The TrueTEX Times Option: Using Times Fonts with TrueTEX

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Abstract

This document explains how to use Times fonts for text and mathematics in TrueTEX. Instructions for installing and using the TrueTEX Times Option are included. Also included are a troubleshooting guide, extensive examples of mathematics in the Times style, font samples, and technical references.

Contents

1 Using Times Text Fonts with TrueTEX

The TrueTEX Times Option allows you to use the Times fonts provided in Windows for LATEX documents. A single style command switches the text and/or mathematics of a LATEX document to use the Times fonts.

The TrueTEX Times Option uses the standard PSNFSS LATEX package for style switching, as documented in the *LATEX Companion*. Your LATEX documents using the Times styles will be compatible with any LATEX implementation that supports the standard packages, not just TrueTEX.

Although you install and use the TrueTEX Times Option for certain documents, you may also continue to use Computer Modern fonts in other documents. The Option adds to the styles available in LATEX, it does not replace them. However, if you want to use Times-style documents exclusively, you could uninstall the Computer Modern fonts from TrueTEX. If you want to only use Computer Modern, you should not install the Times Option.

With the combination of TEX virtual fonts, TrueTEX Unicode rendering, and Microsoft pan-European fonts, using Times instead of Computer Modern fonts with TEX is now much more effective than ever before. The original 7-bit TEX encodings and the multilingual T1 TEX encodings will work, because almost all of the characters TEX expects in a text font are available in the new Microsoft pan-European fonts for multilanguage applications in Windows 95 and NT. The pan-European fonts contain all characters in Windows Glyph List 4 (WGL4), which covers 652 characters required in Western, Central, and Eastern European writing systems, and Greek and Turkish.

While the concept of such switching seems simple, the extra TEX software needed to implement it is enormous, mostly due to the elaborate scheme LATEX uses to manage font encodings in the New Font Select Scheme (NFSS).

To set mathematics in a Times style (Computer Modern is not stylistically similar) requires many symbols not available in the Microsoft text fonts. The TrueTEX Times Option, to provide these symbols, installs three additional TrueType fonts:

Belleek Math Fonts versus Computer Modern

Belleek Math Font	Computer Modern Analog
Belleek Math Symbols (`blsy`)	CM Math Symbols (`cmsy10`)
Belleek Math Extension (`blex`)	CM Math Extension (`cmex10`)
Belleek Math Italic (`rblmi`)	CM Math Italic (`cmmi10`)

The Belleek math fonts are similar to the MathTime fonts[1], which are supported in the LATEX `mathtime` style. Indeed, the metrics and encodings are exactly compatible, so that you can use the LATEX `mathtime` style by simply installing the TrueTEX Times Option.

[1] For compatibility with the LATEX `mathtime` style, the TrueTEX Times Option provides fonts which are metric-compatible with the MathTime fonts published by the TEXplorators Corporation. However, the Belleek math fonts are *not* the MathTime fonts: the Belleek math fonts contain our original hand-crafted designs drawn after the Times style.

2 Installing and Using the Times Option

The Times Option for TrueTeX requires Windows 95 or Windows NT, and release 4.0S or later of the TrueTeX previewer, Unicode edition (`DVIGDI32.EXE`).

2.1 Installing TrueTeX Components

The TrueTeX Times Option contains all the components to create LaTeX documents that use the Windows fonts Times New, Arial, and Courier New for text in place of the usual Computer Modern. Run the `setup.exe` program on the TrueTeX Times disk to automatically install the TeX virtual fonts, Belleek TrueType fonts, LaTeX font and encoding definitions, and the LaTeX styles `times.sty` and `mathtime.sty`. Tables at the end of this document set forth the files installed and their purposes.

The LaTeX styles are taken from the CTAN PSNFSS package. If you should want to install a later distribution of that package from CTAN, you need to make a simple change to the three font definition files `my*mtt.fd`: change the font-name references in the `DeclareFontShape` commands to call on the Belleek fonts, as follows:

File Name	*Declaration Line*
`my1mtt.fd`	`\DeclareFontShape{MY1}` `{mtt}{m}{it}{<->BLMI}{}`
`my2mtt.fd`	`\DeclareFontShape{MY2}` `{mtt}{m}{n}{<->BLSY}{}`
`my3mtt.fd`	`\DeclareFontShape{MY3}` `{mtt}{m}{n}{<->BLEX}{}`

2.2 Installing Windows 95 Components

If you are using Windows 95, you must also install the Windows 95 multilanguage support from the Windows 95 CD-ROM (if you have not already done so), which will then install the pan-European versions of Times New, Arial, and Courier New (the US and western Europe versions of Windows 95 by default supply the lesser-populated ANSI fonts). Windows NT always installs the pan-European versions. See "Installing Multilanguage Support" in the Windows 95 Help (found on the tool bar "Start" button) for details. Of the three components available in "Multilanguage Support Details", you should select Central European and Greek Language Support; Cyrillic is not now used in the Times Option. If you do not have these versions of the fonts installed, certain accented characters that LaTeX expects to use will show up as blank or missing in the previewer.

3 Using the Times Style Options

3.1 Using the Times Text Style

To create a LaTeX document that uses the Times style for text, insert the command:

```
\usepackage{times}
```

before the `\begin{document}` command.

3.2 Using Times Math Style

To create a LaTeX document that uses the Times style for math, insert the command:

```
\usepackage[noTS1]{mathtime}
```

before the `\begin{document}` command. The "`noTS1`" option in the `\usepackage` command tells LaTeX that you do not want to use "companion fonts", which are "TS1" re-encodings of the fonts that provide miscellaneous symbols not supported in the TrueTeX Times option. Note: the exact capitalization, "`noTS1`" is required when you specify the option. This command will also switch the document to Times text, as if you had also included `\usepackage{times}`.

The math components of the TrueTeX Times Option use three additional Belleek TrueType fonts `blsy`, `blex`, and `rblmi`, which provide 333 extra math symbols for LaTeX, symbols which are not in the usual Windows fonts.

Any version of Windows and any release of TrueTeX will work with these fonts, since they are encoded like the TeX 7-bit fonts and do not require Unicode rendering (except for dotlessi, as explained below).

4 Troubleshooting

- *I installed the TrueTeX Times optional disk, but my documents still appear in Computer Modern:* you need to insert `\usepackage{mathtime}` or `\usepackage{times}` into your LaTeX document before `\begin{document}`.

- *LaTeX complains that it can't find* `times.sty` *or* `mathtime.sty`*:* You haven't installed the TrueTeX Times macros, or you installed them in a directory not in the TrueTeX `TEXINPUTS` path.

- *I get the message from LaTeX:* `LaTeX Font Warning: Some font shapes were not available, defaults substituted`*, and the document previews and prints in Computer Modern:* You haven't installed the TrueTeX Times font definitions, or you installed them in a directory not in the TrueTeX `TEXINPUTS` path.

- *I get the message from TeX or LaTeX:* `Font ... not loadable: Metric (TFM) file not found`*:*

  - If font `ptmr8c` led to this message, you are using a recent version of LaTeX which attempts to load miscellaneous symbols from "companion fonts" (the TS1 encoding); the TrueTeX Times option does not support this recent LaTeX enhancement. Specify the "`noTS1`" option, as in `\usepackage[noTS1]{mathtime}`, which tells LaTeX to not load these fonts.

  - You haven't installed the TrueTeX Times font metric files, or you installed them in a directory not in the TrueTeX `TEXFONTS` path.

