {
00165
00166   char newstring[256];
00167   /* Circle hex string pattern is "00000008000024004200240000000000" */
00168   char circle[32]={0x0,0x0,  /* row  1 */
00169                    0x0,0x0,  /* row  2 */
00170                    0x0,0x0,  /* row  3 */
00171                    0x0,0x0,  /* row  4 */
00172                    0x0,0x0,  /* row  5 */
00173                    0x0,0x0,  /* row  6 */
00174                    0x2,0x4,  /* row  7 */
00175                    0x0,0x0,  /* row  8 */
00176                    0x4,0x2,  /* row  9 */
00177                    0x0,0x0,  /* row 10 */
00178                    0x2,0x4,  /* row 11 */
00179                    0x0,0x0,  /* row 12 */
00180                    0x0,0x0,  /* row 13 */
00181                    0x0,0x0,  /* row 14 */
00182                    0x0,0x0,  /* row 15 */
00183                    0x0,0x0}; /* row 16 */
00184
00185   int digit1, digit2; /* corresponding digits in each string */
00186
00187   int i; /* index variables */
00188
00189   /* for each character position, OR the corresponding circle glyph value */
00190   for (i = 0; i < 32; i++) {
00191     glyphstring[i] = toupper (glyphstring[i]);
00192
00193     /* Convert ASCII character to a hexadecimal integer */
00194     digit1 = (glyphstring[i] <= '9') ?
00195              (glyphstring[i] - '0') : (glyphstring[i] - 'A' + 0xA);
00196
00197     /* Superimpose dashed circle */
00198     digit2 = digit1 | circle[i];
00199
00200     /* Convert hexadecimal integer to an ASCII character */
00201     newstring[i] = (digit2 <= 9) ?
00202                    ('0' + digit2) : ('A' + digit2 - 0xA);
00203   }
00204
00205   /* Terminate string for output */
00206   newstring[i++] = '\n';
00207   newstring[i++] = '\0';
00208
00209   memcpy (glyphstring, newstring, i);
00210
00211   return;
00212 }
00213
00214
00215 /**
```

```
00216 @brief Superimpose a double-width dashed combining circle on a glyph bitmap.
00217
00218 @param[in,out] glyphstring A double-width glyph, 16x16 pixels.
00219 */
00220 void
00221 add_double_circle (char *glyphstring, int offset)
00222 {
00223
00224   char newstring[256];
00225   /* Circle hex string pattern is "00000008000024004200240000000000" */
00226
00227   /* For double diacritical glyphs (offset = -8) */
00228   /* Combining circle is left-justified.          */
00229   char circle08[64]={0x0,0x0,0x0,0x0,  /* row  1 */
00230                      0x0,0x0,0x0,0x0,  /* row  2 */
00231                      0x0,0x0,0x0,0x0,  /* row  3 */
00232                      0x0,0x0,0x0,0x0,  /* row  4 */
00233                      0x0,0x0,0x0,0x0,  /* row  5 */
00234                      0x0,0x0,0x0,0x0,  /* row  6 */
00235                      0x2,0x4,0x0,0x0,  /* row  7 */
00236                      0x0,0x0,0x0,0x0,  /* row  8 */
00237                      0x4,0x2,0x0,0x0,  /* row  9 */
00238                      0x0,0x0,0x0,0x0,  /* row 10 */
00239                      0x2,0x4,0x0,0x0,  /* row 11 */
00240                      0x0,0x0,0x0,0x0,  /* row 12 */
00241                      0x0,0x0,0x0,0x0,  /* row 13 */
00242                      0x0,0x0,0x0,0x0,  /* row 14 */
00243                      0x0,0x0,0x0,0x0,  /* row 15 */
00244                      0x0,0x0,0x0,0x0}; /* row 16 */
00245
00246   /* For all other combining glyphs (offset = -16) */
00247   /* Combining circle is centered in 16 columns.    */
00248   char circle16[64]={0x0,0x0,0x0,0x0,  /* row  1 */
00249                      0x0,0x0,0x0,0x0,  /* row  2 */
00250                      0x0,0x0,0x0,0x0,  /* row  3 */
00251                      0x0,0x0,0x0,0x0,  /* row  4 */
00252                      0x0,0x0,0x0,0x0,  /* row  5 */
00253                      0x0,0x0,0x0,0x0,  /* row  6 */
00254                      0x0,0x2,0x4,0x0,  /* row  7 */
00255                      0x0,0x0,0x0,0x0,  /* row  8 */
00256                      0x0,0x4,0x2,0x0,  /* row  9 */
00257                      0x0,0x0,0x0,0x0,  /* row 10 */
00258                      0x0,0x2,0x4,0x0,  /* row 11 */
00259                      0x0,0x0,0x0,0x0,  /* row 12 */
00260                      0x0,0x0,0x0,0x0,  /* row 13 */
00261                      0x0,0x0,0x0,0x0,  /* row 14 */
00262                      0x0,0x0,0x0,0x0,  /* row 15 */
00263                      0x0,0x0,0x0,0x0}; /* row 16 */
00264
00265   char *circle; /* points into circle16 or circle08 */
00266
00267   int digit1, digit2; /* corresponding digits in each string */
00268
00269   int i; /* index variables */
00270
00271
00272   /*
00273 Determine if combining circle is left-justified (offset = -8)
00274 or centered (offset = -16).
00275 */
00276   circle = (offset >= -8) ? circle08 : circle16;
00277
00278   /* for each character position, OR the corresponding circle glyph value */
00279   for (i = 0; i < 64; i++) {
00280     glyphstring[i] = toupper (glyphstring[i]);
00281
00282     /* Convert ASCII character to a hexadecimal integer */
00283     digit1 = (glyphstring[i] <= '9') ?
00284           (glyphstring[i] - '0') : (glyphstring[i] - 'A' + 0xA);
00285
00286     /* Superimpose dashed circle */
00287     digit2 = digit1 | circle[i];
00288
00289     /* Convert hexadecimal integer to an ASCII character */
00290     newstring[i] = (digit2 <= 9) ?
00291                 ('0' + digit2) : ('A' + digit2 - 0xA);
00292   }
00293
00294   /* Terminate string for output */
00295   newstring[i++] = '\n';
00296   newstring[i++] = '\0';
```

```
00297
00298     memcpy (glyphstring, newstring, i);
00299
00300     return;
00301 }
00302
```

5.31 src/unigenwidth.c File Reference

unigenwidth - IEEE 1003.1-2008 setup to calculate wchar_t string widths
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
Include dependency graph for unigenwidth.c:



Macros

- #define MAXSTRING 256

  Maximum input line length - 1.
- #define PIKTO_START 0x0F0E70

  Start of Pikto code point range.
- #define PIKTO_END 0x0F11EF

  End of Pikto code point range.
- #define PIKTO_SIZE (PIKTO_END - PIKTO_START + 1)

Functions

- int main (int argc, char **argv)

  The main function.

5.31.1 Detailed Description

unigenwidth - IEEE 1003.1-2008 setup to calculate wchar_t string widths

Author

Paul Hardy.

Copyright

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All glyphs are treated as 16 pixels high, and can be 8, 16, 24, or 32 pixels wide (resulting in widths of 1, 2, 3, or 4, respectively).
Definition in file unigenwidth.c.

5.31.2 Macro Definition Documentation

5.31.2.1 MAXSTRING

#define MAXSTRING 256
Maximum input line length - 1.
Definition at line 46 of file unigenwidth.c.

5.31.2.2 PIKTO_END

#define PIKTO_END 0x0F11EF
End of Pikto code point range.
Definition at line 50 of file unigenwidth.c.

5.31.2.3 PIKTO_SIZE

#define PIKTO_SIZE (PIKTO_END - PIKTO_START + 1)
Number of code points in Pikto range.
Definition at line 52 of file unigenwidth.c.

5.31.2.4 PIKTO_START

#define PIKTO_START 0x0F0E70
Start of Pikto code point range.
Definition at line 49 of file unigenwidth.c.

5.31.3 Function Documentation

5.31.3.1 main()

int main (
int argc,
char ** argv)
The main function.

Parameters

in	argc	The count of command line arguments.
in	argv	Pointer to array of command line arguments.

Returns

This program exits with status EXIT_SUCCESS.

Definition at line 63 of file unigenwidth.c.

```
00064 {
00065
00066   int i; /* loop variable */
00067
00068   char teststring[MAXSTRING];
00069   int  loc;
00070   char *gstart;
00071
00072   char glyph_width[0x20000];
00073   char pikto_width[PIKTO_SIZE];
00074
00075   FILE *infilefp;
00076
00077   if (argc != 3) {
00078     fprintf (stderr, "\n\nUsage: %s <unifont.hex> <combining.txt>\n\n", argv[0]);
00079     exit (EXIT_FAILURE);
00080   }
00081
00082   /*
00083 Read the collection of hex glyphs.
00084 */
00085   if ((infilefp = fopen (argv[1],"r")) == NULL) {
00086     fprintf (stderr,"ERROR - hex input file %s not found.\n\n", argv[1]);
00087     exit (EXIT_FAILURE);
00088   }
00089
00090   /* Flag glyph as non-existent until found. */
00091   memset (glyph_width, -1, 0x20000 * sizeof (char));
00092   memset (pikto_width, -1, (PIKTO_SIZE) * sizeof (char));
00093
00094   teststring[MAXSTRING-1] = '\0';
00095   while (fgets (teststring, MAXSTRING-1, infilefp) != NULL) {
00096     sscanf (teststring, "%X:%*s", &loc);
00097     if (loc < 0x20000) {
00098       gstart = strchr (teststring,':') + 1;
00099       /*
00100 16 rows per glyph, 2 ASCII hexadecimal digits per byte,
00101 so divide number of digits by 32 (shift right 5 bits).
00102 */
00103       glyph_width[loc] = (strlen (gstart) - 1) » 5;
00104     }
00105     else if ((loc >= PIKTO_START) && (loc <= PIKTO_END)) {
00106       gstart = strchr (teststring,':') + 1;
00107       pikto_width[loc - PIKTO_START] = strlen (gstart) <= 34 ? 1 : 2;
00108     }
00109   }
```

```
00110
00111    fclose (infilefp);
00112
00113    /*
00114 Now read the combining character code points.   These have width of 0.
00115 */
00116    if ((infilefp = fopen (argv[2],"r")) == NULL) {
00117       fprintf (stderr,"ERROR - combining characters file %s not found.\n\n", argv[2]);
00118       exit (EXIT_FAILURE);
00119    }
00120
00121    while (fgets (teststring, MAXSTRING-1, infilefp) != NULL) {
00122       sscanf (teststring, "%X:%*s", &loc);
00123       if (loc < 0x20000) glyph_width[loc] = 0;
00124    }
00125
00126    fclose (infilefp);
00127
00128    /*
00129 Code Points with Unusual Properties (Unicode Standard, Chapter 4).
00130
00131 As of Unifont 10.0.04, use the widths in the "*-nonprinting.hex"
00132 files.   If an application is smart enough to know how to handle
00133 these special cases, it will not render the "nonprinting" glyph
00134 and will treat the code point as being zero-width.
00135 */
00136 // glyph_width[0]=0; /* NULL character */
00137 // for (i = 0x0001; i <= 0x001F; i++) glyph_width[i]=-1; /* Control Characters */
00138 // for (i = 0x007F; i <= 0x009F; i++) glyph_width[i]=-1; /* Control Characters */
00139
00140 // glyph_width[0x034F]=0; /* combining grapheme joiner             */
00141 // glyph_width[0x180B]=0; /* Mongolian free variation selector one  */
00142 // glyph_width[0x180C]=0; /* Mongolian free variation selector two  */
00143 // glyph_width[0x180D]=0; /* Mongolian free variation selector three */
00144 // glyph_width[0x180E]=0; /* Mongolian vowel separator             */
00145 // glyph_width[0x200B]=0; /* zero width space                      */
00146 // glyph_width[0x200C]=0; /* zero width non-joiner                 */
00147 // glyph_width[0x200D]=0; /* zero width joiner                     */
00148 // glyph_width[0x200E]=0; /* left-to-right mark                    */
00149 // glyph_width[0x200F]=0; /* right-to-left mark                    */
00150 // glyph_width[0x202A]=0; /* left-to-right embedding               */
00151 // glyph_width[0x202B]=0; /* right-to-left embedding               */
00152 // glyph_width[0x202C]=0; /* pop directional formatting            */
00153 // glyph_width[0x202D]=0; /* left-to-right override                */
00154 // glyph_width[0x202E]=0; /* right-to-left override                */
00155 // glyph_width[0x2060]=0; /* word joiner                           */
00156 // glyph_width[0x2061]=0; /* function application                  */
00157 // glyph_width[0x2062]=0; /* invisible times                       */
00158 // glyph_width[0x2063]=0; /* invisible separator                   */
00159 // glyph_width[0x2064]=0; /* invisible plus                        */
00160 // glyph_width[0x206A]=0; /* inhibit symmetric swapping            */
00161 // glyph_width[0x206B]=0; /* activate symmetric swapping           */
00162 // glyph_width[0x206C]=0; /* inhibit arabic form shaping           */
00163 // glyph_width[0x206D]=0; /* activate arabic form shaping          */
00164 // glyph_width[0x206E]=0; /* national digit shapes                 */
00165 // glyph_width[0x206F]=0; /* nominal digit shapes                  */
00166
00167 // /* Variation Selector-1 to Variation Selector-16 */
00168 // for (i = 0xFE00; i <= 0xFE0F; i++) glyph_width[i] = 0;
00169
00170 // glyph_width[0xFEFF]=0; /* zero width no-break space         */
00171 // glyph_width[0xFFF9]=0; /* interlinear annotation anchor     */
00172 // glyph_width[0xFFFA]=0; /* interlinear annotation separator  */
00173 // glyph_width[0xFFFB]=0; /* interlinear annotation terminator */
00174    /*
00175 Let glyph widths represent 0xFFFC (object replacement character)
00176 and 0xFFFD (replacement character).
00177 */
00178
00179    /*
00180 Hangul Jamo:
00181
00182 Leading Consonant (Choseong): leave spacing as is.
00183
00184 Hangul Choseong Filler (U+115F): set width to 2.
00185
00186 Hangul Jungseong Filler, Hangul Vowel (Jungseong), and
00187 Final Consonant (Jongseong): set width to 0, because these
00188 combine with the leading consonant as one composite syllabic
00189 glyph.   As of Unicode 5.2, the Hangul Jamo block (U+1100..U+11FF)
00190 is completely filled.
```

```
00191 */
00192   // for (i = 0x1160; i <= 0x11FF; i++) glyph_width[i]=0; /* Vowels & Final Consonants */
00193
00194   /*
00195 Private Use Area -- the width is undefined, but likely
00196 to be 2 charcells wide either from a graphic glyph or
00197 from a four-digit hexadecimal glyph representing the
00198 code point.  Therefore if any PUA glyph does not have
00199 a non-zero width yet, assign it a default width of 2.
00200 The Unicode Standard allows giving PUA characters
00201 default property values; see for example The Unicode
00202 Standard Version 5.0, p. 91.  This same default is
00203 used for higher plane PUA code points below.
00204 */
00205   // for (i = 0xE000; i <= 0xF8FF; i++) {
00206   //    if (glyph_width[i] == 0) glyph_width[i]=2;
00207   // }
00208
00209   /*
00210 <not a character>
00211 */
00212   for (i = 0xFDD0; i <= 0xFDEF; i++) glyph_width[i] = -1;
00213   glyph_width[0xFFFE] = -1; /* Byte Order Mark */
00214   glyph_width[0xFFFF] = -1; /* Byte Order Mark */
00215
00216   /* Surrogate Code Points */
00217   for (i = 0xD800; i <= 0xDFFF; i++) glyph_width[i]=-1;
00218
00219   /* CJK Code Points */
00220   for (i = 0x4E00; i <= 0x9FFF; i++) if (glyph_width[i] < 0) glyph_width[i] = 2;
00221   for (i = 0x3400; i <= 0x4DBF; i++) if (glyph_width[i] < 0) glyph_width[i] = 2;
00222   for (i = 0xF900; i <= 0xFAFF; i++) if (glyph_width[i] < 0) glyph_width[i] = 2;
00223
00224   /*
00225 Now generate the output file.
00226 */
00227   printf ("/*\n");
00228   printf ("   wcwidth and wcswidth functions, as per IEEE 1003.1-2008\n");
00229   printf ("   System Interfaces, pp. 2241 and 2251.\n\n");
00230   printf ("   Author: Paul Hardy, 2013\n\n");
00231   printf ("   Copyright (c) 2013 Paul Hardy\n\n");
00232   printf ("   LICENSE:\n");
00233   printf ("\n");
00234   printf ("      This program is free software: you can redistribute it and/or modify\n");
00235   printf ("      it under the terms of the GNU General Public License as published by\n");
00236   printf ("      the Free Software Foundation, either version 2 of the License, or\n");
00237   printf ("      (at your option) any later version.\n");
00238   printf ("\n");
00239   printf ("      This program is distributed in the hope that it will be useful,\n");
00240   printf ("      but WITHOUT ANY WARRANTY; without even the implied warranty of\n");
00241   printf ("      MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the\n");
00242   printf ("      GNU General Public License for more details.\n");
00243   printf ("\n");
00244   printf ("      You should have received a copy of the GNU General Public License\n");
00245   printf ("      along with this program.  If not, see <http://www.gnu.org/licenses/>.\n");
00246   printf ("*/\n\n");
00247
00248   printf ("#include <wchar.h>\n\n");
00249   printf ("/* Definitions for Pikto CSUR Private Use Area glyphs */\n");
00250   printf ("#define PIKTO_START\t0x%06X\n", PIKTO_START);
00251   printf ("#define PIKTO_END\t0x%06X\n", PIKTO_END);
00252   printf ("#define PIKTO_SIZE\t(PIKTO_END - PIKTO_START + 1)\n");
00253   printf ("\n\n");
00254   printf ("/* wcwidth -- return charcell positions of one code point */\n");
00255   printf ("inline int\nwcwidth (wchar_t wc)\n{\n");
00256   printf ("   return (wcswidth (&wc, 1));\n");
00257   printf ("}\n");
00258   printf ("\n\n");
00259   printf ("int\nwcswidth (const wchar_t *pwcs, size_t n)\n{\n\n");
00260   printf ("   int i;                  /* loop variable                                */\n");
00261   printf ("   unsigned codept;        /* Unicode code point of current character      */\n");
00262   printf ("   unsigned plane;         /* Unicode plane, 0x00..0x10                    */\n");
00263   printf ("   unsigned lower17;       /* lower 17 bits of Unicode code point          */\n");
00264   printf ("   unsigned lower16;       /* lower 16 bits of Unicode code point          */\n");
00265   printf ("   int lowpt, midpt, highpt; /* for binary searching in plane1zeroes[]     */\n");
00266   printf ("   int found;              /* for binary searching in plane1zeroes[]       */\n");
00267   printf ("   int totalwidth;         /* total width of string, in charcells (1 or 2/glyph) */\n");
00268   printf ("   int illegalchar;        /* Whether or not this code point is illegal    */\n");
00269   putchar ('\n');
00270
00271   /*
```

```
00272 Print the glyph_width[] array for glyphs widths in the
00273 Basic Multilingual Plane (Plane 0).
00274 */
00275    printf ("    char glyph_width[0x20000] = {");
00276    for (i = 0; i < 0x10000; i++) {
00277       if ((i & 0x1F) == 0)
00278          printf ("\n      /* U+%04X */ ", i);
00279       printf ("%d,", glyph_width[i]);
00280    }
00281    for (i = 0x10000; i < 0x20000; i++) {
00282       if ((i & 0x1F) == 0)
00283          printf ("\n      /* U+%06X */ ", i);
00284       printf ("%d", glyph_width[i]);
00285       if (i < 0x1FFFF) putchar (',');
00286    }
00287    printf ("\n    };\n\n");
00288
00289    /*
00290 Print the pikto_width[] array for Pikto glyph widths.
00291 */
00292    printf ("    char pikto_width[PIKTO_SIZE] = {");
00293    for (i = 0; i < PIKTO_SIZE; i++) {
00294       if ((i & 0x1F) == 0)
00295          printf ("\n      /* U+%06X */ ", PIKTO_START + i);
00296       printf ("%d", pikto_width[i]);
00297       if ((PIKTO_START + i) < PIKTO_END) putchar (',');
00298    }
00299    printf ("\n    };\n\n");
00300
00301    /*
00302 Execution part of wcswidth.
00303 */
00304    printf ("\n");
00305    printf ("    illegalchar = totalwidth = 0;\n");
00306    printf ("    for (i = 0; !illegalchar && i < n; i++) {\n");
00307    printf ("       codept  = pwcs[i];\n");
00308    printf ("       plane   = codept » 16;\n");
00309    printf ("       lower17 = codept & 0x1FFFF;\n");
00310    printf ("       lower16 = codept & 0xFFFF;\n");
00311    printf ("       if (plane < 2) { /* the most common case */\n");
00312    printf ("          if (glyph_width[lower17] < 0) illegalchar = 1;\n");
00313    printf ("          else totalwidth += glyph_width[lower17];\n");
00314    printf ("       }\n");
00315    printf ("       else { /* a higher plane or beyond Unicode range */\n");
00316    printf ("          if  ((lower16 == 0xFFFE) || (lower16 == 0xFFFF)) {\n");
00317    printf ("             illegalchar = 1;\n");
00318    printf ("          }\n");
00319    printf ("          else if (plane < 4) {  /* Ideographic Plane */\n");
00320    printf ("             totalwidth += 2; /* Default ideographic width */\n");
00321    printf ("          }\n");
00322    printf ("          else if (plane == 0x0F) {  /* CSUR Private Use Area */\n");
00323    printf ("             if (lower16 <= 0x0E6F) { /* Kinya */\n");
00324    printf ("                totalwidth++; /* all Kinya syllables have width 1 */\n");
00325    printf ("             }\n");
00326    printf ("             else if (lower16 <= (PIKTO_END & 0xFFFF)) { /* Pikto */\n");
00327    printf ("                if (pikto_width[lower16 - (PIKTO_START & 0xFFFF)] < 0) illegalchar = 1;\n");
00328    printf ("                else totalwidth += pikto_width[lower16 - (PIKTO_START & 0xFFFF)];\n");
00329    printf ("             }\n");
00330    printf ("          }\n");
00331    printf ("          else if (plane > 0x10) {\n");
00332    printf ("             illegalchar = 1;\n");
00333    printf ("          }\n");
00334    printf ("          /* Other non-printing in higher planes; return -1 as per IEEE 1003.1-2008. */\n");
00335    printf ("          else if (/* language tags */\n");
00336    printf ("                codept == 0x0E0001 || (codept >= 0x0E0020 && codept <= 0x0E007F) ||\n");
00337    printf ("                /* variation selectors, 0x0E0100..0x0E01EF */\n");
00338    printf ("                (codept >= 0x0E0100 && codept <= 0x0E01EF)) {\n");
00339    printf ("             illegalchar = 1;\n");
00340    printf ("          }\n");
00341    printf ("          /*\n");
00342    printf ("             Unicode plane 0x02..0x10 printing character\n");
00343    printf ("          */\n");
00344    printf ("          else {\n");
00345    printf ("             illegalchar = 1; /* code is not in font */\n");
00346    printf ("          }\n");
00347    printf ("\n");
00348    printf ("       }\n");
00349    printf ("    }\n");
00350    printf ("    if (illegalchar) totalwidth = -1;\n");
00351    printf ("\n");
00352    printf ("    return (totalwidth);\n");
```

```
00353     printf ("\n");
00354     printf ("}\n");
00355
00356     exit (EXIT_SUCCESS);
00357 }
```

5.32 unigenwidth.c

Go to the documentation of this file.

```
00001 /**
00002 @file unigenwidth.c
00003
00004 @brief unigenwidth - IEEE 1003.1-2008 setup to calculate
00005 wchar_t string widths
00006
00007 @author Paul Hardy.
00008
00009 @copyright Copyright (C) 2013, 2017 Paul Hardy.
00010
00011 All glyphs are treated as 16 pixels high, and can be
00012 8, 16, 24, or 32 pixels wide (resulting in widths of
00013 1, 2, 3, or 4, respectively).
00014 */
00015 /*
00016 LICENSE:
00017
00018 This program is free software: you can redistribute it and/or modify
00019 it under the terms of the GNU General Public License as published by
00020 the Free Software Foundation, either version 2 of the License, or
00021 (at your option) any later version.
00022
00023 This program is distributed in the hope that it will be useful,
00024 but WITHOUT ANY WARRANTY; without even the implied warranty of
00025 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
00026 GNU General Public License for more details.
00027
00028 You should have received a copy of the GNU General Public License
00029 along with this program.  If not, see <http://www.gnu.org/licenses/>.
00030 */
00031
00032 /*
00033 20 June 2017 [Paul Hardy]:
00034 - Now handles glyphs that are 24 or 32 pixels wide.
00035
00036 8 July 2017 [Paul Hardy]:
00037 - Modifies sscanf format strings to ignore second field after
00038 the ":" field separator, newly added to "*combining.txt" files
00039 and already present in "*.hex" files.
00040 */
00041
00042 #include <stdio.h>
00043 #include <stdlib.h>
00044 #include <string.h>
00045
00046 #define MAXSTRING   256   ///< Maximum input line length - 1.
00047
00048 /* Definitions for Pikto in Plane 15 */
00049 #define PIKTO_START 0x0F0E70   ///< Start of Pikto code point range.
00050 #define PIKTO_END   0x0F11EF   ///< End of Pikto code point range.
00051 /** Number of code points in Pikto range. */
00052 #define PIKTO_SIZE  (PIKTO_END - PIKTO_START + 1)
00053
00054
00055 /**
00056 @brief The main function.
00057
00058 @param[in] argc The count of command line arguments.
00059 @param[in] argv Pointer to array of command line arguments.
00060 @return This program exits with status EXIT_SUCCESS.
00061 */
00062 int
00063 main (int argc, char **argv)
00064 {
00065
00066     int i; /* loop variable */
00067
00068     char teststring[MAXSTRING];
00069     int  loc;
```

```
00070   char *gstart;
00071
00072   char glyph_width[0x20000];
00073   char pikto_width[PIKTO_SIZE];
00074
00075   FILE *infilefp;
00076
00077   if (argc != 3) {
00078     fprintf (stderr, "\n\nUsage: %s <unifont.hex> <combining.txt>\n\n", argv[0]);
00079     exit (EXIT_FAILURE);
00080   }
00081
00082   /*
00083 Read the collection of hex glyphs.
00084 */
00085   if ((infilefp = fopen (argv[1],"r")) == NULL) {
00086     fprintf (stderr,"ERROR - hex input file %s not found.\n\n", argv[1]);
00087     exit (EXIT_FAILURE);
00088   }
00089
00090   /* Flag glyph as non-existent until found. */
00091   memset (glyph_width, -1, 0x20000 * sizeof (char));
00092   memset (pikto_width, -1, (PIKTO_SIZE) * sizeof (char));
00093
00094   teststring[MAXSTRING-1] = '\0';
00095   while (fgets (teststring, MAXSTRING-1, infilefp) != NULL) {
00096     sscanf (teststring, "%X:%*s", &loc);
00097     if (loc < 0x20000) {
00098       gstart = strchr (teststring,':') + 1;
00099       /*
00100 16 rows per glyph, 2 ASCII hexadecimal digits per byte,
00101 so divide number of digits by 32 (shift right 5 bits).
00102 */
00103       glyph_width[loc] = (strlen (gstart) - 1) » 5;
00104     }
00105     else if ((loc >= PIKTO_START) && (loc <= PIKTO_END)) {
00106       gstart = strchr (teststring,':') + 1;
00107       pikto_width[loc - PIKTO_START] = strlen (gstart) <= 34 ? 1 : 2;
00108     }
00109   }
00110
00111   fclose (infilefp);
00112
00113   /*
00114 Now read the combining character code points.  These have width of 0.
00115 */
00116   if ((infilefp = fopen (argv[2],"r")) == NULL) {
00117     fprintf (stderr,"ERROR - combining characters file %s not found.\n\n", argv[2]);
00118     exit (EXIT_FAILURE);
00119   }
00120
00121   while (fgets (teststring, MAXSTRING-1, infilefp) != NULL) {
00122     sscanf (teststring, "%X:%*s", &loc);
00123     if (loc < 0x20000) glyph_width[loc] = 0;
00124   }
00125
00126   fclose (infilefp);
00127
00128   /*
00129 Code Points with Unusual Properties (Unicode Standard, Chapter 4).
00130
00131 As of Unifont 10.0.04, use the widths in the "*-nonprinting.hex"
00132 files.  If an application is smart enough to know how to handle
00133 these special cases, it will not render the "nonprinting" glyph
00134 and will treat the code point as being zero-width.
00135 */
00136 // glyph_width[0]=0; /* NULL character */
00137 // for (i = 0x0001; i <= 0x001F; i++) glyph_width[i]=-1; /* Control Characters */
00138 // for (i = 0x007F; i <= 0x009F; i++) glyph_width[i]=-1; /* Control Characters */
00139
00140 // glyph_width[0x034F]=0; /* combining grapheme joiner            */
00141 // glyph_width[0x180B]=0; /* Mongolian free variation selector one  */
00142 // glyph_width[0x180C]=0; /* Mongolian free variation selector two  */
00143 // glyph_width[0x180D]=0; /* Mongolian free variation selector three */
00144 // glyph_width[0x180E]=0; /* Mongolian vowel separator             */
00145 // glyph_width[0x200B]=0; /* zero width space                      */
00146 // glyph_width[0x200C]=0; /* zero width non-joiner                 */
00147 // glyph_width[0x200D]=0; /* zero width joiner                     */
00148 // glyph_width[0x200E]=0; /* left-to-right mark                    */
00149 // glyph_width[0x200F]=0; /* right-to-left mark                    */
00150 // glyph_width[0x202A]=0; /* left-to-right embedding               */
```

```
00151 // glyph_width[0x202B]=0; /* right-to-left embedding                */
00152 // glyph_width[0x202C]=0; /* pop directional formatting              */
00153 // glyph_width[0x202D]=0; /* left-to-right override                 */
00154 // glyph_width[0x202E]=0; /* right-to-left override                 */
00155 // glyph_width[0x2060]=0; /* word joiner                            */
00156 // glyph_width[0x2061]=0; /* function application                   */
00157 // glyph_width[0x2062]=0; /* invisible times                        */
00158 // glyph_width[0x2063]=0; /* invisible separator                    */
00159 // glyph_width[0x2064]=0; /* invisible plus                         */
00160 // glyph_width[0x206A]=0; /* inhibit symmetric swapping             */
00161 // glyph_width[0x206B]=0; /* activate symmetric swapping            */
00162 // glyph_width[0x206C]=0; /* inhibit arabic form shaping            */
00163 // glyph_width[0x206D]=0; /* activate arabic form shaping           */
00164 // glyph_width[0x206E]=0; /* national digit shapes                  */
00165 // glyph_width[0x206F]=0; /* nominal digit shapes                   */
00166
00167 // /* Variation Selector-1 to Variation Selector-16 */
00168 // for (i = 0xFE00; i <= 0xFE0F; i++) glyph_width[i] = 0;
00169
00170 // glyph_width[0xFEFF]=0; /* zero width no-break space         */
00171 // glyph_width[0xFFF9]=0; /* interlinear annotation anchor     */
00172 // glyph_width[0xFFFA]=0; /* interlinear annotation separator  */
00173 // glyph_width[0xFFFB]=0; /* interlinear annotation terminator */
00174   /*
00175 Let glyph widths represent 0xFFFC (object replacement character)
00176 and 0xFFFD (replacement character).
00177 */
00178
00179   /*
00180 Hangul Jamo:
00181
00182 Leading Consonant (Choseong): leave spacing as is.
00183
00184 Hangul Choseong Filler (U+115F): set width to 2.
00185
00186 Hangul Jungseong Filler, Hangul Vowel (Jungseong), and
00187 Final Consonant (Jongseong): set width to 0, because these
00188 combine with the leading consonant as one composite syllabic
00189 glyph.  As of Unicode 5.2, the Hangul Jamo block (U+1100..U+11FF)
00190 is completely filled.
00191 */
00192   // for (i = 0x1160; i <= 0x11FF; i++) glyph_width[i]=0; /* Vowels & Final Consonants */
00193
00194   /*
00195 Private Use Area -- the width is undefined, but likely
00196 to be 2 charcells wide either from a graphic glyph or
00197 from a four-digit hexadecimal glyph representing the
00198 code point.  Therefore if any PUA glyph does not have
00199 a non-zero width yet, assign it a default width of 2.
00200 The Unicode Standard allows giving PUA characters
00201 default property values; see for example The Unicode
00202 Standard Version 5.0, p. 91.  This same default is
00203 used for higher plane PUA code points below.
00204 */
00205   // for (i = 0xE000; i <= 0xF8FF; i++) {
00206   //   if (glyph_width[i] == 0) glyph_width[i]=2;
00207   // }
00208
00209   /*
00210 <not a character>
00211 */
00212   for (i = 0xFDD0; i <= 0xFDEF; i++) glyph_width[i] = -1;
00213   glyph_width[0xFFFE] = -1; /* Byte Order Mark */
00214   glyph_width[0xFFFF] = -1; /* Byte Order Mark */
00215
00216   /* Surrogate Code Points */
00217   for (i = 0xD800; i <= 0xDFFF; i++) glyph_width[i]=-1;
00218
00219   /* CJK Code Points */
00220   for (i = 0x4E00; i <= 0x9FFF; i++) if (glyph_width[i] < 0) glyph_width[i] = 2;
00221   for (i = 0x3400; i <= 0x4DBF; i++) if (glyph_width[i] < 0) glyph_width[i] = 2;
00222   for (i = 0xF900; i <= 0xFAFF; i++) if (glyph_width[i] < 0) glyph_width[i] = 2;
00223
00224   /*
00225 Now generate the output file.
00226 */
00227   printf ("/*\n");
00228   printf ("   wcwidth and wcswidth functions, as per IEEE 1003.1-2008\n");
00229   printf ("   System Interfaces, pp. 2241 and 2251.\n\n");
00230   printf ("   Author: Paul Hardy, 2013\n\n");
00231   printf ("   Copyright (c) 2013 Paul Hardy\n\n");
```

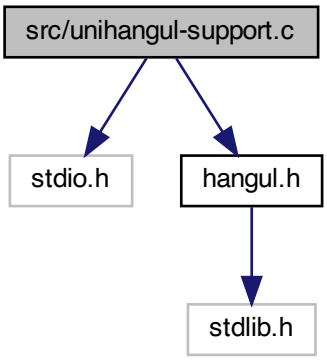
```
00232   printf ("   LICENSE:\n");
00233   printf ("\n");
00234   printf ("      This program is free software: you can redistribute it and/or modify\n");
00235   printf ("      it under the terms of the GNU General Public License as published by\n");
00236   printf ("      the Free Software Foundation, either version 2 of the License, or\n");
00237   printf ("      (at your option) any later version.\n");
00238   printf ("\n");
00239   printf ("      This program is distributed in the hope that it will be useful,\n");
00240   printf ("      but WITHOUT ANY WARRANTY; without even the implied warranty of\n");
00241   printf ("      MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the\n");
00242   printf ("      GNU General Public License for more details.\n");
00243   printf ("\n");
00244   printf ("      You should have received a copy of the GNU General Public License\n");
00245   printf ("      along with this program.  If not, see <http://www.gnu.org/licenses/>.\n");
00246   printf ("*/\n\n");
00247
00248   printf ("#include <wchar.h>\n\n");
00249   printf ("/* Definitions for Pikto CSUR Private Use Area glyphs */\n");
00250   printf ("#define PIKTO_START\t0x%06X\n", PIKTO_START);
00251   printf ("#define PIKTO_END\t0x%06X\n", PIKTO_END);
00252   printf ("#define PIKTO_SIZE\t(PIKTO_END - PIKTO_START + 1)\n");
00253   printf ("\n\n");
00254   printf ("/* wcwidth -- return charcell positions of one code point */\n");
00255   printf ("inline int\nwcwidth (wchar_t wc)\n{\n");
00256   printf ("   return (wcswidth (&wc, 1));\n");
00257   printf ("}\n");
00258   printf ("\n\n");
00259   printf ("int\nwcswidth (const wchar_t *pwcs, size_t n)\n{\n\n");
00260   printf ("   int i;                  /* loop variable                                  */\n");
00261   printf ("   unsigned codept;        /* Unicode code point of current character        */\n");
00262   printf ("   unsigned plane;         /* Unicode plane, 0x00..0x10                      */\n");
00263   printf ("   unsigned lower17;       /* lower 17 bits of Unicode code point            */\n");
00264   printf ("   unsigned lower16;       /* lower 16 bits of Unicode code point            */\n");
00265   printf ("   int lowpt, midpt, highpt; /* for binary searching in plane1zeroes[]       */\n");
00266   printf ("   int found;              /* for binary searching in plane1zeroes[]         */\n");
00267   printf ("   int totalwidth;         /* total width of string, in charcells (1 or 2/glyph) */\n");
00268   printf ("   int illegalchar;        /* Whether or not this code point is illegal      */\n");
00269   putchar ('\n');
00270
00271   /*
00272 Print the glyph_width[] array for glyphs widths in the
00273 Basic Multilingual Plane (Plane 0).
00274 */
00275   printf ("   char glyph_width[0x20000] = {");
00276   for (i = 0; i < 0x10000; i++) {
00277     if ((i & 0x1F) == 0)
00278       printf ("\n      /* U+%04X */ ", i);
00279     printf ("%d,", glyph_width[i]);
00280   }
00281   for (i = 0x10000; i < 0x20000; i++) {
00282     if ((i & 0x1F) == 0)
00283       printf ("\n      /* U+%06X */ ", i);
00284     printf ("%d", glyph_width[i]);
00285     if (i < 0x1FFFF) putchar (',');
00286   }
00287   printf ("\n   };\n\n");
00288
00289   /*
00290 Print the pikto_width[] array for Pikto glyph widths.
00291 */
00292   printf ("   char pikto_width[PIKTO_SIZE] = {");
00293   for (i = 0; i < PIKTO_SIZE; i++) {
00294     if ((i & 0x1F) == 0)
00295       printf ("\n      /* U+%06X */ ", PIKTO_START + i);
00296     printf ("%d", pikto_width[i]);
00297     if ((PIKTO_START + i) < PIKTO_END) putchar (',');
00298   }
00299   printf ("\n   };\n\n");
00300
00301   /*
00302 Execution part of wcswidth.
00303 */
00304   printf ("\n");
00305   printf ("   illegalchar = totalwidth = 0;\n");
00306   printf ("   for (i = 0; !illegalchar && i < n; i++) {\n");
00307   printf ("      codept  = pwcs[i];\n");
00308   printf ("      plane   = codept » 16;\n");
00309   printf ("      lower17 = codept & 0x1FFFF;\n");
00310   printf ("      lower16 = codept & 0xFFFF;\n");
00311   printf ("      if (plane < 2) { /* the most common case */\n");
00312   printf ("        if (glyph_width[lower17] < 0) illegalchar = 1;\n");
```

