Concrete Math font, OTF version

Daniel Flipo
daniel.flipo@free.fr
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1 What is concmath-otf?

The concmath-otf package offers an Opentype version of the Concrete Math font created by Ulrik Vieth in MetaFont. concmath-otf.sty is a replacement for the original concmath.sty package.

It requires LuaTeX or XeTeX as engine and the unicode-math package\(^1\).

Please note that the current version (0.20) is experimental, do expect metrics and glyphs to change until version 1.0 is reached. Comments, suggestions and bug reports are welcome!

2 Usage

2.1 Calling \setmathfont

A basic call for concmath-otf would be:

\usepackage{unicode-math}
\setmathfont{Concrete-Math.otf} % Call by file name or
\setmathfont{Concrete Math} % Call by font name

this loads concmath-otf as math font with the default options, see subsections 3.1 on the following page, 3.2 on page 3 and 3.3 on page 4 for customisation.

Please note that the three sets of text fonts have to be chosen separately, f.i. if you want the Concrete text fonts\(^2\) as Roman font:

\setmainfont{cmunorm.otf}

[\BoldFont = \ cmunobx.otf ,
ItalicFont = \ cmunoti.otf ,
\BoldItalicFont = \ cmunobi.otf ]

otherwise you would get Latin Modern for text fonts (rm, sf and tt).

\(^1\)Please read the documentation unicode-math.pdf.
\(^2\)They are part of the cm-unicode package.
2.2 Calling concmat-otf.sty

A (recommended) alternative is:
\usepackage[options]{concmath-otf}

it loads unicode-math with the default options, sets Concrete-Math as Math font and Concrete Text fonts as Roman fonts (families sf and tt left unchanged) but does a bit more:

1. it checks at \begin{document} if packages amssymb or latexsym are loaded and issues warnings in case they are;
2. it provides aliases for glyphs named differently in Unicode, so that latexsym or AMS names are also available;
3. it reduces spacing in math mode: \thinmuskip, \medmuskip and \thickmuskip are reduced as in fourier.sty. The option loose disables these settings.

Apart from the loose option mentioned above, concmath-otf.sty provides an option no-text to be used for loading the concmath-otf font together with roman text fonts other than Concrete.

3 What is provided?

concmath-otf provides all glyphs available in the concmath, amssymb and latexsym packages and more. Therefore, these two packages should not be loaded as they might override concmath-otf glyphs.

Sans-serif, typewriter glyphs are not supplied. A full list of available glyphs is shown in file unimath-concrete.pdf.

See in section 3.5 on page 6 how to choose from other Math fonts for these styles.

3.1 Upright or slanted?

Package unicode-math follows \TeX conventions for Latin and Greek letters: in math mode, the default option (math-style=\TeX) prints Latin letters a...z A...Z and lowercase greek letters \alpha...\omega slanted (italic) while uppercase greek letters \Gamma...\Omega are printed upright. This can be changed by option math-style as shown in table 1 on the following page.

Bold letters are printed upright except lowercase Greek letters which are slanted (the default option is bold-style=\TeX). This can be changed by option bold-style as shown in table 2 on the next page.

Other possible customisation: \nabla is printed upright and \partial is printed slanted by default, but nabla=italic and partial=upright can change this.

\footnote{Possible options are loose, no-text, Scale= or any of the options described in sections 3.1, 3.2 and 3.3.}
Table 1: Effects of the math-style package option.

<table>
<thead>
<tr>
<th>Package option</th>
<th>Latin</th>
<th>Greek</th>
</tr>
</thead>
<tbody>
<tr>
<td>math-style=ISO</td>
<td>$(a, z, B, X)$</td>
<td>$(\alpha, \beta, \Gamma, \Xi)$</td>
</tr>
<tr>
<td>math-style=TeX</td>
<td>$(a, z, B, X)$</td>
<td>$(\alpha, \beta, \Gamma, \Xi)$</td>
</tr>
<tr>
<td>math-style=french</td>
<td>$(a, z, B, X)$</td>
<td>$(\alpha, \beta, \Gamma, \Xi)$</td>
</tr>
<tr>
<td>math-style=upright</td>
<td>$(a, z, B, X)$</td>
<td>$(\alpha, \beta, \Gamma, \Xi)$</td>
</tr>
</tbody>
</table>

Table 2: Effects of the bold-style package option.

<table>
<thead>
<tr>
<th>Package option</th>
<th>Latin</th>
<th>Greek</th>
</tr>
</thead>
<tbody>
<tr>
<td>bold-style=ISO</td>
<td>$(a, z, B, X)$</td>
<td>$(\alpha, \beta, \Gamma, \Xi)$</td>
</tr>
<tr>
<td>bold-style=TeX</td>
<td>$(a, z, B, X)$</td>
<td>$(\alpha, \beta, \Gamma, \Xi)$</td>
</tr>
<tr>
<td>bold-style=upright</td>
<td>$(a, z, B, X)$</td>
<td>$(\alpha, \beta, \Gamma, \Xi)$</td>
</tr>
</tbody>
</table>

All these options are offered by the unicode-math package but they can be added to the \setmathfont call\(^4\), for example:

```
\setmathfont{Concrete-Math.otf}[math-style=french,partial=upright]
```

will print for the code

\[
\frac{\partial f}{\partial x} = \alpha \mathbf{V} + a \nabla \Gamma + \beta \mathbf{M}
\]

while the default settings would print

\[
\frac{\partial f}{\partial x} = \alpha \mathbf{V} + a \nabla \Gamma + \beta \mathbf{M}
\]

Both shapes remain available anytime: $\uppi, \itpi$ prints $\pi, \pi$.