- *I get the message from TEX or LATEX:* `This NFSS system isn't set up properly:` Either LATEX or the TrueTEX Times Option is out of date with respect to the other. You need an updated version of LATEX or the Times Option, or perhaps both.
- *Accents, or ligatures like* `fi`*, are missing from previewer and/or printed output, or appear as rectangles:*
  - Under Windows 95, if you have not installed the multilanguage options (see Windows Help), the fonts on your system do not contain all the accented characters and ligatures which TEX expects to use, or
  - You are using the Times Option under a non-Unicode version of Windows like Windows 3.1 or Windows for Workgroups 3.11; Windows 95 or Windows NT is required, or
  - If previews are correct but printing is missing characters under Windows 95, the printer driver may not support Unicode: try setting the driver to "print TrueType as graphics," or find a later version of the driver, or use a bit-mapped driver for the same printer or a compatible printer. For example, the LaserJet 4 Plus driver in Windows 95 is known to not presently support Unicode printing, although the LaserJet IIIsi driver does (you can use the IIIsi driver on a 4 Plus printer).
- *Math fonts preview the wrong characters (or boxes in blue), and the printing is similarly incorrect:* The Belleek math fonts are not rendering, because they are not installed (check for them with the Windows Font Installer applet).
- *Math formulas using the Belleek fonts appear OK, but running text still appears in Computer Modern:* The LATEX font definitions, virtual fonts, and/or font metrics for the `times` style are not installed or are not in the `TEXFONTS` or `TEXINPUTS` paths.
- *Documents using Times load and preview slowly compared to Computer Modern:* This is normal, since the Times fonts go through several layers of virtual font mapping to render each character, a design determined by the LATEX package authors, not TrueTEX.
- *The dotless i in the font* `blmi` *is missing:* The Belleek italic dotless i is actually taken from a Unicode character in Times New Roman Italic. You are either using a non-Unicode version of Windows or the TrueTEX previewer, or you have not installed the multilanguage Windows fonts. If the problem manifests itself only when printing in Windows 95, then the printer driver probably has not been updated to support Unicode.
- *When I try to print, a box from Windows appears saying,* "`Dvigdi32 ... An error has occurred in your program. To keep working anyway, click Ignore and save your work in a new file. To quit this program, click Close. You will lose information you entered since your last Save. [Close] [Ignore]`" The error is actually arising in the Microsoft printer driver, not the previewer application `DVIGDI32.EXE`. The error message pops up each time the printed page calls for a Unicode character, such as a ligature. Choosing "`Ignore`" seems to work safely, but the page does not print correctly. Try to find another driver for your printer, or a later version of the driver that is causing the problem.

  This message box takes the prize for annoyances from Microsoft, as it is not only mistaken, but also violates many stylistic guidelines which Microsoft asserts. The message wrongly accuses an innocent application. Programs are supposed to be called "applications" now, not "programs". Messages are supposed to say "select", not "click", because not everyone uses a clicking mouse as a pointing device. The previewer does not "save" work; that part of the message is meaningless and distracting. And you will not lose any information such as the message threatens, but you will get an incorrect printed result.

5 Samples and Tests for Text and Mathematics

5.1 Text Samples and Tests

Here are some samples of text using the Times style, `\usepackage{times}`:

Trouble-Prone Unicode Characters
(The examples should not appear blank,
or as the missing-character rectangle)

The dotless i character

Text mode (\i): ı   Math mode ($\imath$): $\imath$

Ligatures

ff = ﬀ fi = ﬁ fl = ﬂ ffi = ﬃ ffl = ﬄ

Text accents

\\`{o}	ò	\\'{o}	ó	\\^{o}	ô	\\"{o}	ö
\\~{o}	õ	\\={o}	ō	\\.{o}	ȯ	\\u{o}	ŏ
\\v{o}	ǒ	\\H{o}	ő	\\t{oo}	o͡o	\\c{o}	o̧
\\d{o}	ọ	\\b{o}	o̲				

Non-English Characters

\oe	œ	\OE	Œ	\ae	æ	\AE	Æ
\aa	å	\AA	Å	\o	ø	\O	Ø
\l	ł	\L	Ł	\ss	ß	?`	¿
!`	¡						

Special Punctuation

\dag † \ddag ‡ \copyright ©

Note: \P (paragraph sign), \S (section sign), and \pounds (sterling sign) are not available in `times.sty`

Lowercase Greek (math mode)

\alpha	α	\theta	θ	\o	o	\tau	τ
\beta	β	\vartheta	ϑ	\pi	π	\upsilon	υ
\gamma	γ	\iota	ι	\varpi	ϖ	\phi	ϕ
\delta	δ	\kappa	κ	\rho	ρ	\varphi	φ
\epsilon	ϵ	\lambda	λ	\varrho	ϱ	\chi	χ
\varepsilon	ε	\mu	μ	\sigma	σ	\psi	ψ
\zeta	ζ	\nu	ν	\varsigma	ς	\omega	ω
\eta	η	\xi	ξ				

Uppercase Greek (math mode)

\Gamma	Γ	\Lambda	Λ	\Sigma	Σ	\Psi	Ψ
\Delta	Δ	\Xi	Ξ	\Upsilon	Υ	\Omega	Ω
\Theta	Θ	\Pi	Π	\Phi	Φ		

LaTeX Standard Size-Changing Commands
(After the *LaTeX Companion*, Table 7.1)

\tiny	Size
\scriptsize	Size
\footnotesize	Size
\small	Size
\normalsize	Size
\large	Size
\Large	Size
\LARGE	Size
\huge	Size
\Huge	Size

LaTeX NFSS Font-Changing Commands
(After the *LaTeX Companion*, Table 7.2)

\textrm{...}	Typeset text in roman family
\textsf{...}	Typeset text in sans serif family
\texttt{...}	Typeset text in `typewriter` family
\textmd{...}	Typeset text in medium series
\textbf{...}	Typeset text in **bold** series
\textup{...}	Typeset text in upright shape
\textit{...}	Typeset text in *italic* shape
\textsc{...}	Typeset text in SMALL CAPS shape
\emph{...}	Typeset text *emphasized*
\textnormal{...}	Typeset text in the document font
\textsl{...}	(Slanted shape—not supported)

5.2 Math Samples and Tests

Here are some samples of mathematics using Times-style math, `\usepackage{mathtime}`:

Predefined Math Alphabet Identifiers in NFSS
(After the *LaTeX Companion*, Table 7.4)

Command	*Example*	
`\mathcal`	`$\mathcal{A}=a$`	$\mathcal{A}=a$
`\mathrm`	`$\mathrm{max}_i$`	max_i
`\mathbf`	`$\sum x = \mathbf{v}$`	$\sum x = \mathbf{v}$
`\mathsf`	`$\mathsf{G}_1^2$`	G_1^2
`\mathtt`	`$\mathtt{W}(a)$`	$\mathtt{W}(a)$
`\mathnormal`	`$\mathnormal{abc}=abc$`	$\mathnormal{abc}=abc$
`\mathit`	`$differ\neq\mathit{differ}$`	$differ\neq\mathit{differ}$

$$\mathsf{G}=\mathcal{A}+\sum_{i=1}^{n}\mathcal{B}_i \quad (\text{\LaTeX\ \textit{Companion}, eq. 7.1})$$

$$\sum \mathsf{A}_i = a\tan\beta$$

The result will be $x = 10$ **and thus** $y = 12$.

The following samples are from chapters 16–19 of *The TeXbook*, suitably translated into LaTeX commands where appropriate (for example, `\eqalign`'s are translated into the `eqnarray` or `array` environments).

