Another incarnation of Lucida: Lucida + Lucida Math OpenType

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Overview of this talk

- Historical perspective (Choices of available fonts)
- History and Background of Lucida fonts
- Scope of the Lucida TUG distribution
- Problems of the Lucida TUG distribution
- Goals for the Lucida OpenType project
- Project Organization and Team
- Details of font development
- Scope of the Lucida OpenType distribution
- Project Timeline and Status

Historical Perspective

- TeX has been around for 30+ years
- TeX has gone through 3 eras of font technology
  - MetaFont fonts (1980s–1990s)
  - PostScript fonts (1990s–2000s)
  - OpenType fonts (2000s–current)
- Choices of text fonts have grown very large
  - any Type 1 text fonts can be set up for use with pdfTeX
  - any OpenType text fonts can be used with (Lua|Xe)TeX
- Choices of math fonts have always been limited
  - few Type 1 math fonts exist (and require special setup)
  - few OpenType math fonts exist and are ready to use
- Choices of complete families are also limited
  - few complete families exist (Serif, Sans, Mono, Math)

Choices of available math fonts (I)

- MetaFont era (1980s–1990s)
  - CM, AMS Symbols, AMS Euler (original MF designs)
  - Concrete Math, CM Bright (late additions, 1995–2000)
- PostScript era (1990s–2000s)
  - CM, AMS Symbols, AMS Euler (converted from MF)
  - Times + MathTime (sold commercially, early 1990s)
  - Lucida Bright + Math (sold commercially, early 1990s)
  - TM-Math, HV-Math, etc (sold commercially, early 2000s)
  - TX/PX Fonts, MathPazo (late additions, 2000–2005)
  - Fourier, MathDesign (late additions, 2005–2010)
- Why does Lucida matter?
  - Lucida is one of the few available math fonts
  - Lucida is one of the few complete font families

Choices of available math fonts (II)

- OpenType era (2000s–current)
  - Cambria Math (original OT math reference font)
  - Asana Math (converted from PS, derived from PX)
  - Times + XITS Math (derived from STIX, 2000–2010)
  - Neo Euler (under development, incomplete)
  - Lucida Bright + Math (under development)
  - Latin Modern + LM Math (under development)
  - TEX Gyre + TG Math (under development)
- Why does Lucida matter?
  - Choices of OpenType math fonts now in 2010 are as limited as PS math fonts in early 1990s
  - Choices of OpenType math fonts are needed to attract users to new Unicode TEX engines

History of Lucida fonts (I)

- Developed by Bigelow & Holmes
  - Chuck Bigelow: professor at Stanford, Rochester RIT
  - Kris Holmes: type designer of 100+ typefaces
- Design goals
  - usable at low-resolutions (high x-height, high readability)
  - complete extended font family (Serif, Sans, Mono, etc)
  - suitable for math (Greek, symbols, arrows, dingbats, etc)
- Development history
  - originally designed in mid/late 1980s
  - revised and adjusted for TEX in early 1990s
- Available Distributions
  - original version sold via various font companies
  - revised version sold via Y&Y Inc. (early 1990s-2000s)
  - current versions sold via TUG and PCTEX Inc.

History of Lucida fonts (II)

- additional Lucida Unicode distributions exists
  - LucidaConsole, Lucida Sans Unicode (MS Windows)
  - Lucida Grande (Apple Mac OS X)
  - Lucida Bright/Sans/Typewriter (Sun Java JDK)
- Limitations of TUG / Y&Y distribution (Type 1)
  - full set of families (including math and extras)
  - only available in Type 1 format (8-bit font sets)
  - difficult to set up and use (font encoding mess)
  - limited character set / symbol set
- Limitations of Lucida Unicode distributions (TTF)
  - extended character set (Unicode BMP)
  - limited set of families (no math, no extras)

Scope of the Lucida TUG distribution

- Members of Lucida font families (Type 1)
  - Lucida Bright (serif)
  - Lucida New Math
  - Lucida Sans Typewriter
  - Lucida Sans
  - Lucida Typewriter (serif)
  - Lucida Fax, Lucida Casual
  - Lucida Blackletter, Calligraphic, Handwriting
- bundled in two packages
  - basic set + expert set (Y&Y)
  - basic set + complete set (TUG)
- Coverage of font sets
  - text: one 8-bit set each, either TeXnANSI (LY1) or similar
  - math: several 8-bit sets, about same as CM + AMS + extras

Existing Fonts: TUG's Type1 (I)