If your text editor is able to handle greek letters or math symbols, they can be entered in the code instead control sequences (i.e. $\alpha, \beta, \Gamma, ...$ for \alpha, \beta, \Gamma, ...).

### 3.2 Character variants

concmath-otf provides ten “Character Variants” options, listed on table 3 on the following page, to choose between different glyphs for Greek characters and some others.

For instance, to get \epsilon and \phi typeset as $\varepsilon$ and $\phi$ instead of $\epsilon$ and $\varphi$, you can add option CharacterVariant={$3,6$} to the \setmathfont call:

```
\setmathfont{Concrete-Math.otf}[CharacterVariant={$3,6$}]
```

\(^4\)IMHO it is easier to add all options to the \setmathfont command.
Table 3: Character variants.

<table>
<thead>
<tr>
<th>Default</th>
<th>Variant</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>cv01</td>
<td>ℏ</td>
<td>ℏslash</td>
</tr>
<tr>
<td>cv02</td>
<td>∅</td>
<td>∅emptyset</td>
</tr>
<tr>
<td>cv03</td>
<td>ε</td>
<td>εepsilon</td>
</tr>
<tr>
<td>cv04</td>
<td>κ</td>
<td>κkappa</td>
</tr>
<tr>
<td>cv05</td>
<td>π</td>
<td>πpi</td>
</tr>
<tr>
<td>cv06</td>
<td>φ</td>
<td>φphi</td>
</tr>
<tr>
<td>cv07</td>
<td>ρ</td>
<td>ρrho</td>
</tr>
<tr>
<td>cv08</td>
<td>σ</td>
<td>σsigma</td>
</tr>
<tr>
<td>cv09</td>
<td>θ</td>
<td>θtheta</td>
</tr>
<tr>
<td>cv10</td>
<td>Θ</td>
<td>ΘTheta</td>
</tr>
</tbody>
</table>

This works for all shapes and weights of these characters: f.i. \$\symbf{\epsilon}\$, \$\symbf{\phi}\$ are output as $\epsilon$, $\varphi$ instead of $\epsilon$, $\phi$.

Similarly with math-style=french, \$\epsilon\$ and \$\phi\$ are output as $\epsilon$ and $\varphi$ (upright).

Please note that curly braces are mandatory whenever more than one “Character Variant” is selected.

Note: unicode-math defines \hbar as \hslash (U+210F) while amsmath provides two different glyphs (italic h with horizontal or diagonal stroke).

concmath-otf follows unicode-math; the italic h with horizontal stroke can be printed using \hslash or \hbar together with character variant cv01 or with \mithbar (replacement for AMS' command \hbar).

3.3 Stylistic sets

concmath-otf provides four “Stylistic Sets” options to choose between different glyphs for families of mathematical symbols.

StylisticSet=4, alias Style=leqslant, converts (large) inequalities into their slanted variants as shown by table 5a on the next page.

StylisticSet=5, alias Style=smaller, converts some symbols into their smaller variants as shown by table 5b on the following page.

StylisticSet=6, alias Style=subsetneq, converts some inclusion symbols as shown by table 5 on the next page.

To enable Stylistic Sets 4 and 6 for concmath-otf, you should enter

\setmathfont{Concrete-Math.otf}[StylisticSet={4,6}] or \usepackage[Style={leqslant,subsetneq}]{concmath-otf}

then, \$x\leq y \quad A \subsetneq B\$ will print as $x \leq y \quad A \subsetneq B$ instead of $x \leq y \quad A \subseteq B$

These Style aliases are provided by concmath-otf.sty.
Table 4: Stylistic Sets 4 and 5

<table>
<thead>
<tr>
<th>Command</th>
<th>Default</th>
<th>Variant</th>
</tr>
</thead>
<tbody>
<tr>
<td>\leq</td>
<td>≤</td>
<td></td>
</tr>
<tr>
<td>\geq</td>
<td>≥</td>
<td></td>
</tr>
<tr>
<td>\nleq</td>
<td>≰</td>
<td></td>
</tr>
<tr>
<td>\ngeq</td>
<td>≱</td>
<td></td>
</tr>
<tr>
<td>\eqless</td>
<td>⪕</td>
<td></td>
</tr>
<tr>
<td>\eqgtr</td>
<td>⪖</td>
<td></td>
</tr>
</tbody>
</table>

Table 5: Stylistic Sets 6

<table>
<thead>
<tr>
<th>Command</th>
<th>Default</th>
<th>Variant</th>
</tr>
</thead>
<tbody>
<tr>
<td>\subsetneq</td>
<td>⊊</td>
<td></td>
</tr>
<tr>
<td>\supsetneq</td>
<td>⊋</td>
<td></td>
</tr>
<tr>
<td>\subsetneqq</td>
<td>⫋</td>
<td></td>
</tr>
<tr>
<td>\supsetneqq</td>
<td>⫌</td>
<td></td>
</tr>
</tbody>
</table>

3.4 Standard \LaTeX math commands

All standard \LaTeX math commands, all amssymb commands and all latexsym commands are supported by concmath-otf, for some of them loading concmath-otf.sty is required.