`$x^2$`	x^2	`$x_2$`	x_2
`$2^x$`	2^x	`$x^2y^2$`	x^2y^2
`$x ^ 2y ^ 2$`	$x ^ 2y ^ 2$	`$x_2y_2$`	x_2y_2
`$_2F_3$`	$_2F_3$	`$x^{2y}$`	x^{2y}
`$2^{2^x}$`	2^{2^x}	`$2^{2^{2^x}}$`	$2^{2^{2^x}}$
`$y_{x_2}$`	y_{x_2}	`$y_{x^2}$`	y_{x^2}
`$((x^2)^3)^4$`	$((x^2)^3)^4$	`${({(x^2)}^3)}^4$`	${({(x^2)}^3)}^4$
`$x^2_3$`	x^2_3	`$x_3^2$`	x_3^2
`$x^{31415}_{92}+\pi$`	$x^{31415}_{92}+\pi$	`$x_{y^a_b}^{z_c^d}$`	$x_{y^a_b}^{z_c^d}$
`$y_1^\prime$`	$y_1^\prime$	`$y_2^{\prime\prime}$`	$y_2^{\prime\prime}$
`$y_3^{\prime\prime\prime}$`	$y_3^{\prime\prime\prime}$	`$f'[g(x)]g'(x)$`	$f'[g(x)]g'(x)$
`$y_1'+y_2''$`	$y_1'+y_2''$	`$y'_1+y''_2$`	$y'_1+y''_2$
`$y'''_3+g'^2$`	$y'''_3+g'^2$	`$\sqrt2$`	$\sqrt2$
`$\sqrt{x+2}$`	$\sqrt{x+2}$	`$\underline4$`	$\underline4$
`$\overline{x+y}$`	$\overline{x+y}$	`$\overline x+\overline y$`	$\overline x+\overline y$
`$x^{\underline n}$`	$x^{\underline n}$	`$x^{\overline{m+n}}$`	$x^{\overline{m+n}}$
`$\sqrt{x^3+\sqrt\alpha}$`	$\sqrt{x^3+\sqrt\alpha}$	`$\root 3 \of 2$`	$\sqrt[3]{2}$
`$\root n \of {x^n+y^n}$`	$\sqrt[n]{x^n+y^n}$	`$\root n+1 \of a$`	$\sqrt[n+1]{a}$
`$x+y-z$`	$x+y-z$	`$x+y*z$`	$x+y*z$
`$x*y/z$`	$x*y/z$	`$x\times y\cdot z$`	$x\times y\cdot z$
`$x\circ y\bullet z$`	$x\circ y\bullet z$	`$x\cup y\cap z$`	$x\cup y\cap z$
`$x\sqcup y\sqcap z$`	$x\sqcup y\sqcap z$	`$x\vee y\wedge z$`	$x\vee y\wedge z$
`$x\pm y\mp z$`	$x\pm y\mp z$		

It is important to distinguish $\times$ (`\times`) from X (`X`) and from x (`x`); to distinguish $\cup$ (`\cup`) from U (`U`) and from u (`u`); to distinguish $\vee$ (`\vee`) from V (`V`) and from v (`v`); to distinguish $\circ$ (`\circ`) from O (`O`) and from o (`o`). The symbols ‘$\vee$’ and ‘$\wedge$’ can also be called `\lor` and `\land`, since they frequently stand for binary operations that are called “logical or” and “logical and.”

`$x=+1$`	$x=+1$	
`$3.142-$`	$3.142-$	
`$(D*)$`	$(D*)$	
`$K_n^+,K_n^-$`	K_n^+,K_n^-	
`$z^*_{ij}$`	z^*_{ij}	
`$g^\circ \mapsto g^\bullet$`	$g^\circ \mapsto g^\bullet$	
`$f^*(x) \cap f_*(y)$`	$f^*(x) \cap f_*(y)$	
`$x=y>z$`	$x=y>z$	
`$x:=y$`	$x:=y$	
`$x\le y\ne z$`	$x\le y\ne z$	
`$x\sim y\simeq z$`	$x\sim y\simeq z$	
`$x\equiv y\not\equiv z$`	$x\equiv y\not\equiv z$	
`$x\subset y\subseteq z$`	$x\subset y\subseteq z$	
`$f(x,y;z)$`	$f(x,y;z)$	
`$f:A\to B$`	$f:A\to B$	
`$f\colon A\to B$`	$f\colon A\to B$	
`$12,345x$`	$12,345x$	(wrong)
`$12{,}345x$`	$12{,}345x$	(right)
`$\hat a$ $\check a$`	$\hat a$ $\check a$	
`$\tilde a$ $\acute a$`	$\tilde a$ $\acute a$	
`$\grave a$ $\dot a$`	$\grave a$ $\dot a$	
`$\ddot a$ $\breve a$`	$\ddot a$ $\breve a$	
`$\bar a$ $\vec a$`	$\bar a$ $\vec a$	
`$\widehat x,\widetilde x$`	$\widehat x,\widetilde x$	
`$\widehat{xy},\widetilde{xy}$`	$\widehat{xy},\widetilde{xy}$	
`$\widehat{xyz},\widetilde{xyz}$`	$\widehat{xyz},\widetilde{xyz}$	

`$e^{-x^2}$`	e^{-x^2}
`$D\sim p^\alpha M+l$`	$D \sim p^\alpha M + l$
`{\def\ghat{{\hat g}}`	
`$\ghat\in(H^{\pi_1^{-1}})'$}`	$\hat{g} \in (H^{\pi_1^{-1}})'$
`$$x+y^2\over k+1$$`	$\frac{x+y^2}{k+1}$
`$${x+y^2\over k}+1$$`	$\dfrac{x+y^2}{k}+1$
`$$x+{y^2\over k}+1$$`	$x+\dfrac{y^2}{k}+1$
`$$x+{y^2\over k+1}$$`	$x+\dfrac{y^2}{k+1}$
`$$x+y^{2\over k+1}$$`	$x+y^{\frac{2}{k+1}}$
`$${a\over b}\over 2$$`	$\dfrac{\frac{a}{b}}{2}$
`$$a\over{b\over 2}$$`	$\frac{a}{\frac{b}{2}}$
`$$a/b \over 2$$`	$\frac{a/b}{2}$
`$$a \over b/2$$`	$\frac{a}{b/2}$
`$$x\atop y+2$$`	${x \atop y+2}$
`$$n\choose k$$`	$\binom{n}{k}$

$$a_0 + \cfrac{1}{a_1 + \cfrac{1}{a_2 + \cfrac{1}{a_3 + \cfrac{1}{a_4}}}}$$

$$\frac{\dfrac{a}{b}}{\dfrac{c}{d}}.$$

$$\sum_{\substack{0 \le i \le m \\ 0 < j < n}} P(i, j)$$

$$\sum_{i=1}^{p} \sum_{j=1}^{q} \sum_{k=1}^{r} a_{ij} b_{jk} c_{ki}$$

$$\sum_{\substack{1 \le i \le p \\ 1 \le j \le q \\ 1 \le k \le r}} a_{ij} b_{jk} c_{ki}$$

$$\sqrt{1+\sqrt{1+\sqrt{1+\sqrt{1+\sqrt{1+\sqrt{1+\sqrt{1+x}}}}}}}$$

$$\Biggl(\biggl(\Bigl(\bigl((\,(\,(\;)\,)\,)\bigr)\Bigr)\biggr)\Biggr)\;\Biggl\{\biggl\{\Bigl\{\bigl\{\{\,\{\,\{\;\}\,\}\,\}\bigr\}\Bigr\}\biggr\}\Biggr\}$$

Command	*Result*	*Description*
`(`	$($	left parenthesis
`)`	$)$	right parenthesis
`[` or `\lbrack`	$[$	left bracket
`]` or `\rbrack`	$]$	right bracket
`\{` or `\lbrace`	$\{$	left curly brace
`\}` or `\rbrace`	$\}$	right curly brace
`\lfloor`	$\lfloor$	left floor bracket
`\rfloor`	$\rfloor$	right floor bracket
`\lceil`	$\lceil$	left ceiling bracket
`\rceil`	$\rceil$	right ceiling bracket
`\langle`	$\langle$	left angle bracket
`\rangle`	$\rangle$	right angle bracket
`/`	$/$	slash
`\backslash`	$\backslash$	reverse slash
`|` or `\vert`	$\vert$	vertical bar
`||` or `\Vert`	$\Vert$	double vertical bar
`\uparrow`	$\uparrow$	upward arrow
`\Uparrow`	$\Uparrow$	double upward arrow
`\downarrow`	$\downarrow$	downward arrow
`\Downarrow`	$\Downarrow$	double downward arrow
`\updownarrow`	$\updownarrow$	up-and-down arrow
`\Updownarrow`	$\Updownarrow$	double up-and-down arrow

