

Changes in the Newest newtx TUG 2020

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Text fonts using newtx for math support

Newtx comprises newtxtext, an extension of URW Times, and newtxmath, an extension/modification of the old txfonts package. The math part also provides \LaTeX support for the following:

- Libertine/Libertinus
- EBGaramond
- fbb (Bembo based on Cardo)
- ETbb (Bembo based on XETBook)
- Garamondx
- MinionPro
- Cochineal (based on Crimson)
- BaskervilleF
- Baskervaldx
- Heuristica
- Erewhon (Utopia)
- XCharter
- STIX2
- NewCenturySchoolbook

All of the above except Baskervaldx and Garamondx have “enhanced” support by newtxmath, which restricts to them access to a number of new features of newtxmath that are described later in this talk.

Garamondx and EBGaramond

I'm not planning any further updates to the `garamondx` package. It was a real problem for me to support the TeXLive users given that upgrading an installation frequently led to a mix of old and new package components, some in `texmf-local` and some in `texmf-home` because hardly any of us are disciplined enough to foresee the need to check where they installed the previous version before upgrading. An opentype version is available now from <https://github.com/probonopd/font-newg8>.

In any case, the EBGaramond package is a much better choice for most people who wish to use a reworking based on an authentic Garamond font.

I recently added math support as an option to `newtxmath`, having enhanced status.

Some issues:

- The x-height is rather small—very difficult for me to read at natural size.
- The Bold and BoldItalic are still works in progress, with quite a number of glyphs having mis-shapen elements, though usually minor.

I corrected a number of BoldItalic problem glyphs when making math support files for `newtxmath`.

TS1 additions

Some of the text packages that feed into newtx had only minimal TS1 coverage, and in some cases lacked even a centered asterisk character that \LaTeX 's `itemize` environment uses for third level lists. As a result, you might have had to jump through some hoops before you could use macros like `\textfractionsolidus`, `\textfrac`, `\textbigcircle` and `\textcircled` with satisfying results.

In all the “enhanced” fonts linked to newtx, TS1 coverage is now essentially complete and, where possible, `\textcircled` has been refined to make use of small cap or superior letters. E.g., `\textcircled{M}` results in \textcircled{M} with `XChartertext`, based on raising by `.32ex` the small cap `M` rescaled by `.75`.

New realization for theorem fonts

Theorem fonts are italic fonts with upright punctuation and delimiters, which better match the math symbols encountered in theorem statements. Until recently, I've implemented this using the `\slanted` command but I've now changed this to using a new text family `\thfamily` implemented as follows in `scholax.sty`, the `sty` file for the `NewCenturySchoolbook` package.

```
\DeclareRobustCommand\thfamily{%
  \not@math@alphabet\thfamily\relax
  \fontfamily\thdefault\selectfont}
\newcommand*{\thdefault}{zcs-th-TeXGyreScholaX@figurestyle}
\ifzcs@thrm\theoremstyle{plain}
  \patchcmd{\th@plain}{\itshape}{\thfamily}{%
  \message{Replaced itshape by thfamily in theorem style plain.}}{%
  \message{Unable to replace itshape by thfamily in theorem style plain.}}
```

Conformance with PDF/A-1b

The ability to produce pdf documents conforming to the PDF/A-1b (and higher) standard seems to be increasing importance. The pdfx package is an essential ingredient in doing this with pdf_latex. It is also important that the source fonts and tfms meet some conditions, the most important of which is that each font must have a CMAP table that assigns to essentially every glyph a valid unicode value. The exceptions are glyph names like A.alt, which is taken to be a variant form of A, whose unicode value is U+0041. The trickiest part for the text fonts was superscript letters, where appropriate unicode values are in many cases not easily found.

The math fonts in newtx required a lot of changes. The non-alphanumeric symbols could be handled using external files (see below) authored by Ross Moore, assigning unicode values by glyph name, but this was not possible with the alphanumeric math symbols. I reworked each of the Roman and Greek alphabets into new fonts having unicode names, mostly in the range u1Dxxx, so they would validate PDF/A-1b. Your preamble needs a block:

```
\input glyphtounicode.tex
\usepackage[a-1b]{pdfx} % v 1.6.4 or higher
\InputIfFileExists{glyphtounicode-cmr.tex}{}{}
\InputIfFileExists{glyphtounicode-ntx.tex}{}{}
```