- **Lucida Bright**
  - LucidaBright + SMALLCAPS
  - *LucidaBright-Oblique*
  - *LucidaBright-Italic*
  - **LucidaBright-Demi + SMALLCAPS**
  - ***LucidaBright-DemiItalic***
- **Lucida Sans Typewriter**
  - `LucidaSans-Typewriter`
  - *`LucidaSans-TypewriterOblique`*
  - **`LucidaSans-TypewriterBold`**
  - ***`LucidaSans-TypewriterBoldOblique`***
- **Lucida New Math**
  - … *many fonts* …

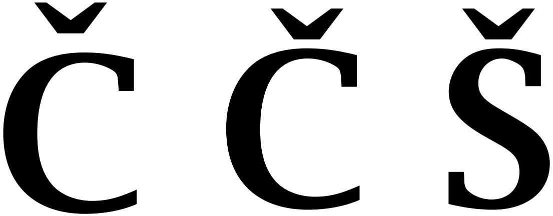
Existing Fonts: TUG's Type1 (II)

- **Lucida Sans**
  - LucidaSans
  - *LucidaSans-Italic*
  - **LucidaSans-Demi**
  - ***LucidaSans-DemiItalic***
  - **LucidaSans-Bold**
  - ***LucidaSans-BoldItalic***
- **Lucida Typewriter**
  - `LucidaTypewriter`
  - *`LucidaTypewriterOblique`*
  - **`LucidaTypewriterBold`**
  - ***`LucidaTypewriterBoldOblique`***

Existing Fonts: TUG's Type1 (III)

- **Lucida Fax**
  - LucidaFax
  - *LucidaFax-Italic*
  - **LucidaFax-Demi**
  - ***LucidaFax-DemiItalic***
- **Lucida Casual**
  - LucidaCasual
  - *LucidaCasual-Italic*
- **Lucida Blackletter**
  - LucidaBlackletter
- **Lucida Calligraphy**
  - *LucidaCalligraphy-Italic*
- **Lucida Handwriting**
  - *LucidaHandwriting-Italic*

Problems of the Lucida TUG distribution



(a) (b) (c)

(a) old: virtual (faked) glyph:
- wrong vertical position
- centered horizontally – also wrong

(b) new: properly positioned accent

(c) old & new: existing glyph

Problems of the Lucida TUG distribution

- Problems / Limitations of 8-bit text fonts
  - limited or incomplete language support in base fonts
  - no direct support for T1 (Cork) encoding by Y&Y
  - support for T1 (Cork) only via virtual fonts (`fontinst`)
  - some glyphs faked, some glyphs missing or broken
  - no support for other encodings at all (CS, QX, L7X, etc)

Goals for the Lucida OpenType project

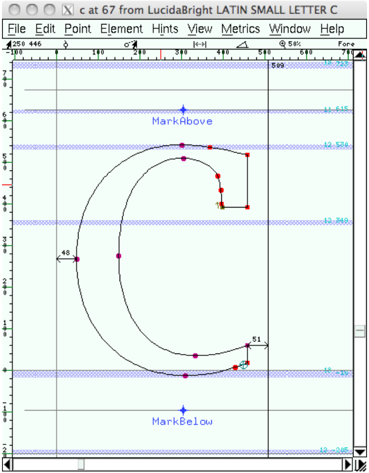
- So one day the idea for an new project was born:
  - *Let’s create a new version of Lucida OpenType!*

- Development goals
  - Repackage Type 1 fonts in OpenType fonts
  - Extend the coverage of the OpenType fonts
  - Provide good Unicode language support (Latin)
    (Design additional accented glyphs as needed)
  - Provide good Unicode math support
    (Design additional math symbols/alphabets)
  - Use latest OpenType font technology
    (Create a full-featured OpenType math font)

Project Organization and Team

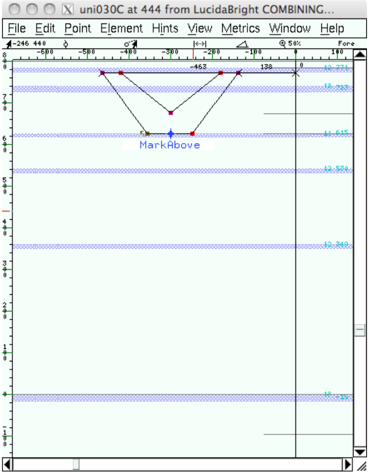
- Project Organization
  - Project set up by TUG in cooperation with B&H
  - B&H provided the designs of additional glyphs
  - Khaled Hosny did the development (supported by TUG)
  - Team members did the testing (and will get free fonts)
  - Fonts will eventually be sold via TUG and B&H
- Team Members
  - Karl Berry (TUG): coordination, legal stuff
  - Chuck Bigelow, Kris Holmes (B&H): glyph design
  - Khaled Hosny: font technlogy, assembly, metrics
  - Mojca Miklavec: testing of text fonts / languages
  - Ulrik Vieth: testing of math fonts / symbols
  - Hans Hagen, Taco Hoekwater: technical advisory