```
00313   printf ("        else totalwidth += glyph_width[lower17];\n");
00314   printf ("      }\n");
00315   printf ("      else { /* a higher plane or beyond Unicode range */\n");
00316   printf ("        if  ((lower16 == 0xFFFE) || (lower16 == 0xFFFF)) {\n");
00317   printf ("          illegalchar = 1;\n");
00318   printf ("        }\n");
00319   printf ("        else if (plane < 4) {  /* Ideographic Plane */\n");
00320   printf ("          totalwidth += 2; /* Default ideographic width */\n");
00321   printf ("        }\n");
00322   printf ("        else if (plane == 0x0F) {  /* CSUR Private Use Area */\n");
00323   printf ("          if (lower16 <= 0x0E6F) { /* Kinya */\n");
00324   printf ("            totalwidth++; /* all Kinya syllables have width 1 */\n");
00325   printf ("          }\n");
00326   printf ("          else if (lower16 <= (PIKTO_END & 0xFFFF)) { /* Pikto */\n");
00327   printf ("            if (pikto_width[lower16 - (PIKTO_START & 0xFFFF)] < 0) illegalchar = 1;\n");
00328   printf ("            else totalwidth += pikto_width[lower16 - (PIKTO_START & 0xFFFF)];\n");
00329   printf ("          }\n");
00330   printf ("        }\n");
00331   printf ("        else if (plane > 0x10) {\n");
00332   printf ("          illegalchar = 1;\n");
00333   printf ("        }\n");
00334   printf ("        /* Other non-printing in higher planes; return -1 as per IEEE 1003.1-2008. */\n");
00335   printf ("        else if (/* language tags */\n");
00336   printf ("                 codept == 0x0E0001 || (codept >= 0x0E0020 && codept <= 0x0E007F) ||\n");
00337   printf ("                 /* variation selectors, 0x0E0100..0x0E01EF */\n");
00338   printf ("                 (codept >= 0x0E0100 && codept <= 0x0E01EF)) {\n");
00339   printf ("          illegalchar = 1;\n");
00340   printf ("        }\n");
00341   printf ("        /*\n");
00342   printf ("          Unicode plane 0x02..0x10 printing character\n");
00343   printf ("        */\n");
00344   printf ("        else {\n");
00345   printf ("          illegalchar = 1; /* code is not in font */\n");
00346   printf ("        }\n");
00347   printf ("\n");
00348   printf ("      }\n");
00349   printf ("    }\n");
00350   printf ("    if (illegalchar) totalwidth = -1;\n");
00351   printf ("\n");
00352   printf ("    return (totalwidth);\n");
00353   printf ("\n");
00354   printf ("}\n");
00355
00356   exit (EXIT_SUCCESS);
00357 }
```

5.33 src/unihangul-support.c File Reference

Functions for converting Hangul letters into syllables.
#include <stdio.h>
#include "hangul.h"

Include dependency graph for unihangul-support.c:



Functions

- unsigned hangul_read_base8 (FILE *infp, unsigned char base[][32])

  Read hangul-base.hex file into a unsigned char array.
- unsigned hangul_read_base16 (FILE *infp, unsigned base[][16])

  Read hangul-base.hex file into a unsigned array.
- void hangul_decompose (unsigned codept, int *initial, int *medial, int *final)

  Decompose a Hangul Syllables code point into three letters.
- unsigned hangul_compose (int initial, int medial, int final)

  Compose a Hangul syllable into a code point, or 0 if none exists.
- void hangul_hex_indices (int choseong, int jungseong, int jongseong, int *cho_index, int *jung_index, int *jong_index)

  Determine index values to the bitmaps for a syllable's components.
- void hangul_variations (int choseong, int jungseong, int jongseong, int *cho_var, int *jung_var, int *jong_var)

  Determine the variations of each letter in a Hangul syllable.
- int cho_variation (int choseong, int jungseong, int jongseong)

  Return the Johab 6/3/1 choseong variation for a syllable.
- int is_wide_vowel (int vowel)

  Whether vowel has rightmost vertical stroke to the right.
- int jung_variation (int choseong, int jungseong, int jongseong)

  Return the Johab 6/3/1 jungseong variation.
- int jong_variation (int choseong, int jungseong, int jongseong)

  Return the Johab 6/3/1 jongseong variation.
- void hangul_syllable (int choseong, int jungseong, int jongseong, unsigned char hangul_base[][32], unsigned char *syllable)

  Given letters in a Hangul syllable, return a glyph.
- int glyph_overlap (unsigned *glyph1, unsigned *glyph2)

  See if two glyphs overlap.

- void combine_glyphs (unsigned *glyph1, unsigned *glyph2, unsigned *combined_glyph)
  Combine two glyphs into one glyph.
- void print_glyph_txt (FILE *fp, unsigned codept, unsigned *this_glyph)
  Print one glyph in Unifont hexdraw plain text style.
- void print_glyph_hex (FILE *fp, unsigned codept, unsigned *this_glyph)
  Print one glyph in Unifont hexdraw hexadecimal string style.
- void one_jamo (unsigned glyph_table[MAX_GLYPHS][16], unsigned jamo, unsigned *jamo_glyph)
  Convert Hangul Jamo choseong, jungseong, and jongseong into a glyph.
- void combined_jamo (unsigned glyph_table[MAX_GLYPHS][16], unsigned cho, unsigned jung, unsigned jong, unsigned *combined_glyph)
  Convert Hangul Jamo choseong, jungseong, and jongseong into a glyph.

5.33.1 Detailed Description

Functions for converting Hangul letters into syllables.
This file contains functions for reading in Hangul letters arranged in a Johab 6/3/1 pattern and composing syllables with them. One function maps an iniital letter (choseong), medial letter (jungseong), and final letter (jongseong) into the Hangul Syllables Unicode block, U+AC00..U+D7A3. Other functions allow formation of glyphs that include the ancient Hangul letters that Hanterm supported. More can be added if desired, with appropriate changes to start positions and lengths defined in "hangul.h".

Author

Paul Hardy

Copyright

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Definition in file unihangul-support.c.

5.33.2 Function Documentation

5.33.2.1 cho_variation()

```
int cho_variation (
            int choseong,
            int jungseong,
            int jongseong )
```

Return the Johab 6/3/1 choseong variation for a syllable.
This function takes the two or three (if jongseong is included) letters that comprise a syllable and determine the variation of the initial consonant (choseong).
Each choseong has 6 variations:

Variation	Occurrence
0	Choseong with a vertical vowel such as "A".
1	Choseong with a horizontal vowel such as "O".
2	Choseong with a vertical and horizontal vowel such as "WA".
3	Same as variation 0, but with jongseong (final consonant).
4	Same as variation 1, but with jongseong (final consonant). Also a horizontal vowel pointing down, such as U and YU.
5	Same as variation 2, but with jongseong (final consonant). Also a horizontal vowel pointing down with vertical element, such as WEO, WE, and WI.

In addition, if the vowel is horizontal and a downward-pointing stroke as in the modern letters U, WEO, WE, WI, and YU, and in archaic letters YU-YEO, YU-YE, YU-I, araea, and araea-i, then 3 is added to the initial variation of 0 to 2, resulting in a choseong variation of 3 to 5, respectively.

Parameters

in	choseong	The 1st letter in the syllable.
in	jungseong	The 2nd letter in the syllable.
in	jongseong	The 3rd letter in the syllable.

Returns

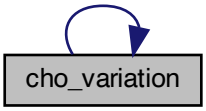
The choseong variation, 0 to 5.

Definition at line 350 of file unihangul-support.c.

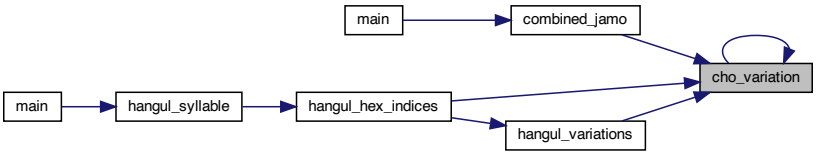
```
00350                                                   {
00351   int cho_variation;  /* Return value */
00352
00353   /*
00354 The Choseong cho_var is determined by the
00355 21 modern + 50 ancient Jungseong, and whether
00356 or not the syllable contains a final consonant
00357 (Jongseong).
00358 */
00359   static int choseong_var [TOTAL_JUNG + 1] = {
00360         /*
00361 Modern Jungseong in positions 0..20.
00362 */
00363 /* Location Variations  Unicode Range    Vowel #    Vowel Names  */
00364 /* -------- ----------  -------------   -------   ----------- */
00365 /* 0x2FB */ 0, 0, 0, // U+1161..U+1163-->[ 0.. 2]  A,   AE,  YA
00366 /* 0x304 */ 0, 0, 0, // U+1164..U+1166-->[ 3.. 5]  YAE, EO,  E
00367 /* 0x30D */ 0, 0,    // U+1167..U+1168-->[ 6.. 7]  YEO, YE
00368 /* 0x313 */ 1,       // U+1169        -->[ 8]      O
00369 /* 0x316 */ 2, 2, 2, // U+116A..U+116C-->[ 9..11]  WA,  WAE, WE
00370 /* 0x31F */ 1, 4,    // U+116D..U+116E-->[12..13]  YO,  U
00371 /* 0x325 */ 5, 5, 5, // U+116F..U+1171-->[14..16]  WEO, WE,  WI
00372 /* 0x32E */ 4, 1,    // U+1172..U+1173-->[17..18]  YU,  EU
00373 /* 0x334 */ 2,       // U+1174        -->[19]      YI
00374 /* 0x337 */ 0,       // U+1175        -->[20]      I
00375         /*
00376 Ancient Jungseong in positions 21..70.
00377 */
00378 /* Location  Variations  Unicode Range    Vowel #       Vowel Names  */
00379 /* --------  ----------  -------------    -------       ----------- */
00380 /* 0x33A: */ 2, 5, 2, // U+1176..U+1178-->[21..23]   A-O,    A-U,   YA-O
00381 /* 0x343: */ 2, 2, 5, // U+1179..U+117B-->[24..26]   YA-YO,  EO-O,  EU-U
00382 /* 0x34C: */ 2, 2, 5, // U+117C..U+117E-->[27..29]   EO-EU, YEO-O,  YEO-U
00383 /* 0x355: */ 2, 5, 5, // U+117F..U+1181-->[30..32]   O-EO,   O-E,    O-YE,
00384 /* 0x35E: */ 4, 4, 2, // U+1182..U+1184-->[33..35]   O-O,    O-U,   YO-YA,
00385 /* 0x367: */ 2, 2, 5, // U+1185..U+1187-->[36..38]   YO-YAE, YO-YEO, YO-O,
00386 /* 0x370: */ 2, 5, 5, // U+1188..U+118A-->[39..41]   YO-I,   U-A,   U-AE,
00387 /* 0x379: */ 5, 5, 5, // U+118B..U+118D-->[42..44] U-EO-EU,  U-YE,  U-U,
00388 /* 0x382: */ 5, 5, 5, // U+118E..U+1190-->[45..47]   YU-A,   YU-EO,  YU-E,
00389 /* 0x38B: */ 5, 5, 2, // U+1191..U+1193-->[48..50]   YU-YEO, YU-YE,  YU-U,
00390 /* 0x394: */ 5, 2, 2, // U+1194..U+1196-->[51..53]   YU-I,   EU-U,   EU-EU,
00391 /* 0x39D: */ 2, 0, 0, // U+1197..U+1199-->[54..56]   YI-U,   I-A,    I-YA,
```

```
00392 /* 0x3A6: */ 2, 5, 2, // U+119A..U+119C-->[57..59]   I-O,    I-U,    I-EU,
00393 /* 0x3AF: */ 0, 1, 2, // U+119D..U+119F-->[60..62] I-ARAEA, ARAEA, ARAEA-EO,
00394 /* 0x3B8: */ 1, 2, 1, // U+11A0..U+11A2-->[63..65] ARAEA-U, ARAEA-I,SSANGARAEA,
00395 /* 0x3C1: */ 2, 5, 0, // U+11A3..U+11A5-->[66..68]   A-EU,  YA-U,  YEO-YA,
00396 /* 0x3CA: */ 2, 2,    // U+11A6..U+11A7-->[69..70]   O-YA,   O-YAE,
00397 #ifdef EXTENDED_HANGUL
00398 /* 0x3D0: */ 2, 4, 5, // U+D7B0..U+D7B2-->[71..73]   O-YEO,  O-O-I, YO-A,
00399 /* 0x3D9: */ 5, 2, 5, // U+D7B3..U+D7B5-->[74..76]  YO-AE,  YO-EO,   U-YEO,
00400 /* 0x3E2: */ 5, 5, 4, // U+D7B6..U+D7B8-->[77..79]   U-I-I, YU-AE,  YU-O,
00401 /* 0x3EB: */ 5, 2, 5, // U+D7B9..U+D7BB-->[80..82]  EU-A,   EU-EO,  EU-E,
00402 /* 0x3F4: */ 4, 2, 3, // U+D7BC..U+D7BE-->[83..85]  EU-O,    I-YA-O, I-YAE,
00403 /* 0x3FD: */ 3, 3, 2, // U+D7BF..U+D7C1-->[86..88]   I-YEO,  I-YE,   I-O-I,
00404 /* 0x406: */ 2, 2, 0, // U+D7C2..U+D7C4-->[89..91]   I-YO,   I-YU,   I-I,
00405 /* 0x40F: */ 2, 2,    // U+D7C5..U+D7C6-->[92..93] ARAEA-A, ARAEA-E,
00406 /* 0x415: */ -1       // Mark end of list of vowels.
00407 #else
00408 /* 0x310: */ -1       // Mark end of list of vowels.
00409 #endif
00410   };
00411
00412
00413   if (jungseong < 0 || jungseong >= TOTAL_JUNG) {
00414     cho_variation = -1;
00415   }
00416   else {
00417     cho_variation = choseong_var [jungseong];
00418     if (choseong >= 0 && jongseong >= 0 && cho_variation < 3)
00419       cho_variation += 3;
00420   }
00421
00422
00423   return cho_variation;
00424 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.33.2.2 combine_glyphs()

```
void combine_glyphs (
            unsigned * glyph1,
```

unsigned * glyph2,
unsigned * combined_glyph)

Combine two glyphs into one glyph.

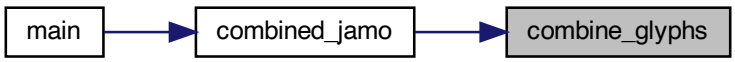
Parameters

in	glyph1	The first glyph to overlap.
in	glyph2	The second glyph to overlap.
out	combined_glyph	The returned combination glyph.

Definition at line 637 of file unihangul-support.c.

```
00638                                       {
00639     int i;
00640
00641     for (i = 0; i < 16; i++)
00642       combined_glyph [i] = glyph1 [i] | glyph2 [i];
00643
00644     return;
00645 }
```

Here is the caller graph for this function:



5.33.2.3 combined_jamo()

void combined_jamo (
unsigned glyph_table[MAX_GLYPHS][16],
unsigned cho,
unsigned jung,

unsigned jong,
unsigned * combined_glyph)

Convert Hangul Jamo choseong, jungseong, and jongseong into a glyph.

This function converts input Hangul choseong, jungseong, and jongseong Unicode code triplets into a Hangul syllable. Any of those with an out of range code point are assigned a blank glyph for combining.
This function performs the following steps:

1) Determine the sequence number of choseong, jungseong, and jongseong, from 0 to the total number of choseong, jungseong, or jongseong, respectively, minus one. The sequence for each is as follows:

   a) Choseong: Unicode code points of U+1100..U+115E and then U+A960..U+A97C.

   b) Jungseong: Unicode code points of U+1161..U+11A7 and then U+D7B0..U+D7C6.

   c) Jongseong: Unicode code points of U+11A8..U+11FF and then U+D7CB..U+D7FB.

2) From the choseong, jungseong, and jongseong sequence number, determine the variation of choseong and jungseong (there is only one jongseong variation, although it is shifted right by one column for some vowels with a pair of long vertical strokes on the right side).

3) Convert the variation numbers for the three syllable components to index locations in the glyph array.

4) Combine the glyph array glyphs into a syllable.

Parameters

in	glyph_table	The collection of all jamo glyphs.
in	cho	The choseong Unicode code point, 0 or 0x1100..0x115F.
in	jung	The jungseong Unicode code point, 0 or 0x1160..0x11A7.

Parameters

in	jong	The jongseong Unicode code point, 0 or 0x11A8..0x11FF.
out	combined_glyph	The output glyph, 16 columns in each of 16 rows.

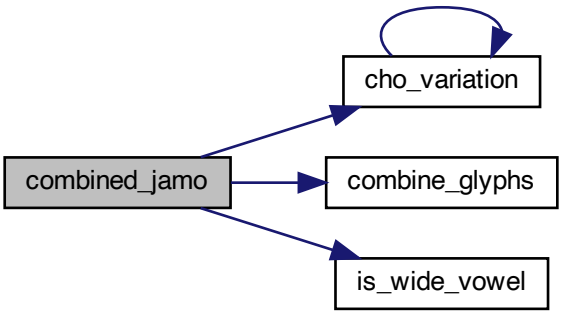
Definition at line 787 of file unihangul-support.c.

```
00789                                   {
00790
00791     int i;  /* Loop variable. */
00792     int cho_num,   jung_num,   jong_num;
00793     int cho_group, jung_group, jong_group;
00794     int cho_index, jung_index, jong_index;
00795
00796     unsigned tmp_glyph[16]; /* Hold shifted jongsung for wide vertical vowel. */
00797
00798     int  cho_variation (int choseong, int jungseong, int jongseong);
00799
00800     void combine_glyphs (unsigned *glyph1, unsigned *glyph2,
00801                          unsigned *combined_glyph);
00802
00803
00804     /* Choose a blank glyph for each syllalbe by default. */
00805     cho_index = jung_index = jong_index = 0x000;
00806
00807     /*
00808 Convert Unicode code points to jamo sequence number
00809 of each letter, or -1 if letter is not in valid range.
00810 */
00811     if (cho >= 0x1100 && cho <= 0x115E)
00812       cho_num = cho - CHO_UNICODE_START;
00813     else if (cho >= CHO_EXTA_UNICODE_START &&
00814              cho < (CHO_EXTA_UNICODE_START + NCHO_EXTA))
00815       cho_num = cho - CHO_EXTA_UNICODE_START + NCHO_MODERN + NJONG_ANCIENT;
00816     else
00817       cho_num = -1;
00818
00819     if (jung >= 0x1161 && jung <= 0x11A7)
00820       jung_num = jung - JUNG_UNICODE_START;
00821     else if (jung >= JUNG_EXTB_UNICODE_START &&
00822              jung < (JUNG_EXTB_UNICODE_START + NJUNG_EXTB))
00823       jung_num = jung - JUNG_EXTB_UNICODE_START + NJUNG_MODERN + NJUNG_ANCIENT;
00824     else
00825       jung_num = -1;
00826
00827     if (jong >= 0x11A8 && jong <= 0x11FF)
00828       jong_num = jong - JONG_UNICODE_START;
00829     else if (jong >= JONG_EXTB_UNICODE_START &&
00830              jong < (JONG_EXTB_UNICODE_START + NJONG_EXTB))
00831       jong_num = jong - JONG_EXTB_UNICODE_START + NJONG_MODERN + NJONG_ANCIENT;
00832     else
00833       jong_num = -1;
00834
00835     /*
00836 Choose initial consonant (choseong) variation based upon
```

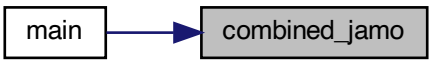
```
00837 the vowel (jungseong) if both are specified.
00838 */
00839   if (cho_num < 0) {
00840     cho_index = cho_group = 0;  /* Use blank glyph for choseong. */
00841   }
00842   else {
00843     if (jung_num < 0 && jong_num < 0) {  /* Choseong is by itself. */
00844       cho_group = 0;
00845       if (cho_index < (NCHO_MODERN + NCHO_ANCIENT))
00846         cho_index = cho_num + JAMO_HEX;
00847       else  /* Choseong is in Hangul Jamo Extended-A range. */
00848         cho_index = cho_num - (NCHO_MODERN + NCHO_ANCIENT)
00849                             + JAMO_EXTA_HEX;
00850     }
00851     else {
00852       if (jung_num >= 0) {  /* Valid jungseong with choseong. */
00853         cho_group = cho_variation (cho_num, jung_num, jong_num);
00854       }
00855       else {  /* Invalid vowel; see if final consonant is valid. */
00856         /*
00857 If initial consonant and final consonant are specified,
00858 set cho_group to 4, which is the group tha would apply
00859 to a horizontal-only vowel such as Hangul "O", so the
00860 consonant appears full-width.
00861 */
00862         cho_group = 0;
00863         if (jong_num >= 0) {
00864           cho_group = 4;
00865         }
00866       }
00867       cho_index = CHO_HEX + CHO_VARIATIONS * cho_num +
00868                   cho_group;
00869     }  /* Choseong combined with jungseong and/or jongseong. */
00870   }  /* Valid choseong. */
00871
00872   /*
00873 Choose vowel (jungseong) variation based upon the choseong
00874 and jungseong.
00875 */
00876   jung_index = jung_group = 0;  /* Use blank glyph for jungseong. */
00877
00878   if (jung_num >= 0) {
00879     if (cho_num < 0 && jong_num < 0) {  /* Jungseong is by itself. */
00880       jung_group = 0;
00881       jung_index = jung_num + JUNG_UNICODE_START;
00882     }
00883     else {
00884       if (jong_num >= 0) {  /* If there is a final consonant. */
00885         if (jong_num == 3) /* Nieun; choose variation 3. */
00886           jung_group = 2;
00887         else
00888           jung_group = 1;
00889       }  /* Valid jongseong. */
00890       /* If valid choseong but no jongseong, choose jungseong variation 0. */
00891       else if (cho_num >= 0)
00892         jung_group = 0;
00893     }
00894     jung_index = JUNG_HEX + JUNG_VARIATIONS * jung_num + jung_group;
00895   }
00896
00897   /*
00898 Choose final consonant (jongseong) based upon whether choseong
00899 and/or jungseong are present.
00900 */
00901   if (jong_num < 0) {
00902     jong_index = jong_group = 0;  /* Use blank glyph for jongseong. */
00903   }
00904   else {  /* Valid jongseong. */
00905     if (cho_num < 0 && jung_num < 0) {  /* Jongseong is by itself. */
00906       jong_group = 0;
00907       jong_index = jung_num + 0x4A8;
00908     }
00909     else {  /* There is only one jongseong variation if combined. */
00910       jong_group = 0;
00911       jong_index = JONG_HEX + JONG_VARIATIONS * jong_num +
00912                    jong_group;
00913     }
00914   }
00915
00916   /*
00917 Now that we know the index locations for choseong, jungseong, and
```

```
00918 jongseong glyphs, combine them into one glyph.
00919 */
00920     combine_glyphs (glyph_table [cho_index], glyph_table [jung_index],
00921                     combined_glyph);
00922
00923     if (jong_index > 0) {
00924       /*
00925 If the vowel has a vertical stroke that is one column
00926 away from the right border, shift this jongseung right
00927 by one column to line up with the rightmost vertical
00928 stroke in the vowel.
00929 */
00930       if (is_wide_vowel (jung_num)) {
00931         for (i = 0; i < 16; i++) {
00932           tmp_glyph [i] = glyph_table [jong_index] [i] » 1;
00933         }
00934         combine_glyphs (combined_glyph, tmp_glyph,
00935                         combined_glyph);
00936       }
00937       else {
00938         combine_glyphs (combined_glyph, glyph_table [jong_index],
00939                         combined_glyph);
00940       }
00941     }
00942
00943     return;
00944 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.33.2.4 glyph_overlap()

```
int glyph_overlap (
                unsigned * glyph1,
                unsigned * glyph2 )
```

See if two glyphs overlap.

Parameters

in	glyph1	The first glyph, as a 16-row bitmap.
in	glyph2	The second glyph, as a 16-row bitmap.

Returns

0 if no overlaps between glyphs, 1 otherwise.

Definition at line 613 of file unihangul-support.c.

```
00613                                           {
00614   int overlaps;  /* Return value; 0 if no overlaps, -1 if overlaps. */
00615   int i;
00616
00617   /* Check for overlaps between the two glyphs. */
00618
00619   i = 0;
00620   do {
00621     overlaps = (glyph1[i] & glyph2[i]) != 0;
00622     i++;
00623   }  while (i < 16 && overlaps == 0);
00624
00625   return overlaps;
00626 }
```

5.33.2.5 hangul_compose()

```
unsigned hangul_compose (
                int initial,
                int medial,
                int final )
```

Compose a Hangul syllable into a code point, or 0 if none exists.

This function takes three letters that can form a modern Hangul syllable and returns the corresponding Unicode Hangul Syllables code point in the range 0xAC00 to 0xD7A3.

If a three-letter combination includes one or more archaic letters, it will not map into the Hangul Syllables range. In that case, the returned code point will be 0 to indicate that no valid Hangul Syllables code point exists.

Parameters

in	initial	The first letter (choseong), 0 to 18.
in	medial	The second letter (jungseong), 0 to 20.
in	final	The third letter (jongseong), 0 to 26 or -1 if none.

Returns

The Unicode Hangul Syllables code point, 0xAC00 to 0xD7A3.

Definition at line 201 of file unihangul-support.c.

```
00201                                           {
00202   unsigned codept;
00203
00204
00205   if (initial >= 0 && initial <= 18 &&
00206       medial  >= 0 && medial  <= 20 &&
00207       final   >= 0 && final   <= 26) {
00208
00209     codept  = 0xAC00;
00210     codept += initial * 21 * 28;
00211     codept += medial  * 28;
00212     codept += final + 1;
00213   }
00214   else {
00215     codept = 0;
00216   }
00217
00218   return codept;
00219 }
```

5.33.2.6 hangul_decompose()

```
void hangul_decompose (
                unsigned codept,
                int * initial,
                int * medial,
                int * final )
```

Decompose a Hangul Syllables code point into three letters.
Decompose a Hangul Syllables code point (U+AC00..U+D7A3) into:

- Choseong 0-19

- Jungseong 0-20
- Jongseong 0-27 or -1 if no jongseong

All letter values are set to -1 if the letters do not form a syllable in the Hangul Syllables range. This function only handles modern Hangul, because that is all that is in the Hangul Syllables range.

Parameters

in	codept	The Unicode code point to decode, from 0xAC00 to 0xD7A3.
out	initial	The 1st letter (choseong) in the syllable.
out	initial	The 2nd letter (jungseong) in the syllable.
out	initial	The 3rd letter (jongseong) in the syllable.

Definition at line 167 of file unihangul-support.c.

```
00167                                                   {
00168
00169     if (codept < 0xAC00 || codept > 0xD7A3) {
00170         *initial = *medial = *final = -1;
00171     }
00172     else {
00173         codept  -= 0xAC00;
00174         *initial =  codept / (28  * 21);
00175         *medial  = (codept /  28) % 21;
00176         *final   =  codept %  28 - 1;
00177     }
00178
00179     return;
00180 }
```

Here is the caller graph for this function:

5.33.2.7 hangul_hex_indices()

```
void hangul_hex_indices (
                int choseong,
                int jungseong,
                int jongseong,
                int * cho_index,
                int * jung_index,
                int * jong_index )
```

Determine index values to the bitmaps for a syllable's components.
This function reads these input values for modern and ancient Hangul letters:

- Choseong number (0 to the number of modern and archaic choseong - 1.
- Jungseong number (0 to the number of modern and archaic jungseong - 1.
- Jongseong number (0 to the number of modern and archaic jongseong - 1, or -1 if none.

It then determines the variation of each letter given the combination with the other two letters (or just choseong and jungseong if the jongseong value is -1).
These variations are then converted into index locations within the glyph array that was read in from the hangul-base.hex file. Those index locations can then be used to form a composite syllable.
There is no restriction to only use the modern Hangul letters.

Parameters

in	choseong	The 1st letter in the syllable.
in	jungseong	The 2nd letter in the syllable.

Parameters

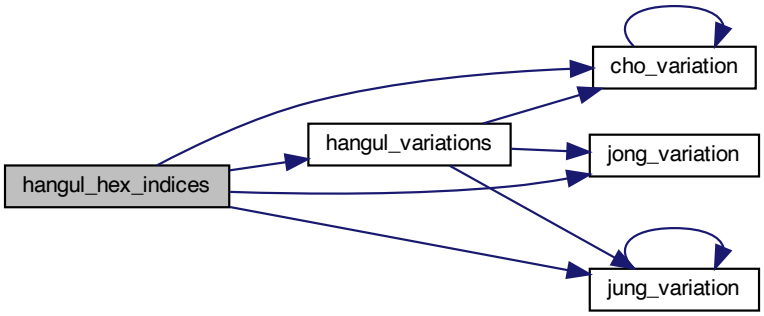
in	jongseong	The 3rd letter in the syllable, or -1 if none.
out	cho_index	Index location to the 1st letter variation from the hangul-base.hex file.
out	jung_index	Index location to the 2nd letter variation from the hangul-base.hex file.
out	jong_index	Index location to the 3rd letter variation from the hangul-base.hex file.

Definition at line 249 of file unihangul-support.c.

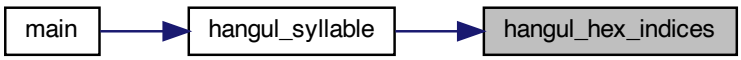
```
00250                                                   {
00251
00252     int cho_variation, jung_variation, jong_variation;  /* Letter variations */
00253
00254     void hangul_variations (int choseong, int jungseong, int jongseong,
```

```
00255           int *cho_variation, int *jung_variation, int *jong_variation);
00256
00257
00258   hangul_variations (choseong, jungseong, jongseong,
00259                      &cho_variation, &jung_variation, &jong_variation);
00260
00261    *cho_index = CHO_HEX +  choseong * CHO_VARIATIONS +  cho_variation;
00262   *jung_index = JUNG_HEX      + jungseong * JUNG_VARIATIONS      + jung_variation;;
00263   *jong_index = jongseong < 0 ? 0x0000 :
00264                 JONG_HEX + jongseong * JONG_VARIATIONS + jong_variation;
00265
00266   return;
00267 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.33.2.8 hangul_read_base16()

unsigned hangul_read_base16 (
FILE * infp,
unsigned base[][16])

Read hangul-base.hex file into a unsigned array.
Read a Hangul base .hex file with separate choseong, jungseong, and jongseong glyphs for syllable formation. The order is:

- Empty glyph in 0x0000 position.
- Initial consonants (choseong).
- Medial vowels and dipthongs (jungseong).

- Final consonants (jongseong).
- Individual letter forms in isolation, not for syllable formation.

The letters are arranged with all variations for one letter before continuing to the next letter. In the current encoding, there are 6 variations of choseong, 3 of jungseong, and 1 of jongseong per letter.

Parameters

in	Input	file pointer; can be stdin.
out	Array	of bit patterns, with 16 16-bit values per letter.

Returns

The maximum code point value read in the file.

Definition at line 116 of file unihangul-support.c.

```
00116                                           {
00117     unsigned codept;
00118     unsigned max_codept;
00119     int      i, j;
00120     char     instring[MAXLINE];
00121
00122
00123     max_codept = 0;
00124
00125     while (fgets (instring, MAXLINE, infp) != NULL) {
00126       sscanf (instring, "%X", &codept);
00127       codept -= PUA_START;
00128       /* If code point is within range, add it */
00129       if (codept < MAX_GLYPHS) {
00130         /* Find the start of the glyph bitmap. */
00131         for (i = 1; instring[i] != '\0' && instring[i] != ':'; i++);
00132         if (instring[i] == ':') {
00133           i++;  /* Skip over ':' to get to start of bitmap. */
00134           for (j = 0; j < 16; j++) {
00135             sscanf (&instring[i], "%4X", &base[codept][j]);
00136             i += 4;
00137           }
00138           if (codept > max_codept) max_codept = codept;
00139         }
00140       }
00141     }
00142
00143     return max_codept;
00144 }
```

Here is the caller graph for this function:

5.33.2.9 hangul_read_base8()

```
unsigned hangul_read_base8 (
            FILE * infp,
            unsigned char base[][32] )
```

Read hangul-base.hex file into a unsigned char array.
Read a Hangul base .hex file with separate choseong, jungseong, and jongseong glyphs for syllable formation. The order is:

- Empty glyph in 0x0000 position.
- Initial consonants (choseong).
- Medial vowels and dipthongs (jungseong).
- Final consonants (jongseong).
- Individual letter forms in isolation, not for syllable formation.