`$\bigl(x-s(x)\bigr)\bigl(y-s(y)\bigr)$`	$\bigl(x-s(x)\bigr)\bigl(y-s(y)\bigr)$
`$\bigl[x-s[x]\bigr]\bigl[y-s[y]\bigr]$`	$\bigl[x-s[x]\bigr]\bigl[y-s[y]\bigr]$
`$\bigl|\||  |\||x|\||-|\||y|\|| \bigr|\||$`	$\bigl\vert\vert x\vert-\vert y\vert\bigr\vert$
`$\bigl\lfloor\sqrt A\bigr\rfloor$`	$\bigl\lfloor\sqrt A\bigr\rfloor$

$$()\,[]\,\{\}\,\lfloor\rfloor\,\lceil\rceil\,\langle\rangle\,/\backslash\,|\,\|\;\uparrow\Uparrow\downarrow\Downarrow\updownarrow\Updownarrow$$

$$\bigl(\bigr)\bigl[\bigr]\bigl\{\bigr\}\bigl\lfloor\bigr\rfloor\bigl\lceil\bigr\rceil\bigl\langle\bigr\rangle\bigl/\bigl\backslash\bigl|\bigl\|\;\bigl\uparrow\bigl\Uparrow\bigl\downarrow\bigl\Downarrow\bigl\updownarrow\bigl\Updownarrow$$

$$\Bigl(\Bigr)\Bigl[\Bigr]\Bigl\{\Bigr\}\Bigl\lfloor\Bigr\rfloor\Bigl\lceil\Bigr\rceil\Bigl\langle\Bigr\rangle\Bigl/\Bigl\backslash\Bigl|\Bigl\|\;\Bigl\uparrow\Bigl\Uparrow\Bigl\downarrow\Bigl\Downarrow\Bigl\updownarrow\Bigl\Updownarrow$$

$$\biggl(\biggr)\biggl[\biggr]\biggl\{\biggr\}\biggl\lfloor\biggr\rfloor\biggl\lceil\biggr\rceil\biggl\langle\biggr\rangle\biggl/\biggl\backslash\biggl|\biggl\|\;\biggl\uparrow\biggl\Uparrow\biggl\downarrow\biggl\Downarrow\biggl\updownarrow\biggl\Updownarrow$$

$$\Biggl(\Biggr)\Biggl[\Biggr]\Biggl\{\Biggr\}\Biggl\lfloor\Biggr\rfloor\Biggl\lceil\Biggr\rceil\Biggl\langle\Biggr\rangle\Biggl/\Biggl\backslash\Biggl|\Biggl\|\;\Biggl\uparrow\Biggl\Uparrow\Biggl\downarrow\Biggl\Downarrow\Biggl\updownarrow\Biggl\Updownarrow$$

$$\left(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}\right)\bigl|\varphi(x+iy)\bigr|^2=0$$

$$\pi(n) = \sum_{m=2}^{n} \left\lfloor \left(\sum_{k=1}^{m-1} \lfloor (m/k) \big/ \lceil m/k \rceil \rfloor \right)^{-1} \right\rfloor.$$

$$|x| = \begin{cases} x, & \text{if } x \ge 0 \\ -x, & \text{if } x < 0 \end{cases}$$

$$\ldots\bigg\vert\ldots\bigg\Vert\ldots\bigg\arrowvert\ldots\bigg\Arrowvert\ldots\bigg\bracevert\ldots\bigg\lgroup\ldots\bigg\rgroup\ldots\bigg\lmoustache\ldots\bigg\rmoustache\ldots$$

$$\ldots\Bigg\vert\ldots\Bigg\Vert\ldots\Bigg\arrowvert\ldots\Bigg\Arrowvert\ldots\Bigg\bracevert\ldots\Bigg\lgroup\ldots\Bigg\rgroup\ldots\Bigg\lmoustache\ldots\Bigg\rmoustache\ldots$$

$$p_1(n) = \lim_{m\to\infty} \sum_{\nu=0}^{\infty} \bigl(1 - \cos^{2m}(\nu!^n \pi/n)\bigr).$$

`$\sqrt{{\rm Var}(X)}$`	$\sqrt{{\rm Var}(X)}$
`$x_{\rm max}-x_{\rm min}$`	$x_{\rm max}-x_{\rm min}$
`${\rm LL}(k)\Rightarrow{\rm LR}(k)$`	${\rm LL}(k)\Rightarrow{\rm LR}(k)$
`$\exp(x+{\rm constant})$`	$\exp(x+{\rm constant})$
`$x^3+{\rm lower\ order\ terms}$`	$x^3+{\rm lower\ order\ terms}$
`$\sqrt{\hbox{Var}(X)}$`	$\sqrt{\hbox{Var}(X)}$
`$\hbox{LL}(k)\Rightarrow\hbox{LR}(k)$`	$\hbox{LL}(k)\Rightarrow\hbox{LR}(k)$
`$\exp(x+\hbox{constant})$`	$\exp(x+\hbox{constant})$
`$x^3+\hbox{lower order terms}$`	$x^3+\hbox{lower order terms}$

$$\lim_{n\to\infty} x_n \text{ exists} \iff \limsup_{n\to\infty} x_n = \liminf_{n\to\infty} x_n.$$

$$\lim_{n\to\infty} x_n \text{ exists} \iff \varlimsup_{n\to\infty} x_n = \varliminf_{n\to\infty} x_n.$$

`$\gcd(m,n)=\gcd(n,m\bmod n)$`	$\gcd(m,n)=\gcd(n,m\bmod n)$
`$x\equiv y+1\pmod{m^2}$`	$x\equiv y+1\pmod{m^2}$
`$\it last:=first$`	$\mathit{last} := \mathit{first}$
`$\it x\_coord(point\_2)$`	$\mathit{x\_coord}(\mathit{point\_2})$

$$\mathit{available} + \sum_{i=1}^{n} \max\bigl(\mathit{full}(i), \mathit{reserved}(i)\bigr) = \mathit{capacity}.$$

for $j := 2$ **step** 1 **until** n **do**
  begin $\mathit{accum} := A[j]$; $k := j - 1$; $A[0] := \mathit{accum}$;
  while $A[k] > \mathit{accum}$ **do**
    begin $A[k+1] := A[k]$; $k := k - 1$;
    end;
  $A[k+1] := \mathit{accum}$;
  end.

$$F_n = F_{n-1} + F_{n-2}, \qquad n \ge 2.$$

$$F_n = F_{n-1} + F_{n-2}, n \ge 2.$$

$$\text{The Fibonacci numbers satisfy } F_n = F_{n-1} + F_{n-2} \text{ for } n \ge 2.$$

Let H be a Hilbert space, C a closed bounded convex subset of H, T a nonexpansive self map of C. Suppose that as $n \to \infty$, $a_{n,k} \to 0$ for each k, and $\gamma_n = \sum_{k=0}^{\infty}(a_{n,k+1} - a_{n,k})^+ \to 0$. Then for each x in C, $A_n x = \sum_{k=0}^{\infty} a_{n,k} T^k x$ converges weakly to a fixed point of T.

`$\int_0^\infty f(x)\,dx$`	$\int_0^\infty f(x)\,dx$
`$y\,dx-x\,dy$`	$y\,dx-x\,dy$
`$dx\,dy=r\,dr\,d\theta$`	$dx\,dy=r\,dr\,d\theta$
`$x\,dy/dx$`	$x\,dy/dx$
`$$\int_1^x{dt\over t}$$`	$\int_1^x \frac{dt}{t}$

`$55\rm\,mi/hr$`	$55\,\mathrm{mi/hr}$
`$g=9.8\rm\,m/sec^2$`	$g=9.8\,\mathrm{m/sec}^2$
`$\rm1\,ml=1.000028\,cc$`	$\mathrm{1\,ml=1.000028\,cc}$

$$\hbar = 1.0545 \times 10^{-27}\,\mathrm{erg\,sec}.$$

`$(2n)!/\bigl(n!\,(n+1)!\bigr)$`	$(2n)!/\bigl(n!\,(n+1)!\bigr)$
`$${52!\over13!\,13!\,26!}$$`	$\dfrac{52!}{13!\,13!\,26!}$
`$\sqrt2\,x$`	$\sqrt2\,x$
`$\sqrt{\,\log x}$`	$\sqrt{\,\log x}$
`$O\bigl(1/\sqrt n\,\bigr)$`	$O\bigl(1/\sqrt n\,\bigr)$
`$[\,0,1)$`	$[\,0,1)$
`$\log n\,(\log\log n)^2$`	$\log n\,(\log\log n)^2$
`$x^2\!/2$`	$x^2\!/2$
`$n/\!\log n$`	$n/\!\log n$
`$\Gamma_{\!2}+\Delta^{\!2}$`	$\Gamma_{\!2}+\Delta^{\!2}$
`$R_i{}^j{}_{\!kl}$`	$R_i{}^j{}_{\!kl}$
`$\int_0^x\!\int_0^y dF(u,v)$`	$\int_0^x\!\int_0^y dF(u,v)$
`$$\int\!\!\!\int_D dx\,dy$$`	$\displaystyle\int\!\!\!\int_D dx\,dy$