Positioning of combining marks (I)



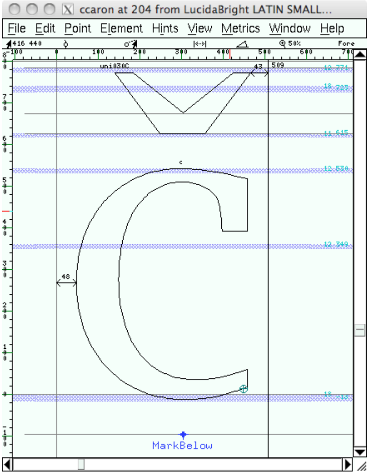
```
StartChar: c
Encoding: 99 99 85
Width: 509
Flags: W
AnchorPoint: "MarkBelow" 303 -96 basechar 0
AnchorPoint: "MarkAbove" 303 626 basechar 0
SplineSet
398 392 m 1
397 401 l 1
397 411 396 422 394 434 c 0
391 451 389 462 386 468 c 0
376 492 340 510 303 510 c 0
208 510 149 420 149 275 c 0
149 127 218 36 331 36 c 0
375 36 424 45 458 60 c 1
458 18 l 1
445 13 435 9 429 7 c 0
392 -5 350 -12 309 -12 c 0
154 -12 48 101 48 267 c 0
48 432 149 542 300 542 c 0
320 542 343 540 368 537 c 1
398 532 415 529 458 518 c 1
458 392 l 1
398 392 l 1
EndSplineSet
EndChar
```

Positioning of combining marks (II)


uni030C at 444 from LucidaBright COMBINING...
File Edit Point Element Hints View Metrics Window Help
-246 440
50%
Fore
-600 -500 -400 -300 -200 -100 0 100
-463
138
0
MarkAbove

```
StartChar: uni030C
Encoding: 780 780 354
Width: 0
Flags: W
AnchorPoint: "MarkAbove" -301 626 mark 0
SplineSet
-355 626 m 1
-463 771 l 1
-421 771 l 1
-301 675 l 1
-180 771 l 1
-138 771 l 1
-247 626 l 1
-355 626 l 1
EndSplineSet
EndChar
```

Positioning of combining marks (III)


ccaron at 204 from LucidaBright LATIN SMALL...
File Edit Point Element Hints View Metrics Window Help
416 440
50%
Fore
uni030C
43
509
c
48
MarkBelow

```
StartChar: ccaron
Encoding: 269 269 374
Width: 509
VWidth: 0
AnchorPoint: "MarkBelow" 303 -96 basechar 0
Refer: 354 780 N 1 0 0 1 604 0 2
Refer: 85 99 N 1 0 0 1 0 0 2
EndChar
```

Combining accents (I)

- Work properly when using positioning marks:
  - **mark**: `MarkToBase` font feature
  - **mkmk**: `MarkToMark`
- **Examples**:
  - c + combining caron (U+030C)

    properly: čČ LM-like: čČ TeX: čČ
  - U + combining inverted breve below (U+032F)

    properly: U̯Ȕ̯ LM-like: U̯Ȕ̯

Combining accents (II)

- Font features: **mark** (`MarkToBase`) & **mkmk** (`MarkToMark`)
- Ideally requires placing top and bottom position marks to all letters: time consuming
- Very tight time constraints:
  - finished only in Lucida Bright Regular
  - incomplete in other fonts (font features are disabled)
  - high priority to be completed
- It would be nice if also **OpenType Latin Modern** followed the standard.

Scope of Lucida OpenType distribution

- Members of Lucida font families (OTF)
  - Lucida Bright (serif)
  - Lucida Math
  - Lucida Sans Typewriter
- Coverage of text fonts
  - Latin: most European languages covered
  - Greek: not in scope, only as needed for math
  - Cyrillic, Arabic, Hebrew, Thai: not in scope
- Coverage of math alphabets
  - most math alphabets covered (few exceptions)
  - most math symbols covered

Scope of Lucida OpenType distribution

- Some numbers:
  - other Lucida Unicode fonts:
    - Lucida Console: 667 total glyphs, 244 lowercase
    - Lucida Sans Unicode: 1779 total glyphs, 465 lowercase
    - Lucida Grande: 2826 total glyphs, 1072 lowercase
  - old Lucida Type1 fonts:
    - Lucida Bright: 252 glyphs (including ff-ligs)
    - Lucida Sans TT: 249 glyphs
  - new Lucida OTF fonts:
    - Lucida Bright (rm): 956 total glyphs, 476 lowercase (incl. sc)
    - Lucida Bright (bf): 528 total glyphs, 230 lowercase (incl. sc)
    - Lucida Bright (it): 396 total glyphs, 138 lowercase
    - Lucida Bright (bi): 396 total glyphs, 138 lowercase
    - Lucida Sans TT: 359 total glyphs, 120 lowercase