The letters are arranged with all variations for one letter before continuing to the next letter. In the current encoding, there are 6 variations of choseong, 3 of jungseong, and 1 of jongseong per letter.

Parameters

in	Input	file pointer; can be stdin.
out	Array	of bit patterns, with 32 8-bit values per letter.

Returns

The maximum code point value read in the file.

Definition at line 63 of file unihangul-support.c.

```
00063                                           {
00064   unsigned codept;
00065   unsigned max_codept;
00066   int      i, j;
00067   char     instring[MAXLINE];
00068
00069
00070   max_codept = 0;
00071
00072   while (fgets (instring, MAXLINE, infp) != NULL) {
00073     sscanf (instring, "%X", &codept);
00074     codept -= PUA_START;
00075     /* If code point is within range, add it */
00076     if (codept < MAX_GLYPHS) {
00077       /* Find the start of the glyph bitmap. */
00078       for (i = 1; instring[i] != '\0' && instring[i] != ':'; i++);
00079       if (instring[i] == ':') {
00080         i++;  /* Skip over ':' to get to start of bitmap. */
00081         for (j = 0; j < 32; j++) {
00082           sscanf (&instring[i], "%2hhX", &base[codept][j]);
00083           i += 2;
00084         }
00085         if (codept > max_codept) max_codept = codept;
00086       }
00087     }
00088   }
00089
00090   return max_codept;
00091 }
```

Here is the caller graph for this function:

5.33.2.10 hangul_syllable()

```
void hangul_syllable (
                int choseong,
                int jungseong,
                int jongseong,
                unsigned char hangul_base[][32],
                unsigned char * syllable )
```

Given letters in a Hangul syllable, return a glyph.

This function returns a glyph bitmap comprising up to three Hangul letters that form a syllable. It reads the three component letters (choseong, jungseong, and jungseong), then calls a function that determines the appropriate variation of each letter, returning the letter bitmap locations in the glyph array. Then these letter bitmaps are combined with a logical OR operation to produce a final bitmap, which forms a 16 row by 16 column bitmap glyph.

Parameters

in	choseong	The 1st letter in the composite glyph.
in	jungseong	The 2nd letter in the composite glyph.
in	jongseong	The 3rd letter in the composite glyph.
in	hangul_base	The glyphs read from the "hangul_base.hex" file.

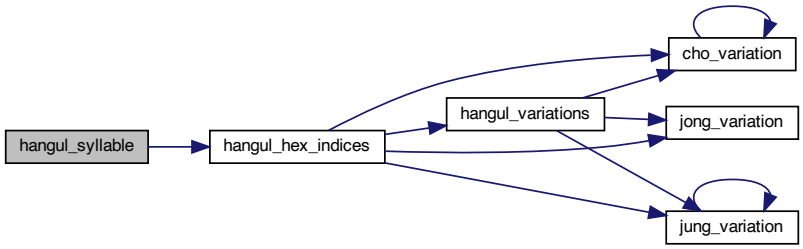
Returns

syllable The composite syllable, as a 16 by 16 pixel bitmap.

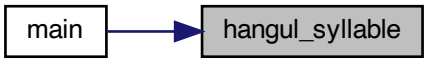
Definition at line 583 of file unihangul-support.c.

```
00584                                                                   {
00585
00586     int       i;  /* loop variable */
00587     int       cho_hex, jung_hex, jong_hex;
00588     unsigned char glyph_byte;
00589
00590
00591     hangul_hex_indices (choseong, jungseong, jongseong,
00592                         &cho_hex, &jung_hex, &jong_hex);
00593
00594     for (i = 0; i < 32; i++) {
00595       glyph_byte  = hangul_base [cho_hex][i];
00596       glyph_byte |= hangul_base [jung_hex][i];
00597       if (jong_hex >= 0) glyph_byte |= hangul_base [jong_hex][i];
00598       syllable[i] = glyph_byte;
00599     }
00600
00601     return;
00602 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.33.2.11 hangul_variations()

```
void hangul_variations (
            int choseong,
            int jungseong,
            int jongseong,
            int * cho_var,
            int * jung_var,
            int * jong_var )
```

Determine the variations of each letter in a Hangul syllable.
Given the three letters that will form a syllable, return the variation of each letter used to form the composite glyph.
This function can determine variations for both modern and archaic Hangul letters; it is not limited to only the letters combinations that comprise the Unicode Hangul Syllables range.
This function reads these input values for modern and ancient Hangul letters:

- Choseong number (0 to the number of modern and archaic choseong - 1.
- Jungseong number (0 to the number of modern and archaic jungseong - 1.
- Jongseong number (0 to the number of modern and archaic jongseong - 1, or -1 if none.

It then determines the variation of each letter given the combination with the other two letters (or just choseong and jungseong if the jongseong value is -1).

Parameters

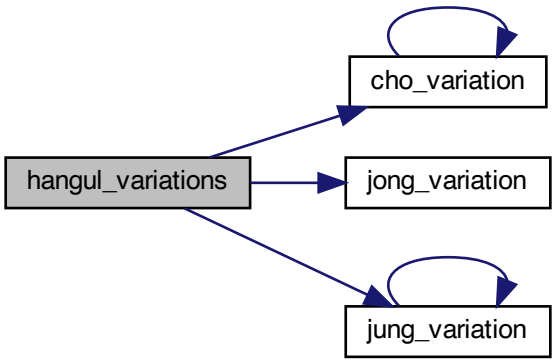
in	choseong	The 1st letter in the syllable.
in	jungseong	The 2nd letter in the syllable.
in	jongseong	The 3rd letter in the syllable, or -1 if none.
out	cho_var	Variation of the 1st letter from the hangul-base.hex file.
out	jung_var	Variation of the 2nd letter from the hangul-base.hex file.
out	jong_var	Variation of the 3rd letter from the hangul-base.hex file.

Definition at line 298 of file unihangul-support.c.

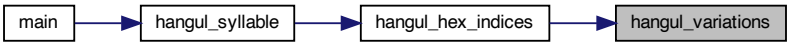
```
00299                                                   {
00300
00301     int  cho_variation (int choseong, int jungseong, int jongseong);
00302     int jung_variation (int choseong, int jungseong, int jongseong);
```

```
00303    int jong_variation (int choseong, int jungseong, int jongseong);
00304
00305    /*
00306 Find the variation for each letter component.
00307 */
00308     *cho_var =  cho_variation (choseong, jungseong, jongseong);
00309    *jung_var = jung_variation (choseong, jungseong, jongseong);
00310    *jong_var = jong_variation (choseong, jungseong, jongseong);
00311
00312
00313    return;
00314 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



5.33.2.12 is_wide_vowel()

int is_wide_vowel (
int vowel)

Whether vowel has rightmost vertical stroke to the right.

Parameters

in	vowel	Vowel number, from 0 to TOTAL_JUNG - 1.

Returns

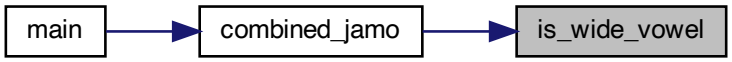
1 if this vowel's vertical stroke is wide on the right side; else 0.

Definition at line 434 of file unihangul-support.c.

```
00434                       {
00435   int retval;  /* Return value. */
00436
00437   static int wide_vowel [TOTAL_JUNG + 1] = {
00438         /*
00439 Modern Jungseong in positions 0..20.
00440 */
00441 /* Location Variations  Unicode Range    Vowel #    Vowel Names  */
00442 /* -------- ----------  --------------   -------    ----------- */
00443 /* 0x2FB */ 0, 1, 0, // U+1161..U+1163-->[ 0.. 2]  A,   AE,  YA
00444 /* 0x304 */ 1, 0, 1, // U+1164..U+1166-->[ 3.. 5]  YAE, EO,  E
00445 /* 0x30D */ 0, 1,    // U+1167..U+1168-->[ 6.. 7]  YEO, YE
00446 /* 0x313 */ 0,       // U+1169       -->[ 8]       O
00447 /* 0x316 */ 0, 1, 0, // U+116A..U+116C-->[ 9..11]  WA,  WAE, WE
00448 /* 0x31F */ 0, 0,    // U+116D..U+116E-->[12..13]  YO,  U
00449 /* 0x325 */ 0, 1, 0, // U+116F..U+1171-->[14..16]  WEO, WE,  WI
00450 /* 0x32E */ 0, 0,    // U+1172..U+1173-->[17..18]  YU,  EU
00451 /* 0x334 */ 0,       // U+1174       -->[19]       YI
00452 /* 0x337 */ 0,       // U+1175       -->[20]       I
00453         /*
00454 Ancient Jungseong in positions 21..70.
00455 */
00456 /* Location  Variations  Unicode Range    Vowel #       Vowel Names  */
00457 /* --------  ----------  --------------   -------       ----------- */
00458 /* 0x33A: */ 0, 0, 0, // U+1176..U+1178-->[21..23]   A-O,    A-U,   YA-O
00459 /* 0x343: */ 0, 0, 0, // U+1179..U+117B-->[24..26]   YA-YO,  EO-O,  EU-U
00460 /* 0x34C: */ 0, 0, 0, // U+117C..U+117E-->[27..29]   EO-EU, YEO-O,  YEO-U
00461 /* 0x355: */ 0, 1, 1, // U+117F..U+1181-->[30..32]   O-EO,   O-E,    O-YE,
00462 /* 0x35E: */ 0, 0, 0, // U+1182..U+1184-->[33..35]   O-O,    O-U,   YO-YA,
00463 /* 0x367: */ 1, 0, 0, // U+1185..U+1187-->[36..38]   YO-YAE, YO-YEO, YO-O,
00464 /* 0x370: */ 0, 0, 1, // U+1188..U+118A-->[39..41]   YO-I,   U-A,   U-AE,
00465 /* 0x379: */ 0, 1, 0, // U+118B..U+118D-->[42..44]  U-EO-EU,  U-YE,  U-U,
00466 /* 0x382: */ 0, 0, 1, // U+118E..U+1190-->[45..47]   YU-A,   YU-EO,  YU-E,
00467 /* 0x38B: */ 0, 1, 0, // U+1191..U+1193-->[48..50]   YU-YEO, YU-YE,  YU-U,
00468 /* 0x394: */ 0, 0, 0, // U+1194..U+1196-->[51..53]   YU-I,   EU-U,   EU-EU,
00469 /* 0x39D: */ 0, 0, 0, // U+1197..U+1199-->[54..56]   YI-U,   I-A,    I-YA,
00470 /* 0x3A6: */ 0, 0, 0, // U+119A..U+119C-->[57..59]   I-O,    I-U,    I-EU,
00471 /* 0x3AF: */ 0, 0, 0, // U+119D..U+119F-->[60..62] I-ARAEA, ARAEA, ARAEA-EO,
00472 /* 0x3B8: */ 0, 0, 0, // U+11A0..U+11A2-->[63..65] ARAEA-U, ARAEA-I,SSANGARAEA,
00473 /* 0x3C1: */ 0, 0, 0, // U+11A3..U+11A5-->[66..68]   A-EU,  YA-U,  YEO-YA,
00474 /* 0x3CA: */ 0, 1,    // U+11A6..U+11A7-->[69..70]   O-YA,   O-YAE
00475 #ifdef EXTENDED_HANGUL
00476 /* 0x3D0: */ 0, 0, 0, // U+D7B0..U+D7B2-->[71..73]   O-YEO,  O-O-I, YO-A,
00477 /* 0x3D9: */ 1, 0, 0, // U+D7B3..U+D7B5-->[74..76]   YO-AE,  YO-EO,  U-YEO,
00478 /* 0x3E2: */ 1, 1, 0, // U+D7B6..U+D7B8-->[77..79]   U-I-I, YU-AE,  YU-O,
00479 /* 0x3EB: */ 0, 0, 1, // U+D7B9..U+D7BB-->[80..82]   EU-A,   EU-EO,  EU-E,
00480 /* 0x3F4: */ 0, 0, 1, // U+D7BC..U+D7BE-->[83..85]   EU-O,   I-YA-O, I-YAE,
00481 /* 0x3FD: */ 0, 1, 0, // U+D7BF..U+D7C1-->[86..88]   I-YEO,  I-YE,   I-O-I,
00482 /* 0x406: */ 0, 0, 1, // U+D7C2..U+D7C4-->[89..91]   I-YO,   I-YU,   I-I,
00483 /* 0x40F: */ 0, 1,    // U+D7C5..U+D7C6-->[92..93] ARAEA-A, ARAEA-E,
00484 /* 0x415: */ -1       // Mark end of list of vowels.
00485 #else
00486 /* 0x310: */ -1       // Mark end of list of vowels.
00487 #endif
00488   };
00489
00490
00491   if (vowel >= 0 && vowel < TOTAL_JUNG) {
```

```
00492       retval = wide_vowel [vowel];
00493     }
00494     else {
00495       retval = 0;
00496     }
00497
00498
00499     return retval;
00500 }
```

Here is the caller graph for this function:



5.33.2.13 jong_variation()

```
int jong_variation (
                int choseong,
                int jungseong,
                int jongseong )   [inline]
```

Return the Johab 6/3/1 jongseong variation.

There is only one jongseong variation, so this function always returns 0. It is a placeholder function for possible future adaptation to other johab encodings.

Parameters

in	choseong	The 1st letter in the syllable.
in	jungseong	The 2nd letter in the syllable.
in	jongseong	The 3rd letter in the syllable.

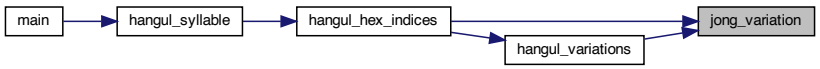
Returns

The jongseong variation, always 0.

Definition at line 558 of file unihangul-support.c.

```
00558                                                {
00559
00560     return 0;  /* There is only one Jongseong variation. */
00561 }
```

Here is the caller graph for this function:



5.33.2.14 jung_variation()

```
int jung_variation (
            int choseong,
            int jungseong,
            int jongseong )   [inline]
```

Return the Johab 6/3/1 jungseong variation.

This function takes the two or three (if jongseong is included) letters that comprise a syllable and determine the variation of the vowel (jungseong).

Each jungseong has 3 variations:

Variation	Occurrence
0	Jungseong with only chungseong (no jungseong).
1	Jungseong with chungseong and jungseong (except nieun).
2	Jungseong with chungseong and jungseong nieun.

Parameters

in	choseong	The 1st letter in the syllable.
in	jungseong	The 2nd letter in the syllable.
in	jongseong	The 3rd letter in the syllable.

Returns

The jungseong variation, 0 to 2.

Definition at line 524 of file unihangul-support.c.

```
00524                                                {
00525   int jung_variation;  /* Return value */
00526
00527   if (jungseong < 0) {
00528     jung_variation = -1;
00529   }
00530   else {
00531     jung_variation = 0;
00532     if (jongseong >= 0) {
00533       if (jongseong == 3)
00534         jung_variation = 2;  /* Vowel for final Nieun. */
00535       else
00536         jung_variation = 1;
00537     }
00538   }
00539
00540
00541   return jung_variation;
00542 }
```

Here is the call graph for this function:

Here is the caller graph for this function:

5.33.2.15 one_jamo()

```
void one_jamo (
            unsigned glyph_table[MAX_GLYPHS][16],
            unsigned jamo,
            unsigned * jamo_glyph )
```

Convert Hangul Jamo choseong, jungseong, and jongseong into a glyph.

Parameters

in	glyph_table	The collection of all jamo glyphs.
in	jamo	The Unicode code point, 0 or 0x1100..0x115F.
out	jamo_glyph	The output glyph, 16 columns in each of 16 rows.

Definition at line 717 of file unihangul-support.c.

```
00718                                       {
00719
00720     int i;  /* Loop variable */
00721     int glyph_index;  /* Location of glyph in "hangul-base.hex" array */
00722
00723
00724     /* If jamo is invalid range, use blank glyph, */
00725     if (jamo >= 0x1100 && jamo <= 0x11FF) {
00726       glyph_index = jamo - 0x1100 + JAMO_HEX;
00727     }
00728     else if (jamo >= 0xA960 && jamo <= 0xA97F) {
00729       glyph_index = jamo - 0xA960 + JAMO_EXTA_HEX;
00730     }
00731     else if (jamo >= 0xD7B0 && jamo <= 0xD7FF) {
00732       glyph_index = jamo - 0x1100 + JAMO_EXTB_HEX;
00733     }
00734     else {
00735       glyph_index = 0;
00736     }
00737
00738     for (i = 0; i < 16; i++) {
00739       jamo_glyph [i] = glyph_table [glyph_index] [i];
00740     }
00741
00742     return;
00743 }
```

5.33.2.16 print_glyph_hex()

```
void print_glyph_hex (
                FILE * fp,
                unsigned codept,
                unsigned * this_glyph )
```

Print one glyph in Unifont hexdraw hexadecimal string style.

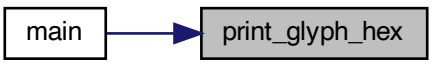
Parameters

in	fp	The file pointer for output.
in	codept	The Unicode code point to print with the glyph.
in	this_glyph	The 16-row by 16-column glyph to print.

Definition at line 692 of file unihangul-support.c.

```
00692                                                   {
00693
00694     int i;
00695
00696
00697     fprintf (fp, "%04X:", codept);
00698
00699     /* for each this_glyph row */
00700     for (i = 0; i < 16; i++) {
00701       fprintf (fp, "%04X", this_glyph[i]);
00702     }
00703     fputc ('\n', fp);
00704
00705     return;
00706 }
```

Here is the caller graph for this function:



5.33.2.17 print_glyph_txt()

```
void print_glyph_txt (
            FILE * fp,
            unsigned codept,
            unsigned * this_glyph )
```

Print one glyph in Unifont hexdraw plain text style.

Parameters

in	fp	The file pointer for output.
in	codept	The Unicode code point to print with the glyph.
in	this_glyph	The 16-row by 16-column glyph to print.

Definition at line 656 of file unihangul-support.c.

```
00656                                                   {
00657    int i;
00658    unsigned mask;
00659
00660
00661    fprintf (fp, "%04X:", codept);
00662
00663    /* for each this_glyph row */
00664    for (i = 0; i < 16; i++) {
00665       mask = 0x8000;
00666       fputc ('\t', fp);
00667       while (mask != 0x0000) {
00668          if (mask & this_glyph [i]) {
00669             fputc ('#', fp);
00670          }
00671          else {
00672             fputc ('-', fp);
00673          }
00674          mask >>= 1;  /* shift to next bit in this_glyph row */
00675       }
00676       fputc ('\n', fp);
00677    }
00678    fputc ('\n', fp);
00679
00680    return;
00681 }
```