$$x + y = \max\{x, y\} + \min\{x, y\}$$

`$x_1+\cdots+x_n$`	$x_1+\cdots+x_n$
`$x_1=\cdots=x_n=0$`	$x_1=\cdots=x_n=0$
`$A_1\times\cdots\times A_n$`	$A_1\times\cdots\times A_n$
`$f(x_1,\ldots,x_n)$`	$f(x_1,\ldots,x_n)$
`$x_1x_2\ldots x_n$`	$x_1x_2\ldots x_n$
`$(1-x)(1-x^2)\ldots(1-x^n)$`	$(1-x)(1-x^2)\ldots(1-x^n)$
`$n(n-1)\ldots(1)$`	$n(n-1)\ldots(1)$

$$x_1 + \cdots + x_n \qquad \text{and} \qquad (x_1, \ldots, x_n),$$

$$x_1 + x_1x_2 + \cdots + x_1x_2 \ldots x_n$$

$$(x_1, \ldots, x_n) \cdot (y_1, \ldots, y_n) = x_1y_1 + \cdots + x_ny_n$$

Prove that $(1-x)^{-1} = 1 + x + x^2 + \cdots$.

Clearly $a_i < b_i$ for $i = 1, 2, \ldots, n$.

The coefficients $c_0, c_1, \ldots, c_n$ are positive.

$$\underbrace{x + y + z}_{>0}.$$

$$A = \begin{pmatrix} x-\lambda & 1 & 0 \\ 0 & x-\lambda & 1 \\ 0 & 0 & x-\lambda \end{pmatrix}.$$

$$\begin{bmatrix} a & b & c \\ d & e & f \end{bmatrix} \begin{bmatrix} u & x \\ v & y \\ w & z \end{bmatrix}$$

$$A = \begin{pmatrix} a_{11} & a_{12} & \ldots & a_{1n} \\ a_{21} & a_{22} & \ldots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \ldots & a_{mn} \end{pmatrix}$$

$$\begin{pmatrix} y_1 \\ \vdots \\ y_k \end{pmatrix}$$

$$M = \begin{array}{c} \\ C \\ I \\ C' \end{array} \begin{array}{c} \begin{array}{ccc} C & I & C' \end{array} \\ \begin{pmatrix} 1 & 0 & 0 \\ b & 1-b & 0 \\ 0 & a & 1-a \end{pmatrix} \end{array}$$

n^{th} root

$$\mathbf{S}^{-1}\mathbf{T}\mathbf{S} = \mathbf{dg}(\omega_1, \ldots, \omega_n) = \Lambda$$

$$\Pr(\, m = n \mid m + n = 3 \,)$$

$$\sin 18^\circ = \tfrac{1}{4}(\sqrt{5} - 1)$$

$$k = 1.38 \times 10^{-16}\,\text{erg}/^\circ\text{K}$$

$$\bar{\Phi} \subset NL_1^*/N = \bar{L}_1^* \subseteq \cdots \subseteq NL_n^*/N = \bar{L}_n^*$$

$$I(\lambda) = \textstyle\iint_D g(x,y)e^{i\lambda h(x,y)}\,dx\,dy$$

$$\textstyle\int_0^1 \cdots \int_0^1 f(x_1, \ldots, x_n)\,dx_1 \ldots dx_n$$

$$x_{2m} \equiv \begin{cases} Q(X_m^2 - P_2W_m^2) - 2S^2 & (m \text{ odd}) \\ P_2^2(X_m^2 - P_2W_m^2) - 2S^2 & (m \text{ even}) \end{cases} \pmod{N}.$$

$$(1 + x_1z + x_1^2z^2 + \cdots) \ldots (1 + x_nz + x_n^2z^2 + \cdots) = \frac{1}{(1 - x_1z) \ldots (1 - x_nz)}.$$

$$\prod_{j \ge 0} \biggl(\sum_{k \ge 0} a_{jk} z^k \biggr) = \sum_{n \ge 0} z^n \Biggl(\sum_{\substack{k_0, k_1, \ldots \ge 0 \\ k_0 + k_1 + \cdots = n}} a_{0k_0} a_{1k_1} \ldots \Biggr).$$

$$\frac{(n_1+n_2+\cdots+n_m)!}{n_1!\,n_2!\ldots n_m!} = \binom{n_1+n_2}{n_2}\binom{n_1+n_2+n_3}{n_3}\ldots\binom{n_1+n_2+\cdots+n_m}{n_m}.$$

$$\Pi_R\begin{bmatrix}a_1,a_2,\ldots,a_M\\ b_1,b_2,\ldots,b_N\end{bmatrix} = \prod_{n=0}^{R}\frac{(1-q^{a_1+n})(1-q^{a_2+n})\ldots(1-q^{a_M+n})}{(1-q^{b_1+n})(1-q^{b_2+n})\ldots(1-q^{b_N+n})}.$$

$$\sum_{p\text{ prime}} f(p) = \int_{t>1} f(t)\,d\pi(t).$$

$$\{\underbrace{\overbrace{a,\ldots,a}^{k\ a\text{'s}},\overbrace{b,\ldots,b}^{l\ b\text{'s}}}_{k+l\text{ elements}}\}.$$

$$\begin{pmatrix}\begin{pmatrix}a&b\\c&d\end{pmatrix} & \begin{pmatrix}e&f\\g&h\end{pmatrix}\\ 0 & \begin{pmatrix}i&j\\k&l\end{pmatrix}\end{pmatrix}.$$

$$\det\begin{vmatrix}c_0&c_1&c_2&\ldots&c_n\\ c_1&c_2&c_3&\ldots&c_{n+1}\\ c_2&c_3&c_4&\ldots&c_{n+2}\\ \vdots&\vdots&\vdots&&\vdots\\ c_n&c_{n+1}&c_{n+2}&\ldots&c_{2n}\end{vmatrix} > 0.$$

$$\sum_{x\in A}{}' f(x) \stackrel{\text{def}}{=} \sum_{\substack{x\in A\\ x\neq 0}} f(x).$$

$$2\uparrow\uparrow k \stackrel{\text{def}}{=} 2^{2^{2^{\cdot^{\cdot^{\cdot^{2}}}}}}\Big\}{\scriptstyle k}.$$

$$\begin{array}{ccccccccc}
&&&&&&0&&\\
&&&&&&\Big\downarrow&&\\
0&\longrightarrow&\mathcal{O}_C&\xrightarrow{\iota}&\mathcal{E}&\xrightarrow{\rho}&\mathcal{L}&\longrightarrow&0\\
&&\Big\|&&\Big\downarrow{\scriptstyle\phi}&&\Big\downarrow{\scriptstyle\psi}&&\\
0&\longrightarrow&\mathcal{O}_C&\longrightarrow&\pi_*\mathcal{O}_D&\xrightarrow{\delta}&R^1f_*\mathcal{O}_V(-D)&\longrightarrow&0\\
&&&&&&\Big\downarrow{\scriptstyle\theta_i\otimes\gamma^{-1}}&&\\
&&&&&&R^1f_*\big(\mathcal{O}_V(-iM)\big)\otimes\gamma^{-1}&&\\
&&&&&&\Big\downarrow&&\\
&&&&&&0&&
\end{array}$$

$$\sum_{n=0}^{\infty} a_n z^n \qquad \text{converges if} \qquad |z| < \Big(\limsup_{n\to\infty}\sqrt[n]{|a_n|}\Big)^{-1}.$$

$$\frac{f(x+\Delta x)-f(x)}{\Delta x} \to f'(x) \qquad \text{as } \Delta x\to 0.$$