Adding some Special Characters

It is sometimes desirable to add characters to a font that are not contained in any of the usual encodings but which may be considered important by some group of TeX users. Such things can be considerably messier to handle in \LaTeX than in Unicode TeX. E.g.:

- Alternate forms of some symbols like oldstyle 1: 1 versus ı. In \LaTeX , a replacement tfm was needed just for one symbol difference. (May not be necessary, but is faster.)
- Addition of large Eszett (capital sharp S) for use in German orthography as an optional element since 2017.
- Specialized forms of Serbian-Montenegrin Cyrillic letters, mainly in italic shapes. Currently, realized only in XCharter. (Not simple to make.)
- Enhanced fonts now have their own versions of symbols like `\hslash`, `\hbar`, `\lambdaslash`, `\lambdabar`, `\Angstrom` and `\Zbar`, all based on glyphs from the text font.

Fraction macros

The simplest fraction macro would be one looking something like

```
\def\textfrac#1#2{% #1<-numerator, #2<-denominator  
\textnu{#1}\textfractionsolidus\textde{#2}}
```

This assumes you do have access to the `fractionsolidus` character in `textcomp`, and you have numerator and denominator figures available, otherwise all these can be manufactured from other figures. The result is usually not of high quality.

I've been experimenting with some more complicated approaches, not that nice looking fractions of any real importance, but simply because it's there. The one I've been using for a while in `newttext` has proved to be rather opaque and not as easy to configure as the one now in `XCharter`, and the latter will be used in all the text packages I maintain.

The new `\newcommand{\textfrac}[3][]` is defined somewhat like the above, but includes table of kerns between numerator digits and `fractionsolidus`, and between `fractionsolidus` and denominator digits. E.g., `\textfrac{27}{45}` produces $^{27}_{45}$, and `\textfrac[3]{21}{71}` produces 3^{21}_{71} . (The kern to each side of `fractionsolidus` is configureable by means of the options `foresolidus` and `aftsolidus`.)

Math symbol shapes and slopes

- CM Math is the visual standard for math symbols. “Uppercase symbols.”
- Most math packages have uppercase symbols. Exceptions: MnSymbol, libertinusmath—problematic for older eyes.

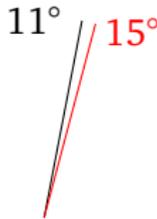
$X \leq x$

Computer Modern

$X \leq x$

Libertinusmath

- The math italic letters are normally derived from text font italic. The *italic slant* can range from 9° to 16° or more. IMO, 11–13° is the sweet region—fonts derived from the original Times, Baskerville or Garamond can appear too sloped. Caslon, at 22°, is impossibly so.



*X*Charter-Italic, *Times-Italic*

Comparison of math metrics

Package	T-CapH	T-xH	T-VstemW	T-vstemW	M-AxisH	M-LineW
Fourier	637	451	91	86	259	52
Newtx	662	450	102	84	257	56
Newpx	689	459	95	84	270	58
mtpro2	•	•	•	•	252	46
stix	662	450	102	84	250	66
stix2	657	473	91	83	258	68
Libertinust1math	645	429	85	79	260	40
ComputerModern	683	431	89	66	250	40
Lucida	723	530	109	100	297	39

T- : Text, M- : Math

CapH : Capital Height, xH : xheight

VstemW : UC vertical stem width, vstemW : LC vertical stem width

M-AxisH : Math axis height, M-LineW : Default rule width

Expanding math encodings

The `symbols` and `largesymbols` math fonts had already been expanded to 256 slots, abandoning strict conformity with the 128 slot standards used in early TeX math. More recently, the `letters` was expanded to 256 slots, with the initial 128 slot array identical to the familiar OML encoding. (The `lettersA` math font contains mainly upright alphabets like Greek, Fraktur and Blackboard Bold and has been rearranged to optimize space for those alphabets.) Much of the additional space in `letters` is used for additional script alphabets.

The additional alphabets do not sit in traditional slots and require a new, rather complex macro `\ntx@alfa` which takes 7 arguments, allowing definitions like:

```
\DeclareRobustCommand{\vwmathbb}[1]{\ntx@alfa{#1}{193}{225}{125}{126}{43}{lettersA}}
```

- #1 is a string of characters you wish to typeset in BB;
- 193, 225 are the slot where uppercase, lowercase A reside;
- 125, 126 are the slot with dotlessi, dotlessj;
- 43 is the slot where figure 0 resides and `lettersA` indicates the math family.

An empty argument signifies no such glyph in the font.