5.34 unihangul-support.c

Go to the documentation of this file.

```
00001 /**
00002 @file unihangul-support.c
00003
00004 @brief Functions for converting Hangul letters into syllables
00005
00006 This file contains functions for reading in Hangul letters
00007 arranged in a Johab 6/3/1 pattern and composing syllables
00008 with them.  One function maps an iniital letter (choseong),
00009 medial letter (jungseong), and final letter (jongseong)
00010 into the Hangul Syllables Unicode block, U+AC00..U+D7A3.
00011 Other functions allow formation of glyphs that include
00012 the ancient Hangul letters that Hanterm supported.  More
00013 can be added if desired, with appropriate changes to
00014 start positions and lengths defined in "hangul.h".
00015
00016 @author Paul Hardy
00017
00018 @copyright Copyright © 2023 Paul Hardy
00019 */
00020 /*
00021 LICENSE:
00022
00023 This program is free software: you can redistribute it and/or modify
00024 it under the terms of the GNU General Public License as published by
00025 the Free Software Foundation, either version 2 of the License, or
00026 (at your option) any later version.
00027
00028 This program is distributed in the hope that it will be useful,
00029 but WITHOUT ANY WARRANTY; without even the implied warranty of
00030 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
00031 GNU General Public License for more details.
00032
00033 You should have received a copy of the GNU General Public License
00034 along with this program.  If not, see <http://www.gnu.org/licenses/>.
00035 */
00036
00037 #include <stdio.h>
00038 #include "hangul.h"
00039
00040
00041 /**
00042 @brief Read hangul-base.hex file into a unsigned char array.
00043
00044 Read a Hangul base .hex file with separate choseong, jungseong,
00045 and jongseong glyphs for syllable formation.  The order is:
00046
00047 - Empty glyph in 0x0000 position.
00048 - Initial consonants (choseong).
00049 - Medial vowels and dipthongs (jungseong).
00050 - Final consonants (jongseong).
00051 - Individual letter forms in isolation, not for syllable formation.
00052
00053 The letters are arranged with all variations for one letter
00054 before continuing to the next letter.  In the current
00055 encoding, there are 6 variations of choseong, 3 of jungseong,
00056 and 1 of jongseong per letter.
00057
00058 @param[in] Input file pointer; can be stdin.
00059 @param[out] Array of bit patterns, with 32 8-bit values per letter.
00060 @return The maximum code point value read in the file.
00061 */
00062 unsigned
00063 hangul_read_base8 (FILE *infp, unsigned char base[][32]) {
00064   unsigned codept;
00065   unsigned max_codept;
00066   int      i, j;
00067   char     instring[MAXLINE];
00068
00069
00070   max_codept = 0;
00071
00072   while (fgets (instring, MAXLINE, infp) != NULL) {
00073     sscanf (instring, "%X", &codept);
00074     codept -= PUA_START;
00075     /* If code point is within range, add it */
00076     if (codept < MAX_GLYPHS) {
00077       /* Find the start of the glyph bitmap. */
```

```
00078         for (i = 1; instring[i] != '\0' && instring[i] != ':'; i++);
00079         if (instring[i] == ':') {
00080           i++;  /* Skip over ':' to get to start of bitmap. */
00081           for (j = 0; j < 32; j++) {
00082             sscanf (&instring[i], "%2hhX", &base[codept][j]);
00083             i += 2;
00084           }
00085           if (codept > max_codept) max_codept = codept;
00086         }
00087       }
00088     }
00089
00090     return max_codept;
00091 }
00092
00093
00094 /**
00095 @brief Read hangul-base.hex file into a unsigned array.
00096
00097 Read a Hangul base .hex file with separate choseong, jungseong,
00098 and jongseong glyphs for syllable formation.  The order is:
00099
00100 - Empty glyph in 0x0000 position.
00101 - Initial consonants (choseong).
00102 - Medial vowels and dipthongs (jungseong).
00103 - Final consonants (jongseong).
00104 - Individual letter forms in isolation, not for syllable formation.
00105
00106 The letters are arranged with all variations for one letter
00107 before continuing to the next letter.  In the current
00108 encoding, there are 6 variations of choseong, 3 of jungseong,
00109 and 1 of jongseong per letter.
00110
00111 @param[in] Input file pointer; can be stdin.
00112 @param[out] Array of bit patterns, with 16 16-bit values per letter.
00113 @return The maximum code point value read in the file.
00114 */
00115 unsigned
00116 hangul_read_base16 (FILE *infp, unsigned base[][16]) {
00117     unsigned codept;
00118     unsigned max_codept;
00119     int      i, j;
00120     char     instring[MAXLINE];
00121
00122
00123     max_codept = 0;
00124
00125     while (fgets (instring, MAXLINE, infp) != NULL) {
00126       sscanf (instring, "%X", &codept);
00127       codept -= PUA_START;
00128       /* If code point is within range, add it */
00129       if (codept < MAX_GLYPHS) {
00130         /* Find the start of the glyph bitmap. */
00131         for (i = 1; instring[i] != '\0' && instring[i] != ':'; i++);
00132         if (instring[i] == ':') {
00133           i++;  /* Skip over ':' to get to start of bitmap. */
00134           for (j = 0; j < 16; j++) {
00135             sscanf (&instring[i], "%4X", &base[codept][j]);
00136             i += 4;
00137           }
00138           if (codept > max_codept) max_codept = codept;
00139         }
00140       }
00141     }
00142
00143     return max_codept;
00144 }
00145
00146
00147 /**
00148 @brief Decompose a Hangul Syllables code point into three letters.
00149
00150 Decompose a Hangul Syllables code point (U+AC00..U+D7A3) into:
00151
00152 - Choseong    0-19
00153 - Jungseong   0-20
00154 - Jongseong   0-27 or -1 if no jongseong
00155
00156 All letter values are  set to -1 if the letters do not
00157 form a syllable in the Hangul Syllables range.  This function
00158 only handles modern Hangul, because that is all that is in
```

```
00159 the Hangul Syllables range.
00160
00161 @param[in] codept The Unicode code point to decode, from 0xAC00 to 0xD7A3.
00162 @param[out] initial The 1st letter (choseong)  in the syllable.
00163 @param[out] initial The 2nd letter (jungseong) in the syllable.
00164 @param[out] initial The 3rd letter (jongseong) in the syllable.
00165 */
00166 void
00167 hangul_decompose (unsigned codept, int *initial, int *medial, int *final) {
00168
00169     if (codept < 0xAC00 || codept > 0xD7A3) {
00170         *initial = *medial = *final = -1;
00171     }
00172     else {
00173         codept  -= 0xAC00;
00174         *initial =  codept / (28  * 21);
00175         *medial  = (codept /  28) % 21;
00176         *final   =  codept %  28 - 1;
00177     }
00178
00179     return;
00180 }
00181
00182
00183 /**
00184 @brief Compose a Hangul syllable into a code point, or 0 if none exists.
00185
00186 This function takes three letters that can form a modern Hangul
00187 syllable and returns the corresponding Unicode Hangul Syllables
00188 code point in the range 0xAC00 to 0xD7A3.
00189
00190 If a three-letter combination includes one or more archaic letters,
00191 it will not map into the Hangul Syllables range.  In that case,
00192 the returned code point will be 0 to indicate that no valid
00193 Hangul Syllables code point exists.
00194
00195 @param[in] initial The first letter (choseong), 0 to 18.
00196 @param[in] medial  The second letter (jungseong), 0 to 20.
00197 @param[in] final   The third letter (jongseong), 0 to 26 or -1 if none.
00198 @return The Unicode Hangul Syllables code point, 0xAC00 to 0xD7A3.
00199 */
00200 unsigned
00201 hangul_compose (int initial, int medial, int final) {
00202     unsigned codept;
00203
00204
00205     if (initial >= 0 && initial <= 18 &&
00206         medial  >= 0 && medial  <= 20 &&
00207         final   >= 0 && final   <= 26) {
00208
00209         codept  = 0xAC00;
00210         codept += initial * 21 * 28;
00211         codept += medial  * 28;
00212         codept += final + 1;
00213     }
00214     else {
00215         codept = 0;
00216     }
00217
00218     return codept;
00219 }
00220
00221
00222 /**
00223 @brief Determine index values to the bitmaps for a syllable's components.
00224
00225 This function reads these input values for modern and ancient Hangul letters:
00226
00227 - Choseong  number (0 to the number of modern and archaic choseong  - 1.
00228 - Jungseong number (0 to the number of modern and archaic jungseong - 1.
00229 - Jongseong number (0 to the number of modern and archaic jongseong - 1, or -1 if none.
00230
00231 It then determines the variation of each letter given the combination with
00232 the other two letters (or just choseong and jungseong if the jongseong value
00233 is -1).
00234
00235 These variations are then converted into index locations within the
00236 glyph array that was read in from the hangul-base.hex file.  Those
00237 index locations can then be used to form a composite syllable.
00238
00239 There is no restriction to only use the modern Hangul letters.
```

```
00240
00241 @param[in] choseong  The 1st letter in the syllable.
00242 @param[in] jungseong The 2nd letter in the syllable.
00243 @param[in] jongseong The 3rd letter in the syllable, or -1 if none.
00244 @param[out] cho_index Index location to the 1st letter variation from the hangul-base.hex file.
00245 @param[out] jung_index Index location to the 2nd letter variation from the hangul-base.hex file.
00246 @param[out] jong_index Index location to the 3rd letter variation from the hangul-base.hex file.
00247 */
00248 void
00249 hangul_hex_indices (int choseong, int jungseong, int jongseong,
00250                     int *cho_index, int *jung_index, int *jong_index) {
00251
00252   int cho_variation, jung_variation, jong_variation;  /* Letter variations */
00253
00254   void hangul_variations (int choseong, int jungseong, int jongseong,
00255           int *cho_variation, int *jung_variation, int *jong_variation);
00256
00257
00258   hangul_variations (choseong, jungseong, jongseong,
00259                      &cho_variation, &jung_variation, &jong_variation);
00260
00261    *cho_index = CHO_HEX +  choseong * CHO_VARIATIONS +  cho_variation;
00262   *jung_index = JUNG_HEX      + jungseong * JUNG_VARIATIONS      + jung_variation;;
00263   *jong_index = jongseong < 0 ? 0x0000 :
00264                 JONG_HEX + jongseong * JONG_VARIATIONS + jong_variation;
00265
00266   return;
00267 }
00268
00269
00270 /**
00271 @brief Determine the variations of each letter in a Hangul syllable.
00272
00273 Given the three letters that will form a syllable, return the variation
00274 of each letter used to form the composite glyph.
00275
00276 This function can determine variations for both modern and archaic
00277 Hangul letters; it is not limited to only the letters combinations
00278 that comprise the Unicode Hangul Syllables range.
00279
00280 This function reads these input values for modern and ancient Hangul letters:
00281
00282 - Choseong  number (0 to the number of modern and archaic choseong  - 1.
00283 - Jungseong number (0 to the number of modern and archaic jungseong - 1.
00284 - Jongseong number (0 to the number of modern and archaic jongseong - 1, or -1 if none.
00285
00286 It then determines the variation of each letter given the combination with
00287 the other two letters (or just choseong and jungseong if the jongseong value
00288 is -1).
00289
00290 @param[in] choseong  The 1st letter in the syllable.
00291 @param[in] jungseong The 2nd letter in the syllable.
00292 @param[in] jongseong The 3rd letter in the syllable, or -1 if none.
00293 @param[out] cho_var  Variation of the 1st letter from the hangul-base.hex file.
00294 @param[out] jung_var Variation of the 2nd letter from the hangul-base.hex file.
00295 @param[out] jong_var Variation of the 3rd letter from the hangul-base.hex file.
00296 */
00297 void
00298 hangul_variations (int choseong, int jungseong, int jongseong,
00299                    int *cho_var, int *jung_var, int *jong_var) {
00300
00301   int  cho_variation (int choseong, int jungseong, int jongseong);
00302   int jung_variation (int choseong, int jungseong, int jongseong);
00303   int jong_variation (int choseong, int jungseong, int jongseong);
00304
00305   /*
00306 Find the variation for each letter component.
00307 */
00308    *cho_var =  cho_variation (choseong, jungseong, jongseong);
00309   *jung_var = jung_variation (choseong, jungseong, jongseong);
00310   *jong_var = jong_variation (choseong, jungseong, jongseong);
00311
00312
00313   return;
00314 }
00315
00316
00317 /**
00318 @brief Return the Johab 6/3/1 choseong variation for a syllable.
00319
00320 This function takes the two or three (if jongseong is included)
```

```
00321 letters that comprise a syllable and determine the variation
00322 of the initial consonant (choseong).
00323
00324 Each choseong has 6 variations:
00325
00326 Variation   Occurrence
00327 ---------   ----------
00328 0       Choseong with a vertical vowel such as "A".
00329 1       Choseong with a horizontal vowel such as "O".
00330 2       Choseong with a vertical and horizontal vowel such as "WA".
00331 3       Same as variation 0, but with jongseong (final consonant).
00332 4       Same as variation 1, but with jongseong (final consonant).
00333 Also a horizontal vowel pointing down, such as U and YU.
00334 5       Same as variation 2, but with jongseong (final consonant).
00335 Also a horizontal vowel pointing down with vertical element,
00336 such as WEO, WE, and WI.
00337
00338 In addition, if the vowel is horizontal and a downward-pointing stroke
00339 as in the modern letters U, WEO, WE, WI, and YU, and in archaic
00340 letters YU-YEO, YU-YE, YU-I, araea, and araea-i, then 3 is added
00341 to the initial variation of 0 to 2, resulting in a choseong variation
00342 of 3 to 5, respectively.
00343
00344 @param[in] choseong  The 1st letter in the syllable.
00345 @param[in] jungseong The 2nd letter in the syllable.
00346 @param[in] jongseong The 3rd letter in the syllable.
00347 @return The choseong variation, 0 to 5.
00348 */
00349 int
00350 cho_variation (int choseong, int jungseong, int jongseong) {
00351   int cho_variation;  /* Return value */
00352
00353   /*
00354 The Choseong cho_var is determined by the
00355 21 modern + 50 ancient Jungseong, and whether
00356 or not the syllable contains a final consonant
00357 (Jongseong).
00358 */
00359   static int choseong_var [TOTAL_JUNG + 1] = {
00360         /*
00361 Modern Jungseong in positions 0..20.
00362 */
00363 /* Location Variations  Unicode Range    Vowel #    Vowel Names  */
00364 /* -------- ---------- -------------  -------   ----------- */
00365 /* 0x2FB */ 0, 0, 0, // U+1161..U+1163-->[ 0.. 2]  A,   AE,  YA
00366 /* 0x304 */ 0, 0, 0, // U+1164..U+1166-->[ 3.. 5]  YAE, EO,  E
00367 /* 0x30D */ 0, 0,    // U+1167..U+1168-->[ 6.. 7]  YEO, YE
00368 /* 0x313 */ 1,       // U+1169        -->[ 8]      O
00369 /* 0x316 */ 2, 2, 2, // U+116A..U+116C-->[ 9..11]  WA,  WAE, WE
00370 /* 0x31F */ 1, 4,    // U+116D..U+116E-->[12..13]  YO,  U
00371 /* 0x325 */ 5, 5, 5, // U+116F..U+1171-->[14..16]  WEO, WE,  WI
00372 /* 0x32E */ 4, 1,    // U+1172..U+1173-->[17..18]  YU,  EU
00373 /* 0x334 */ 2,       // U+1174        -->[19]      YI
00374 /* 0x337 */ 0,       // U+1175        -->[20]      I
00375         /*
00376 Ancient Jungseong in positions 21..70.
00377 */
00378 /* Location  Variations  Unicode Range    Vowel #       Vowel Names  */
00379 /* --------  ----------  -------------   -------      ----------- */
00380 /* 0x33A: */ 2, 5, 2, // U+1176..U+1178-->[21..23]   A-O,    A-U,   YA-O
00381 /* 0x343: */ 2, 2, 5, // U+1179..U+117B-->[24..26]   YA-YO,  EO-O,  EU-U
00382 /* 0x34C: */ 2, 2, 5, // U+117C..U+117E-->[27..29]   EO-EU, YEO-O,  YEO-U
00383 /* 0x355: */ 2, 5, 5, // U+117F..U+1181-->[30..32]   O-EO,   O-E,   O-YE,
00384 /* 0x35E: */ 4, 4, 2, // U+1182..U+1184-->[33..35]   O-O,    O-U,   YO-YA,
00385 /* 0x367: */ 2, 2, 5, // U+1185..U+1187-->[36..38]   YO-YAE, YO-YEO, YO-O,
00386 /* 0x370: */ 2, 5, 5, // U+1188..U+118A-->[39..41]   YO-I,   U-A,   U-AE,
00387 /* 0x379: */ 5, 5, 5, // U+118B..U+118D-->[42..44]  U-EO-EU,  U-YE,  U-U,
00388 /* 0x382: */ 5, 5, 5, // U+118E..U+1190-->[45..47]   YU-A,   YU-EO,  YU-E,
00389 /* 0x38B: */ 5, 5, 2, // U+1191..U+1193-->[48..50]   YU-YEO, YU-YE,  YU-U,
00390 /* 0x394: */ 5, 2, 2, // U+1194..U+1196-->[51..53]   YU-I,   EU-U,   EU-EU,
00391 /* 0x39D: */ 2, 0, 0, // U+1197..U+1199-->[54..56]   YI-U,   I-A,    I-YA,
00392 /* 0x3A6: */ 2, 5, 2, // U+119A..U+119C-->[57..59]   I-O,    I-U,    I-EU,
00393 /* 0x3AF: */ 0, 1, 2, // U+119D..U+119F-->[60..62]  I-ARAEA, ARAEA, ARAEA-EO,
00394 /* 0x3B8: */ 1, 2, 1, // U+11A0..U+11A2-->[63..65]  ARAEA-U, ARAEA-I,SSANGARAEA,
00395 /* 0x3C1: */ 2, 5, 0, // U+11A3..U+11A5-->[66..68]   A-EU,   YA-U,   YEO-YA,
00396 /* 0x3CA: */ 2, 2,    // U+11A6..U+11A7-->[69..70]   O-YA,   O-YAE,
00397 #ifdef EXTENDED_HANGUL
00398 /* 0x3D0: */ 2, 4, 5, // U+D7B0..U+D7B2-->[71..73]   O-YEO,  O-O-I, YO-A,
00399 /* 0x3D9: */ 5, 2, 5, // U+D7B3..U+D7B5-->[74..76]   YO-AE,  YO-EO,  U-YEO,
00400 /* 0x3E2: */ 5, 5, 4, // U+D7B6..U+D7B8-->[77..79]   U-I-I, YU-AE,  YU-O,
00401 /* 0x3EB: */ 5, 2, 5, // U+D7B9..U+D7BB-->[80..82]   EU-A,   EU-EO,  EU-E,
```

```
00402 /* 0x3F4: */ 4, 2, 3, // U+D7BC..U+D7BE-->[83..85]  EU-O,    I-YA-O, I-YAE,
00403 /* 0x3FD: */ 3, 3, 2, // U+D7BF..U+D7C1-->[86..88]  I-YEO,  I-YE,   I-O-I,
00404 /* 0x406: */ 2, 2, 0, // U+D7C2..U+D7C4-->[89..91]  I-YO,   I-YU,   I-I,
00405 /* 0x40F: */ 2, 2,    // U+D7C5..U+D7C6-->[92..93] ARAEA-A, ARAEA-E,
00406 /* 0x415: */ -1       // Mark end of list of vowels.
00407 #else
00408 /* 0x310: */ -1       // Mark end of list of vowels.
00409 #endif
00410   };
00411
00412
00413   if (jungseong < 0 || jungseong >= TOTAL_JUNG) {
00414     cho_variation = -1;
00415   }
00416   else {
00417     cho_variation = choseong_var [jungseong];
00418     if (choseong >= 0 && jongseong >= 0 && cho_variation < 3)
00419       cho_variation += 3;
00420   }
00421
00422
00423   return cho_variation;
00424 }
00425
00426
00427 /**
00428 @brief Whether vowel has rightmost vertical stroke to the right.
00429
00430 @param[in] vowel Vowel number, from 0 to TOTAL_JUNG - 1.
00431 @return 1 if this vowel's vertical stroke is wide on the right side; else 0.
00432 */
00433 int
00434 is_wide_vowel (int vowel) {
00435   int retval;  /* Return value. */
00436
00437   static int wide_vowel [TOTAL_JUNG + 1] = {
00438         /*
00439 Modern Jungseong in positions 0..20.
00440 */
00441 /* Location Variations  Unicode Range    Vowel #    Vowel Names  */
00442 /* -------- ----------  --------------   -------   ----------- */
00443 /* 0x2FB */ 0, 1, 0, // U+1161..U+1163-->[ 0.. 2]  A,   AE,  YA
00444 /* 0x304 */ 1, 0, 1, // U+1164..U+1166-->[ 3.. 5]  YAE, EO,  E
00445 /* 0x30D */ 0, 1,    // U+1167..U+1168-->[ 6.. 7]  YEO, YE
00446 /* 0x313 */ 0,       // U+1169       -->[ 8]      O
00447 /* 0x316 */ 0, 1, 0, // U+116A..U+116C-->[ 9..11]  WA,  WAE, WE
00448 /* 0x31F */ 0, 0,    // U+116D..U+116E-->[12..13]  YO,  U
00449 /* 0x325 */ 0, 1, 0, // U+116F..U+1171-->[14..16]  WEO, WE,  WI
00450 /* 0x32E */ 0, 0,    // U+1172..U+1173-->[17..18]  YU,  EU
00451 /* 0x334 */ 0,       // U+1174       -->[19]      YI
00452 /* 0x337 */ 0,       // U+1175       -->[20]      I
00453         /*
00454 Ancient Jungseong in positions 21..70.
00455 */
00456 /* Location  Variations  Unicode Range    Vowel #       Vowel Names  */
00457 /* --------  ----------  --------------   -------      ----------- */
00458 /* 0x33A: */ 0, 0, 0, // U+1176..U+1178-->[21..23]   A-O,    A-U,   YA-O
00459 /* 0x343: */ 0, 0, 0, // U+1179..U+117B-->[24..26]   YA-YO,  EO-O,  EU-U
00460 /* 0x34C: */ 0, 0, 0, // U+117C..U+117E-->[27..29]   EO-EU, YEO-O,  YEO-U
00461 /* 0x355: */ 0, 1, 1, // U+117F..U+1181-->[30..32]   O-EO,   O-E,   O-YE,
00462 /* 0x35E: */ 0, 0, 0, // U+1182..U+1184-->[33..35]   O-O,    O-U,   YO-YA,
00463 /* 0x367: */ 1, 0, 0, // U+1185..U+1187-->[36..38]   YO-YAE, YO-YEO, YO-O,
00464 /* 0x370: */ 0, 0, 1, // U+1188..U+118A-->[39..41]   YO-I,   U-A,   U-AE,
00465 /* 0x379: */ 0, 1, 0, // U+118B..U+118D-->[42..44]  U-EO-EU,  U-YE,  U-U,
00466 /* 0x382: */ 0, 0, 1, // U+118E..U+1190-->[45..47]   YU-A,   YU-EO,  YU-E,
00467 /* 0x38B: */ 0, 1, 0, // U+1191..U+1193-->[48..50]   YU-YEO, YU-YE,  YU-U,
00468 /* 0x394: */ 0, 0, 0, // U+1194..U+1196-->[51..53]   YU-I,   EU-U,   EU-EU,
00469 /* 0x39D: */ 0, 0, 0, // U+1197..U+1199-->[54..56]   YI-U,   I-A,    I-YA,
00470 /* 0x3A6: */ 0, 0, 0, // U+119A..U+119C-->[57..59]   I-O,    I-U,    I-EU,
00471 /* 0x3AF: */ 0, 0, 0, // U+119D..U+119F-->[60..62] I-ARAEA, ARAEA, ARAEA-EO,
00472 /* 0x3B8: */ 0, 0, 0, // U+11A0..U+11A2-->[63..65] ARAEA-U, ARAEA-I,SSANGARAEA,
00473 /* 0x3C1: */ 0, 0, 0, // U+11A3..U+11A5-->[66..68]   A-EU,   YA-U,  YEO-YA,
00474 /* 0x3CA: */ 0, 1,    // U+11A6..U+11A7-->[69..70]   O-YA,   O-YAE
00475 #ifdef EXTENDED_HANGUL
00476 /* 0x3D0: */ 0, 0, 0, // U+D7B0..U+D7B2-->[71..73]   O-YEO,  O-O-I, YO-A,
00477 /* 0x3D9: */ 1, 0, 0, // U+D7B3..U+D7B5-->[74..76]   YO-AE,  YO-EO,  U-YEO,
00478 /* 0x3E2: */ 1, 1, 0, // U+D7B6..U+D7B8-->[77..79]   U-I-I, YU-AE,  YU-O,
00479 /* 0x3EB: */ 0, 0, 1, // U+D7B9..U+D7BB-->[80..82]  EU-A,   EU-EO,  EU-E,
00480 /* 0x3F4: */ 0, 0, 1, // U+D7BC..U+D7BE-->[83..85]  EU-O,    I-YA-O, I-YAE,
00481 /* 0x3FD: */ 0, 1, 0, // U+D7BF..U+D7C1-->[86..88]   I-YEO,  I-YE,   I-O-I,
00482 /* 0x406: */ 0, 0, 1, // U+D7C2..U+D7C4-->[89..91]   I-YO,   I-YU,   I-I,
```

```
00483 /* 0x40F: */ 0, 1,    // U+D7C5..U+D7C6-->[92..93] ARAEA-A, ARAEA-E,
00484 /* 0x415: */ -1       // Mark end of list of vowels.
00485 #else
00486 /* 0x310: */ -1       // Mark end of list of vowels.
00487 #endif
00488   };
00489
00490
00491   if (vowel >= 0 && vowel < TOTAL_JUNG) {
00492     retval = wide_vowel [vowel];
00493   }
00494   else {
00495     retval = 0;
00496   }
00497
00498
00499   return retval;
00500 }
00501
00502
00503 /**
00504 @brief Return the Johab 6/3/1 jungseong variation.
00505
00506 This function takes the two or three (if jongseong is included)
00507 letters that comprise a syllable and determine the variation
00508 of the vowel (jungseong).
00509
00510 Each jungseong has 3 variations:
00511
00512 Variation   Occurrence
00513 ---------   ----------
00514 0       Jungseong with only chungseong (no jungseong).
00515 1       Jungseong with chungseong and jungseong (except nieun).
00516 2       Jungseong with chungseong and jungseong nieun.
00517
00518 @param[in] choseong  The 1st letter in the syllable.
00519 @param[in] jungseong The 2nd letter in the syllable.
00520 @param[in] jongseong The 3rd letter in the syllable.
00521 @return The jungseong variation, 0 to 2.
00522 */
00523 inline int
00524 jung_variation (int choseong, int jungseong, int jongseong) {
00525   int jung_variation;  /* Return value */
00526
00527   if (jungseong < 0) {
00528     jung_variation = -1;
00529   }
00530   else {
00531     jung_variation = 0;
00532     if (jongseong >= 0) {
00533       if (jongseong == 3)
00534         jung_variation = 2;  /* Vowel for final Nieun. */
00535       else
00536         jung_variation = 1;
00537     }
00538   }
00539
00540
00541   return jung_variation;
00542 }
00543
00544
00545 /**
00546 @brief Return the Johab 6/3/1 jongseong variation.
00547
00548 There is only one jongseong variation, so this function
00549 always returns 0.   It is a placeholder function for
00550 possible future adaptation to other johab encodings.
00551
00552 @param[in] choseong  The 1st letter in the syllable.
00553 @param[in] jungseong The 2nd letter in the syllable.
00554 @param[in] jongseong The 3rd letter in the syllable.
00555 @return The jongseong variation, always 0.
00556 */
00557 inline int
00558 jong_variation (int choseong, int jungseong, int jongseong) {
00559
00560   return 0;  /* There is only one Jongseong variation. */
00561 }
00562
00563
```

```
00564 /**
00565 @brief Given letters in a Hangul syllable, return a glyph.
00566
00567 This function returns a glyph bitmap comprising up to three
00568 Hangul letters that form a syllable.  It reads the three
00569 component letters (choseong, jungseong, and jungseong),
00570 then calls a function that determines the appropriate
00571 variation of each letter, returning the letter bitmap locations
00572 in the glyph array.  Then these letter bitmaps are combined
00573 with a logical OR operation to produce a final bitmap,
00574 which forms a 16 row by 16 column bitmap glyph.
00575
00576 @param[in] choseong  The 1st letter in the composite glyph.
00577 @param[in] jungseong The 2nd letter in the composite glyph.
00578 @param[in] jongseong The 3rd letter in the composite glyph.
00579 @param[in] hangul_base The glyphs read from the "hangul_base.hex" file.
00580 @return syllable The composite syllable, as a 16 by 16 pixel bitmap.
00581 */
00582 void
00583 hangul_syllable (int choseong, int jungseong, int jongseong,
00584                  unsigned char hangul_base[][32], unsigned char *syllable) {
00585
00586   int      i;  /* loop variable */
00587   int      cho_hex, jung_hex, jong_hex;
00588   unsigned char glyph_byte;
00589
00590
00591   hangul_hex_indices (choseong, jungseong, jongseong,
00592                       &cho_hex, &jung_hex, &jong_hex);
00593
00594   for (i = 0; i < 32; i++) {
00595     glyph_byte  = hangul_base [cho_hex][i];
00596     glyph_byte |= hangul_base [jung_hex][i];
00597     if (jong_hex >= 0) glyph_byte |= hangul_base [jong_hex][i];
00598     syllable[i] = glyph_byte;
00599   }
00600
00601   return;
00602 }
00603
00604
00605 /**
00606 @brief See if two glyphs overlap.
00607
00608 @param[in] glyph1 The first glyph, as a 16-row bitmap.
00609 @param[in] glyph2 The second glyph, as a 16-row bitmap.
00610 @return 0 if no overlaps between glyphs, 1 otherwise.
00611 */
00612 int
00613 glyph_overlap (unsigned *glyph1, unsigned *glyph2) {
00614   int overlaps;  /* Return value; 0 if no overlaps, -1 if overlaps. */
00615   int i;
00616
00617   /* Check for overlaps between the two glyphs. */
00618
00619   i = 0;
00620   do {
00621     overlaps = (glyph1[i] & glyph2[i]) != 0;
00622     i++;
00623   }  while (i < 16 && overlaps == 0);
00624
00625   return overlaps;
00626 }
00627
00628
00629 /**
00630 @brief Combine two glyphs into one glyph.
00631
00632 @param[in] glyph1 The first glyph to overlap.
00633 @param[in] glyph2 The second glyph to overlap.
00634 @param[out] combined_glyph The returned combination glyph.
00635 */
00636 void
00637 combine_glyphs (unsigned *glyph1, unsigned *glyph2,
00638                 unsigned *combined_glyph) {
00639   int i;
00640
00641   for (i = 0; i < 16; i++)
00642     combined_glyph [i] = glyph1 [i] | glyph2 [i];
00643
00644   return;
```

```
00645 }
00646
00647
00648 /**
00649 @brief Print one glyph in Unifont hexdraw plain text style.
00650
00651 @param[in] fp          The file pointer for output.
00652 @param[in] codept      The Unicode code point to print with the glyph.
00653 @param[in] this_glyph The 16-row by 16-column glyph to print.
00654 */
00655 void
00656 print_glyph_txt (FILE *fp, unsigned codept, unsigned *this_glyph) {
00657    int i;
00658    unsigned mask;
00659
00660
00661    fprintf (fp, "%04X:", codept);
00662
00663    /* for each this_glyph row */
00664    for (i = 0; i < 16; i++) {
00665       mask = 0x8000;
00666       fputc ('\t', fp);
00667       while (mask != 0x0000) {
00668          if (mask & this_glyph [i]) {
00669             fputc ('#', fp);
00670          }
00671          else {
00672             fputc ('-', fp);
00673          }
00674          mask >>= 1;  /* shift to next bit in this_glyph row */
00675       }
00676       fputc ('\n', fp);
00677    }
00678    fputc ('\n', fp);
00679
00680    return;
00681 }
00682
00683
00684 /**
00685 @brief Print one glyph in Unifont hexdraw hexadecimal string style.
00686
00687 @param[in] fp          The file pointer for output.
00688 @param[in] codept      The Unicode code point to print with the glyph.
00689 @param[in] this_glyph The 16-row by 16-column glyph to print.
00690 */
00691 void
00692 print_glyph_hex (FILE *fp, unsigned codept, unsigned *this_glyph) {
00693
00694    int i;
00695
00696
00697    fprintf (fp, "%04X:", codept);
00698
00699    /* for each this_glyph row */
00700    for (i = 0; i < 16; i++) {
00701       fprintf (fp, "%04X", this_glyph[i]);
00702    }
00703    fputc ('\n', fp);
00704
00705    return;
00706 }
00707
00708
00709 /**
00710 @brief Convert Hangul Jamo choseong, jungseong, and jongseong into a glyph.
00711
00712 @param[in]  glyph_table The collection of all jamo glyphs.
00713 @param[in]  jamo        The Unicode code point, 0 or 0x1100..0x115F.
00714 @param[out] jamo_glyph  The output glyph, 16 columns in each of 16 rows.
00715 */
00716 void
00717 one_jamo (unsigned glyph_table [MAX_GLYPHS][16],
00718           unsigned jamo, unsigned *jamo_glyph) {
00719
00720    int i;  /* Loop variable */
00721    int glyph_index;  /* Location of glyph in "hangul-base.hex" array */
00722
00723
00724    /* If jamo is invalid range, use blank glyph, */
00725    if (jamo >= 0x1100 && jamo <= 0x11FF) {
```

```
00726       glyph_index = jamo - 0x1100 + JAMO_HEX;
00727     }
00728     else if (jamo >= 0xA960 && jamo <= 0xA97F) {
00729       glyph_index = jamo - 0xA960 + JAMO_EXTA_HEX;
00730     }
00731     else if (jamo >= 0xD7B0 && jamo <= 0xD7FF) {
00732       glyph_index = jamo - 0x1100 + JAMO_EXTB_HEX;
00733     }
00734     else {
00735       glyph_index = 0;
00736     }
00737
00738     for (i = 0; i < 16; i++) {
00739       jamo_glyph [i] = glyph_table [glyph_index] [i];
00740     }
00741
00742     return;
00743 }
00744
00745
00746 /**
00747 @brief Convert Hangul Jamo choseong, jungseong, and jongseong into a glyph.
00748
00749 This function converts input Hangul choseong, jungseong, and jongseong
00750 Unicode code triplets into a Hangul syllable.  Any of those with an
00751 out of range code point are assigned a blank glyph for combining.
00752
00753 This function performs the following steps:
00754
00755 1) Determine the sequence number of choseong, jungseong,
00756 and jongseong, from 0 to the total number of choseong,
00757 jungseong, or jongseong, respectively, minus one.  The
00758 sequence for each is as follows:
00759
00760 a) Choseong: Unicode code points of U+1100..U+115E
00761 and then U+A960..U+A97C.
00762
00763 b) Jungseong: Unicode code points of U+1161..U+11A7
00764 and then U+D7B0..U+D7C6.
00765
00766 c) Jongseong: Unicode code points of U+11A8..U+11FF
00767 and then U+D7CB..U+D7FB.
00768
00769 2) From the choseong, jungseong, and jongseong sequence number,
00770 determine the variation of choseong and jungseong (there is
00771 only one jongseong variation, although it is shifted right
00772 by one column for some vowels with a pair of long vertical
00773 strokes on the right side).
00774
00775 3) Convert the variation numbers for the three syllable
00776 components to index locations in the glyph array.
00777
00778 4) Combine the glyph array glyphs into a syllable.
00779
00780 @param[in] glyph_table The collection of all jamo glyphs.
00781 @param[in] cho The choseong Unicode code point, 0 or 0x1100..0x115F.
00782 @param[in] jung The jungseong Unicode code point, 0 or 0x1160..0x11A7.
00783 @param[in] jong The jongseong Unicode code point, 0 or 0x11A8..0x11FF.
00784 @param[out] combined_glyph The output glyph, 16 columns in each of 16 rows.
00785 */
00786 void
00787 combined_jamo (unsigned glyph_table [MAX_GLYPHS][16],
00788                unsigned cho, unsigned jung, unsigned jong,
00789                unsigned *combined_glyph) {
00790
00791   int i;  /* Loop variable. */
00792   int cho_num,   jung_num,   jong_num;
00793   int cho_group, jung_group, jong_group;
00794   int cho_index, jung_index, jong_index;
00795
00796   unsigned tmp_glyph[16]; /* Hold shifted jongsung for wide vertical vowel. */
00797
00798   int  cho_variation (int choseong, int jungseong, int jongseong);
00799
00800   void combine_glyphs (unsigned *glyph1, unsigned *glyph2,
00801                        unsigned *combined_glyph);
00802
00803
00804   /* Choose a blank glyph for each syllalbe by default. */
00805   cho_index = jung_index = jong_index = 0x000;
00806
```

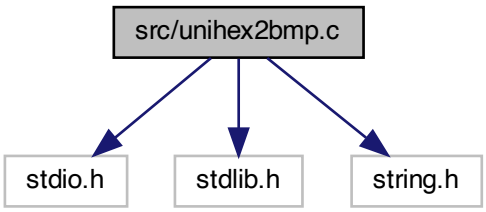
```
00807   /*
00808 Convert Unicode code points to jamo sequence number
00809 of each letter, or -1 if letter is not in valid range.
00810 */
00811   if (cho >= 0x1100 && cho <= 0x115E)
00812     cho_num = cho - CHO_UNICODE_START;
00813   else if (cho >= CHO_EXTA_UNICODE_START &&
00814           cho < (CHO_EXTA_UNICODE_START + NCHO_EXTA))
00815     cho_num = cho - CHO_EXTA_UNICODE_START + NCHO_MODERN + NJONG_ANCIENT;
00816   else
00817     cho_num = -1;
00818
00819   if (jung >= 0x1161 && jung <= 0x11A7)
00820     jung_num = jung - JUNG_UNICODE_START;
00821   else if (jung >= JUNG_EXTB_UNICODE_START &&
00822           jung < (JUNG_EXTB_UNICODE_START + NJUNG_EXTB))
00823     jung_num = jung - JUNG_EXTB_UNICODE_START + NJUNG_MODERN + NJUNG_ANCIENT;
00824   else
00825     jung_num = -1;
00826
00827   if (jong >= 0x11A8 && jong <= 0x11FF)
00828     jong_num = jong - JONG_UNICODE_START;
00829   else if (jong >= JONG_EXTB_UNICODE_START &&
00830           jong < (JONG_EXTB_UNICODE_START + NJONG_EXTB))
00831     jong_num = jong - JONG_EXTB_UNICODE_START + NJONG_MODERN + NJONG_ANCIENT;
00832   else
00833     jong_num = -1;
00834
00835   /*
00836 Choose initial consonant (choseong) variation based upon
00837 the vowel (jungseong) if both are specified.
00838 */
00839   if (cho_num < 0) {
00840     cho_index = cho_group = 0;  /* Use blank glyph for choseong. */
00841   }
00842   else {
00843     if (jung_num < 0 && jong_num < 0) {  /* Choseong is by itself. */
00844       cho_group = 0;
00845       if (cho_index < (NCHO_MODERN + NCHO_ANCIENT))
00846         cho_index = cho_num + JAMO_HEX;
00847       else  /* Choseong is in Hangul Jamo Extended-A range. */
00848         cho_index = cho_num - (NCHO_MODERN + NCHO_ANCIENT)
00849                     + JAMO_EXTA_HEX;
00850     }
00851     else {
00852       if (jung_num >= 0) {  /* Valid jungseong with choseong. */
00853         cho_group = cho_variation (cho_num, jung_num, jong_num);
00854       }
00855       else {  /* Invalid vowel; see if final consonant is valid. */
00856         /*
00857 If initial consonant and final consonant are specified,
00858 set cho_group to 4, which is the group tha would apply
00859 to a horizontal-only vowel such as Hangul "O", so the
00860 consonant appears full-width.
00861 */
00862         cho_group = 0;
00863         if (jong_num >= 0) {
00864           cho_group = 4;
00865         }
00866       }
00867       cho_index = CHO_HEX + CHO_VARIATIONS * cho_num +
00868                   cho_group;
00869     }  /* Choseong combined with jungseong and/or jongseong. */
00870   }  /* Valid choseong. */
00871
00872   /*
00873 Choose vowel (jungseong) variation based upon the choseong
00874 and jungseong.
00875 */
00876   jung_index = jung_group = 0;  /* Use blank glyph for jungseong. */
00877
00878   if (jung_num >= 0) {
00879     if (cho_num < 0 && jong_num < 0) {  /* Jungseong is by itself. */
00880       jung_group = 0;
00881       jung_index = jung_num + JUNG_UNICODE_START;
00882     }
00883     else {
00884       if (jong_num >= 0) {  /* If there is a final consonant. */
00885         if (jong_num == 3) /* Nieun; choose variation 3. */
00886           jung_group = 2;
00887         else
```

```
00888               jung_group = 1;
00889           }  /* Valid jongseong. */
00890           /* If valid choseong but no jongseong, choose jungseong variation 0. */
00891           else if (cho_num >= 0)
00892             jung_group = 0;
00893       }
00894       jung_index = JUNG_HEX + JUNG_VARIATIONS * jung_num + jung_group;
00895     }
00896
00897     /*
00898 Choose final consonant (jongseong) based upon whether choseong
00899 and/or jungseong are present.
00900 */
00901     if (jong_num < 0) {
00902       jong_index = jong_group = 0;  /* Use blank glyph for jongseong. */
00903     }
00904     else {  /* Valid jongseong. */
00905       if (cho_num < 0 && jung_num < 0) {  /* Jongseong is by itself. */
00906         jong_group = 0;
00907         jong_index = jung_num + 0x4A8;
00908       }
00909       else {  /* There is only one jongseong variation if combined. */
00910         jong_group = 0;
00911         jong_index = JONG_HEX + JONG_VARIATIONS * jong_num +
00912                      jong_group;
00913       }
00914     }
00915
00916     /*
00917 Now that we know the index locations for choseong, jungseong, and
00918 jongseong glyphs, combine them into one glyph.
00919 */
00920     combine_glyphs (glyph_table [cho_index], glyph_table [jung_index],
00921                     combined_glyph);
00922
00923     if (jong_index > 0) {
00924       /*
00925 If the vowel has a vertical stroke that is one column
00926 away from the right border, shift this jongseung right
00927 by one column to line up with the rightmost vertical
00928 stroke in the vowel.
00929 */
00930       if (is_wide_vowel (jung_num)) {
00931         for (i = 0; i < 16; i++) {
00932           tmp_glyph [i] = glyph_table [jong_index] [i] » 1;
00933         }
00934         combine_glyphs (combined_glyph, tmp_glyph,
00935                         combined_glyph);
00936       }
00937       else {
00938         combine_glyphs (combined_glyph, glyph_table [jong_index],
00939                         combined_glyph);
00940       }
00941     }
00942
00943     return;
00944 }
00945
```

5.35 src/unihex2bmp.c File Reference

unihex2bmp - Turn a GNU Unifont hex glyph page of 256 code points into a bitmap for editing
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

Include dependency graph for unihex2bmp.c:



Macros

- #define MAXBUF 256

Functions

- int main (int argc, char *argv[])

  The main function.
- int hex2bit (char *instring, unsigned char character[32][4])

  Generate a bitmap for one glyph.
- int init (unsigned char bitmap[17 *32][18 *4])

  Initialize the bitmap grid.

Variables

- char * hex [18]

  GNU Unifont bitmaps for hexadecimal digits.
- unsigned char hexbits [18][32]

  The digits converted into bitmaps.
- unsigned unipage =0

  Unicode page number, 0x00..0xff.
- int flip =1

  Transpose entire matrix as in Unicode book.

5.35.1 Detailed Description

unihex2bmp - Turn a GNU Unifont hex glyph page of 256 code points into a bitmap for editing

Author

Paul Hardy, unifoundry <at> unifoundry.com, December 2007

Copyright

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This program reads in a GNU Unifont .hex file, extracts a range of 256 code points, and converts it a Microsoft Bitmap (.bmp) or Wireless Bitmap file.
Synopsis: unihex2bmp [-iin_file.hex] [-oout_file.bmp] [-f] [-phex_page_num] [-w]
Definition in file unihex2bmp.c.

5.35.2 Macro Definition Documentation

5.35.2.1 MAXBUF

#define MAXBUF 256
Definition at line 50 of file unihex2bmp.c.

5.35.3 Function Documentation

5.35.3.1 hex2bit()

int hex2bit (
char * instring,
unsigned char character[32][4])
Generate a bitmap for one glyph.
Convert the portion of a hex string after the ':' into a character bitmap.
If string is >= 128 characters, it will fill all 4 bytes per row. If string is >= 64 characters and < 128, it will fill 2 bytes per row. Otherwise, it will fill 1 byte per row.

Parameters

in	instring	The character array containing the glyph bitmap.
out	character	Glyph bitmap, 8, 16, or 32 columns by 16 rows tall.

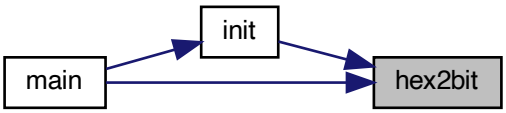
Returns

Always returns 0.

Definition at line 367 of file unihex2bmp.c.

```
00368 {
00369
00370   int i;  /* current row in bitmap character */
00371   int j;  /* current character in input string */
00372   int k;  /* current byte in bitmap character */
00373   int width;  /* number of output bytes to fill - 1: 0, 1, 2, or 3 */
00374
00375   for (i=0; i<32; i++)  /* erase previous character */
00376     character[i][0] = character[i][1] = character[i][2] = character[i][3] = 0;
00377   j=0;  /* current location is at beginning of instring */
00378
00379   if (strlen (instring) <= 34)  /* 32 + possible '\r', '\n' */
00380     width = 0;
00381   else if (strlen (instring) <= 66)  /* 64 + possible '\r', '\n' */
00382     width = 1;
00383   else if (strlen (instring) <= 98)  /* 96 + possible '\r', '\n' */
00384     width = 3;
00385   else  /* the maximum allowed is quadruple-width */
00386     width = 4;
00387
00388   k = (width > 1) ? 0 : 1; /* if width > double, start at index 1 else at 0 */
00389
00390   for (i=8; i<24; i++) {  /* 16 rows per input character, rows 8..23 */
00391     sscanf (&instring[j], "%2hhx", &character[i][k]);
00392     j += 2;
00393     if (width > 0) { /* add next pair of hex digits to this row */
00394       sscanf (&instring[j], "%2hhx", &character[i][k+1]);
00395       j += 2;
00396       if (width > 1) { /* add next pair of hex digits to this row */
00397         sscanf (&instring[j], "%2hhx", &character[i][k+2]);
00398         j += 2;
00399         if (width > 2) {  /* quadruple-width is maximum width */
00400           sscanf (&instring[j], "%2hhx", &character[i][k+3]);
00401           j += 2;
00402         }
00403       }
00404     }
00405   }
00406
00407   return (0);
00408 }
```

Here is the caller graph for this function:



5.35.3.2 init()

```
int init (
            unsigned char bitmap[17 *32][18 *4] )
```

Initialize the bitmap grid.

Parameters

out	bitmap	The bitmap to generate, with 32x32 pixel glyph areas.

Returns

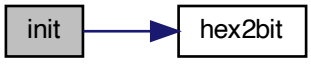
Always returns 0.

Definition at line 418 of file unihex2bmp.c.

```
00419 {
00420    int i, j;
00421    unsigned char charbits[32][4];  /* bitmap for one character, 4 bytes/row */
00422    unsigned toppixelrow;
00423    unsigned thiscol;
00424    unsigned char pnybble0, pnybble1, pnybble2, pnybble3;
00425
00426    for (i=0; i<18; i++) { /* bitmaps for '0'..'9', 'A'-'F', 'u', '+' */
00427
00428       hex2bit (&hex[i][5], charbits);  /* convert hex string to 32*4 bitmap */
00429
00430       for (j=0; j<32; j++) hexbits[i][j] = ~charbits[j][1];
00431    }
00432
00433    /*
00434 Initialize bitmap to all white.
00435 */
00436    for (toppixelrow=0; toppixelrow < 17*32; toppixelrow++) {
00437       for (thiscol=0; thiscol<18; thiscol++) {
00438          bitmap[toppixelrow][(thiscol << 2)    ] = 0xff;
00439          bitmap[toppixelrow][(thiscol << 2) | 1] = 0xff;
00440          bitmap[toppixelrow][(thiscol << 2) | 2] = 0xff;
00441          bitmap[toppixelrow][(thiscol << 2) | 3] = 0xff;
00442       }
00443    }
00444    /*
00445 Write the "u+nnnn" table header in the upper left-hand corner,
00446 where nnnn is the upper 16 bits of a 32-bit Unicode assignment.
00447 */
00448    pnybble3 = (unipage >> 20);
00449    pnybble2 = (unipage >> 16) & 0xf;
00450    pnybble1 = (unipage >> 12) & 0xf;
00451    pnybble0 = (unipage >>  8) & 0xf;
00452    for (i=0; i<32; i++) {
00453       bitmap[i][1] = hexbits[16][i];  /* copy 'u' */
00454       bitmap[i][2] = hexbits[17][i];  /* copy '+' */
00455       bitmap[i][3] = hexbits[pnybble3][i];
00456       bitmap[i][4] = hexbits[pnybble2][i];
00457       bitmap[i][5] = hexbits[pnybble1][i];
00458       bitmap[i][6] = hexbits[pnybble0][i];
00459    }
00460    /*
00461 Write low-order 2 bytes of Unicode number assignments, as hex labels
00462 */
00463    pnybble3 = (unipage >> 4) & 0xf;  /* Highest-order hex digit */
00464    pnybble2 = (unipage     ) & 0xf;  /* Next highest-order hex digit */
00465    /*
00466 Write the column headers in bitmap[][] (row headers if flipped)
00467 */
00468    toppixelrow = 32 * 17 - 1; /* maximum pixel row number */
00469    /*
00470 Label the column headers. The hexbits[][] bytes are split across two
00471 bitmap[][] entries to center a the hex digits in a column of 4 bytes.
00472 OR highest byte with 0xf0 and lowest byte with 0x0f to make outer
00473 nybbles white (0=black, 1-white).
```

```
00474 */
00475   for (i=0; i<16; i++) {
00476     for (j=0; j<32; j++) {
00477       if (flip) {  /* transpose matrix */
00478         bitmap[j][((i+2) « 2) | 0]  = (hexbits[pnybble3][j] » 4) | 0xf0;
00479         bitmap[j][((i+2) « 2) | 1]  = (hexbits[pnybble3][j] « 4) |
00480                                       (hexbits[pnybble2][j] » 4);
00481         bitmap[j][((i+2) « 2) | 2]  = (hexbits[pnybble2][j] « 4) |
00482                                       (hexbits[i][j] » 4);
00483         bitmap[j][((i+2) « 2) | 3]  = (hexbits[i][j] « 4) | 0x0f;
00484       }
00485       else {
00486         bitmap[j][((i+2) « 2) | 1] = (hexbits[i][j] » 4) | 0xf0;
00487         bitmap[j][((i+2) « 2) | 2] = (hexbits[i][j] « 4) | 0x0f;
00488       }
00489     }
00490   }
00491   /*
00492 Now use the single hex digit column graphics to label the row headers.
00493 */
00494   for (i=0; i<16; i++) {
00495     toppixelrow = 32 * (i + 1) - 1; /* from bottom to top    */
00496
00497     for (j=0; j<32; j++) {
00498       if (!flip) {  /* if not transposing matrix */
00499         bitmap[toppixelrow + j][4] = hexbits[pnybble3][j];
00500         bitmap[toppixelrow + j][5] = hexbits[pnybble2][j];
00501       }
00502       bitmap[toppixelrow + j][6] = hexbits[i][j];
00503     }
00504   }
00505   /*
00506 Now draw grid lines in bitmap, around characters we just copied.
00507 */
00508   /* draw vertical lines 2 pixels wide */
00509   for (i=1*32; i<17*32; i++) {
00510     if ((i & 0x1f) == 7)
00511       i++;
00512     else if ((i & 0x1f) == 14)
00513       i += 2;
00514     else if ((i & 0x1f) == 22)
00515       i++;
00516     for (j=1; j<18; j++) {
00517       bitmap[i][(j « 2) | 3] &= 0xfe;
00518     }
00519   }
00520   /* draw horizontal lines 1 pixel tall */
00521   for (i=1*32-1; i<18*32-1; i+=32) {
00522     for (j=2; j<18; j++) {
00523       bitmap[i][(j « 2)    ] = 0x00;
00524       bitmap[i][(j « 2) | 1] = 0x81;
00525       bitmap[i][(j « 2) | 2] = 0x81;
00526       bitmap[i][(j « 2) | 3] = 0x00;
00527     }
00528   }
00529   /* fill in top left corner pixel of grid */
00530   bitmap[31][7] = 0xfe;
00531
00532   return (0);
00533 }
```

Here is the call graph for this function:



Here is the caller graph for this function:

5.35.3.3 main()

```
int main (
                int argc,
                char * argv[] )
```

The main function.