$$\|u_i\| = 1, \qquad u_i\cdot u_j = 0 \quad \text{if } i\neq j.$$

$$\text{The confluent image of} \quad \begin{Bmatrix}\text{an arc}\\ \text{a circle}\\ \text{a fan}\end{Bmatrix} \quad \text{is} \quad \begin{Bmatrix}\text{an arc}\\ \text{an arc or a circle}\\ \text{a fan or an arc}\end{Bmatrix}.$$

$$\prod_{k\ge 0}\frac{1}{(1-q^kz)} = \sum_{n\ge 0} z^n \bigg/ \prod_{1\le k\le n}(1-q^k)$$

$$\begin{array}{rcl} X_1+\cdots+X_p & = & m \\ Y_1+\cdots+Y_q & = & n \end{array}$$

$$\begin{array}{rcl} T(n) \le T(2^{\lceil \lg n\rceil}) & \le & c(3^{\lceil \lg n\rceil} - 2^{\lceil \lg n\rceil}) \\ & < & 3c\cdot 3^{\lg n} \\ & = & 3c\, n^{\lg 3} \end{array}$$

$$\left\{\begin{array}{rcl} \alpha & = & f(z) \\ \beta & = & f(z^2) \\ \gamma & = & f(z^3) \end{array}\right\} \qquad \left\{\begin{array}{rcl} x & = & \alpha^2-\beta \\ y & = & 2\gamma \end{array}\right\}$$

$$\sum_{1\le j\le n}\frac{1}{(x_j-x_1)\ldots(x_j-x_{j-1})(x-x_j)(x_j-x_{j+1})\ldots(x_j-x_n)} = \frac{1}{(x-x_1)\ldots(x-x_n)}. \tag{27}$$

$$\frac{q^{\frac12 n(n+1)}(ea;q^2)_\infty(eq/a;q^2)_\infty(caq/e;q^2)_\infty(cq^2/ae;q^2)_\infty}{(e;q)_\infty(cq/e;q)_\infty}$$

$$\frac{\begin{array}{l} q^{\frac12 n(n+1)}(ea;q^2)_\infty(eq/a;q^2)_\infty \\ \qquad\qquad (caq/e;q^2)_\infty(cq^2/ae;q^2)_\infty \end{array}}{(e;q)_\infty(cq/e;q)_\infty}$$

$$A,\ldots,Z \quad a,\ldots,z \quad \Gamma,\ldots,\Omega \quad \mathit{\Gamma},\ldots,\mathit{\Omega} \quad \alpha,\ldots,\omega$$

$$\aleph_\alpha \times \aleph_\beta = \aleph_\beta \iff \alpha \le \beta$$

$$\forall\varepsilon > \alpha, \mathit{\Gamma}_\alpha \hookrightarrow \mathit{\Gamma}_\varepsilon$$
$$|x-a| < \delta \Rightarrow |f(x)-l| < \varepsilon$$

$$\underbrace{V\times\cdots\times V}_{k}\times\underbrace{V\times\cdots\times V}_{l}\to\underbrace{V\times\cdots\times V}_{k+l}$$

$$\{x \mid x\ne x\} = \emptyset \qquad (A\cap B)^\circ \subset A^\circ \cap B^\circ$$

$$\hat{x} + \widehat{X} + \widehat{xy} + \widehat{xyz} + \vec{A}$$

$$R_{ijkl} = -R_{jikl} = -R_{ijlk} = R_{klij}$$

$$(f \circ g)'(x) = f'(g(x)) \cdot g'(x)$$

$$f(x) = \begin{cases} |x| & x > a \\ -|x| & x \leq a \end{cases}$$

$$\int_{-\infty}^{\infty} e^{-x \cdot x}\, dx = \sqrt{\pi}$$

$$X = \sum_i \xi^i \frac{\partial}{\partial x^i} + \sum_j x^j \frac{\partial}{\partial \dot{x}^j}$$

5.3 Text and Belleek Math Font Tables

The following tables show the complete character sets for the main text font (Times New Roman) and the three Belleek fonts: `blmi`, `blsy`, and `blex`. Each entry in the table should show a character, and should not appear blue in the previewer. Certain entries in the tables will appear as "NE"; this is normal.

Test of Times New Roman (OT1 Encoding)

NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	ff	fi	fl	ffi	ffl
ı	NE	`	´	ˇ	˘	¯	˚	¸	ß	æ	œ	ø	Æ	Œ	Ø
NE	!	”	#	$	%	&	’	(	)	*	+	,	-	.	/
0	1	2	3	4	5	6	7	8	9	:	;	¡	=	¿	?
@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
P	Q	R	S	T	U	V	W	X	Y	Z	[	“	]	ˆ	˙
‘	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
p	q	r	s	t	u	v	w	x	y	z	–	—	˝	˜	¨

NE–Not encoded in font

Test of `blmi` (Belleek Math Italic, MY1 or OML Encoding)

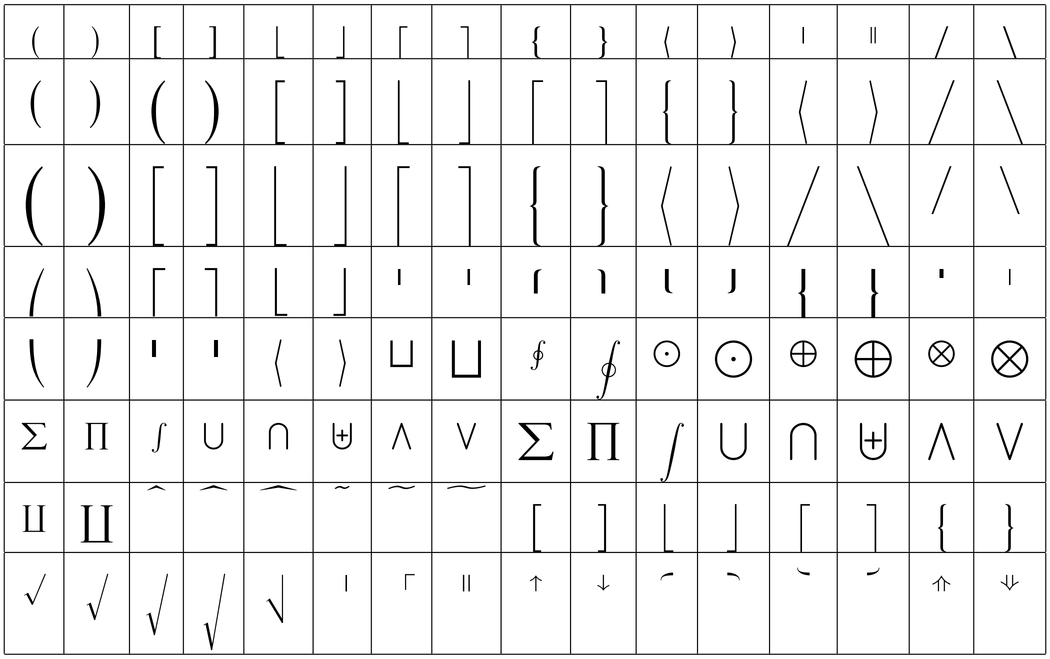
$\mathit{\Gamma}$	$\mathit{\Delta}$	$\mathit{\Theta}$	$\mathit{\Lambda}$	$\mathit{\Xi}$	$\mathit{\Pi}$	$\mathit{\Sigma}$	$\mathit{\Upsilon}$	$\mathit{\Phi}$	$\mathit{\Psi}$	$\mathit{\Omega}$	α	β	γ	δ	ϵ
ζ	η	θ	ι	κ	λ	μ	ν	ξ	π	ρ	σ	τ	υ	ϕ	χ
ψ	ω	ε	ϑ	ϖ	ϱ	ς	φ	$\leftharpoonup$	$\leftharpoondown$	$\rightharpoonup$	$\rightharpoondown$	ͨ	ͻ	(	)
Γ	Δ	Θ	Λ	Ξ	Π	Σ	ϒ	Φ	Ψ	.	,	<	/	>	$\star$
∂	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
P	Q	R	S	T	U	V	W	X	Y	Z	$\flat$	$\natural$	$\sharp$	$\smile$	$\frown$
ℓ	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
p	q	r	s	t	u	v	w	x	y	z	$\imath$	$\jmath$	$\wp$	$\varkappa$	$\mathbf{\Omega}$

Test of `blsy` (Belleek Math Symbols, MY2 or OMS Encoding)