Various wide accents are also supported:

- \widehat and \widetilde
  \[ \hat{x} \widehat{x} \widehat{xx} \widehat{xxx} \widehat{xxxx} \widehat{xxxxx} \widehat{xxxxxx} \]

- \overline and \underline
  \[ \bar{x} \overline{x} \underline{x} \underline{xy} \underline{xyz} \]

- \wideoverbar: \[ \overline{x} \overline{xy} \overline{xyz} \]

- \overparen and \underparen
  \[ \overparen{x} \overparen{xy} \overparen{xyz} \underparen{xy} \underparen{xyz} \]
\[
x \quad xx \quad xyz \quad \frac{x+z}{2} \quad a+b+...+z
\]

- \texttt{\overbrace} and \texttt{\underbrace}

\[
\overbrace{a} \quad \overbrace{ab} \quad \overbrace{abc} \quad \overbrace{abcd} \quad \overbrace{abcde} \quad \frac{3}{3} \quad \overbrace{a+b+c} \quad \overbrace{a+b+...+z} \quad \frac{26}{26}
\]

- \texttt{\overrightarrow} and \texttt{\overleftarrow}

\[
\overrightarrow{\nu} \quad \overrightarrow{M} \quad \overrightarrow{\nu \nu} \quad \overrightarrow{AB} \quad \overrightarrow{ABC} \quad \overrightarrow{ABCD} \quad \overrightarrow{ABCDEFGH}.
\]

\[
\overleftarrow{\nu} \quad \overleftarrow{M} \quad \overleftarrow{\nu \nu} \quad \overleftarrow{AB} \quad \overleftarrow{ABC} \quad \overleftarrow{ABCD} \quad \overleftarrow{ABCDEFGH}
\]

- Finally \texttt{\widearc} and \texttt{\overrightarc} (loading concmath-otf.sty is required)

\[
\overarc{AMB} \quad \overarc{AMB}
\]

### 3.5 Mathematical alphabets

- All Latin and Greek characters are available in italic, upright, bold and bold italic via the \texttt{\symit{}}, \texttt{\symup{}}, \texttt{\symbf{}}, and \texttt{\symbfit{}} commands.

- Calligraphic alphabet (\texttt{\symscr} or \texttt{\symcal} or \texttt{\mathcal} command), uppercase:

\[
\mathcal{ABCDEFGHIJKLMNOPQRSTUVWXYZ}
\]

- Blackboard-bold alphabet (\texttt{\symbb} or \texttt{\mathbb} command), uppercase only except lowercase \texttt{\textbackslash Bbbk} (AMS)

\[
\text{\textbackslash Bbbk}\quad\mathbb{ABCDEFGHIJKLMNOPQRSTUVWXYZ}\quad k
\]

- Fraktur alphabet, borrowed from Latin Modern

\[
\text{\textbackslash setmathfont{Asana-Math.otf}[range=frak,Scale=MatchUppercase]}\quad \texttt{\symfrak{ABCDEFGHIJKLMNOPQRSTUVWXYZ}...abcdefghijklmnopqrstuvwxyz}
\]

but this can overwritten, i.e.

\[
\mathfrak{ABCDEFGHIJKLMNOPQRSTUVWXYZ}...abcdefghijklmnopqrstuvwxyz
\]

- Sans serif and Typewriter alphabets have to be imported, i.e.
3.6 Missing symbols

concmath-otf does not aim at being as complete as STIXTwoMath-Regular or Cambria, the current glyph coverage compares with TeXGyre Math fonts. In case some symbols do not show up in the output file, you will see warnings in the .log file, for instance:

Missing character: There is no ⇒ (U+2964) in font ErewhonMath

Borrowing them from a more complete font, say Asana-Math, is a possible workaround:
\setmathfont{Asana-Math.otf}[range={"2964"},Scale=1.02] scaling is possible, multiple character ranges are separated with commas:
\setmathfont{Asana-Math.otf}[range={"294A-"2951,"2964,"2ABB-"2ABE"}]

Let’s mention albatross, a useful tool to find out the list of fonts providing a given glyph: f.i. type in a terminal “albatross U+2964”, see the manpage or albatross-manual.pdf.

4 Acknowledgements

The original Metafont glyphs have been converted first to Type1 (pfa) using mftrace and fontforge. The cm-unicode package has also helped a lot while cleaning the glyphs.

I am grateful to George Williams and his co-workers for providing and maintaining FontForge and to Ulrik Vieth for his illuminating paper published in TUGboat 2009 Volume 30 about Open Type Math.