Parameters

in	argc	The count of command line arguments.
in	argv	Pointer to array of command line arguments.

Returns

This program exits with status 0.

Definition at line 99 of file unihex2bmp.c.

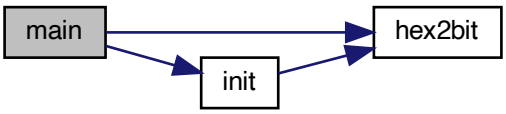
```
00100 {
00101
00102     int i, j;                 /* loop variables                    */
00103     unsigned k0;              /* temp Unicode char variable        */
00104     unsigned swap;            /* temp variable for swapping values */
00105     char inbuf[256];          /* input buffer                      */
00106     unsigned filesize;        /* size of file in bytes             */
00107     unsigned bitmapsize;      /* size of bitmap image in bytes     */
00108     unsigned thischar;        /* the current character             */
00109     unsigned char thischarbyte; /* unsigned char lowest byte of Unicode char */
00110     int thischarrow;          /* row 0..15 where this character belongs  */
00111     int thiscol;              /* column 0..15 where this character belongs */
00112     int toppixelrow;          /* pixel row, 0..16*32-1             */
00113     unsigned lastpage=0;      /* the last Unicode page read in font file */
```

```
00114   int wbmp=0;                 /* set to 1 if writing .wbmp format file */
00115
00116   unsigned char bitmap[17*32][18*4]; /* final bitmap */
00117   unsigned char charbits[32][4];  /* bitmap for one character, 4 bytes/row */
00118
00119   char *infile="", *outfile="";  /* names of input and output files */
00120   FILE *infp, *outfp;       /* file pointers of input and output files */
00121
00122   /* initializes bitmap row/col labeling, &c. */
00123   int init (unsigned char bitmap[17*32][18*4]);
00124
00125   /* convert hex string --> bitmap */
00126   int hex2bit (char *instring, unsigned char character[32][4]);
00127
00128   bitmapsize = 17*32*18*4;  /* 17 rows by 18 cols, each 4 bytes */
00129
00130   if (argc > 1) {
00131     for (i = 1; i < argc; i++) {
00132       if (argv[i][0] == '-') {  /* this is an option argument */
00133         switch (argv[i][1]) {
00134           case 'f':  /* flip (transpose) glyphs in bitmap as in standard */
00135             flip = !flip;
00136             break;
00137           case 'i':  /* name of input file */
00138             infile = &argv[i][2];
00139             break;
00140           case 'o':  /* name of output file */
00141             outfile = &argv[i][2];
00142             break;
00143           case 'p':  /* specify a Unicode page other than default of 0 */
00144             sscanf (&argv[i][2], "%x", &unipage); /* Get Unicode page */
00145             break;
00146           case 'w':  /* write a .wbmp file instead of a .bmp file */
00147             wbmp = 1;
00148             break;
00149           default:    /* if unrecognized option, print list and exit */
00150             fprintf (stderr, "\nSyntax:\n\n");
00151             fprintf (stderr, "   %s -p<Unicode_Page> ", argv[0]);
00152             fprintf (stderr, "-i<Input_File> -o<Output_File> -w\n\n");
00153             fprintf (stderr, "   -w specifies .wbmp output instead of ");
00154             fprintf (stderr, "default Windows .bmp output.\n\n");
00155             fprintf (stderr, "   -p is followed by 1 to 6 ");
00156             fprintf (stderr, "Unicode page hex digits ");
00157             fprintf (stderr, "(default is Page 0).\n\n");
00158             fprintf (stderr, "\nExample:\n\n");
00159             fprintf (stderr, "   %s -p83 -iunifont.hex -ou83.bmp\n\n\n",
00160                   argv[0]);
00161             exit (1);
00162         }
00163       }
00164     }
00165   }
00166   /*
00167 Make sure we can open any I/O files that were specified before
00168 doing anything else.
00169 */
00170   if (strlen (infile) > 0) {
00171     if ((infp = fopen (infile, "r")) == NULL) {
00172       fprintf (stderr, "Error: can't open %s for input.\n", infile);
00173       exit (1);
00174     }
00175   }
00176   else {
00177     infp = stdin;
00178   }
00179   if (strlen (outfile) > 0) {
00180     if ((outfp = fopen (outfile, "w")) == NULL) {
00181       fprintf (stderr, "Error: can't open %s for output.\n", outfile);
00182       exit (1);
00183     }
00184   }
00185   else {
00186     outfp = stdout;
00187   }
00188
00189   (void)init(bitmap); /* initialize bitmap with row/column headers, etc. */
00190
00191   /*
00192 Read in the characters in the page
00193 */
00194   while (lastpage <= unipage && fgets (inbuf, MAXBUF-1, infp) != NULL) {
```

```
00195       sscanf (inbuf, "%x", &thischar);
00196       lastpage = thischar » 8; /* keep Unicode page to see if we can stop */
00197       if (lastpage == unipage) {
00198         thischarbyte = (unsigned char)(thischar & 0xff);
00199         for (k0=0; inbuf[k0] != ':'; k0++);
00200         k0++;
00201         hex2bit (&inbuf[k0], charbits);  /* convert hex string to 32*4 bitmap */
00202
00203         /*
00204 Now write character bitmap upside-down in page array, to match
00205 .bmp file order.  In the .wbmp‘ and .bmp files, white is a '1'
00206 bit and black is a '0' bit, so complement charbits[][].
00207 */
00208
00209         thiscol = (thischarbyte & 0xf) + 2;  /* column number will be 1..16  */
00210         thischarrow = thischarbyte » 4;     /* charcter row number, 0..15   */
00211         if (flip) {  /* swap row and column placement */
00212           swap = thiscol;
00213           thiscol = thischarrow;
00214           thischarrow = swap;
00215           thiscol += 2;       /* column index starts at 1 */
00216           thischarrow -= 2;   /* row index starts at 0    */
00217         }
00218         toppixelrow = 32 * (thischarrow + 1) - 1; /* from bottom to top    */
00219
00220         /*
00221 Copy the center of charbits[][] because hex characters only
00222 occupy rows 8 to 23 and column byte 2 (and for 16 bit wide
00223 characters, byte 3).  The charbits[][] array was given 32 rows
00224 and 4 column bytes for completeness in the beginning.
00225 */
00226         for (i=8; i<24; i++) {
00227           bitmap[toppixelrow + i][(thiscol « 2) | 0] =
00228             ~charbits[i][0] & 0xff;
00229           bitmap[toppixelrow + i][(thiscol « 2) | 1] =
00230             ~charbits[i][1] & 0xff;
00231           bitmap[toppixelrow + i][(thiscol « 2) | 2] =
00232             ~charbits[i][2] & 0xff;
00233           /* Only use first 31 bits; leave vertical rule in 32nd column */
00234           bitmap[toppixelrow + i][(thiscol « 2) | 3] =
00235             ~charbits[i][3] & 0xfe;
00236         }
00237         /*
00238 Leave white space in 32nd column of rows 8, 14, 15, and 23
00239 to leave 16 pixel height upper, middle, and lower guides.
00240 */
00241         bitmap[toppixelrow +  8][(thiscol « 2) | 3] |= 1;
00242         bitmap[toppixelrow + 14][(thiscol « 2) | 3] |= 1;
00243         bitmap[toppixelrow + 15][(thiscol « 2) | 3] |= 1;
00244         bitmap[toppixelrow + 23][(thiscol « 2) | 3] |= 1;
00245       }
00246     }
00247     /*
00248 Now write the appropriate bitmap file format, either
00249 Wireless Bitmap or Microsoft Windows bitmap.
00250 */
00251     if (wbmp) {  /* Write a Wireless Bitmap .wbmp format file */
00252       /*
00253 Write WBMP header
00254 */
00255       fprintf (outfp, "%c", 0x00); /* Type of image; always 0 (monochrome) */
00256       fprintf (outfp, "%c", 0x00); /* Reserved; always 0                   */
00257       fprintf (outfp, "%c%c", 0x84, 0x40); /* Width  = 576 pixels          */
00258       fprintf (outfp, "%c%c", 0x84, 0x20); /* Height = 544 pixels          */
00259       /*
00260 Write bitmap image
00261 */
00262       for (toppixelrow=0; toppixelrow <= 17*32-1; toppixelrow++) {
00263         for (j=0; j<18; j++) {
00264           fprintf (outfp, "%c", bitmap[toppixelrow][(j«2)    ]);
00265           fprintf (outfp, "%c", bitmap[toppixelrow][(j«2) | 1]);
00266           fprintf (outfp, "%c", bitmap[toppixelrow][(j«2) | 2]);
00267           fprintf (outfp, "%c", bitmap[toppixelrow][(j«2) | 3]);
00268         }
00269       }
00270     }
00271     else {  /* otherwise, write a Microsoft Windows .bmp format file */
00272       /*
00273 Write the .bmp file -- start with the header, then write the bitmap
00274 */
00275
```

```
00276       /* 'B', 'M' appears at start of every .bmp file */
00277       fprintf (outfp, "%c%c", 0x42, 0x4d);
00278
00279       /* Write file size in bytes */
00280       filesize   = 0x3E + bitmapsize;
00281       fprintf (outfp, "%c", (unsigned char)((filesize        ) & 0xff));
00282       fprintf (outfp, "%c", (unsigned char)((filesize » 0x08) & 0xff));
00283       fprintf (outfp, "%c", (unsigned char)((filesize » 0x10) & 0xff));
00284       fprintf (outfp, "%c", (unsigned char)((filesize » 0x18) & 0xff));
00285
00286       /* Reserved - 0's */
00287       fprintf (outfp, "%c%c%c%c", 0x00, 0x00, 0x00, 0x00);
00288
00289       /* Offset from start of file to bitmap data */
00290       fprintf (outfp, "%c%c%c%c", 0x3E, 0x00, 0x00, 0x00);
00291
00292       /* Length of bitmap info header */
00293       fprintf (outfp, "%c%c%c%c", 0x28, 0x00, 0x00, 0x00);
00294
00295       /* Width of bitmap in pixels */
00296       fprintf (outfp, "%c%c%c%c", 0x40, 0x02, 0x00, 0x00);
00297
00298       /* Height of bitmap in pixels */
00299       fprintf (outfp, "%c%c%c%c", 0x20, 0x02, 0x00, 0x00);
00300
00301       /* Planes in bitmap (fixed at 1) */
00302       fprintf (outfp, "%c%c", 0x01, 0x00);
00303
00304       /* bits per pixel (1 = monochrome) */
00305       fprintf (outfp, "%c%c", 0x01, 0x00);
00306
00307       /* Compression (0 = none) */
00308       fprintf (outfp, "%c%c%c%c", 0x00, 0x00, 0x00, 0x00);
00309
00310       /* Size of bitmap data in bytes */
00311       fprintf (outfp, "%c", (unsigned char)((bitmapsize        ) & 0xff));
00312       fprintf (outfp, "%c", (unsigned char)((bitmapsize » 0x08) & 0xff));
00313       fprintf (outfp, "%c", (unsigned char)((bitmapsize » 0x10) & 0xff));
00314       fprintf (outfp, "%c", (unsigned char)((bitmapsize » 0x18) & 0xff));
00315
00316       /* Horizontal resolution in pixels per meter */
00317       fprintf (outfp, "%c%c%c%c", 0xC4, 0x0E, 0x00, 0x00);
00318
00319       /* Vertical resolution in pixels per meter */
00320       fprintf (outfp, "%c%c%c%c", 0xC4, 0x0E, 0x00, 0x00);
00321
00322       /* Number of colors used */
00323       fprintf (outfp, "%c%c%c%c", 0x02, 0x00, 0x00, 0x00);
00324
00325       /* Number of important colors */
00326       fprintf (outfp, "%c%c%c%c", 0x02, 0x00, 0x00, 0x00);
00327
00328       /* The color black: B=0x00, G=0x00, R=0x00, Filler=0xFF */
00329       fprintf (outfp, "%c%c%c%c", 0x00, 0x00, 0x00, 0x00);
00330
00331       /* The color white: B=0xFF, G=0xFF, R=0xFF, Filler=0xFF */
00332       fprintf (outfp, "%c%c%c%c", 0xFF, 0xFF, 0xFF, 0x00);
00333
00334       /*
00335  Now write the raw data bits.  Data is written from the lower
00336  left-hand corner of the image to the upper right-hand corner
00337  of the image.
00338  */
00339       for (toppixelrow=17*32-1; toppixelrow >= 0; toppixelrow--) {
00340          for (j=0; j<18; j++) {
00341             fprintf (outfp, "%c", bitmap[toppixelrow][(j«2)    ]);
00342             fprintf (outfp, "%c", bitmap[toppixelrow][(j«2) | 1]);
00343             fprintf (outfp, "%c", bitmap[toppixelrow][(j«2) | 2]);
00344
00345             fprintf (outfp, "%c", bitmap[toppixelrow][(j«2) | 3]);
00346          }
00347       }
00348    }
00349    exit (0);
00350 }
```

Here is the call graph for this function:



5.35.4 Variable Documentation

5.35.4.1 flip

int flip =1

Transpose entire matrix as in Unicode book.
Definition at line 88 of file unihex2bmp.c.

5.35.4.2 hex

char* hex[18]

Initial value:

```
= {
    "0030:0000000018244242424224224180000",
    "0031:0000000008182808080808083E0000",
    "0032:000000003C4242020C102040407E0000",
    "0033:000000003C4242021C020242423C0000",
    "0034:00000000040C142444447E0404040000",
    "0035:000000007E4040407C020202423C0000",
    "0036:000000001C2040407C424242423C0000",
    "0037:000000007E020204040808080800000",
    "0038:000000003C4242423C424242423C0000",
    "0039:000000003C4242423E02020204380000",
    "0041:0000000018242442427E424242420000",
    "0042:000000007C4242427C424242427C0000",
    "0043:000000003C4242404040042423C0000",
    "0044:0000000078444242424242244780000",
    "0045:000000007E4040407C404040407E0000",
    "0046:000000007E4040407C40404040400000",
    "0055:0000000042424242424242423C0000",
    "002B:0000000000000808087F080808000000"
  }
```

GNU Unifont bitmaps for hexadecimal digits.
These are the GNU Unifont hex strings for '0'-'9' and 'A'-'F', for encoding as bit strings in row and column headers.
Looking at the final bitmap as a grid of 32*32 bit tiles, the first row contains a hexadecimal character string of the first 3 hex digits in a 4 digit Unicode character name; the top column contains a hex character string of the 4th (low-order) hex digit of the Unicode character.
Definition at line 65 of file unihex2bmp.c.

5.35.4.3 hexbits

unsigned char hexbits[18][32]

The digits converted into bitmaps.

Definition at line 85 of file unihex2bmp.c.

5.35.4.4 unipage

unsigned unipage =0
Unicode page number, 0x00..0xff.
Definition at line 87 of file unihex2bmp.c.

5.36 unihex2bmp.c

Go to the documentation of this file.

```
00001 /**
00002 @file unihex2bmp.c
00003
00004 @brief unihex2bmp - Turn a GNU Unifont hex glyph page of 256 code points
00005 into a bitmap for editing
00006
00007 @author Paul Hardy, unifoundry <at> unifoundry.com, December 2007
00008
00009 @copyright Copyright (C) 2007, 2008, 2013, 2017 Paul Hardy
00010
00011 This program reads in a GNU Unifont .hex file, extracts a range of
00012 256 code points, and converts it a Microsoft Bitmap (.bmp) or Wireless
00013 Bitmap file.
00014
00015 Synopsis: unihex2bmp [-iin_file.hex] [-oout_file.bmp]
00016 [-f] [-phex_page_num] [-w]
00017 */
00018 /*
00019 LICENSE:
00020
00021 This program is free software: you can redistribute it and/or modify
00022 it under the terms of the GNU General Public License as published by
00023 the Free Software Foundation, either version 2 of the License, or
00024 (at your option) any later version.
00025
00026 This program is distributed in the hope that it will be useful,
00027 but WITHOUT ANY WARRANTY; without even the implied warranty of
00028 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
00029 GNU General Public License for more details.
00030
00031 You should have received a copy of the GNU General Public License
00032 along with this program.  If not, see <http://www.gnu.org/licenses/>.
00033 */
00034
00035 /*
00036 20 June 2017 [Paul Hardy]:
00037 - Adds capability to output triple-width and quadruple-width (31 pixels
00038 wide, not 32) glyphs.  The 32nd column in a glyph cell is occupied by
00039 the vertical cell border, so a quadruple-width glyph can only occupy
00040 the first 31 columns; the 32nd column is ignored.
00041
00042 21 October 2023 [Paul Hardy]:
00043 - Added full prototypes in main function for init and hex2bit functions.
00044 */
00045
00046 #include <stdio.h>
00047 #include <stdlib.h>
00048 #include <string.h>
00049
00050 #define MAXBUF 256
00051
00052
00053 /**
00054 @brief GNU Unifont bitmaps for hexadecimal digits.
00055
00056 These are the GNU Unifont hex strings for '0'-'9' and 'A'-'F',
00057 for encoding as bit strings in row and column headers.
00058
00059 Looking at the final bitmap as a grid of 32*32 bit tiles, the
00060 first row contains a hexadecimal character string of the first
00061 3 hex digits in a 4 digit Unicode character name; the top column
00062 contains a hex character string of the 4th (low-order) hex digit
00063 of the Unicode character.
```

```
00064 */
00065 char *hex[18]= {
00066       "0030:0000000018244242424224180000",  /* Hex digit 0 */
00067       "0031:0000000008182808080808083E0000",  /* Hex digit 1 */
00068       "0032:000000003C4242020C102040407E0000",  /* Hex digit 2 */
00069       "0033:000000003C4242021C020242423C0000",  /* Hex digit 3 */
00070       "0034:00000000040C142444447E0404040000",  /* Hex digit 4 */
00071       "0035:000000007E4040407C020202423C0000",  /* Hex digit 5 */
00072       "0036:000000001C2040407C424242423C0000",  /* Hex digit 6 */
00073       "0037:000000007E0202040404080808080000",  /* Hex digit 7 */
00074       "0038:000000003C4242423C424242423C0000",  /* Hex digit 8 */
00075       "0039:000000003C4242423E02020204380000",  /* Hex digit 9 */
00076       "0041:0000000018242442427E424242420000",  /* Hex digit A */
00077       "0042:000000007C4242427C424242427C0000",  /* Hex digit B */
00078       "0043:000000003C4242404040042423C0000",  /* Hex digit C */
00079       "0044:0000000078444242424242244780000",  /* Hex digit D */
00080       "0045:000000007E4040407C404040407E0000",  /* Hex digit E */
00081       "0046:000000007E4040407C40404040400000",  /* Hex digit F */
00082       "0055:0000000042424242424242423C0000",  /* Unicode 'U' */
00083       "002B:0000000000000808087F080808000000"   /* Unicode '+' */
00084    };
00085 unsigned char hexbits[18][32]; ///< The digits converted into bitmaps.
00086
00087 unsigned unipage=0;   ///< Unicode page number, 0x00..0xff.
00088 int flip=1;           ///< Transpose entire matrix as in Unicode book.
00089
00090
00091 /**
00092 @brief The main function.
00093
00094 @param[in] argc The count of command line arguments.
00095 @param[in] argv Pointer to array of command line arguments.
00096 @return This program exits with status 0.
00097 */
00098 int
00099 main (int argc, char *argv[])
00100 {
00101
00102    int i, j;                  /* loop variables                    */
00103    unsigned k0;               /* temp Unicode char variable        */
00104    unsigned swap;             /* temp variable for swapping values */
00105    char inbuf[256];           /* input buffer                      */
00106    unsigned filesize;         /* size of file in bytes             */
00107    unsigned bitmapsize;       /* size of bitmap image in bytes     */
00108    unsigned thischar;         /* the current character             */
00109    unsigned char thischarbyte; /* unsigned char lowest byte of Unicode char */
00110    int thischarrow;           /* row 0..15 where this character belongs  */
00111    int thiscol;               /* column 0..15 where this character belongs */
00112    int toppixelrow;           /* pixel row, 0..16*32-1             */
00113    unsigned lastpage=0;       /* the last Unicode page read in font file */
00114    int wbmp=0;                /* set to 1 if writing .wbmp format file */
00115
00116    unsigned char bitmap[17*32][18*4]; /* final bitmap */
00117    unsigned char charbits[32][4];  /* bitmap for one character, 4 bytes/row */
00118
00119    char *infile="", *outfile="";  /* names of input and output files */
00120    FILE *infp, *outfp;       /* file pointers of input and output files */
00121
00122    /* initializes bitmap row/col labeling, &c. */
00123    int init (unsigned char bitmap[17*32][18*4]);
00124
00125    /* convert hex string --> bitmap */
00126    int hex2bit (char *instring, unsigned char character[32][4]);
00127
00128    bitmapsize = 17*32*18*4;  /* 17 rows by 18 cols, each 4 bytes */
00129
00130    if (argc > 1) {
00131       for (i = 1; i < argc; i++) {
00132          if (argv[i][0] == '-') {  /* this is an option argument */
00133             switch (argv[i][1]) {
00134                case 'f':  /* flip (transpose) glyphs in bitmap as in standard */
00135                   flip = !flip;
00136                   break;
00137                case 'i':  /* name of input file */
00138                   infile = &argv[i][2];
00139                   break;
00140                case 'o':  /* name of output file */
00141                   outfile = &argv[i][2];
00142                   break;
00143                case 'p':  /* specify a Unicode page other than default of 0 */
00144                   sscanf (&argv[i][2], "%x", &unipage); /* Get Unicode page */
```

```
00145                 break;
00146               case 'w':   /* write a .wbmp file instead of a .bmp file */
00147                 wbmp = 1;
00148                 break;
00149               default:    /* if unrecognized option, print list and exit */
00150                 fprintf (stderr, "\nSyntax:\n\n");
00151                 fprintf (stderr, "    %s -p<Unicode_Page> ", argv[0]);
00152                 fprintf (stderr, "-i<Input_File> -o<Output_File> -w\n\n");
00153                 fprintf (stderr, "    -w specifies .wbmp output instead of ");
00154                 fprintf (stderr, "default Windows .bmp output.\n\n");
00155                 fprintf (stderr, "    -p is followed by 1 to 6 ");
00156                 fprintf (stderr, "Unicode page hex digits ");
00157                 fprintf (stderr, "(default is Page 0).\n\n");
00158                 fprintf (stderr, "\nExample:\n\n");
00159                 fprintf (stderr, "    %s -p83 -iunifont.hex -ou83.bmp\n\n\n",
00160                       argv[0]);
00161                 exit (1);
00162             }
00163           }
00164       }
00165     }
00166     /*
00167 Make sure we can open any I/O files that were specified before
00168 doing anything else.
00169 */
00170     if (strlen (infile) > 0) {
00171       if ((infp = fopen (infile, "r")) == NULL) {
00172         fprintf (stderr, "Error: can't open %s for input.\n", infile);
00173         exit (1);
00174       }
00175     }
00176     else {
00177       infp = stdin;
00178     }
00179     if (strlen (outfile) > 0) {
00180       if ((outfp = fopen (outfile, "w")) == NULL) {
00181         fprintf (stderr, "Error: can't open %s for output.\n", outfile);
00182         exit (1);
00183       }
00184     }
00185     else {
00186       outfp = stdout;
00187     }
00188
00189     (void)init(bitmap); /* initialize bitmap with row/column headers, etc. */
00190
00191     /*
00192 Read in the characters in the page
00193 */
00194     while (lastpage <= unipage && fgets (inbuf, MAXBUF-1, infp) != NULL) {
00195       sscanf (inbuf, "%x", &thischar);
00196       lastpage = thischar » 8; /* keep Unicode page to see if we can stop */
00197       if (lastpage == unipage) {
00198         thischarbyte = (unsigned char)(thischar & 0xff);
00199         for (k0=0; inbuf[k0] != ':'; k0++);
00200         k0++;
00201         hex2bit (&inbuf[k0], charbits);  /* convert hex string to 32*4 bitmap */
00202
00203         /*
00204 Now write character bitmap upside-down in page array, to match
00205 .bmp file order.  In the .wbmp‘ and .bmp files, white is a '1'
00206 bit and black is a '0' bit, so complement charbits[][].
00207 */
00208
00209         thiscol = (thischarbyte & 0xf) + 2;  /* column number will be 1..16  */
00210         thischarrow = thischarbyte » 4;     /* charcter row number, 0..15   */
00211         if (flip) {  /* swap row and column placement */
00212           swap = thiscol;
00213           thiscol = thischarrow;
00214           thischarrow = swap;
00215           thiscol += 2;       /* column index starts at 1 */
00216           thischarrow -= 2;   /* row index starts at 0    */
00217         }
00218         toppixelrow = 32 * (thischarrow + 1) - 1; /* from bottom to top    */
00219
00220         /*
00221 Copy the center of charbits[][] because hex characters only
00222 occupy rows 8 to 23 and column byte 2 (and for 16 bit wide
00223 characters, byte 3).  The charbits[][] array was given 32 rows
00224 and 4 column bytes for completeness in the beginning.
00225 */
```

```
00226         for (i=8; i<24; i++) {
00227            bitmap[toppixelrow + i][(thiscol « 2) | 0] =
00228               ~charbits[i][0] & 0xff;
00229            bitmap[toppixelrow + i][(thiscol « 2) | 1] =
00230               ~charbits[i][1] & 0xff;
00231            bitmap[toppixelrow + i][(thiscol « 2) | 2] =
00232               ~charbits[i][2] & 0xff;
00233            /* Only use first 31 bits; leave vertical rule in 32nd column */
00234            bitmap[toppixelrow + i][(thiscol « 2) | 3] =
00235               ~charbits[i][3] & 0xfe;
00236         }
00237         /*
00238 Leave white space in 32nd column of rows 8, 14, 15, and 23
00239 to leave 16 pixel height upper, middle, and lower guides.
00240 */
00241         bitmap[toppixelrow +  8][(thiscol « 2) | 3] |= 1;
00242         bitmap[toppixelrow + 14][(thiscol « 2) | 3] |= 1;
00243         bitmap[toppixelrow + 15][(thiscol « 2) | 3] |= 1;
00244         bitmap[toppixelrow + 23][(thiscol « 2) | 3] |= 1;
00245      }
00246   }
00247   /*
00248 Now write the appropriate bitmap file format, either
00249 Wireless Bitmap or Microsoft Windows bitmap.
00250 */
00251   if (wbmp) {  /* Write a Wireless Bitmap .wbmp format file */
00252      /*
00253 Write WBMP header
00254 */
00255      fprintf (outfp, "%c", 0x00); /* Type of image; always 0 (monochrome) */
00256      fprintf (outfp, "%c", 0x00); /* Reserved; always 0                   */
00257      fprintf (outfp, "%c%c", 0x84, 0x40); /* Width  = 576 pixels          */
00258      fprintf (outfp, "%c%c", 0x84, 0x20); /* Height = 544 pixels          */
00259      /*
00260 Write bitmap image
00261 */
00262      for (toppixelrow=0; toppixelrow <= 17*32-1; toppixelrow++) {
00263         for (j=0; j<18; j++) {
00264            fprintf (outfp, "%c", bitmap[toppixelrow][(j«2)    ]);
00265            fprintf (outfp, "%c", bitmap[toppixelrow][(j«2) | 1]);
00266            fprintf (outfp, "%c", bitmap[toppixelrow][(j«2) | 2]);
00267            fprintf (outfp, "%c", bitmap[toppixelrow][(j«2) | 3]);
00268         }
00269      }
00270   }
00271   else {  /* otherwise, write a Microsoft Windows .bmp format file */
00272      /*
00273 Write the .bmp file -- start with the header, then write the bitmap
00274 */
00275
00276      /* 'B', 'M' appears at start of every .bmp file */
00277      fprintf (outfp, "%c%c", 0x42, 0x4d);
00278
00279      /* Write file size in bytes */
00280      filesize   = 0x3E + bitmapsize;
00281      fprintf (outfp, "%c", (unsigned char)((filesize        ) & 0xff));
00282      fprintf (outfp, "%c", (unsigned char)((filesize » 0x08) & 0xff));
00283      fprintf (outfp, "%c", (unsigned char)((filesize » 0x10) & 0xff));
00284      fprintf (outfp, "%c", (unsigned char)((filesize » 0x18) & 0xff));
00285
00286      /* Reserved - 0's */
00287      fprintf (outfp, "%c%c%c%c", 0x00, 0x00, 0x00, 0x00);
00288
00289      /* Offset from start of file to bitmap data */
00290      fprintf (outfp, "%c%c%c%c", 0x3E, 0x00, 0x00, 0x00);
00291
00292      /* Length of bitmap info header */
00293      fprintf (outfp, "%c%c%c%c", 0x28, 0x00, 0x00, 0x00);
00294
00295      /* Width of bitmap in pixels */
00296      fprintf (outfp, "%c%c%c%c", 0x40, 0x02, 0x00, 0x00);
00297
00298      /* Height of bitmap in pixels */
00299      fprintf (outfp, "%c%c%c%c", 0x20, 0x02, 0x00, 0x00);
00300
00301      /* Planes in bitmap (fixed at 1) */
00302      fprintf (outfp, "%c%c", 0x01, 0x00);
00303
00304      /* bits per pixel (1 = monochrome) */
00305      fprintf (outfp, "%c%c", 0x01, 0x00);
00306
```

```
00307       /* Compression (0 = none) */
00308       fprintf (outfp, "%c%c%c%c", 0x00, 0x00, 0x00, 0x00);
00309
00310       /* Size of bitmap data in bytes */
00311       fprintf (outfp, "%c", (unsigned char)((bitmapsize        ) & 0xff));
00312       fprintf (outfp, "%c", (unsigned char)((bitmapsize » 0x08) & 0xff));
00313       fprintf (outfp, "%c", (unsigned char)((bitmapsize » 0x10) & 0xff));
00314       fprintf (outfp, "%c", (unsigned char)((bitmapsize » 0x18) & 0xff));
00315
00316       /* Horizontal resolution in pixels per meter */
00317       fprintf (outfp, "%c%c%c%c", 0xC4, 0x0E, 0x00, 0x00);
00318
00319       /* Vertical resolution in pixels per meter */
00320       fprintf (outfp, "%c%c%c%c", 0xC4, 0x0E, 0x00, 0x00);
00321
00322       /* Number of colors used */
00323       fprintf (outfp, "%c%c%c%c", 0x02, 0x00, 0x00, 0x00);
00324
00325       /* Number of important colors */
00326       fprintf (outfp, "%c%c%c%c", 0x02, 0x00, 0x00, 0x00);
00327
00328       /* The color black: B=0x00, G=0x00, R=0x00, Filler=0xFF */
00329       fprintf (outfp, "%c%c%c%c", 0x00, 0x00, 0x00, 0x00);
00330
00331       /* The color white: B=0xFF, G=0xFF, R=0xFF, Filler=0xFF */
00332       fprintf (outfp, "%c%c%c%c", 0xFF, 0xFF, 0xFF, 0x00);
00333
00334       /*
00335 Now write the raw data bits.  Data is written from the lower
00336 left-hand corner of the image to the upper right-hand corner
00337 of the image.
00338 */
00339       for (toppixelrow=17*32-1; toppixelrow >= 0; toppixelrow--) {
00340         for (j=0; j<18; j++) {
00341           fprintf (outfp, "%c", bitmap[toppixelrow][(j«2)    ]);
00342           fprintf (outfp, "%c", bitmap[toppixelrow][(j«2) | 1]);
00343           fprintf (outfp, "%c", bitmap[toppixelrow][(j«2) | 2]);
00344
00345           fprintf (outfp, "%c", bitmap[toppixelrow][(j«2) | 3]);
00346         }
00347       }
00348     }
00349     exit (0);
00350 }
00351
00352
00353 /**
00354 @brief Generate a bitmap for one glyph.
00355
00356 Convert the portion of a hex string after the ':' into a character bitmap.
00357
00358 If string is >= 128 characters, it will fill all 4 bytes per row.
00359 If string is >= 64 characters and < 128, it will fill 2 bytes per row.
00360 Otherwise, it will fill 1 byte per row.
00361
00362 @param[in] instring The character array containing the glyph bitmap.
00363 @param[out] character Glyph bitmap, 8, 16, or 32 columns by 16 rows tall.
00364 @return Always returns 0.
00365 */
00366 int
00367 hex2bit (char *instring, unsigned char character[32][4])
00368 {
00369
00370     int i;  /* current row in bitmap character */
00371     int j;  /* current character in input string */
00372     int k;  /* current byte in bitmap character */
00373     int width;  /* number of output bytes to fill - 1: 0, 1, 2, or 3 */
00374
00375     for (i=0; i<32; i++)  /* erase previous character */
00376       character[i][0] = character[i][1] = character[i][2] = character[i][3] = 0;
00377     j=0;  /* current location is at beginning of instring */
00378
00379     if (strlen (instring) <= 34)  /* 32 + possible '\r', '\n' */
00380       width = 0;
00381     else if (strlen (instring) <= 66)  /* 64 + possible '\r', '\n' */
00382       width = 1;
00383     else if (strlen (instring) <= 98)  /* 96 + possible '\r', '\n' */
00384       width = 3;
00385     else  /* the maximum allowed is quadruple-width */
00386       width = 4;
00387
```