More on expanded math encodings

`\vmathbb{1+R}^2_{\vmathbb{P}} + \vmathbb{a}\jmath\Gamma/\mathbb{C}` renders as:

$$1 + \mathbb{R}_{\mathbb{P}}^2 + a\jmath\Gamma/\mathbb{C}$$

Script example with option `uprightscript` in force: `\mathscr{L\cup F}` renders as:

$\mathscr{L} \cup \mathscr{F}$

- Active characters like `^` and `_` are NOT handled properly by macros based on `\ntx@alfa`, and will produce mysterious error messages.
- The only control sequences recognized are `\imath` and `\jmath`, which it handles appropriately.
- Symbols outside the alphanumeric range are passed along, as are unavailable symbols.

Fraktur alphabet

The Fraktur alphabet that used to be in newtxmath was not really suited to fonts like Times, seeming to have been designed for lighter math fonts such as Computer Modern. As part of my enhancement project, I worked on the Fraktur symbols, making them slightly taller and noticeably thicker in the horizontal direction. Here is a comparison between old, new and STIX, first at normal size and then magnified by a factor of 5.

New: $\mathfrak{A}\mathfrak{M}$ Old: $\mathfrak{A}\mathfrak{M}$ STIX: $\mathfrak{A}\mathfrak{M}$

New: $\mathfrak{A}\mathfrak{M}$ Old: $\mathfrak{A}\mathfrak{M}$ STIX: $\mathfrak{A}\mathfrak{M}$

It appears to me that the New Fraktur is just a bit lighter than the STIX Fraktur, and less shapely.

Allowing adjustments for subscript kerns

Because of problems with superscript letters with long tails to the left (e.g., j , y , β , ρ), I reworked the spacing in all the math fonts to ensure that superscripts did not collide with the letters to which they are superscripts—mainly a problem with letters that are obese to the right, like D and Ω . As a consequence, those same problem superscript letters now become problem subscripts and it was necessary to work out a scheme to compensate. There is now for each enhanced font a file that the user can modify at will that applies a kern to the the left of the subscript, if it is the first element of the subscript.

The file name for XCharter (used for this document) is `newtx-xcharter-substex`. It contains a line

```
{j}{-2}
```

which, when read in, expands to

```
\if\next j\mkern-2 mu\else
```

(If the first entry is a control sequence, like `\beta`, then `\if\next` is replaced by `\ifx\next`.)

The effect is to insert a kern of -2μ before a subscript beginning with j . To see this in action requires the option `subscriptcorrection` to `newtxmath`:

Without `subscriptcorrection`: $D^j P_j$;

With `subscriptcorrection`: $D^j P_j$

Adaptive vector accent

The `newtxmath` package did not until recently have an adaptive vector accent whose vector shape matched that of `newtxmath`—the \TeX macro `\overrightarrow` and the `esvect` package are adaptive but do not match the vector accents in `newtxmath`. I've modified the code from `esvect` somewhat but kept the command names (`\vv`, `\vv*`) the same.

For a comparison of these vector accents, `\vec{XY}` `\vv{XY}` `\overrightarrow{XY}` render as \vec{XY} \overrightarrow{XY} \overrightarrow{XY} .

- `\vv{AB}` renders as \overline{AB} .
- `\vv*{AB}{x}` renders as \overline{AB}_x . This provides better horizontal spacing of subscripts than `\vv{AB}_{x}`, \overline{AB}_x .
- You can also do `\vv*{AB}{\vv{CD}}`, which renders as $\overline{AB}_{\overline{CD}}$.
- You can change the vertical space between the arrow and the accentee by means of the package option `vecsep`, whose default value is `.25ex`.

XeLaTeX/LuaLaTeX usage

You may use newtxmath and one of its related text fonts by observing the following order of package loading.

```
\documentclass{article}
\renewcommand*{\rmdefault}{ntxtlf} % newtx with tabular lining figures for math
%\usepackage[T1]{fontenc} % OT1 is default
% load other packages for sans serif, typewriter that you may wish to use in math
% By default, newtxmath switches to OT1 for operators but has option noOT1
\usepackage[vvarbb]{newtxmath} %pick up operators family from ot1ntxtlf.fd
\usepackage[no-math]{fontspec}
\usepackage{newtxtext} % default is T1 encoding
%\setmainfont{TeXGyreTermesX}
```

If you wish to use the opentype family TeXGyreTermesX instead of the \LaTeX text font package newtxtext, uncomment the last line and comment the preceding line.