$-$	$\cdot$	$\times$	$\ast$	$\div$	$\diamond$	$\pm$	$\mp$	$\oplus$	$\ominus$	$\otimes$	$\oslash$	$\odot$	$\bigcirc$	$\circ$	$\bullet$
$\asymp$	$\equiv$	$\subseteq$	$\supseteq$	$\leq$	$\geq$	$\preceq$	$\succeq$	$\sim$	$\approx$	$\subset$	$\supset$	$\ll$	$\gg$	$\prec$	$\succ$
$\leftarrow$	$\rightarrow$	$\uparrow$	$\downarrow$	$\leftrightarrow$	$\nearrow$	$\searrow$	$\simeq$	$\Leftarrow$	$\Rightarrow$	$\Uparrow$	$\Downarrow$	$\Leftrightarrow$	$\nwarrow$	$\swarrow$	$\propto$
$\prime$	∞	$\in$	$\ni$	$\triangle$	$\triangledown$	/	¦	$\forall$	$\exists$	$\neg$	$\emptyset$	$\Re$	$\Im$	$\top$	$\bot$
$\aleph$	⌢	$\circ$	$+$	$=$	$\vec{}$	$\triangleright$	$\triangleleft$	$=$	;	`	´	ˇ	˘	¯	ˆ
˙	˜	¨	—	NE	NE	NE	NE	NE	NE	NE	$\cup$	$\cap$	$\uplus$	$\wedge$	$\vee$
$\vdash$	$\dashv$	$\lfloor$	$\rfloor$	$\lceil$	$\rceil$	$\{$	$\}$	$\langle$	$\rangle$	$\vert$	$\Vert$	$\updownarrow$	$\Updownarrow$	$\backslash$	$\wr$
$\surd$	$\amalg$	∇	$\int$	$\sqcup$	$\sqcap$	$\sqsubseteq$	$\sqsupseteq$	NE	NE	NE	NE	$\clubsuit$	$\diamondsuit$	$\heartsuit$	$\spadesuit$

NE–Not encoded in font

Test of `blex` (Belleek Math Extension, MY3 or OMX Encoding)



6 Understanding Technical Details

6.1 How TrueTEX Uses Standard Windows Fonts

The LATEX NFSS (a "new font selection scheme", described in the *LATEX Companion*) rationalizes the font-selection mechanism in LATEX, which in previous versions had been limited and inflexible. An optional LATEX package, collectively and confusingly called "PSNFSS" (PostScript-NFSS, although PostScript is not necessarily involved), instructs LATEX to use various "PostScript" fonts for text, instead of the default Computer Modern fonts. The `times` style from PSNFSS (`times.sty`) is one component of the package; that style switches LATEX to use the Times font for Roman text, the Helvetica font for sans serif text, and the Courier font for typewriter text; where these three type styles roughly correspond to the roman, italic, and typewriter styles presumed to be available in LATEX. The use of the label "PostScript" in the package is a bit of confusion, because the fonts can just as well be implemented in TrueType or other method, and PostScript does not necessarily have any role in the system, as is exhibited in TrueTEX.

The `times` style is written at a high enough level that the version published by the package authors on CTAN can be used without modification in TrueTEX. The style file calls upon various LATEX font definition (`*.fd`) files, but even these files are used in the original form. The `*.fd` files in turn call upon various fonts, and it is here that TrueTEX departs from the PostScript implementation, using TEX virtual fonts to implement the various PostScript fonts called on by `times`, using the TrueType fonts as the actual fonts.

Ultimately, the PSNFSS mechanism resolves characters down to a few "actual fonts" which need not necessarily be PostScript fonts. In TrueTEX, we can implement the same fonts using TrueType fonts in Windows. Indeed, the TrueType multilingual fonts on Windows 95 or NT contain a superset of the PostScript character sets, and contain many TEX characters that are missing from the PostScript fonts (although to preserve compatibility of LATEX documents with PostScript-based implementations we have not exploited this extension). Windows provides TrueType equivalents for the `times` style fonts: Times New Roman (for Times), Arial (for Helvetica), and Courier.

The virtual PSNFSS fonts use common TEX Computer Modern encodings like OT1 or T1 for text. The Times-style math fonts use encodings MY1 for `blmi`, MY2 for `blsy`, and MY3 for `blex`. The text virtual fonts refer in turn to characters in an 8-bit real font encoding known as "8r", which uses undefined codes from the "Adobe Standard Encoding" to encode new characters, and also re-defines other slots for other new characters. The 8r encoding was invented[2] in the context of LATEX for the purpose of re-encoding Type 1 fonts so as to make certain unencoded characters favored by LATEX from the standard set in Type 1 fonts available for 8-bit output. For example, in a PostScript-based implementation, the font `ptmr8r` is the real font Times-Roman in the 8r encoding. In our TrueType and Unicode implementation, we make `ptmr8r` a virtual font which in turn refers to the Times New Roman (TrueType) real font, and which re-maps the PostScript character codes of the 8r encoding to the appropriate Unicode characters in an extended virtual font (`*.xvf`) or 8-bit characters in a standard virtual fonts (`*.vf`).

The following table lists how we have virtualized the PostScript fonts (presumed by the PSNFSS package) using TrueType fonts. The "core" fonts in this implementation use the standard Microsoft fonts Times New, Arial, and Courier. Certain shape variations which are "difficult" to select in LATEX, like the oblique shapes, require additional TrueType fonts not provided with Windows; we have made

[2] The author being Sebastian Rahtz as part of the `fontinst` tools.

certain choices from the widely available font bundle included in Corel Draw. The non-Microsoft fonts typically have smaller character sets (the ANSI characters only), so even if you have the fonts installed, not all characters may be populated in those shapes.

PostScript Real Fonts vs. TrueTEX Virtual Fonts for PSNFSS

"8r"-encoded PSNFSS real font	TrueTEX Windows Face Name[1]	PostScript Font Name	dvips modifier
pcrb8r	courbd	Courier-Bold	
pcrbo8r	courbi	Courier-BoldOblique	
pcrr8r	cour	Courier	
pcrro8r	couri	Courier-Oblique	
phvb8r	arialbd	Helvetica-Bold	
phvb8rn	Switzerland Narrow Bold	Helvetica-Narrow-Bold	
phvbo8r	arialbi	Helvetica-BoldOblique	
phvbo8rn	Switzerland Narrow BdIt	Helvetica-Narrow-BoldOblique	
phvbon8r	Swiss Bold Cond Italic	Helvetica-BoldOblique	.82 ExtendFont
phvbrn8r	Swiss Bold Condensed	Helvetica-Bold	.82 ExtendFont
phvl8r	Swiss Light[2]	Helvetica-Light	
phvlo8r	Swiss Light Italic	Helvetica-LightOblique	
phvr8r	arial	Helvetica	
phvr8rn	Switzerland Narrow Rom	Helvetica-Narrow	
phvro8r	ariali	Helvetica-Oblique	
phvro8rn	Switzerland Narrow Ital	Helvetica-Narrow-Oblique	
phvron8r	Swiss Cond Italic	Helvetica-Oblique	.82 ExtendFont
phvrrn8r	Swiss Condensed	Helvetica	.82 ExtendFont
psyro	Symbol	Symbol	.167 SlantFont
ptmb8r	timesbd	Times-Bold	
ptmbi8r	timesbi	Times-BoldItalic	
ptmbo8r	timesbi[3]	Times-Bold	.167 SlantFont
ptmr8r	times	Times-Roman	
ptmri8r	timesi	Times-Italic	
ptmro8r	timesi[3]	Times-Roman	.167 SlantFont
ptmrre8r	times[3]	Times-Roman	1.2 ExtendFont
ptmrrn8r	times[3]	Times-Roman	.82 ExtendFont

[1] Windows face names are in uppercase; lowercase are TEX equivalent names
[2] "Swiss" is BitStream's Swiss 721
[3] Closest unstretched font

6.2 How TrueTEX Uses the Belleek Math Fonts

The `blsy` and `blex` fonts do not use virtual font mapping, since the actual TrueType fonts implement the "TEX ad hoc" encoding of 7-bit TrueTEX fonts in Windows. The `blmi` font is a virtual font (implemented in files `blmi.vf` and `blmi.xvf`) which maps the `blmi` characters to the two actual TrueType fonts `rblmi` and `timesi` (Times New Roman Italic). In this virtual `blmi`, the alphabet characters A–Z and a–z, and the character dotlessi, map to Times New Roman Italic; all other characters map to `rblmi`.