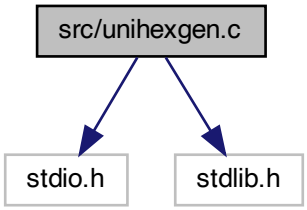
```
00388    k = (width > 1) ? 0 : 1; /* if width > double, start at index 1 else at 0 */
00389
00390    for (i=8; i<24; i++) {  /* 16 rows per input character, rows 8..23 */
00391       sscanf (&instring[j], "%2hhx", &character[i][k]);
00392       j += 2;
00393       if (width > 0) { /* add next pair of hex digits to this row */
00394          sscanf (&instring[j], "%2hhx", &character[i][k+1]);
00395          j += 2;
00396          if (width > 1) { /* add next pair of hex digits to this row */
00397             sscanf (&instring[j], "%2hhx", &character[i][k+2]);
00398             j += 2;
00399             if (width > 2) {  /* quadruple-width is maximum width */
00400                sscanf (&instring[j], "%2hhx", &character[i][k+3]);
00401                j += 2;
00402             }
00403          }
00404       }
00405    }
00406
00407    return (0);
00408 }
00409
00410
00411 /**
00412 @brief Initialize the bitmap grid.
00413
00414 @param[out] bitmap The bitmap to generate, with 32x32 pixel glyph areas.
00415 @return Always returns 0.
00416 */
00417 int
00418 init (unsigned char bitmap[17*32][18*4])
00419 {
00420    int i, j;
00421    unsigned char charbits[32][4];  /* bitmap for one character, 4 bytes/row */
00422    unsigned toppixelrow;
00423    unsigned thiscol;
00424    unsigned char pnybble0, pnybble1, pnybble2, pnybble3;
00425
00426    for (i=0; i<18; i++) { /* bitmaps for '0'..'9', 'A'-'F', 'u', '+' */
00427
00428       hex2bit (&hex[i][5], charbits);  /* convert hex string to 32*4 bitmap */
00429
00430       for (j=0; j<32; j++) hexbits[i][j] = ~charbits[j][1];
00431    }
00432
00433    /*
00434 Initialize bitmap to all white.
00435 */
00436    for (toppixelrow=0; toppixelrow < 17*32; toppixelrow++) {
00437       for (thiscol=0; thiscol<18; thiscol++) {
00438          bitmap[toppixelrow][(thiscol « 2)    ] = 0xff;
00439          bitmap[toppixelrow][(thiscol « 2) | 1] = 0xff;
00440          bitmap[toppixelrow][(thiscol « 2) | 2] = 0xff;
00441          bitmap[toppixelrow][(thiscol « 2) | 3] = 0xff;
00442       }
00443    }
00444    /*
00445 Write the "u+nnnn" table header in the upper left-hand corner,
00446 where nnnn is the upper 16 bits of a 32-bit Unicode assignment.
00447 */
00448    pnybble3 = (unipage » 20);
00449    pnybble2 = (unipage » 16) & 0xf;
00450    pnybble1 = (unipage » 12) & 0xf;
00451    pnybble0 = (unipage »  8) & 0xf;
00452    for (i=0; i<32; i++) {
00453       bitmap[i][1] = hexbits[16][i];  /* copy 'u' */
00454       bitmap[i][2] = hexbits[17][i];  /* copy '+' */
00455       bitmap[i][3] = hexbits[pnybble3][i];
00456       bitmap[i][4] = hexbits[pnybble2][i];
00457       bitmap[i][5] = hexbits[pnybble1][i];
00458       bitmap[i][6] = hexbits[pnybble0][i];
00459    }
00460    /*
00461 Write low-order 2 bytes of Unicode number assignments, as hex labels
00462 */
00463    pnybble3 = (unipage » 4) & 0xf;  /* Highest-order hex digit */
00464    pnybble2 = (unipage     ) & 0xf;  /* Next highest-order hex digit */
00465    /*
00466 Write the column headers in bitmap[][] (row headers if flipped)
00467 */
00468    toppixelrow = 32 * 17 - 1; /* maximum pixel row number */
```

```
00469    /*
00470 Label the column headers. The hexbits[][] bytes are split across two
00471 bitmap[][] entries to center a the hex digits in a column of 4 bytes.
00472 OR highest byte with 0xf0 and lowest byte with 0x0f to make outer
00473 nybbles white (0=black, 1-white).
00474 */
00475    for (i=0; i<16; i++) {
00476       for (j=0; j<32; j++) {
00477          if (flip) {  /* transpose matrix */
00478             bitmap[j][((i+2) « 2) | 0]  = (hexbits[pnybble3][j] » 4) | 0xf0;
00479             bitmap[j][((i+2) « 2) | 1]  = (hexbits[pnybble3][j] « 4) |
00480                                           (hexbits[pnybble2][j] » 4);
00481             bitmap[j][((i+2) « 2) | 2]  = (hexbits[pnybble2][j] « 4) |
00482                                           (hexbits[i][j] » 4);
00483             bitmap[j][((i+2) « 2) | 3]  = (hexbits[i][j] « 4) | 0x0f;
00484          }
00485          else {
00486             bitmap[j][((i+2) « 2) | 1] = (hexbits[i][j] » 4) | 0xf0;
00487             bitmap[j][((i+2) « 2) | 2] = (hexbits[i][j] « 4) | 0x0f;
00488          }
00489       }
00490    }
00491    /*
00492 Now use the single hex digit column graphics to label the row headers.
00493 */
00494    for (i=0; i<16; i++) {
00495       toppixelrow = 32 * (i + 1) - 1; /* from bottom to top    */
00496
00497       for (j=0; j<32; j++) {
00498          if (!flip) {  /* if not transposing matrix */
00499             bitmap[toppixelrow + j][4] = hexbits[pnybble3][j];
00500             bitmap[toppixelrow + j][5] = hexbits[pnybble2][j];
00501          }
00502          bitmap[toppixelrow + j][6] = hexbits[i][j];
00503       }
00504    }
00505    /*
00506 Now draw grid lines in bitmap, around characters we just copied.
00507 */
00508    /* draw vertical lines 2 pixels wide */
00509    for (i=1*32; i<17*32; i++) {
00510       if ((i & 0x1f) == 7)
00511          i++;
00512       else if ((i & 0x1f) == 14)
00513          i += 2;
00514       else if ((i & 0x1f) == 22)
00515          i++;
00516       for (j=1; j<18; j++) {
00517          bitmap[i][(j « 2) | 3] &= 0xfe;
00518       }
00519    }
00520    /* draw horizontal lines 1 pixel tall */
00521    for (i=1*32-1; i<18*32-1; i+=32) {
00522       for (j=2; j<18; j++) {
00523          bitmap[i][(j « 2)    ] = 0x00;
00524          bitmap[i][(j « 2) | 1] = 0x81;
00525          bitmap[i][(j « 2) | 2] = 0x81;
00526          bitmap[i][(j « 2) | 3] = 0x00;
00527       }
00528    }
00529    /* fill in top left corner pixel of grid */
00530    bitmap[31][7] = 0xfe;
00531
00532    return (0);
00533 }
```

5.37 src/unihexgen.c File Reference

unihexgen - Generate a series of glyphs containing hexadecimal code points
#include <stdio.h>
#include <stdlib.h>

Include dependency graph for unihexgen.c:



Functions

- int main (int argc, char *argv[])

  The main function.
- void hexprint4 (int thiscp)

  Generate a bitmap containing a 4-digit Unicode code point.
- void hexprint6 (int thiscp)

  Generate a bitmap containing a 6-digit Unicode code point.

Variables

- char hexdigit [16][5]

  Bitmap pattern for each hexadecimal digit.

5.37.1 Detailed Description

unihexgen - Generate a series of glyphs containing hexadecimal code points

Author

Paul Hardy

Copyright

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This program generates glyphs in Unifont .hex format that contain four- or six-digit hexadecimal numbers in a 16x16 pixel area. These are rendered as white digits on a black background.
argv[1] is the starting code point (as a hexadecimal string, with no leading "0x".
argv[2] is the ending code point (as a hexadecimal string, with no leading "0x".

For example:

```
unihexgen e000 f8ff > pua.hex
```

This generates the Private Use Area glyph file.

This utility program works in Roman Czyborra's unifont.hex file format, the basis of the GNU Unifont package.
Definition in file unihexgen.c.

5.37.2 Function Documentation

5.37.2.1 hexprint4()

void hexprint4 (
int thiscp)

Generate a bitmap containing a 4-digit Unicode code point.
Takes a 4-digit Unicode code point as an argument and prints a unifont.hex string for it to stdout.

Parameters

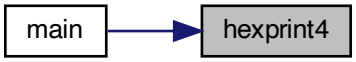
in	thiscp	The current code point for which to generate a glyph.

Definition at line 160 of file unihexgen.c.

```
00161 {
00162
00163    int grid[16]; /* the glyph grid we'll build */
00164
00165    int row;      /* row number in current glyph */
00166    int digitrow; /* row number in current hex digit being rendered */
00167    int rowbits;  /* 1 & 0 bits to draw current glyph row */
00168
00169    int d1, d2, d3, d4; /* four hexadecimal digits of each code point */
00170
00171    d1 = (thiscp » 12) & 0xF;
00172    d2 = (thiscp »  8) & 0xF;
00173    d3 = (thiscp »  4) & 0xF;
00174    d4 = (thiscp      ) & 0xF;
00175
00176    /* top and bottom rows are white */
00177    grid[0] = grid[15] = 0x0000;
00178
00179    /* 14 inner rows are 14-pixel wide black lines, centered */
00180    for (row = 1; row < 15; row++) grid[row] = 0x7FFE;
00181
00182    printf ("%04X:", thiscp);
00183
00184    /*
00185 Render the first row of 2 hexadecimal digits
00186 */
00187    digitrow = 0; /* start at top of first row of digits to render */
00188    for (row = 2; row < 7; row++) {
00189       rowbits = (hexdigit[d1][digitrow] « 9) |
00190                 (hexdigit[d2][digitrow] « 3);
00191       grid[row] ^= rowbits; /* digits appear as white on black background */
00192       digitrow++;
00193    }
00194
00195    /*
00196 Render the second row of 2 hexadecimal digits
00197 */
00198    digitrow = 0; /* start at top of first row of digits to render */
00199    for (row = 9; row < 14; row++) {
00200       rowbits = (hexdigit[d3][digitrow] « 9) |
00201                 (hexdigit[d4][digitrow] « 3);
00202       grid[row] ^= rowbits; /* digits appear as white on black background */
00203       digitrow++;
```

```
00204     }
00205
00206     for (row = 0; row < 16; row++) printf ("%04X", grid[row] & 0xFFFF);
00207
00208     putchar ('\n');
00209
00210     return;
00211 }
```

Here is the caller graph for this function:



5.37.2.2 hexprint6()

```
void hexprint6 (
                int thiscp )
```

Generate a bitmap containing a 6-digit Unicode code point.
Takes a 6-digit Unicode code point as an argument and prints a unifont.hex string for it to stdout.

Parameters

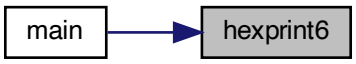
in	thiscp	The current code point for which to generate a glyph.

Definition at line 223 of file unihexgen.c.

```
00224 {
00225
00226     int grid[16]; /* the glyph grid we'll build */
00227
00228     int row;      /* row number in current glyph */
00229     int digitrow; /* row number in current hex digit being rendered */
00230     int rowbits;  /* 1 & 0 bits to draw current glyph row */
00231
00232     int d1, d2, d3, d4, d5, d6; /* six hexadecimal digits of each code point */
00233
00234     d1 = (thiscp » 20) & 0xF;
00235     d2 = (thiscp » 16) & 0xF;
00236     d3 = (thiscp » 12) & 0xF;
00237     d4 = (thiscp »  8) & 0xF;
00238     d5 = (thiscp »  4) & 0xF;
00239     d6 = (thiscp      ) & 0xF;
00240
00241     /* top and bottom rows are white */
00242     grid[0] = grid[15] = 0x0000;
```

```
00243
00244    /* 14 inner rows are 16-pixel wide black lines, centered */
00245    for (row = 1; row < 15; row++) grid[row] = 0xFFFF;
00246
00247
00248    printf ("%06X:", thiscp);
00249
00250    /*
00251 Render the first row of 3 hexadecimal digits
00252 */
00253    digitrow = 0; /* start at top of first row of digits to render */
00254    for (row = 2; row < 7; row++) {
00255       rowbits = (hexdigit[d1][digitrow] « 11) |
00256                 (hexdigit[d2][digitrow] «  6) |
00257                 (hexdigit[d3][digitrow] «  1);
00258       grid[row] ^= rowbits; /* digits appear as white on black background */
00259       digitrow++;
00260    }
00261
00262    /*
00263 Render the second row of 3 hexadecimal digits
00264 */
00265    digitrow = 0; /* start at top of first row of digits to render */
00266    for (row = 9; row < 14; row++) {
00267       rowbits = (hexdigit[d4][digitrow] « 11) |
00268                 (hexdigit[d5][digitrow] «  6) |
00269                 (hexdigit[d6][digitrow] «  1);
00270       grid[row] ^= rowbits; /* digits appear as white on black background */
00271       digitrow++;
00272    }
00273
00274    for (row = 0; row < 16; row++) printf ("%04X", grid[row] & 0xFFFF);
00275
00276    putchar ('\n');
00277
00278    return;
00279 }
```

Here is the caller graph for this function:



5.37.2.3 main()

```
int main (
                int argc,
                char * argv[] )
```

The main function.

Parameters

in	argc	The count of command line arguments.
in	argv	Pointer to array of command line arguments (code point range).

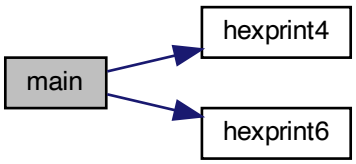
Returns

This program exits with status EXIT_SUCCESS.

Definition at line 112 of file unihexgen.c.

```
00113 {
00114
00115    int startcp, endcp, thiscp;
00116    void hexprint4(int); /* function to print one 4-digit unifont.hex code point */
00117    void hexprint6(int); /* function to print one 6-digit unifont.hex code point */
00118
00119    if (argc != 3) {
00120       fprintf (stderr,"\n%s - generate unifont.hex code points as\n", argv[0]);
00121       fprintf (stderr,"four-digit hexadecimal numbers in a 2 by 2 grid,\n");
00122       fprintf (stderr,"or six-digit hexadecimal numbers in a 3 by 2 grid.\n");
00123       fprintf (stderr,"Syntax:\n\n");
00124       fprintf (stderr,"      %s first_code_point last_code_point > glyphs.hex\n\n", argv[0]);
00125       fprintf (stderr,"Example (to generate glyphs for the Private Use Area):\n\n");
00126       fprintf (stderr,"      %s e000 f8ff > pua.hex\n\n", argv[0]);
00127       exit (EXIT_FAILURE);
00128    }
00129
00130    sscanf (argv[1], "%x", &startcp);
00131    sscanf (argv[2], "%x", &endcp);
00132
00133    startcp &= 0xFFFFFF; /* limit to 6 hex digits */
00134    endcp   &= 0xFFFFFF; /* limit to 6 hex digits */
00135
00136    /*
00137 For each code point in the desired range, generate a glyph.
00138 */
00139    for (thiscp = startcp; thiscp <= endcp; thiscp++) {
00140       if (thiscp <= 0xFFFF) {
00141          hexprint4 (thiscp); /* print digits 2/line, 2 lines */
00142       }
00143       else {
00144          hexprint6 (thiscp); /* print digits 3/line, 2 lines */
00145       }
00146    }
00147    exit (EXIT_SUCCESS);
00148 }
```

Here is the call graph for this function:



5.37.3 Variable Documentation

5.37.3.1 hexdigit

char hexdigit[16][5]
Initial value:
= {
{0x6,0x9,0x9,0x9,0x6},
{0x2,0x6,0x2,0x2,0x7},
{0xF,0x1,0xF,0x8,0xF},
{0xE,0x1,0x7,0x1,0xE},
{0x9,0x9,0xF,0x1,0x1},
{0xF,0x8,0xF,0x1,0xF},
{0x6,0x8,0xE,0x9,0x6},
{0xF,0x1,0x2,0x4,0x4},
{0x6,0x9,0x6,0x9,0x6},
{0x6,0x9,0x7,0x1,0x6},
{0xF,0x9,0xF,0x9,0x9},
{0xE,0x9,0xE,0x9,0xE},
{0x7,0x8,0x8,0x8,0x7},
{0xE,0x9,0x9,0x9,0xE},
{0xF,0x8,0xE,0x8,0xF},
{0xF,0x8,0xE,0x8,0x8}
}
Bitmap pattern for each hexadecimal digit.
hexdigit[][] definition: the bitmap pattern for each hexadecimal digit.
Each digit is drawn as a 4 wide by 5 high bitmap, so each digit row is one hexadecimal digit, and each entry has 5 rows.
For example, the entry for digit 1 is:
{0x2,0x6,0x2,0x2,0x7},
which corresponds graphically to:
–#- ==> 0010 ==> 0x2 -##- ==> 0110 ==> 0x6 –#- ==> 0010 ==> 0x2 –#- ==> 0010 ==> 0x2 -### ==> 0111 ==> 0x7
These row values will then be exclusive-ORed with four one bits (binary 1111, or 0xF) to form white digits on a black background.
Functions hexprint4 and hexprint6 share the hexdigit array; they print four-digit and six-digit hexadecimal code points in a single glyph, respectively.
Definition at line 84 of file unihexgen.c.

5.38 unihexgen.c

Go to the documentation of this file.
00001 /**

```
00002 @file unihexgen.c
00003
00004 @brief unihexgen - Generate a series of glyphs containing
00005 hexadecimal code points
00006
00007 @author Paul Hardy
00008
00009 @copyright Copyright (C) 2013 Paul Hardy
00010
00011 This program generates glyphs in Unifont .hex format that contain
00012 four- or six-digit hexadecimal numbers in a 16x16 pixel area.  These
00013 are rendered as white digits on a black background.
00014
00015 argv[1] is the starting code point (as a hexadecimal
00016 string, with no leading "0x".
00017
00018 argv[2] is the ending code point (as a hexadecimal
00019 string, with no leading "0x".
00020
00021 For example:
00022
00023 unihexgen e000 f8ff > pua.hex
00024
00025 This generates the Private Use Area glyph file.
00026
00027 This utility program works in Roman Czyborra's unifont.hex file
00028 format, the basis of the GNU Unifont package.
00029 */
00030 /*
00031 This program is released under the terms of the GNU General Public
00032 License version 2, or (at your option) a later version.
00033
00034 LICENSE:
00035
00036 This program is free software: you can redistribute it and/or modify
00037 it under the terms of the GNU General Public License as published by
00038 the Free Software Foundation, either version 2 of the License, or
00039 (at your option) any later version.
00040
00041 This program is distributed in the hope that it will be useful,
00042 but WITHOUT ANY WARRANTY; without even the implied warranty of
00043 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
00044 GNU General Public License for more details.
00045
00046 You should have received a copy of the GNU General Public License
00047 along with this program.  If not, see <http://www.gnu.org/licenses/>.
00048 */
00049
00050 #include <stdio.h>
00051 #include <stdlib.h>
00052
00053
00054 /**
00055 @brief Bitmap pattern for each hexadecimal digit.
00056
00057 hexdigit[][] definition: the bitmap pattern for
00058 each hexadecimal digit.
00059
00060 Each digit is drawn as a 4 wide by 5 high bitmap,
00061 so each digit row is one hexadecimal digit, and
00062 each entry has 5 rows.
00063
00064 For example, the entry for digit 1 is:
00065
00066 {0x2,0x6,0x2,0x2,0x7},
00067
00068 which corresponds graphically to:
00069
00070 --#-  ==>  0010  ==>  0x2
00071 -##-  ==>  0110  ==>  0x6
00072 --#-  ==>  0010  ==>  0x2
00073 --#-  ==>  0010  ==>  0x2
00074 -###  ==>  0111  ==>  0x7
00075
00076 These row values will then be exclusive-ORed with four one bits
00077 (binary 1111, or 0xF) to form white digits on a black background.
00078
00079
00080 Functions hexprint4 and hexprint6 share the hexdigit array;
00081 they print four-digit and six-digit hexadecimal code points
00082 in a single glyph, respectively.
```

```
00083 */
00084 char hexdigit[16][5] = {
00085    {0x6,0x9,0x9,0x9,0x6},  /* 0x0 */
00086    {0x2,0x6,0x2,0x2,0x7},  /* 0x1 */
00087    {0xF,0x1,0xF,0x8,0xF},  /* 0x2 */
00088    {0xE,0x1,0x7,0x1,0xE},  /* 0x3 */
00089    {0x9,0x9,0xF,0x1,0x1},  /* 0x4 */
00090    {0xF,0x8,0xF,0x1,0xF},  /* 0x5 */
00091    {0x6,0x8,0xE,0x9,0x6},  /* 0x6 */ // {0x8,0x8,0xF,0x9,0xF} [alternate square form of 6]
00092    {0xF,0x1,0x2,0x4,0x4},  /* 0x7 */
00093    {0x6,0x9,0x6,0x9,0x6},  /* 0x8 */
00094    {0x6,0x9,0x7,0x1,0x6},  /* 0x9 */ // {0xF,0x9,0xF,0x1,0x1} [alternate square form of 9]
00095    {0xF,0x9,0xF,0x9,0x9},  /* 0xA */
00096    {0xE,0x9,0xE,0x9,0xE},  /* 0xB */
00097    {0x7,0x8,0x8,0x8,0x7},  /* 0xC */
00098    {0xE,0x9,0x9,0x9,0xE},  /* 0xD */
00099    {0xF,0x8,0xE,0x8,0xF},  /* 0xE */
00100    {0xF,0x8,0xE,0x8,0x8}   /* 0xF */
00101 };
00102
00103
00104 /**
00105 @brief The main function.
00106
00107 @param[in] argc The count of command line arguments.
00108 @param[in] argv Pointer to array of command line arguments (code point range).
00109 @return This program exits with status EXIT_SUCCESS.
00110 */
00111 int
00112 main (int argc, char *argv[])
00113 {
00114
00115    int startcp, endcp, thiscp;
00116    void hexprint4(int); /* function to print one 4-digit unifont.hex code point */
00117    void hexprint6(int); /* function to print one 6-digit unifont.hex code point */
00118
00119    if (argc != 3) {
00120       fprintf (stderr,"\n%s - generate unifont.hex code points as\n", argv[0]);
00121       fprintf (stderr,"four-digit hexadecimal numbers in a 2 by 2 grid,\n");
00122       fprintf (stderr,"or six-digit hexadecimal numbers in a 3 by 2 grid.\n");
00123       fprintf (stderr,"Syntax:\n\n");
00124       fprintf (stderr,"      %s first_code_point last_code_point > glyphs.hex\n\n", argv[0]);
00125       fprintf (stderr,"Example (to generate glyphs for the Private Use Area):\n\n");
00126       fprintf (stderr,"      %s e000 f8ff > pua.hex\n\n", argv[0]);
00127       exit (EXIT_FAILURE);
00128    }
00129
00130    sscanf (argv[1], "%x", &startcp);
00131    sscanf (argv[2], "%x", &endcp);
00132
00133    startcp &= 0xFFFFFF; /* limit to 6 hex digits */
00134    endcp   &= 0xFFFFFF; /* limit to 6 hex digits */
00135
00136    /*
00137 For each code point in the desired range, generate a glyph.
00138 */
00139    for (thiscp = startcp; thiscp <= endcp; thiscp++) {
00140       if (thiscp <= 0xFFFF) {
00141          hexprint4 (thiscp); /* print digits 2/line, 2 lines */
00142       }
00143       else {
00144          hexprint6 (thiscp); /* print digits 3/line, 2 lines */
00145       }
00146    }
00147    exit (EXIT_SUCCESS);
00148 }
00149
00150
00151 /**
00152 @brief Generate a bitmap containing a 4-digit Unicode code point.
00153
00154 Takes a 4-digit Unicode code point as an argument
00155 and prints a unifont.hex string for it to stdout.
00156
00157 @param[in] thiscp The current code point for which to generate a glyph.
00158 */
00159 void
00160 hexprint4 (int thiscp)
00161 {
00162
00163    int grid[16]; /* the glyph grid we'll build */
```

```
00164
00165    int row;      /* row number in current glyph */
00166    int digitrow; /* row number in current hex digit being rendered */
00167    int rowbits;  /* 1 & 0 bits to draw current glyph row */
00168
00169    int d1, d2, d3, d4; /* four hexadecimal digits of each code point */
00170
00171    d1 = (thiscp » 12) & 0xF;
00172    d2 = (thiscp »  8) & 0xF;
00173    d3 = (thiscp »  4) & 0xF;
00174    d4 = (thiscp      ) & 0xF;
00175
00176    /* top and bottom rows are white */
00177    grid[0] = grid[15] = 0x0000;
00178
00179    /* 14 inner rows are 14-pixel wide black lines, centered */
00180    for (row = 1; row < 15; row++) grid[row] = 0x7FFE;
00181
00182    printf ("%04X:", thiscp);
00183
00184    /*
00185 Render the first row of 2 hexadecimal digits
00186 */
00187    digitrow = 0; /* start at top of first row of digits to render */
00188    for (row = 2; row < 7; row++) {
00189       rowbits = (hexdigit[d1][digitrow] « 9) |
00190                 (hexdigit[d2][digitrow] « 3);
00191       grid[row] ^= rowbits; /* digits appear as white on black background */
00192       digitrow++;
00193    }
00194
00195    /*
00196 Render the second row of 2 hexadecimal digits
00197 */
00198    digitrow = 0; /* start at top of first row of digits to render */
00199    for (row = 9; row < 14; row++) {
00200       rowbits = (hexdigit[d3][digitrow] « 9) |
00201                 (hexdigit[d4][digitrow] « 3);
00202       grid[row] ^= rowbits; /* digits appear as white on black background */
00203       digitrow++;
00204    }
00205
00206    for (row = 0; row < 16; row++) printf ("%04X", grid[row] & 0xFFFF);
00207
00208    putchar ('\n');
00209
00210    return;
00211 }
00212
00213
00214 /**
00215 @brief Generate a bitmap containing a 6-digit Unicode code point.
00216
00217 Takes a 6-digit Unicode code point as an argument
00218 and prints a unifont.hex string for it to stdout.
00219
00220 @param[in] thiscp The current code point for which to generate a glyph.
00221 */
00222 void
00223 hexprint6 (int thiscp)
00224 {
00225
00226    int grid[16]; /* the glyph grid we'll build */
00227
00228    int row;      /* row number in current glyph */
00229    int digitrow; /* row number in current hex digit being rendered */
00230    int rowbits;  /* 1 & 0 bits to draw current glyph row */
00231
00232    int d1, d2, d3, d4, d5, d6; /* six hexadecimal digits of each code point */
00233
00234    d1 = (thiscp » 20) & 0xF;
00235    d2 = (thiscp » 16) & 0xF;
00236    d3 = (thiscp » 12) & 0xF;
00237    d4 = (thiscp »  8) & 0xF;
00238    d5 = (thiscp »  4) & 0xF;
00239    d6 = (thiscp      ) & 0xF;
00240
00241    /* top and bottom rows are white */
00242    grid[0] = grid[15] = 0x0000;
00243
00244    /* 14 inner rows are 16-pixel wide black lines, centered */
```

```
00245    for (row = 1; row < 15; row++) grid[row] = 0xFFFF;
00246
00247
00248    printf ("%06X:", thiscp);
00249
00250    /*
00251 Render the first row of 3 hexadecimal digits
00252 */
00253    digitrow = 0; /* start at top of first row of digits to render */
00254    for (row = 2; row < 7; row++) {
00255       rowbits = (hexdigit[d1][digitrow] « 11) |
00256                 (hexdigit[d2][digitrow] «  6) |
00257                 (hexdigit[d3][digitrow] «  1);
00258       grid[row] ^= rowbits; /* digits appear as white on black background */
00259       digitrow++;
00260    }
00261
00262    /*
00263 Render the second row of 3 hexadecimal digits
00264 */
00265    digitrow = 0; /* start at top of first row of digits to render */
00266    for (row = 9; row < 14; row++) {
00267       rowbits = (hexdigit[d4][digitrow] « 11) |
00268                 (hexdigit[d5][digitrow] «  6) |
00269                 (hexdigit[d6][digitrow] «  1);
00270       grid[row] ^= rowbits; /* digits appear as white on black background */
00271       digitrow++;
00272    }
00273
00274    for (row = 0; row < 16; row++) printf ("%04X", grid[row] & 0xFFFF);
00275
00276    putchar ('\n');
00277
00278    return;
00279 }
00280
```

5.39 unihexpose.c

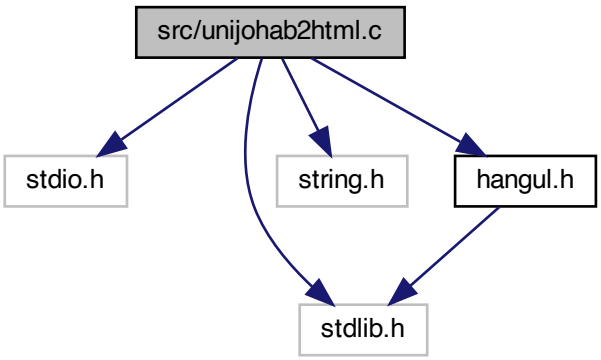
```
00001 /**
00002 @file: unihetranspose.c
00003
00004 @brief: Transpose Unifont glyph bitmaps.
00005
00006 This program takes Unifont .hex format glyphs and converts those
00007 glyphs so that each byte (two hexadecimal digits in the .hex file)
00008 represents a column of 8 rows.  This simplifies use with graphics
00009 display controllers that write lines consisting of 8 rows at a time
00010 to a display.
00011
00012 The bytes are ordered as first all the columns for the glyph in
00013 the first 8 rows, then all the columns in the next 8 rows, with
00014 columns ordered from left to right.
00015
00016 This file must be linked with functions in unifont-support.c.
00017
00018 @author Paul Hardy
00019
00020 @copyright Copyright © 2023 Paul Hardy
00021 */
00022 /*
00023 LICENSE:
00024
00025 This program is free software: you can redistribute it and/or modify
00026 it under the terms of the GNU General Public License as published by
00027 the Free Software Foundation, either version 2 of the License, or
00028 (at your option) any later version.
00029
00030 This program is distributed in the hope that it will be useful,
00031 but WITHOUT ANY WARRANTY; without even the implied warranty of
00032 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
00033 GNU General Public License for more details.
00034
00035 You should have received a copy of the GNU General Public License
00036 along with this program.  If not, see <http://www.gnu.org/licenses/>.
00037 */
00038 #include <stdio.h>
00039 #include <stdlib.h>
```

```
00040
00041 #define MAXWIDTH 128
00042
00043 int
00044 main (int argc, char *argv[]) {
00045   unsigned codept;     /* Unicode code point for glyph */
00046   char instring [MAXWIDTH];   /* input Unifont hex string */
00047   char outstring [MAXWIDTH];  /* output Unfont hex string */
00048   int  width;          /* width of current glyph */
00049   unsigned char glyph     [16][2];
00050   unsigned char glyphbits [16][16];  /* One glyphbits row, for transposing */
00051   unsigned char transpose [2][16];  /* Transponsed glyphbits bitmap   */
00052
00053   void print_syntax ();
00054
00055   void parse_hex (char *hexstring,
00056                   int *width,
00057                   unsigned *codept,
00058                   unsigned char glyph[16][2]);
00059
00060   void glyph2bits (int width,
00061                    unsigned char glyph[16][2],
00062                    unsigned char glyphbits [16][16]);
00063
00064   void hexpose (int  width,
00065                 unsigned char glyphbits [16][16],
00066                 unsigned char transpose [2][16]);
00067
00068   void xglyph2string (int width, unsigned codept,
00069                       unsigned char transpose [2][16],
00070                       char *outstring);
00071
00072   if (argc > 1) {
00073     print_syntax ();
00074     exit (EXIT_FAILURE);
00075   }
00076
00077   while (fgets (instring, MAXWIDTH, stdin) != NULL) {
00078     parse_hex (instring, &width, &codept, glyph);
00079
00080     glyph2bits (width, glyph, glyphbits);
00081
00082     hexpose (width, glyphbits, transpose);
00083
00084     xglyph2string (width, codept, transpose, outstring);
00085
00086     fprintf (stdout, "%s\n", outstring);
00087   }
00088
00089   exit (EXIT_SUCCESS);
00090 }
00091
00092
00093 void
00094 print_syntax () {
00095
00096   fprintf (stderr, "\nSyntax: unihexpose < input.hex > output.hex\n\n");
00097
00098   return;
00099 }
00100
```

5.40 src/unijohab2html.c File Reference

Display overalpped Hangul letter combinations in a grid.
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include "hangul.h"

Include dependency graph for unijohab2html.c:



Macros

- #define MAXFILENAME 1024
- #define START_JUNG 0

  Vowel index of first vowel with which to begin.
- #define RED 0xCC0000

  Color code for slightly unsaturated HTML red.
- #define GREEN 0x00CC00

  Color code for slightly unsaturated HTML green.
- #define BLUE 0x0000CC

  Color code for slightly unsaturated HTML blue.
- #define BLACK 0x000000

  Color code for HTML black.
- #define WHITE 0xFFFFFF

  Color code for HTML white.

Functions

- int main (int argc, char *argv[])

  The main function.
- void parse_args (int argc, char *argv[], int *inindex, int *outindex, int *modern_only)

  Parse command line arguments.

5.40.1 Detailed Description

Display overalpped Hangul letter combinations in a grid.
This displays overlapped letters that form Unicode Hangul Syllables combinations, as a tool to determine bounding boxes for all combinations. It works with both modern and archaic Hangul letters.
Input is a Unifont .hex file such as the "hangul-base.hex" file that is part of the Unifont package. Glyphs are all processed as being 16 pixels wide and 16 pixels tall.

Output is an HTML file containing 16 by 16 pixel grids shwoing overlaps in table format, arranged by variation of the initial consonant (choseong).
Initial consonants (choseong) have 6 variations. In general, the first three are for combining with vowels (jungseong) that are vertical, horizontal, or vertical and horizontal, respectively; the second set of three variations are for combinations with a final consonant.
The output HTML file can be viewed in a web browser.

Author

Paul Hardy

Copyright

Copyright © 2023 Paul Hardy

Definition in file unijohab2html.c.

5.40.2 Macro Definition Documentation

5.40.2.1 BLACK

#define BLACK 0x000000
Color code for HTML black.
Definition at line 62 of file unijohab2html.c.

5.40.2.2 BLUE

#define BLUE 0x0000CC
Color code for slightly unsaturated HTML blue.
Definition at line 61 of file unijohab2html.c.

5.40.2.3 GREEN

#define GREEN 0x00CC00
Color code for slightly unsaturated HTML green.
Definition at line 60 of file unijohab2html.c.

5.40.2.4 MAXFILENAME

#define MAXFILENAME 1024
Definition at line 52 of file unijohab2html.c.

5.40.2.5 RED

#define RED 0xCC0000
Color code for slightly unsaturated HTML red.
Definition at line 59 of file unijohab2html.c.

5.40.2.6 START_JUNG

#define START_JUNG 0
Vowel index of first vowel with which to begin.
Definition at line 54 of file unijohab2html.c.

5.40.2.7 WHITE

#define WHITE 0xFFFFFF
Color code for HTML white.
Definition at line 63 of file unijohab2html.c.