New OTF fonts in the TUG distribution

- **Lucida Bright**
  - LucidaBright
  - *LucidaBright-Italic*
  - **LucidaBright-Demi**
  - ***LucidaBright-DemiItalic***
- **Lucida Sans Typewriter**
  - `LucidaSans-Typewriter`
  - *`LucidaSans-TypewriterOblique`*
  - **`LucidaSans-TypewriterBold`**
  - ***`LucidaSans-TypewriterBoldOblique`***
- **Lucida Math**
  - *… only one font …*

Alphabets in the math fonts

- Math alphabets

`\mathup`	$\mathup{ABCXYZ}\ \mathup{abcxyz}$	$\mathup{AB\Gamma\Xi\Psi\Omega}\ \mathup{\alpha\beta\gamma\xi\psi\omega}$	$\mathup{0123}$
`\mathit`	$\mathit{ABCXYZ}\ \mathit{abcxyz}$	$\mathit{AB\Gamma\Xi\Psi\Omega}\ \mathit{\alpha\beta\gamma\xi\psi\omega}$	
`\mathbfup`	$\mathbfup{ABCXYZ}\ \mathbfup{abcxyz}$	$\mathbfup{AB\Gamma\Xi\Psi\Omega}\ \mathbfup{\alpha\beta\gamma\xi\psi\omega}$	$\mathbfup{0123}$
`\mathbfit`	$\mathbfit{ABCXYZ}\ \mathbfit{abcxyz}$	$\mathbfit{AB\Gamma\Xi\Psi\Omega}\ \mathbfit{\alpha\beta\gamma\xi\psi\omega}$	
`\mathsfup`	$\mathsfup{ABCXYZ}\ \mathsfup{abcxyz}$		$\mathsfup{0123}$
`\mathsfit`	$\mathsfit{ABCXYZ}\ \mathsfit{abcxyz}$		
`\mathbfsfup`	$\mathbfsfup{ABCXYZ}\ \mathbfsfup{abcxyz}$	$\mathbfsfup{AB\Gamma\Xi\Psi\Omega}\ \mathbfsfup{\alpha\beta\gamma\xi\psi\omega}$	$\mathbfsfup{0123}$
`\mathbfsfit`	$\mathbfsfit{ABCXYZ}\ \mathbfsfit{abcxyz}$	$\mathbfsfit{AB\Gamma\Xi\Psi\Omega}\ \mathbfsfit{\alpha\beta\gamma\xi\psi\omega}$	
`\mathscr`	$\mathscr{ABCXYZ}\ \mathscr{abcxyz}$		
`\mathbfscr`	$\mathbfscr{ABCXYZ}$		
`\mathfrak`	$\mathfrak{ABCXYZ}\ \mathfrak{abcxyz}$		
`\mathbffrak`			
`\mathbb`	$\mathbb{ABCXYZ}$		

Samples of math fonts

- Math sample

Theorem 1 (Residue Theorem). Let f be analytic in the region G except for the isolated singularities $a_1, a_2, \ldots, a_m$. If γ is a closed rectifiable curve in G which does not pass through any of the points a_k and if $\gamma \approx 0$ in G then

$$\frac{1}{2\pi i}\int_\gamma f = \sum_{k=1}^{m} n(\gamma; a_k)\operatorname{Res}(f; a_k).$$

Theorem 2 (Maximum Modulus). *Let G be a bounded open set in $\mathbb{C}$ and suppose that f is a continuous function on G^- which is analytic in G. Then*

$$\max\{|f(z)| : z \in G^-\} = \max\{|f(z)| : z \in \partial G\}.$$

Project Timeline and Status

- Project Timeline
  - Project idea in September 2010 (ConTEXt meeting)
  - Project set up by TUG with B&H in November 2010
  - Glyph designs provided by B&H in December 2010
  - Font development and testing since January 2011
- Project Status:
  - few missing letters in text fonts to be designed
  - few missing symbols in math fonts to be designed
  - few missing math alphabets (e.g. bold Script, Fraktur)
  - more testing needed to ensure quality / combatibility
  - Font development and testing will continue
  - Khaled will have to leave the project very soon
  - B&H have no time now to draw remaining glyphs now
  - remaining work may be delayed, no release date yet