6.3 How LATEX and the NFSS Access the Fonts

Font selection in LATEX has grown into a gloriously complicated matter, which we can't begin to describe here; instead you should refer to the material in the *LATEX Companion* chapter 7, "Font Selection." There you will be told that the current (new) scheme allows "integrating new font families easily into an existing LATEX system." One has to question how "easy" it is, since switching text requires several hundred lines of `.dtx` code (documented LATEX macros), while switching math requires about 1200 lines! All that can be said is that it is perhaps not as difficult as it could have been in the old scheme.

Be assured, though, that you don't need to know much about LATEX font selection to have it work correctly for you; the styles at least make it easy for you to get what you want. What follow is an explanation of some details of what's happening in the `times` and `mathtime` styles.

At the lowest level, LATEX understands fonts merely by their metrics, as in `.tfm` files. The new scheme also provides a way to specify font encoding in `.def` files, and to specify scaling and shape possibilites in `.fd` files. The TrueTEX Times Option installs a set of font metrics `.tfm`'s for the Windows text fonts and Belleek math fonts. These fonts are similar to the ones presumed in the `times` and `mathtime` styles, and work compatibly with the `.def` and `.fd` tables in the associated PSNFSS package.

So the switch from PostScript fonts to a TrueType implementation is hardly visible to LaTeX at all. Indeed, the only difference is that some of the metrics have changed very slightly. All the same fonts with the same names are apparently available, and those fonts are the ones called for in the DVI output from LaTeX. The isolation from the substitution is finally undone when the DVI translator resolves TeX virtual fonts into actual fonts: all of the PostScript font names which LaTeX used will, during DVI translation of virtual fonts, map to various TrueType fonts. This mapping embodies not merely a substitution of font names, but also an elaborate translation of character codes that matches the PostScript character codes with Unicode equivalents, and even composition of missing characters from other available characters, such as ligatures being composed from concatenated single letters.

6.4 How the LaTeX Styles Switch LaTeX to Use the Fonts

The `times` style is thoroughly simple. It merely switches the default Roman, sans serif, and typewriter fonts to the Times, Helvetica, and Courier fonts. Details of shape and size selection are handled at run time by the NFSS.

Math font switching in the `mathtime` style is far more complex. The style must establish the relevant encodings of the math fonts, and declare the availability of math symbols, operators, and alphabets. Many cases of code locations in fonts for lists of math symbols and accents must be enumerated explicitly.

6.5 Component Files of the TrueTeX Times Option Distribution

Files Specific to the TrueTeX Times Option	
Files	Purpose
`p{cr,hv,tm}{,b,c,i,o}-{,7t,8t,8r}{,n}-{.vf,.xvf,.tfm,.xfm}`	Virtual fonts which simulate various encodings and styles for PostScript (`p`) fonts Times (`tm`), Helvetica (`hv`), and Courier (`cr`). Shape variations can be combinations of bold (`o`), condensed (`c`), italic (`i`), and oblique (`o`). Encoding variations can be 7- or 8-bit bit TeX text (`7t` or `8t`), or 8-bit raw (`8r`). The underlying actual fonts are TrueType fonts standard in Windows: Times New Roman, Arial, and Courier New. The metrics (`.tfm`'s) are derived from the TrueType fonts and are slightly different from those which would be derived from the similar PostScript fonts. The standard virtual font files (`.vf`'s) map references to characters in the virtual PostScript fonts to 8-bit codes in the TrueType actual fonts. The Omega-extended virtual fonts (`.xvf`'s) are similar to the `.vf`'s, but also access extra Unicode characters in the TrueType actual fonts not available with the 8-bit TrueType codes, yielding complete coverage of the PostScript encodings. Since the 8-bit codes of the TrueType fonts do not cover all the characters in the PostScript fonts, the `.vf` virtual fonts are incomplete, and the Omega-extended (`.xvf`) versions are preferred; the `.vf`'s are included for compatibility with non-Omega-capable software. These files might be considered a partial "TrueTeX NFSS" system, analogous to the LaTeX package for PostScript NFSS (PSNFSS). We created these files by exporting metrics from the TrueTeX previewer.
`bl{ex,sy}{.vf,.tfm}`	Metrics for the LaTeX Times-style math extension and symbol fonts, and virtual fonts which translate references from the 7-bit LaTeX fonts to the 7-bit Belleek implementations in TrueType. The math font metrics (`blex.tfm`, `blsy.tfm`) are identical to those presumed in the CTAN PSNFSS package, which provides compatibility with competitive implementations. We created the virtual fonts by exporting metrics from the TrueTeX previewer.
`blmi.tfm`, `blmi.vf`, `blmi.xvf`, `rblmi.tfm`	Metrics for the LaTeX Times-style math italic font, plus a virtual font (both standard and Omega-extended versions) which translates references from the 7-bit LaTeX font to the 7-bit Belleek implementation in TrueType (in most cases) or to TrueType Times New Roman (in certain other cases). This virtual font (`blmi`) is different in two regards from the two other virtual fonts (`blex` and `blsy`): (1) since it is composed from two actual fonts, another virtual level is required, thus the extra `rblmi` font, and (2) since the actual characters used in Times New Roman are in Unicode positions, an Omega-extended virtual font is used (`blmi.xvf`). The math font metrics (`blmi.tfm`) are identical to those presumed in the CTAN PSNFSS package, which provides compatibility with competitive implementations. We created the virtual font by exporting metrics from the previewer. The metrics for the raw TrueType font are also included for completeness.
`*.cod`	TrueTeX encoding tables for the Belleek math font encodings. We used these to export virtual fonts from the TrueTeX Previewer. Experts can use these encoding specifications to modify the software.
`{blex,blsy,rblmi}.ttf`	TrueType font files for the Belleek math fonts. The TrueTeX Times Option Setup disk(s) install these fonts into your Windows system. We created the fonts using a graphical font editor and proprietary software tools, including `ttf_edit`.
`arial*.tfm`, `times*.tfm`, and `cour*.tfm`	Metrics (provided for completeness) for the raw TrueType fonts. These are not really usable, because the raw fonts are not in an encoding TeX can use directly, but they are needed for `.vf` to `.vpl` (or `.xvf` to `.xpl`) conversion, and vice versa. We generated these files by exporting metrics from the TrueTeX previewer.

Files (unmodified) from the CTAN PSNFSS Distribution	
Files	Purpose
`times.sty`	Style file which switches LaTeX text mode to use Times, Helvetica, and Courier fonts instead of Computer Modern Roman, sans serif, and typewriter. Calls on various LaTeX font definition files (`{8r,oml,oms,ot1,t1}{pcr,phv,ptm}.fd`).
`mathtime.sty`	Style file which switches LaTeX math mode to use Times-style math fonts instead of Computer Modern math extension, math symbols, and math italic. Calls on various LaTeX font definition files (`my{1,2,3}mtt.fd`). Also calls on `times.sty` to switch text mode to use Times fonts, if that switch has not yet been made in the LaTeX document.
`{8r,oml,oms,ot1,t1}-{pcr,phv,ptm}.fd`	LaTeX NFSS text font definition files for the various shapes, sizes, and encodings of Times Roman, Helvetica, and Courier virtual fonts. These also assign a virtual font name to each variant. Each combination of encoding and typeface has its own `.fd` file; then each `.fd` file in turn defines a number of shape variations, such as bold and italic.
`my{1,2,3}mtt.fd`	Current versions of the LaTeX NFSS math font definition files for various encodings of Times-style math fonts for LaTeX. These three encodings are close to, but not identical to, the OML-OMS-OMX encodings of the Computer Modern math fonts. These font definition files also assign a font name to each variant; for the TrueTeX Times Option the assignment is to the Belleek math fonts `blex`, `blmi`, and `blsy`; which is a slight change from the way the files appear on CTAN.