5.40.3 Function Documentation

5.40.3.1 main()

int main (
int argc,
char * argv[])
The main function.
Definition at line 70 of file unijohab2html.c.

```
00070                           {
00071   int i, j;  /* loop variables */
00072   unsigned codept;
00073   unsigned max_codept;
00074   int      modern_only = 0;  /* To just use modern Hangul */
00075   int      group, consonant1, vowel, consonant2;
00076   int      vowel_variation;
00077   unsigned glyph[MAX_GLYPHS][16];
00078   unsigned tmp_glyph [16];  /* To build one combined glyph at a time. */
00079   unsigned mask;
00080   unsigned overlapped;      /* To find overlaps */
00081   int      ancient_choseong; /* Flag when within ancient choseong range. */
00082
00083   /*
00084 16x16 pixel grid for each Choseong group, for:
00085
00086 Group 0 to Group 5 with no Jongseong
00087 Group 3 to Group 5 with Jongseong except Nieun
00088 Group 3 to Group 5 with Jongseong Nieun
00089
00090 12 grids total.
00091
00092 Each grid cell will hold a 32-bit HTML RGB color.
00093 */
00094   unsigned grid[12][16][16];
00095
00096   /*
00097 Matrices to detect and report overlaps.  Identify vowel
00098 variations where an overlap occurred.  For most vowel
00099 variations, there will be no overlap.  Then go through
00100 choseong, and then jongseong to find the overlapping
00101 combinations.  This saves storage space as an alternative
00102 to storing large 2- or 3-dimensional overlap matrices.
00103 */
00104   // jungcho: Jungseong overlap with Choseong
00105   unsigned jungcho [TOTAL_JUNG * JUNG_VARIATIONS];
00106   // jongjung: Jongseong overlap with Jungseong -- for future expansion
00107   // unsigned jongjung [TOTAL_JUNG * JUNG_VARIATIONS];
00108
00109   int glyphs_overlap;     /* If glyph pair being considered overlap. */
00110   int cho_overlaps  = 0;  /* Number of choseong+vowel overlaps.       */
00111   // int jongjung_overlaps = 0;  /* Number of vowel+jongseong overlaps. */
00112
00113   int  inindex = 0;
00114   int  outindex = 0;
00115   FILE *infp, *outfp;     /* Input and output file pointers. */
00116
```

```
00117   void     parse_args (int argc, char *argv[], int *inindex, int *outindex,
00118                        int *modern_only);
00119   int      cho_variation      (int cho, int jung, int jong);
00120   unsigned hangul_read_base16 (FILE *infp, unsigned glyph[][16]);
00121   int  glyph_overlap (unsigned *glyph1, unsigned *glyph2);
00122
00123   void combine_glyphs (unsigned *glyph1, unsigned *glyph2,
00124                        unsigned *combined_glyph);
00125   void print_glyph_txt (FILE *fp, unsigned codept, unsigned *this_glyph);
00126
00127
00128   /*
00129 Parse command line arguments to open input & output files, if given.
00130 */
00131   if (argc > 1) {
00132     parse_args (argc, argv, &inindex, &outindex, &modern_only);
00133   }
00134
00135   if (inindex == 0) {
00136     infp = stdin;
00137   }
00138   else {
00139     infp = fopen (argv[inindex], "r");
00140     if (infp == NULL) {
00141       fprintf (stderr, "\n*** ERROR: Cannot open %s for input.\n\n",
00142                argv[inindex]);
00143       exit (EXIT_FAILURE);
00144     }
00145   }
00146   if (outindex == 0) {
00147     outfp = stdout;
00148   }
00149   else {
00150     outfp = fopen (argv[outindex], "w");
00151     if (outfp == NULL) {
00152       fprintf (stderr, "\n*** ERROR: Cannot open %s for output.\n\n",
00153                argv[outindex]);
00154       exit (EXIT_FAILURE);
00155     }
00156   }
00157
00158   /*
00159 Initialize glyph array to all zeroes.
00160 */
00161   for (codept = 0; codept < MAX_GLYPHS; codept++) {
00162     for (i = 0; i < 16; i++) glyph[codept][i] = 0x0000;
00163   }
00164
00165   /*
00166 Initialize overlap matrices to all zeroes.
00167 */
00168   for (i = 0; i < TOTAL_JUNG * JUNG_VARIATIONS; i++) {
00169     jungcho  [i] = 0;
00170   }
00171   // jongjung is reserved for expansion.
00172   // for (i = 0; i < TOTAL_JONG * JONG_VARIATIONS; i++) {
00173   //    jongjung [i] = 0;
00174   // }
00175
00176   /*
00177 Read Hangul base glyph file.
00178 */
00179   max_codept = hangul_read_base16 (infp, glyph);
00180   if (max_codept > 0x8FF) {
00181     fprintf (stderr, "\nWARNING: Hangul glyph range exceeds PUA space.\n\n");
00182   }
00183
00184   /*
00185 If only examining modern Hangul, fill the ancient glyphs
00186 with blanks to guarantee they won't overlap.  This is
00187 not as efficient as ending loops sooner, but is easier
00188 to verify for correctness.
00189 */
00190   if (modern_only) {
00191     for (i = 0x0073; i < JUNG_HEX; i++) {
00192       for (j = 0; j < 16; j++) glyph[i][j] = 0x0000;
00193     }
00194     for (i = 0x027A; i < JONG_HEX; i++) {
00195       for (j = 0; j < 16; j++) glyph[i][j] = 0x0000;
00196     }
00197     for (i = 0x032B; i < 0x0400; i++) {
```

```
00198         for (j = 0; j < 16; j++) glyph[i][j] = 0x0000;
00199       }
00200     }
00201 
00202     /*
00203 Initialize grids to all black (no color) for each of
00204 the 12 Choseong groups.
00205 */
00206     for (group = 0; group < 12; group++) {
00207       for (i = 0; i < 16; i++) {
00208         for (j = 0; j < 16; j++) {
00209           grid[group][i][j] = BLACK;  /* No color at first */
00210         }
00211       }
00212     }
00213 
00214     /*
00215 Superimpose all Choseong glyphs according to group.
00216 Each grid spot with choseong will be blue.
00217 */
00218     for (group = 0; group < 6; group++) {
00219       for (consonant1 = CHO_HEX + group;
00220            consonant1 < CHO_HEX +
00221                         CHO_VARIATIONS * TOTAL_CHO;
00222            consonant1 += CHO_VARIATIONS) {
00223         for (i = 0; i < 16; i++) { /* For each glyph row */
00224           mask = 0x8000;
00225           for (j = 0; j < 16; j++) {
00226             if (glyph[consonant1][i] & mask) grid[group][i][j] |= BLUE;
00227             mask »= 1;  /* Get next bit in glyph row */
00228           }
00229         }
00230       }
00231     }
00232 
00233     /*
00234 Fill with Choseong (initial consonant) to prepare
00235 for groups 3-5 with jongseong except niuen (group+3),
00236 then for groups 3-5 with jongseong nieun (group+6).
00237 */
00238     for (group = 3; group < 6; group++) {
00239       for (i = 0; i < 16; i++) {
00240         for (j = 0; j < 16; j++) {
00241           grid[group + 6][i][j] = grid[group + 3][i][j]
00242                                 = grid[group][i][j];
00243         }
00244       }
00245     }
00246 
00247     /*
00248 For each Jungseong, superimpose first variation on
00249 appropriate Choseong group for grids 0 to 5.
00250 */
00251     for (vowel = START_JUNG; vowel < TOTAL_JUNG; vowel++) {
00252       group = cho_variation (-1, vowel, -1);
00253       glyphs_overlap = 0;  /* Assume the 2 glyphs do not overlap. */
00254 
00255       for (i = 0; i < 16; i++) { /* For each glyph row */
00256         mask = 0x8000;
00257         for (j = 0; j < 16; j++) {
00258           if (glyph[JUNG_HEX + JUNG_VARIATIONS * vowel][i] & mask) {
00259             /*
00260 If there was already blue in this grid cell,
00261 mark this vowel variation as having overlap
00262 with choseong (initial consonant) letter(s).
00263 */
00264             if (grid[group][i][j] & BLUE) glyphs_overlap = 1;
00265 
00266             /* Add green to grid cell color. */
00267             grid[group][i][j] |= GREEN;
00268           }
00269           mask »= 1;  /* Mask for next bit in glyph row */
00270         }  /* for j */
00271       }  /* for i */
00272       if (glyphs_overlap) {
00273         jungcho [JUNG_VARIATIONS * vowel] = 1;
00274         cho_overlaps++;
00275       }
00276     }  /* for each vowel */
00277 
00278     /*
```

```
00279 For each Jungseong, superimpose second variation on
00280 appropriate Choseong group for grids 6 to 8.
00281 */
00282   for (vowel = START_JUNG; vowel < TOTAL_JUNG; vowel++) {
00283     /*
00284 The second vowel variation is for combination with
00285 a final consonant (Jongseong), with initial consonant
00286 (Choseong) variations (or "groups") 3 to 5.  Thus,
00287 if the vowel type returns an initial Choseong group
00288 of 0 to 2, add 3 to it.
00289 */
00290     group = cho_variation (-1, vowel, -1);
00291     /*
00292 Groups 0 to 2 don't use second vowel variation,
00293 so increment if group is below 2.
00294 */
00295     if (group < 3) group += 3;
00296     glyphs_overlap = 0;  /* Assume the 2 glyphs do not overlap. */
00297
00298     for (i = 0; i < 16; i++) { /* For each glyph row */
00299       mask = 0x8000;  /* Start mask at leftmost glyph bit */
00300       for (j = 0; j < 16; j++) {  /* For each column in this row */
00301         /* "+ 1" is to get each vowel's second variation */
00302         if (glyph [JUNG_HEX +
00303                    JUNG_VARIATIONS * vowel + 1][i] & mask) {
00304           /* If this cell has blue already, mark as overlapped. */
00305           if (grid [group + 3][i][j] & BLUE) glyphs_overlap = 1;
00306
00307           /* Superimpose green on current cell color. */
00308           grid [group + 3][i][j] |= GREEN;
00309         }
00310         mask >>= 1;  /* Get next bit in glyph row */
00311       }  /* for j */
00312     }  /* for i */
00313     if (glyphs_overlap) {
00314       jungcho [JUNG_VARIATIONS * vowel + 1] = 1;
00315       cho_overlaps++;
00316     }
00317   }  /* for each vowel */
00318
00319   /*
00320 For each Jungseong, superimpose third variation on
00321 appropriate Choseong group for grids 9 to 11 for
00322 final consonant (Jongseong) of Nieun.
00323 */
00324   for (vowel = START_JUNG; vowel < TOTAL_JUNG; vowel++) {
00325     group = cho_variation (-1, vowel, -1);
00326     if (group < 3) group += 3;
00327     glyphs_overlap = 0;  /* Assume the 2 glyphs do not overlap. */
00328
00329     for (i = 0; i < 16; i++) { /* For each glyph row */
00330       mask = 0x8000;
00331       for (j = 0; j < 16; j++) {
00332         if (glyph[JUNG_HEX +
00333                   JUNG_VARIATIONS * vowel + 2][i] & mask) {
00334           /* If this cell has blue already, mark as overlapped. */
00335           if (grid[group + 6][i][j] & BLUE) glyphs_overlap = 1;
00336
00337           grid[group + 6][i][j] |= GREEN;
00338         }
00339         mask >>= 1;  /* Get next bit in glyph row */
00340       }  /* for j */
00341     }  /* for i */
00342     if (glyphs_overlap) {
00343       jungcho [JUNG_VARIATIONS * vowel + 2] = 1;
00344       cho_overlaps++;
00345     }
00346   }  /* for each vowel */
00347
00348
00349   /*
00350 Superimpose all final consonants except nieun for grids 6 to 8.
00351 */
00352   for (consonant2 = 0; consonant2 < TOTAL_JONG; consonant2++) {
00353     /*
00354 Skip over Jongseong Nieun, because it is covered in
00355 grids 9 to 11 after this loop.
00356 */
00357     if (consonant2 == 3) consonant2++;
00358
00359     glyphs_overlap = 0;  /* Assume the 2 glyphs do not overlap. */
```

```
00360       for (i = 0; i < 16; i++) { /* For each glyph row */
00361         mask = 0x8000;
00362         for (j = 0; j < 16; j++) {
00363           if (glyph [JONG_HEX +
00364                   JONG_VARIATIONS * consonant2][i] & mask) {
00365             if (grid[6][i][j] & GREEN ||
00366                 grid[7][i][j] & GREEN ||
00367                 grid[8][i][j] & GREEN) glyphs_overlap = 1;
00368
00369             grid[6][i][j] |= RED;
00370             grid[7][i][j] |= RED;
00371             grid[8][i][j] |= RED;
00372           }
00373           mask »= 1;  /* Get next bit in glyph row */
00374         }  /* for j */
00375       }  /* for i */
00376       // jongjung is for expansion
00377       // if (glyphs_overlap) {
00378       //    jongjung [JONG_VARIATIONS * consonant2] = 1;
00379       //    jongjung_overlaps++;
00380       // }
00381     }  /* for each final consonant except nieun */
00382
00383     /*
00384 Superimpose final consonant 3 (Jongseong Nieun) on
00385 groups 9 to 11.
00386 */
00387     codept = JONG_HEX + 3 * JONG_VARIATIONS;
00388
00389     for (i = 0; i < 16; i++) { /* For each glyph row */
00390       mask = 0x8000;
00391       for (j = 0; j < 16; j++) {
00392         if (glyph[codept][i] & mask) {
00393           grid[ 9][i][j] |= RED;
00394           grid[10][i][j] |= RED;
00395           grid[11][i][j] |= RED;
00396         }
00397         mask »= 1;  /* Get next bit in glyph row */
00398       }
00399     }
00400
00401
00402     /*
00403 Turn the black (uncolored) cells into white for better
00404 visibility of grid when displayed.
00405 */
00406     for (group = 0; group < 12; group++) {
00407       for (i = 0; i < 16; i++) {
00408         for (j = 0; j < 16; j++) {
00409           if (grid[group][i][j] == BLACK) grid[group][i][j] = WHITE;
00410         }
00411       }
00412     }
00413
00414
00415     /*
00416 Generate HTML output.
00417 */
00418     fprintf (outfp, "<html>\n");
00419     fprintf (outfp, "<head>\n");
00420     fprintf (outfp, "  <title>Johab 6/3/1 Overlaps</title>\n");
00421     fprintf (outfp, "</head>\n");
00422     fprintf (outfp, "<body bgcolor=\"#FFFFCC\">\n");
00423
00424     fprintf (outfp, "<center>\n");
00425     fprintf (outfp, "  <h1>Unifont Hangul Jamo Syllable Components</h1>\n");
00426     fprintf (outfp, "  <h2>Johab 6/3/1 Overlap</h2><br><br>\n");
00427
00428     /* Print the color code key for the table. */
00429     fprintf (outfp, "  <table border=\"1\" cellpadding=\"10\">\n");
00430     fprintf (outfp, "    <tr><th colspan=\"2\" align=\"center\" bgcolor=\"#FFCC80\">");
00431     fprintf (outfp, "<font size=\"+1\">Key</font></th></tr>\n");
00432     fprintf (outfp, "    <tr>\n");
00433     fprintf (outfp, "      <th align=\"center\" bgcolor=\"#FFFF80\">Color</th>\n");
00434     fprintf (outfp, "      <th align=\"center\" bgcolor=\"#FFFF80\">Letter(s)</th>\n");
00435     fprintf (outfp, "    </tr>\n");
00436
00437     fprintf (outfp, "    <tr><td bgcolor=\"#%06X\">", BLUE);
00438     fprintf (outfp, "    </td>");
00439     fprintf (outfp, "<td>Choseong (Initial Consonant)</td></tr>\n");
00440
```

```
00441   fprintf (outfp, "    <tr><td bgcolor=\"#%06X\">", GREEN);
00442   fprintf (outfp, "    </td>");
00443   fprintf (outfp, "<td>Jungseong (Medial Vowel/Diphthong)</td></tr>\n");
00444
00445   fprintf (outfp, "    <tr><td bgcolor=\"#%06X\">", RED);
00446   fprintf (outfp, "    </td>");
00447   fprintf (outfp, "<td>Jongseong (Final Consonant)</td></tr>\n");
00448
00449   fprintf (outfp, "    <tr><td bgcolor=\"#%06X\">", BLUE | GREEN);
00450   fprintf (outfp, "    </td>");
00451   fprintf (outfp, "<td>Choseong + Jungseong Overlap</td></tr>\n");
00452
00453   fprintf (outfp, "    <tr><td bgcolor=\"#%06X\">", GREEN | RED);
00454   fprintf (outfp, "    </td>");
00455   fprintf (outfp, "<td>Jungseong + Jongseong Overlap</td></tr>\n");
00456
00457   fprintf (outfp, "    <tr><td bgcolor=\"#%06X\">", RED | BLUE);
00458   fprintf (outfp, "    </td>");
00459   fprintf (outfp, "<td>Choseong + Jongseong Overlap</td></tr>\n");
00460
00461   fprintf (outfp, "    <tr><td bgcolor=\"#%06X\">", RED | GREEN | BLUE);
00462   fprintf (outfp, "    </td>");
00463   fprintf (outfp, "<td>Choseong + Jungseong + Jongseong Overlap</td></tr>\n");
00464
00465   fprintf (outfp, "  </table>\n");
00466   fprintf (outfp, "  <br><br>\n");
00467
00468
00469   for (group = 0; group < 12; group++) {
00470     /* Arrange tables 3 across, 3 down. */
00471     if ((group % 3) == 0) {
00472       fprintf (outfp, "  <table border=\"0\" cellpadding=\"10\">\n");
00473       fprintf (outfp, "    <tr>\n");
00474     }
00475
00476     fprintf (outfp, "      <td>\n");
00477     fprintf (outfp, "        <table border=\"3\" cellpadding=\"2\">\n");
00478     fprintf (outfp, "          <tr><th colspan=\"16\" bgcolor=\"#FFFF80\">");
00479     fprintf (outfp, "Choseong Group %d, %s %s</th></tr>\n",
00480              group < 6 ? group : (group > 8 ? group - 6 : group - 3),
00481              group < 6 ? (group < 3 ? "No" : "Without") : "With",
00482              group < 9 ? "Jongseong" : "Nieun");
00483
00484     for (i = 0; i < 16; i++) {
00485       fprintf (outfp, "          <tr>\n");
00486       for (j = 0; j < 16; j++) {
00487         fprintf (outfp, "            <td bgcolor=\"#%06X\">",
00488                  grid[group][i][j]);
00489         fprintf (outfp, "    </td>\n");
00490       }
00491       fprintf (outfp, "          </tr>\n");
00492     }
00493
00494     fprintf (outfp, "        </td>\n");
00495     fprintf (outfp, "      </tr>\n");
00496     fprintf (outfp, "    </table>\n");
00497     fprintf (outfp, "  </td>\n");
00498
00499     if ((group % 3) == 2) {
00500       fprintf (outfp, "  </tr>\n");
00501       fprintf (outfp, "  </table>\n  </br>\n");
00502     }
00503   }
00504
00505   /* Wrap up HTML table output. */
00506   fprintf (outfp, "</center>\n");
00507
00508   /*
00509 Print overlapping initial consonant + vowel combinations.
00510 */
00511   fprintf (outfp, "<h2>%d Vowel Overlaps with Initial Consonants Found</h2>",
00512            cho_overlaps);
00513   fprintf (outfp, "<font size=\"+1\"><pre>\n");
00514
00515   for (i = JUNG_HEX;
00516        i < JUNG_HEX + TOTAL_JUNG * JUNG_VARIATIONS;
00517        i++) {
00518     /*
00519 If this vowel variation (Jungseong) had overlaps
00520 with one or more initial consonants (Choseong),
00521 find and print them.
```

```
00522 */
00523       if (jungcho [i - JUNG_HEX]) {
00524         ancient_choseong = 0;  /* Not within ancient choseong range yet. */
00525         fprintf (outfp, "<font color=\"#0000FF\"><b>");
00526         if (i >= JUNG_ANCIENT_HEX) {
00527           if (i >= JUNG_EXTB_HEX) fprintf (outfp, "Extended-B ");
00528           fprintf (outfp, "Ancient ");
00529         }
00530         fprintf (outfp, "Vowel at 0x%04X and&hellip;</b>", i + PUA_START);
00531         fprintf (outfp, "</font>\n\n");
00532 
00533         /*
00534 Get current vowel number, 0 to (TOTAL_JUNG - 1), and
00535 current vowel variation, 0 or 1, or 2 for final nieun.
00536 */
00537         vowel = (i - JUNG_HEX) / JUNG_VARIATIONS;
00538         vowel_variation = (i - JUNG_HEX) % JUNG_VARIATIONS;
00539 
00540         /* Get first Choseong group for this vowel, 0 to 5. */
00541         group = cho_variation (-1, vowel, -1);
00542 
00543         /*
00544 If this vowel variation is used with a final consonant
00545 (Jongseong) and the default initial consonant (Choseong)
00546 group for this vowel is < 3, add 3 to current Chosenong
00547 group.
00548 */
00549         if (vowel_variation > 0 && group < 3) group += 3;
00550 
00551         for (consonant1 = 0; consonant1 < TOTAL_CHO; consonant1++) {
00552           overlapped = glyph_overlap (glyph [i],
00553                       glyph [consonant1 * CHO_VARIATIONS
00554                           + CHO_HEX + group]);
00555 
00556           /*
00557 If we just entered ancient choseong range, flag it.
00558 */
00559           if (overlapped && consonant1 >= 19 && ancient_choseong == 0) {
00560             fprintf (outfp, "<font color=\"#0000FF\"><b>");
00561             fprintf (outfp, "&hellip;Ancient Choseong&hellip;</b></font>\n");
00562             ancient_choseong = 1;
00563           }
00564           /*
00565 If overlapping choseong found, print combined glyph.
00566 */
00567           if (overlapped != 0) {
00568 
00569             combine_glyphs (glyph [i],
00570                         glyph [consonant1 * CHO_VARIATIONS
00571                             + CHO_HEX + group],
00572                         tmp_glyph);
00573 
00574             print_glyph_txt (outfp,
00575                          PUA_START +
00576                          consonant1 * CHO_VARIATIONS +
00577                          CHO_HEX + group,
00578                          tmp_glyph);
00579 
00580           }  /* If overlapping pixels found. */
00581         }  /* For each initial consonant (Choseong) */
00582       }  /* Find the initial consonant that overlapped this vowel variation. */
00583     }  /* For each variation of each vowel (Jungseong) */
00584 
00585     fputc ('\n', outfp);
00586 
00587     fprintf (outfp, "</pre></font>\n");
00588     fprintf (outfp, "</body>\n");
00589     fprintf (outfp, "</html>\n");
00590 
00591     fclose (infp);
00592     fclose (outfp);
00593 
00594 
00595     exit (EXIT_SUCCESS);
00596 }
```

5.40.3.2 parse_args()

```
void parse_args (
                int argc,
                char * argv[],
                int * inindex,
                int * outindex,
                int * modern_only )
```

Parse command line arguments.

Parameters

in	argc	The argc parameter to the main function.
in	argv	The argv command line arguments to the main function.
in,out	infile	The input filename; defaults to NULL.
in,out	outfile	The output filename; defaults to NULL.

Definition at line 608 of file unijohab2html.c.

```
00609                           {
00610   int arg_count;  /* Current index into argv[]. */
00611
00612   int strncmp (const char *s1, const char *s2, size_t n);
00613
```

```
00614
00615    arg_count = 1;
00616
00617    while (arg_count < argc) {
00618       /* If input file is specified, open it for read access. */
00619       if (strncmp (argv [arg_count], "-i", 2) == 0) {
00620          arg_count++;
00621          if (arg_count < argc) {
00622             *inindex = arg_count;
00623          }
00624       }
00625       /* If only modern Hangul is desired, set modern_only flag. */
00626       else if (strncmp (argv [arg_count], "-m", 2) == 0 ||
00627                strncmp (argv [arg_count], "--modern", 8) == 0) {
00628          *modern_only = 1;
00629       }
00630       /* If output file is specified, open it for write access. */
00631       else if (strncmp (argv [arg_count], "-o", 2) == 0) {
00632          arg_count++;
00633          if (arg_count < argc) {
00634             *outindex = arg_count;
00635          }
00636       }
00637       /* If help is requested, print help message and exit. */
00638       else if (strncmp (argv [arg_count], "-h",     2) == 0 ||
00639                strncmp (argv [arg_count], "--help", 6) == 0) {
00640          printf ("\nunijohab2html [options]\n\n");
00641          printf ("     Generates an HTML page of overlapping Hangul letters from an input\n");
00642          printf ("     Unifont .hex file encoded in Johab 6/3/1 format.\n\n");
00643
00644          printf ("     Option        Parameters    Function\n");
00645          printf ("     ------        ----------    --------\n");
00646          printf ("     -h, --help                  Print this message and exit.\n\n");
00647          printf ("     -i            input_file    Unifont hangul-base.hex formatted input file.\n\n");
00648          printf ("     -o            output_file   HTML output file showing overlapping letters.\n\n");
00649          printf ("     -m, --modern                Only examine modern Hangul letters.\n\n");
00650          printf ("     Example:\n\n");
00651          printf ("          unijohab2html -i hangul-base.hex -o hangul-syllables.html\n\n");
00652
00653          exit (EXIT_SUCCESS);
00654       }
00655
00656       arg_count++;
00657    }
00658
00659    return;
00660 }
```

5.41 unijohab2html.c

Go to the documentation of this file.

```
00001 /**
00002 @file unijohab2html.c
00003
00004 @brief Display overalpped Hangul letter combinations in a grid.
00005
00006 This displays overlapped letters that form Unicode Hangul Syllables
00007 combinations, as a tool to determine bounding boxes for all combinations.
00008 It works with both modern and archaic Hangul letters.
00009
00010 Input is a Unifont .hex file such as the "hangul-base.hex" file that
00011 is part of the Unifont package.  Glyphs are all processed as being
00012 16 pixels wide and 16 pixels tall.
00013
00014 Output is an HTML file containing 16 by 16 pixel grids shwoing
00015 overlaps in table format, arranged by variation of the initial
00016 consonant (choseong).
00017
00018 Initial consonants (choseong) have 6 variations.  In general, the
00019 first three are for combining with vowels (jungseong) that are
00020 vertical, horizontal, or vertical and horizontal, respectively;
00021 the second set of three variations are for combinations with a final
00022 consonant.
00023
00024 The output HTML file can be viewed in a web browser.
00025
00026 @author Paul Hardy
00027
```

```
00028 @copyright Copyright © 2023 Paul Hardy
00029 */
00030 /*
00031 LICENSE:
00032
00033 This program is free software: you can redistribute it and/or modify
00034 it under the terms of the GNU General Public License as published by
00035 the Free Software Foundation, either version 2 of the License, or
00036 (at your option) any later version.
00037
00038 This program is distributed in the hope that it will be useful,
00039 but WITHOUT ANY WARRANTY; without even the implied warranty of
00040 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
00041 GNU General Public License for more details.
00042
00043 You should have received a copy of the GNU General Public License
00044 along with this program.  If not, see <http://www.gnu.org/licenses/>.
00045 */
00046
00047 #include <stdio.h>
00048 #include <stdlib.h>
00049 #include <string.h>
00050 #include "hangul.h"
00051
00052 #define MAXFILENAME 1024
00053
00054 #define START_JUNG 0    ///< Vowel index of first vowel with which to begin.
00055 // #define START_JUNG 21  /* Use this #define for just ancient vowels */
00056
00057
00058 /* (Red, Green, Blue) HTML color coordinates. */
00059 #define RED 0xCC0000  ///< Color code for slightly unsaturated HTML red.
00060 #define GREEN   0x00CC00  ///< Color code for slightly unsaturated HTML green.
00061 #define BLUE    0x0000CC  ///< Color code for slightly unsaturated HTML blue.
00062 #define BLACK   0x000000  ///< Color code for HTML black.
00063 #define WHITE   0xFFFFFF  ///< Color code for HTML white.
00064
00065
00066 /**
00067 @brief The main function.
00068 */
00069 int
00070 main (int argc, char *argv[]) {
00071   int i, j;  /* loop variables */
00072   unsigned codept;
00073   unsigned max_codept;
00074   int      modern_only = 0;  /* To just use modern Hangul */
00075   int      group, consonant1, vowel, consonant2;
00076   int      vowel_variation;
00077   unsigned glyph[MAX_GLYPHS][16];
00078   unsigned tmp_glyph [16];  /* To build one combined glyph at a time. */
00079   unsigned mask;
00080   unsigned overlapped;       /* To find overlaps */
00081   int      ancient_choseong; /* Flag when within ancient choseong range. */
00082
00083   /*
00084 16x16 pixel grid for each Choseong group, for:
00085
00086 Group 0 to Group 5 with no Jongseong
00087 Group 3 to Group 5 with Jongseong except Nieun
00088 Group 3 to Group 5 with Jongseong Nieun
00089
00090 12 grids total.
00091
00092 Each grid cell will hold a 32-bit HTML RGB color.
00093 */
00094   unsigned grid[12][16][16];
00095
00096   /*
00097 Matrices to detect and report overlaps.  Identify vowel
00098 variations where an overlap occurred.  For most vowel
00099 variations, there will be no overlap.  Then go through
00100 choseong, and then jongseong to find the overlapping
00101 combinations.  This saves storage space as an alternative
00102 to storing large 2- or 3-dimensional overlap matrices.
00103 */
00104   // jungcho: Jungseong overlap with Choseong
00105   unsigned jungcho [TOTAL_JUNG * JUNG_VARIATIONS];
00106   // jongjung: Jongseong overlap with Jungseong -- for future expansion
00107   // unsigned jongjung [TOTAL_JUNG * JUNG_VARIATIONS];
00108
```

```
00109   int glyphs_overlap;     /* If glyph pair being considered overlap. */
00110   int cho_overlaps  = 0;  /* Number of choseong+vowel overlaps.       */
00111   // int jongjung_overlaps = 0;  /* Number of vowel+jongseong overlaps. */
00112
00113   int  inindex = 0;
00114   int  outindex = 0;
00115   FILE *infp, *outfp;     /* Input and output file pointers. */
00116
00117   void     parse_args (int argc, char *argv[], int *inindex, int *outindex,
00118                        int *modern_only);
00119   int      cho_variation      (int cho, int jung, int jong);
00120   unsigned hangul_read_base16 (FILE *infp, unsigned glyph[][16]);
00121   int  glyph_overlap (unsigned *glyph1, unsigned *glyph2);
00122
00123   void combine_glyphs (unsigned *glyph1, unsigned *glyph2,
00124                        unsigned *combined_glyph);
00125   void print_glyph_txt (FILE *fp, unsigned codept, unsigned *this_glyph);
00126
00127
00128   /*
00129 Parse command line arguments to open input & output files, if given.
00130 */
00131   if (argc > 1) {
00132     parse_args (argc, argv, &inindex, &outindex, &modern_only);
00133   }
00134
00135   if (inindex == 0) {
00136     infp = stdin;
00137   }
00138   else {
00139     infp = fopen (argv[inindex], "r");
00140     if (infp == NULL) {
00141       fprintf (stderr, "\n*** ERROR: Cannot open %s for input.\n\n",
00142                argv[inindex]);
00143       exit (EXIT_FAILURE);
00144     }
00145   }
00146   if (outindex == 0) {
00147     outfp = stdout;
00148   }
00149   else {
00150     outfp = fopen (argv[outindex], "w");
00151     if (outfp == NULL) {
00152       fprintf (stderr, "\n*** ERROR: Cannot open %s for output.\n\n",
00153                argv[outindex]);
00154       exit (EXIT_FAILURE);
00155     }
00156   }
00157
00158   /*
00159 Initialize glyph array to all zeroes.
00160 */
00161   for (codept = 0; codept < MAX_GLYPHS; codept++) {
00162     for (i = 0; i < 16; i++) glyph[codept][i] = 0x0000;
00163   }
00164
00165   /*
00166 Initialize overlap matrices to all zeroes.
00167 */
00168   for (i = 0; i < TOTAL_JUNG * JUNG_VARIATIONS; i++) {
00169     jungcho  [i] = 0;
00170   }
00171   // jongjung is reserved for expansion.
00172   // for (i = 0; i < TOTAL_JONG * JONG_VARIATIONS; i++) {
00173   //   jongjung [i] = 0;
00174   // }
00175
00176   /*
00177 Read Hangul base glyph file.
00178 */
00179   max_codept = hangul_read_base16 (infp, glyph);
00180   if (max_codept > 0x8FF) {
00181     fprintf (stderr, "\nWARNING: Hangul glyph range exceeds PUA space.\n\n");
00182   }
00183
00184   /*
00185 If only examining modern Hangul, fill the ancient glyphs
00186 with blanks to guarantee they won't overlap.  This is
00187 not as efficient as ending loops sooner, but is easier
00188 to verify for correctness.
00189 */
```

```
00190   if (modern_only) {
00191     for (i = 0x0073; i < JUNG_HEX; i++) {
00192       for (j = 0; j < 16; j++) glyph[i][j] = 0x0000;
00193     }
00194     for (i = 0x027A; i < JONG_HEX; i++) {
00195       for (j = 0; j < 16; j++) glyph[i][j] = 0x0000;
00196     }
00197     for (i = 0x032B; i < 0x0400; i++) {
00198       for (j = 0; j < 16; j++) glyph[i][j] = 0x0000;
00199     }
00200   }
00201
00202   /*
00203 Initialize grids to all black (no color) for each of
00204 the 12 Choseong groups.
00205 */
00206   for (group = 0; group < 12; group++) {
00207     for (i = 0; i < 16; i++) {
00208       for (j = 0; j < 16; j++) {
00209         grid[group][i][j] = BLACK;  /* No color at first */
00210       }
00211     }
00212   }
00213
00214   /*
00215 Superimpose all Choseong glyphs according to group.
00216 Each grid spot with choseong will be blue.
00217 */
00218   for (group = 0; group < 6; group++) {
00219     for (consonant1 = CHO_HEX + group;
00220          consonant1 < CHO_HEX +
00221                       CHO_VARIATIONS * TOTAL_CHO;
00222          consonant1 += CHO_VARIATIONS) {
00223       for (i = 0; i < 16; i++) { /* For each glyph row */
00224         mask = 0x8000;
00225         for (j = 0; j < 16; j++) {
00226           if (glyph[consonant1][i] & mask) grid[group][i][j] |= BLUE;
00227           mask »= 1;  /* Get next bit in glyph row */
00228         }
00229       }
00230     }
00231   }
00232
00233   /*
00234 Fill with Choseong (initial consonant) to prepare
00235 for groups 3-5 with jongseong except niuen (group+3),
00236 then for groups 3-5 with jongseong nieun (group+6).
00237 */
00238   for (group = 3; group < 6; group++) {
00239     for (i = 0; i < 16; i++) {
00240       for (j = 0; j < 16; j++) {
00241         grid[group + 6][i][j] = grid[group + 3][i][j]
00242                               = grid[group][i][j];
00243       }
00244     }
00245   }
00246
00247   /*
00248 For each Jungseong, superimpose first variation on
00249 appropriate Choseong group for grids 0 to 5.
00250 */
00251   for (vowel = START_JUNG; vowel < TOTAL_JUNG; vowel++) {
00252     group = cho_variation (-1, vowel, -1);
00253     glyphs_overlap = 0;  /* Assume the 2 glyphs do not overlap. */
00254
00255     for (i = 0; i < 16; i++) { /* For each glyph row */
00256       mask = 0x8000;
00257       for (j = 0; j < 16; j++) {
00258         if (glyph[JUNG_HEX + JUNG_VARIATIONS * vowel][i] & mask) {
00259           /*
00260 If there was already blue in this grid cell,
00261 mark this vowel variation as having overlap
00262 with choseong (initial consonant) letter(s).
00263 */
00264           if (grid[group][i][j] & BLUE) glyphs_overlap = 1;
00265
00266           /* Add green to grid cell color. */
00267           grid[group][i][j] |= GREEN;
00268         }
00269         mask »= 1;  /* Mask for next bit in glyph row */
00270       }  /* for j */
```

```
00271       }  /* for i */
00272       if (glyphs_overlap) {
00273         jungcho [JUNG_VARIATIONS * vowel] = 1;
00274         cho_overlaps++;
00275       }
00276     }  /* for each vowel */
00277
00278     /*
00279 For each Jungseong, superimpose second variation on
00280 appropriate Choseong group for grids 6 to 8.
00281 */
00282     for (vowel = START_JUNG; vowel < TOTAL_JUNG; vowel++) {
00283       /*
00284 The second vowel variation is for combination with
00285 a final consonant (Jongseong), with initial consonant
00286 (Choseong) variations (or "groups") 3 to 5.  Thus,
00287 if the vowel type returns an initial Choseong group
00288 of 0 to 2, add 3 to it.
00289 */
00290       group = cho_variation (-1, vowel, -1);
00291       /*
00292 Groups 0 to 2 don't use second vowel variation,
00293 so increment if group is below 2.
00294 */
00295       if (group < 3) group += 3;
00296       glyphs_overlap = 0;  /* Assume the 2 glyphs do not overlap. */
00297
00298       for (i = 0; i < 16; i++) { /* For each glyph row */
00299         mask = 0x8000;  /* Start mask at leftmost glyph bit */
00300         for (j = 0; j < 16; j++) {  /* For each column in this row */
00301           /* "+ 1" is to get each vowel's second variation */
00302           if (glyph [JUNG_HEX +
00303                   JUNG_VARIATIONS * vowel + 1][i] & mask) {
00304             /* If this cell has blue already, mark as overlapped. */
00305             if (grid [group + 3][i][j] & BLUE) glyphs_overlap = 1;
00306
00307             /* Superimpose green on current cell color. */
00308             grid [group + 3][i][j] |= GREEN;
00309           }
00310           mask »= 1;  /* Get next bit in glyph row */
00311         }  /* for j */
00312       }  /* for i */
00313       if (glyphs_overlap) {
00314         jungcho [JUNG_VARIATIONS * vowel + 1] = 1;
00315         cho_overlaps++;
00316       }
00317     }  /* for each vowel */
00318
00319     /*
00320 For each Jungseong, superimpose third variation on
00321 appropriate Choseong group for grids 9 to 11 for
00322 final consonant (Jongseong) of Nieun.
00323 */
00324     for (vowel = START_JUNG; vowel < TOTAL_JUNG; vowel++) {
00325       group = cho_variation (-1, vowel, -1);
00326       if (group < 3) group += 3;
00327       glyphs_overlap = 0;  /* Assume the 2 glyphs do not overlap. */
00328
00329       for (i = 0; i < 16; i++) { /* For each glyph row */
00330         mask = 0x8000;
00331         for (j = 0; j < 16; j++) {
00332           if (glyph[JUNG_HEX +
00333                   JUNG_VARIATIONS * vowel + 2][i] & mask) {
00334             /* If this cell has blue already, mark as overlapped. */
00335             if (grid[group + 6][i][j] & BLUE) glyphs_overlap = 1;
00336
00337             grid[group + 6][i][j] |= GREEN;
00338           }
00339           mask »= 1;  /* Get next bit in glyph row */
00340         }  /* for j */
00341       }  /* for i */
00342       if (glyphs_overlap) {
00343         jungcho [JUNG_VARIATIONS * vowel + 2] = 1;
00344         cho_overlaps++;
00345       }
00346     }  /* for each vowel */
00347
00348
00349     /*
00350 Superimpose all final consonants except nieun for grids 6 to 8.
00351 */
```

```
00352   for (consonant2 = 0; consonant2 < TOTAL_JONG; consonant2++) {
00353     /*
00354 Skip over Jongseong Nieun, because it is covered in
00355 grids 9 to 11 after this loop.
00356 */
00357     if (consonant2 == 3) consonant2++;
00358
00359     glyphs_overlap = 0;  /* Assume the 2 glyphs do not overlap. */
00360     for (i = 0; i < 16; i++) { /* For each glyph row */
00361       mask = 0x8000;
00362       for (j = 0; j < 16; j++) {
00363         if (glyph [JONG_HEX +
00364                 JONG_VARIATIONS * consonant2][i] & mask) {
00365           if (grid[6][i][j] & GREEN ||
00366               grid[7][i][j] & GREEN ||
00367               grid[8][i][j] & GREEN) glyphs_overlap = 1;
00368
00369           grid[6][i][j] |= RED;
00370           grid[7][i][j] |= RED;
00371           grid[8][i][j] |= RED;
00372         }
00373         mask »= 1;  /* Get next bit in glyph row */
00374       }  /* for j */
00375     }  /* for i */
00376     // jongjung is for expansion
00377     // if (glyphs_overlap) {
00378     //   jongjung [JONG_VARIATIONS * consonant2] = 1;
00379     //   jongjung_overlaps++;
00380     // }
00381   }  /* for each final consonant except nieun */
00382
00383   /*
00384 Superimpose final consonant 3 (Jongseong Nieun) on
00385 groups 9 to 11.
00386 */
00387   codept = JONG_HEX + 3 * JONG_VARIATIONS;
00388
00389   for (i = 0; i < 16; i++) { /* For each glyph row */
00390     mask = 0x8000;
00391     for (j = 0; j < 16; j++) {
00392       if (glyph[codept][i] & mask) {
00393         grid[ 9][i][j] |= RED;
00394         grid[10][i][j] |= RED;
00395         grid[11][i][j] |= RED;
00396       }
00397       mask »= 1;  /* Get next bit in glyph row */
00398     }
00399   }
00400
00401
00402   /*
00403 Turn the black (uncolored) cells into white for better
00404 visibility of grid when displayed.
00405 */
00406   for (group = 0; group < 12; group++) {
00407     for (i = 0; i < 16; i++) {
00408       for (j = 0; j < 16; j++) {
00409         if (grid[group][i][j] == BLACK) grid[group][i][j] = WHITE;
00410       }
00411     }
00412   }
00413
00414
00415   /*
00416 Generate HTML output.
00417 */
00418   fprintf (outfp, "<html>\n");
00419   fprintf (outfp, "<head>\n");
00420   fprintf (outfp, "  <title>Johab 6/3/1 Overlaps</title>\n");
00421   fprintf (outfp, "</head>\n");
00422   fprintf (outfp, "<body bgcolor=\"#FFFFCC\">\n");
00423
00424   fprintf (outfp, "<center>\n");
00425   fprintf (outfp, "  <h1>Unifont Hangul Jamo Syllable Components</h1>\n");
00426   fprintf (outfp, "  <h2>Johab 6/3/1 Overlap</h2><br><br>\n");
00427
00428   /* Print the color code key for the table. */
00429   fprintf (outfp, "  <table border=\"1\" cellpadding=\"10\">\n");
00430   fprintf (outfp, "    <tr><th colspan=\"2\" align=\"center\" bgcolor=\"#FFCC80\">");
00431   fprintf (outfp, "<font size=\"+1\">Key</font></th></tr>\n");
00432   fprintf (outfp, "    <tr>\n");
```

```
00433   fprintf (outfp, "      <th align=\"center\" bgcolor=\"#FFFF80\">Color</th>\n");
00434   fprintf (outfp, "      <th align=\"center\" bgcolor=\"#FFFF80\">Letter(s)</th>\n");
00435   fprintf (outfp, "    </tr>\n");
00436
00437   fprintf (outfp, "    <tr><td bgcolor=\"#%06X\">", BLUE);
00438   fprintf (outfp, "    </td>");
00439   fprintf (outfp, "<td>Choseong (Initial Consonant)</td></tr>\n");
00440
00441   fprintf (outfp, "    <tr><td bgcolor=\"#%06X\">", GREEN);
00442   fprintf (outfp, "    </td>");
00443   fprintf (outfp, "<td>Jungseong (Medial Vowel/Diphthong)</td></tr>\n");
00444
00445   fprintf (outfp, "    <tr><td bgcolor=\"#%06X\">", RED);
00446   fprintf (outfp, "    </td>");
00447   fprintf (outfp, "<td>Jongseong (Final Consonant)</td></tr>\n");
00448
00449   fprintf (outfp, "    <tr><td bgcolor=\"#%06X\">", BLUE | GREEN);
00450   fprintf (outfp, "    </td>");
00451   fprintf (outfp, "<td>Choseong + Jungseong Overlap</td></tr>\n");
00452
00453   fprintf (outfp, "    <tr><td bgcolor=\"#%06X\">", GREEN | RED);
00454   fprintf (outfp, "    </td>");
00455   fprintf (outfp, "<td>Jungseong + Jongseong Overlap</td></tr>\n");
00456
00457   fprintf (outfp, "    <tr><td bgcolor=\"#%06X\">", RED | BLUE);
00458   fprintf (outfp, "    </td>");
00459   fprintf (outfp, "<td>Choseong + Jongseong Overlap</td></tr>\n");
00460
00461   fprintf (outfp, "    <tr><td bgcolor=\"#%06X\">", RED | GREEN | BLUE);
00462   fprintf (outfp, "    </td>");
00463   fprintf (outfp, "<td>Choseong + Jungseong + Jongseong Overlap</td></tr>\n");
00464
00465   fprintf (outfp, "  </table>\n");
00466   fprintf (outfp, "  <br><br>\n");
00467
00468
00469   for (group = 0; group < 12; group++) {
00470     /* Arrange tables 3 across, 3 down. */
00471     if ((group % 3) == 0) {
00472       fprintf (outfp, "  <table border=\"0\" cellpadding=\"10\">\n");
00473       fprintf (outfp, "    <tr>\n");
00474     }
00475
00476     fprintf (outfp, "      <td>\n");
00477     fprintf (outfp, "        <table border=\"3\" cellpadding=\"2\">\n");
00478     fprintf (outfp, "          <tr><th colspan=\"16\" bgcolor=\"#FFFF80\">");
00479     fprintf (outfp, "Choseong Group %d, %s %s</th></tr>\n",
00480             group < 6 ? group : (group > 8 ? group - 6 : group - 3),
00481             group < 6 ? (group < 3 ? "No" : "Without") : "With",
00482             group < 9 ? "Jongseong" : "Nieun");
00483
00484     for (i = 0; i < 16; i++) {
00485       fprintf (outfp, "          <tr>\n");
00486       for (j = 0; j < 16; j++) {
00487         fprintf (outfp, "            <td bgcolor=\"#%06X\">",
00488                 grid[group][i][j]);
00489         fprintf (outfp, "    </td>\n");
00490       }
00491       fprintf (outfp, "          </tr>\n");
00492     }
00493
00494     fprintf (outfp, "        </td>\n");
00495     fprintf (outfp, "      </tr>\n");
00496     fprintf (outfp, "    </table>\n");
00497     fprintf (outfp, "  </td>\n");
00498
00499     if ((group % 3) == 2) {
00500       fprintf (outfp, "  </tr>\n");
00501       fprintf (outfp, "  </table>\n  </br>\n");
00502     }
00503   }
00504
00505   /* Wrap up HTML table output. */
00506   fprintf (outfp, "</center>\n");
00507
00508   /*
00509 Print overlapping initial consonant + vowel combinations.
00510 */
00511   fprintf (outfp, "<h2>%d Vowel Overlaps with Initial Consonants Found</h2>",
00512           cho_overlaps);
00513   fprintf (outfp, "<font size=\"+1\"><pre>\n");
```

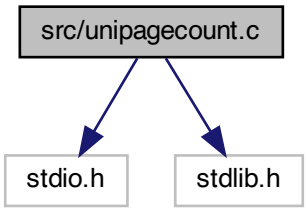
```
00514
00515   for (i = JUNG_HEX;
00516        i < JUNG_HEX + TOTAL_JUNG * JUNG_VARIATIONS;
00517        i++) {
00518      /*
00519 If this vowel variation (Jungseong) had overlaps
00520 with one or more initial consonants (Choseong),
00521 find and print them.
00522 */
00523      if (jungcho [i - JUNG_HEX]) {
00524        ancient_choseong = 0;  /* Not within ancient choseong range yet. */
00525        fprintf (outfp, "<font color=\"#0000FF\"><b>");
00526        if (i >= JUNG_ANCIENT_HEX) {
00527          if (i >= JUNG_EXTB_HEX) fprintf (outfp, "Extended-B ");
00528          fprintf (outfp, "Ancient ");
00529        }
00530        fprintf (outfp, "Vowel at 0x%04X and&hellip;</b>", i + PUA_START);
00531        fprintf (outfp, "</font>\n\n");
00532
00533        /*
00534 Get current vowel number, 0 to (TOTAL_JUNG - 1), and
00535 current vowel variation, 0 or 1, or 2 for final nieun.
00536 */
00537        vowel = (i - JUNG_HEX) / JUNG_VARIATIONS;
00538        vowel_variation = (i - JUNG_HEX) % JUNG_VARIATIONS;
00539
00540        /* Get first Choseong group for this vowel, 0 to 5. */
00541        group = cho_variation (-1, vowel, -1);
00542
00543        /*
00544 If this vowel variation is used with a final consonant
00545 (Jongseong) and the default initial consonant (Choseong)
00546 group for this vowel is < 3, add 3 to current Chosenong
00547 group.
00548 */
00549        if (vowel_variation > 0 && group < 3) group += 3;
00550
00551        for (consonant1 = 0; consonant1 < TOTAL_CHO; consonant1++) {
00552          overlapped = glyph_overlap (glyph [i],
00553                       glyph [consonant1 * CHO_VARIATIONS
00554                           + CHO_HEX + group]);
00555
00556          /*
00557 If we just entered ancient choseong range, flag it.
00558 */
00559          if (overlapped && consonant1 >= 19 && ancient_choseong == 0) {
00560            fprintf (outfp, "<font color=\"#0000FF\"><b>");
00561            fprintf (outfp, "&hellip;Ancient Choseong&hellip;</b></font>\n");
00562            ancient_choseong = 1;
00563          }
00564          /*
00565 If overlapping choseong found, print combined glyph.
00566 */
00567          if (overlapped != 0) {
00568
00569            combine_glyphs (glyph [i],
00570                         glyph [consonant1 * CHO_VARIATIONS
00571                             + CHO_HEX + group],
00572                         tmp_glyph);
00573
00574            print_glyph_txt (outfp,
00575                          PUA_START +
00576                          consonant1 * CHO_VARIATIONS +
00577                          CHO_HEX + group,
00578                          tmp_glyph);
00579
00580          }  /* If overlapping pixels found. */
00581        }  /* For each initial consonant (Choseong) */
00582      }  /* Find the initial consonant that overlapped this vowel variation. */
00583    }  /* For each variation of each vowel (Jungseong) */
00584
00585    fputc ('\n', outfp);
00586
00587    fprintf (outfp, "</pre></font>\n");
00588    fprintf (outfp, "</body>\n");
00589    fprintf (outfp, "</html>\n");
00590
00591    fclose (infp);
00592    fclose (outfp);
00593
00594
```

```
00595     exit (EXIT_SUCCESS);
00596 }
00597
00598
00599 /**
00600 @brief Parse command line arguments.
00601
00602 @param[in] argc The argc parameter to the main function.
00603 @param[in] argv The argv command line arguments to the main function.
00604 @param[in,out] infile The input filename; defaults to NULL.
00605 @param[in,out] outfile The output filename; defaults to NULL.
00606 */
00607 void
00608 parse_args (int argc, char *argv[], int *inindex, int *outindex,
00609                 int *modern_only) {
00610   int arg_count;  /* Current index into argv[]. */
00611
00612   int strncmp (const char *s1, const char *s2, size_t n);
00613
00614
00615   arg_count = 1;
00616
00617   while (arg_count < argc) {
00618     /* If input file is specified, open it for read access. */
00619     if (strncmp (argv [arg_count], "-i", 2) == 0) {
00620       arg_count++;
00621       if (arg_count < argc) {
00622         *inindex = arg_count;
00623       }
00624     }
00625     /* If only modern Hangul is desired, set modern_only flag. */
00626     else if (strncmp (argv [arg_count], "-m", 2) == 0 ||
00627              strncmp (argv [arg_count], "--modern", 8) == 0) {
00628       *modern_only = 1;
00629     }
00630     /* If output file is specified, open it for write access. */
00631     else if (strncmp (argv [arg_count], "-o", 2) == 0) {
00632       arg_count++;
00633       if (arg_count < argc) {
00634         *outindex = arg_count;
00635       }
00636     }
00637     /* If help is requested, print help message and exit. */
00638     else if (strncmp (argv [arg_count], "-h",     2) == 0 ||
00639              strncmp (argv [arg_count], "--help", 6) == 0) {
00640       printf ("\nunijohab2html [options]\n\n");
00641       printf ("     Generates an HTML page of overlapping Hangul letters from an input\n");
00642       printf ("     Unifont .hex file encoded in Johab 6/3/1 format.\n\n");
00643
00644       printf ("     Option        Parameters    Function\n");
00645       printf ("     ------        ----------    --------\n");
00646       printf ("     -h, --help                  Print this message and exit.\n\n");
00647       printf ("     -i            input_file    Unifont hangul-base.hex formatted input file.\n\n");
00648       printf ("     -o            output_file   HTML output file showing overlapping letters.\n\n");
00649       printf ("     -m, --modern                Only examine modern Hangul letters.\n\n");
00650       printf ("     Example:\n\n");
00651       printf ("          unijohab2html -i hangul-base.hex -o hangul-syllables.html\n\n");
00652
00653       exit (EXIT_SUCCESS);
00654     }
00655
00656     arg_count++;
00657   }
00658
00659   return;
00660 }
00661
```

5.42 src/unipagecount.c File Reference

unipagecount - Count the number of glyphs defined in each page of 256 code points
#include <stdio.h>
#include <stdlib.h>

Include dependency graph for unipagecount.c:



Macros

- #define MAXBUF 256

  Maximum input line size - 1.

Functions

- int main (int argc, char *argv[])

  The main function.
- void mkftable (unsigned plane, int pagecount[256], int links)

  Create an HTML table linked to PNG images.

5.42.1 Detailed Description

unipagecount - Count the number of glyphs defined in each page of 256 code points

Author

Paul Hardy, unifoundry <at> unifoundry.com, December 2007

Copyright

Copyright (C) 2007, 2008, 2013, 2014 Paul Hardy

This program counts the number of glyphs that are defined in each "page" of 256 code points, and prints the counts in an 8 x 8 grid. Input is from stdin. Output is to stdout.
The background color of each cell in a 16-by-16 grid of 256 code points is shaded to indicate percentage coverage. Red indicates 0% coverage, green represents 100% coverage, and colors in between pure red and pure green indicate partial coverage on a scale.
Each code point range number can be a hyperlink to a PNG file for that 256-code point range's corresponding bitmap glyph image.
Synopsis:

```
unipagecount < font_file.hex > count.txt
unipagecount -phex_page_num < font_file.hex  -- just 256 points
unipagecount -h < font_file.hex              -- HTML table
unipagecount -P1 -h < font.hex > count.html  -- Plane 1, HTML out
unipagecount -l < font_file.hex              -- linked HTML table
```

Definition in file unipagecount.c.

5.42.2 Macro Definition Documentation

5.42.2.1 MAXBUF

#define MAXBUF 256
Maximum input line size - 1.
Definition at line 59 of file unipagecount.c.

5.42.3 Function Documentation

5.42.3.1 main()

int main (
int argc,
char * argv[])
The main function.

Parameters

in	argc	The count of command line arguments.
in	argv	Pointer to array of command line arguments.

Returns

This program exits with status 0.

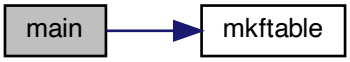
Definition at line 70 of file unipagecount.c.

```
00071 {
00072
00073   char inbuf[MAXBUF]; /* Max 256 characters in an input line */
00074   int i, j;  /* loop variables */
00075   unsigned plane=0; /* Unicode plane number, 0 to 0x16 */
00076   unsigned page;  /* unicode page (256 bytes wide) */
00077   unsigned unichar; /* unicode character */
00078   int pagecount[256] = {256 * 0};
00079   int onepage=0; /* set to one if printing character grid for one page */
00080   int pageno=0; /* page number selected if only examining one page */
00081   int html=0;   /* =0: print plain text; =1: print HTML */
00082   int links=0;  /* =1: print HTML links; =0: don't print links */
00083
00084   /* make (print) flipped HTML table */
00085   void mkftable (unsigned plane, int pagecount[256], int links);
00086
```

```
00087   size_t strlen();
00088
00089   if (argc > 1 && argv[1][0] == '-') {  /* Parse option */
00090     plane = 0;
00091     for (i = 1; i < argc; i++) {
00092       switch (argv[i][1]) {
00093         case 'p':  /* specified -p<hexpage> -- use given page number */
00094           sscanf (&argv[1][2], "%x", &pageno);
00095           if (pageno >= 0 && pageno <= 255) onepage = 1;
00096           break;
00097         case 'h':  /* print HTML table instead of text table */
00098           html = 1;
00099           break;
00100         case 'l':  /* print hyperlinks in HTML table */
00101           links = 1;
00102           html = 1;
00103           break;
00104         case 'P':  /* Plane number specified */
00105           plane = atoi(&argv[1][2]);
00106           break;
00107       }
00108     }
00109   }
00110   /*
00111 Initialize pagecount to account for noncharacters.
00112 */
00113   if (!onepage && plane==0) {
00114     pagecount[0xfd] = 32;  /* for U+FDD0..U+FDEF */
00115   }
00116   pagecount[0xff] = 2;   /* for U+nnFFFE, U+nnFFFF */
00117   /*
00118 Read one line at a time from input.  The format is:
00119
00120 <hexpos>:<hexbitmap>
00121
00122 where <hexpos> is the hexadecimal Unicode character position
00123 in the range 00..FF and <hexbitmap> is the sequence of hexadecimal
00124 digits of the character, laid out in a grid from left to right,
00125 top to bottom.  The character is assumed to be 16 rows of variable
00126 width.
00127 */
00128   while (fgets (inbuf, MAXBUF-1, stdin) != NULL) {
00129     sscanf (inbuf, "%X", &unichar);
00130     page = unichar » 8;
00131     if (onepage) { /* only increment counter if this is page we want */
00132       if (page == pageno) { /* character is in the page we want */
00133         pagecount[unichar & 0xff]++; /* mark character as covered */
00134       }
00135     }
00136     else { /* counting all characters in all pages */
00137       if (plane == 0) {
00138         /* Don't add in noncharacters (U+FDD0..U+FDEF, U+FFFE, U+FFFF) */
00139         if (unichar < 0xfdd0 || (unichar > 0xfdef && unichar < 0xfffe))
00140           pagecount[page]++;
00141       }
00142       else {
00143         if ((page » 8) == plane) { /* code point is in desired plane */
00144           pagecount[page & 0xFF]++;
00145         }
00146       }
00147     }
00148   }
00149   if (html) {
00150     mkftable (plane, pagecount, links);
00151   }
00152   else {  /* Otherwise, print plain text table */
00153     if (plane > 0) fprintf (stdout, "  ");
00154     fprintf (stdout,
00155       "    0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F\n");
00156     for (i=0; i<0x10; i++) {
00157       fprintf (stdout,"%02X%X ", plane, i); /* row header */
00158       for (j=0; j<0x10; j++) {
00159         if (onepage) {
00160           if (pagecount[i*16+j])
00161             fprintf (stdout," *  ");
00162           else
00163             fprintf (stdout," .  ");
00164         }
00165         else {
00166           fprintf (stdout, "%3X ", pagecount[i*16+j]);
00167         }
```

```
00168           }
00169           fprintf (stdout,"\n");
00170         }
00171
00172     }
00173     exit (0);
00174 }
```

Here is the call graph for this function:



5.42.3.2 mkftable()

```
void mkftable (
                unsigned plane,
                int pagecount[256],
                int links )
```

Create an HTML table linked to PNG images.

This function creates an HTML table to show PNG files in a 16 by 16 grid. The background color of each "page" of 256 code points is shaded from red (for 0% coverage) to green (for 100% coverage).

Parameters

in	plane	The Unicode plane, 0..17.
in	pagecount	Array with count of glyphs in each 256 code point range.

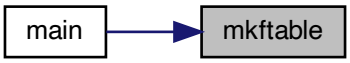
Parameters

in	links	1 = generate hyperlinks, 0 = do not generate hyperlinks.

Definition at line 190 of file unipagecount.c.

```
00191 {
00192   int i, j;
00193   int count;
00194   unsigned bgcolor;
00195
00196   printf ("<html>\n");
00197   printf ("<body>\n");
00198   printf ("<table border=\"3\" align=\"center\">\n");
00199   printf ("  <tr><th colspan=\"16\" bgcolor=\"#ffcc80\">");
00200   printf ("GNU Unifont Glyphs<br>with Page Coverage for Plane %d<br>(Green=100%%, Red=0%%)</th></tr>\n",
      plane);
00201   for (i = 0x0; i <= 0xF; i++) {
00202     printf ("  <tr>\n");
00203     for (j = 0x0; j <= 0xF; j++) {
00204       count = pagecount[ (i « 4) | j ];
00205
00206       /* print link in cell if links == 1 */
00207       if (plane != 0 || (i < 0xd || (i == 0xd && j < 0x8) || (i == 0xf && j > 0x8))) {
00208         /* background color is light green if completely done */
00209         if (count == 0x100) bgcolor = 0xccffcc;
00210         /* otherwise background is a shade of yellow to orange to red */
00211         else bgcolor = 0xff0000 | (count « 8) | (count » 1);
00212         printf ("    <td bgcolor=\"#%06X\">", bgcolor);
00213         if (plane == 0)
00214           printf ("<a href=\"png/plane%02X/uni%02X%X%X.png\">%X%X</a>", plane, plane, i, j, i, j);
00215         else
00216           printf ("<a href=\"png/plane%02X/uni%02X%X%X.png\">%02X%X%X</a>", plane, plane, i, j, plane, i, j);
00217         printf ("</td>\n");
00218       }
00219       else if (i == 0xd) {
00220         if (j == 0x8) {
00221           printf ("    <td align=\"center\" colspan=\"8\" bgcolor=\"#cccccc\">");
00222           printf ("<b>Surrogate Pairs</b>");
00223           printf ("</td>\n");
00224         } /* otherwise don't print anything more columns in this row */
00225       }
00226       else if (i == 0xe) {
00227         if (j == 0x0) {
00228           printf ("    <td align=\"center\" colspan=\"16\" bgcolor=\"#cccccc\">");
00229           printf ("<b>Private Use Area</b>");
00230           printf ("</td>\n");
00231         } /* otherwise don't print any more columns in this row */
00232       }
00233       else if (i == 0xf) {
00234         if (j == 0x0) {
00235           printf ("    <td align=\"center\" colspan=\"9\" bgcolor=\"#cccccc\">");
00236           printf ("<b>Private Use Area</b>");
00237           printf ("</td>\n");
00238         }
00239       }
00240     }
00241     printf ("  </tr>\n");
00242   }
00243   printf ("</table>\n");
00244   printf ("</body>\n");
00245   printf ("</html>\n");
00246
00247   return;
00248 }
```

Here is the caller graph for this function:



5.43 unipagecount.c

Go to the documentation of this file.

```
00001 /**
00002 @file unipagecount.c
00003
00004 @brief unipagecount - Count the number of glyphs defined in each page
00005 of 256 code points
00006
00007 @author Paul Hardy, unifoundry <at> unifoundry.com, December 2007
00008
00009 @copyright Copyright (C) 2007, 2008, 2013, 2014 Paul Hardy
00010
00011 This program counts the number of glyphs that are defined in each
00012 "page" of 256 code points, and prints the counts in an 8 x 8 grid.
00013 Input is from stdin.  Output is to stdout.
00014
00015 The background color of each cell in a 16-by-16 grid of 256 code points
00016 is shaded to indicate percentage coverage.  Red indicates 0% coverage,
00017 green represents 100% coverage, and colors in between pure red and pure
00018 green indicate partial coverage on a scale.
00019
00020 Each code point range number can be a hyperlink to a PNG file for
00021 that 256-code point range's corresponding bitmap glyph image.
00022
00023 Synopsis:
00024
00025 unipagecount < font_file.hex > count.txt
00026 unipagecount -phex_page_num < font_file.hex  -- just 256 points
00027 unipagecount -h < font_file.hex              -- HTML table
00028 unipagecount -P1 -h < font.hex > count.html  -- Plane 1, HTML out
00029 unipagecount -l < font_file.hex             -- linked HTML table
00030 */
00031 /*
00032 LICENSE:
00033
00034 This program is free software: you can redistribute it and/or modify
00035 it under the terms of the GNU General Public License as published by
00036 the Free Software Foundation, either version 2 of the License, or
00037 (at your option) any later version.
00038
00039 This program is distributed in the hope that it will be useful,
00040 but WITHOUT ANY WARRANTY; without even the implied warranty of
00041 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
00042 GNU General Public License for more details.
00043
00044 You should have received a copy of the GNU General Public License
00045 along with this program.  If not, see <http://www.gnu.org/licenses/>.
00046 */
00047
00048 /*
00049 2018, Paul Hardy: Changed "Private Use" to "Private Use Area" in
00050 output HTML file.
00051
00052 21 October 2023 [Paul Hardy]:
00053 - Added full prototype for mkftable function in main function.
00054 */
00055
00056 #include <stdio.h>
00057 #include <stdlib.h>
00058
```

```
00059 #define MAXBUF 256 ///< Maximum input line size - 1.
00060
00061
00062 /**
00063 @brief The main function.
00064
00065 @param[in] argc The count of command line arguments.
00066 @param[in] argv Pointer to array of command line arguments.
00067 @return This program exits with status 0.
00068 */
00069 int
00070 main (int argc, char *argv[])
00071 {
00072
00073   char inbuf[MAXBUF]; /* Max 256 characters in an input line */
00074   int i, j;  /* loop variables */
00075   unsigned plane=0; /* Unicode plane number, 0 to 0x16 */
00076   unsigned page;  /* unicode page (256 bytes wide) */
00077   unsigned unichar; /* unicode character */
00078   int pagecount[256] = {256 * 0};
00079   int onepage=0; /* set to one if printing character grid for one page */
00080   int pageno=0; /* page number selected if only examining one page */
00081   int html=0;   /* =0: print plain text; =1: print HTML */
00082   int links=0;  /* =1: print HTML links; =0: don't print links */
00083
00084   /* make (print) flipped HTML table */
00085   void mkftable (unsigned plane, int pagecount[256], int links);
00086
00087   size_t strlen();
00088
00089   if (argc > 1 && argv[1][0] == '-') {  /* Parse option */
00090     plane = 0;
00091     for (i = 1; i < argc; i++) {
00092       switch (argv[i][1]) {
00093         case 'p':  /* specified -p<hexpage> -- use given page number */
00094           sscanf (&argv[1][2], "%x", &pageno);
00095           if (pageno >= 0 && pageno <= 255) onepage = 1;
00096           break;
00097         case 'h':  /* print HTML table instead of text table */
00098           html = 1;
00099           break;
00100         case 'l':  /* print hyperlinks in HTML table */
00101           links = 1;
00102           html = 1;
00103           break;
00104         case 'P':  /* Plane number specified */
00105           plane = atoi(&argv[1][2]);
00106           break;
00107       }
00108     }
00109   }
00110   /*
00111 Initialize pagecount to account for noncharacters.
00112 */
00113   if (!onepage && plane==0) {
00114     pagecount[0xfd] = 32;  /* for U+FDD0..U+FDEF */
00115   }
00116   pagecount[0xff] = 2;   /* for U+nnFFFE, U+nnFFFF */
00117   /*
00118 Read one line at a time from input.  The format is:
00119
00120 <hexpos>:<hexbitmap>
00121
00122 where <hexpos> is the hexadecimal Unicode character position
00123 in the range 00..FF and <hexbitmap> is the sequence of hexadecimal
00124 digits of the character, laid out in a grid from left to right,
00125 top to bottom.  The character is assumed to be 16 rows of variable
00126 width.
00127 */
00128   while (fgets (inbuf, MAXBUF-1, stdin) != NULL) {
00129     sscanf (inbuf, "%X", &unichar);
00130     page = unichar » 8;
00131     if (onepage) { /* only increment counter if this is page we want */
00132       if (page == pageno) { /* character is in the page we want */
00133         pagecount[unichar & 0xff]++; /* mark character as covered */
00134       }
00135     }
00136     else { /* counting all characters in all pages */
00137       if (plane == 0) {
00138         /* Don't add in noncharacters (U+FDD0..U+FDEF, U+FFFE, U+FFFF) */
00139         if (unichar < 0xfdd0 || (unichar > 0xfdef && unichar < 0xfffe))
```

```
00140               pagecount[page]++;
00141           }
00142           else {
00143             if ((page » 8) == plane) { /* code point is in desired plane */
00144               pagecount[page & 0xFF]++;
00145             }
00146           }
00147         }
00148       }
00149       if (html) {
00150         mkftable (plane, pagecount, links);
00151       }
00152       else {  /* Otherwise, print plain text table */
00153         if (plane > 0) fprintf (stdout, "   ");
00154         fprintf (stdout,
00155           "    0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F\n");
00156         for (i=0; i<0x10; i++) {
00157           fprintf (stdout,"%02X%X ", plane, i); /* row header */
00158           for (j=0; j<0x10; j++) {
00159             if (onepage) {
00160               if (pagecount[i*16+j])
00161                 fprintf (stdout," *  ");
00162               else
00163                 fprintf (stdout," .  ");
00164             }
00165             else {
00166               fprintf (stdout, "%3X ", pagecount[i*16+j]);
00167             }
00168           }
00169           fprintf (stdout,"\n");
00170         }
00171
00172       }
00173       exit (0);
00174 }
00175
00176
00177 /**
00178 @brief Create an HTML table linked to PNG images.
00179
00180 This function creates an HTML table to show PNG files
00181 in a 16 by 16 grid.  The background color of each "page"
00182 of 256 code points is shaded from red (for 0% coverage)
00183 to green (for 100% coverage).
00184
00185 @param[in] plane The Unicode plane, 0..17.
00186 @param[in] pagecount Array with count of glyphs in each 256 code point range.
00187 @param[in] links 1 = generate hyperlinks, 0 = do not generate hyperlinks.
00188 */
00189 void
00190 mkftable (unsigned plane, int pagecount[256], int links)
00191 {
00192   int i, j;
00193   int count;
00194   unsigned bgcolor;
00195
00196   printf ("<html>\n");
00197   printf ("<body>\n");
00198   printf ("<table border=\"3\" align=\"center\">\n");
00199   printf ("  <tr><th colspan=\"16\" bgcolor=\"#ffcc80\">");
00200   printf ("GNU Unifont Glyphs<br>with Page Coverage for Plane %d<br>(Green=100%%, Red=0%%)</th></tr>\n",
      plane);
00201   for (i = 0x0; i <= 0xF; i++) {
00202     printf ("  <tr>\n");
00203     for (j = 0x0; j <= 0xF; j++) {
00204       count = pagecount[ (i « 4) | j ];
00205
00206       /* print link in cell if links == 1 */
00207       if (plane != 0 || (i < 0xd || (i == 0xd && j < 0x8) || (i == 0xf && j > 0x8))) {
00208         /* background color is light green if completely done */
00209         if (count == 0x100) bgcolor = 0xccffcc;
00210         /* otherwise background is a shade of yellow to orange to red */
00211         else bgcolor = 0xff0000 | (count « 8) | (count » 1);
00212         printf ("    <td bgcolor=\"#%06X\">", bgcolor);
00213         if (plane == 0)
00214           printf ("<a href=\"png/plane%02X/uni%02X%X%X.png\">%X%X</a>", plane, plane, i, j, i, j);
00215         else
00216           printf ("<a href=\"png/plane%02X/uni%02X%X%X.png\">%02X%X%X</a>", plane, plane, i, j, plane, i, j);
00217         printf ("</td>\n");
00218       }
00219       else if (i == 0xd) {
```

```
00220             if (j == 0x8) {
00221                printf ("    <td align=\"center\" colspan=\"8\" bgcolor=\"#cccccc\">");
00222                printf ("<b>Surrogate Pairs</b>");
00223                printf ("</td>\n");
00224             } /* otherwise don't print anything more columns in this row */
00225          }
00226          else if (i == 0xe) {
00227             if (j == 0x0) {
00228                printf ("    <td align=\"center\" colspan=\"16\" bgcolor=\"#cccccc\">");
00229                printf ("<b>Private Use Area</b>");
00230                printf ("</td>\n");
00231             } /* otherwise don't print any more columns in this row */
00232          }
00233          else if (i == 0xf) {
00234             if (j == 0x0) {
00235                printf ("    <td align=\"center\" colspan=\"9\" bgcolor=\"#cccccc\">");
00236                printf ("<b>Private Use Area</b>");
00237                printf ("</td>\n");
00238             }
00239          }
00240       }
00241       printf ("  </tr>\n");
00242    }
00243    printf ("</table>\n");
00244    printf ("</body>\n");
00245    printf ("</html>\n");
00246
00247    return;
00248 }
```

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