

# Concrete Math font, OTF version

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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<sup>1</sup>.

Please note that the current version (0.61) 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 file name
```

this loads concmath-otf as maths font <sup>2</sup> 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<sup>3</sup> as Roman font:

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<sup>1</sup>Please read the documentation unicode-math.pdf.

<sup>2</sup>Both calls work equally well with LuaTeX; with XeTeX a call by font name will fail unless the font is declared as a *system font*.

<sup>3</sup>They are part of the cm-unicode package.

```
\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).

## 2.2 Calling concmath-otf.sty

A (recommended) alternative is:

```
\usepackage[ options 4 ]{concmath-otf}
```

it loads `unicode-math` with the default options, sets Concrete-Math as maths 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 maths 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.

A full list of available glyphs is shown in file `unimath-concrete.pdf`.

See in section 3.5 on page 7 how to choose from other maths 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  $a\dots z$   $A\dots Z$  and lowercase Greek letters  $\alpha\dots\omega$  slanted (italic) while uppercase Greek letters  $\text{A}\Gamma\dots\Omega$  are printed upright. This can be changed by option `math-style` as shown in table 1 on the following page.

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<sup>4</sup>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.

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

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.

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

Package option	Latin	Greek
<code>bold-style=ISO</code>	$(a, z, B, X)$	$(\alpha, \beta, \Gamma, \Xi)$
<code>bold-style=TeX</code>	$(\mathbf{a}, \mathbf{z}, \mathbf{B}, \mathbf{X})$	$(\alpha, \beta, \Gamma, \Xi)$
<code>bold-style=upright</code>	$(\mathbf{a}, \mathbf{z}, \mathbf{B}, \mathbf{X})$	$(\alpha, \beta, \Gamma, \Xi)$

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

All these options are offered by the `unicode-math` package but they can be added to the `\setmathfont` call<sup>5</sup>, for example:

`\setmathfont{Concrete-Math.otf}[math-style=french,partial=upright]`  
will print for the code

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

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

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: `\muppi`, `\mitpi` prints  $\pi, \pi$ .

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

## 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.

<sup>5</sup>IMHO it is easier to add *all options* to the `\setmathfont` command.

Table 3: Character variants.

	Default	Variant	Name
cv01	$\hbar$	$\hbar$	<code>\hslash</code>
cv02	$\emptyset$	$\emptyset$	<code>\emptyset</code>
cv03	$\epsilon$	$\epsilon$	<code>\epsilon</code>
cv04	$\kappa$	$\kappa$	<code>\kappa</code>
cv05	$\pi$	$\varpi$	<code>\pi</code>
cv06	$\phi$	$\varphi$	<code>\phi</code>
cv07	$\rho$	$\varrho$	<code>\rho</code>
cv08	$\sigma$	$\varsigma$	<code>\sigma</code>
cv09	$\theta$	$\vartheta$	<code>\theta</code>
cv10	$\Theta$	$\Theta$	<code>\Theta</code>

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

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

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 maths symbols.

`StylisticSet=4`, alias<sup>6</sup> `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

<sup>6</sup>These Style aliases are provided by `concmath-otf.sty`.

Table 4: Stylistic Sets 4 and 5

(a) Style=leqslant (+ss04)			(b) Style=smaller (+ss05)		
Command	Default	Variant	Command	Default	Variant
<code>\leq</code>	$\leq$	$\leqslant$	<code>\in</code>	$\in$	$\in$
<code>\geq</code>	$\geq$	$\geqslant$	<code>\ni</code>	$\ni$	$\ni$
<code>\nleq</code>	$\not\leq$	$\not\leqslant$	<code>\mid</code>	$ $	$ $
<code>\ngeq</code>	$\not\geq$	$\not\geqslant$	<code>\nmid</code>	$\nmid$	$\nmid$
<code>\leqq</code>	$\leq\leq$	$\leq\leqslant$	<code>\parallel</code>	$\parallel$	$\parallel$
<code>\geqq</code>	$\geq\geq$	$\geq\geqslant$	<code>\nparallel</code>	$\nparallel$	$\nparallel$
<code>\nleqq</code>	$\not\leq\leq$	$\not\leq\leqslant$			
<code>\ngeqq</code>	$\not\geq\geq$	$\not\geq\geqslant$			
<code>\eqless</code>	$\lessdot$	$\lessdot$			
<code>\eqgtr</code>	$\gtrdot$	$\gtrdot$			
<code>\lesseqgtr</code>	$\lesseqgtr$	$\lesseqgtr$			
<code>\gtreqless</code>	$\gtreqless$	$\gtreqless$			
<code>\lesseqqgtr</code>	$\lesseqqgtr$	$\lesseqqgtr$			
<code>\gtreqqless</code>	$\gtreqqless$	$\gtreqqless$			

Table 5: Stylistic Sets 6

Command	Default	Variant
<code>\subsetneq</code>	$\subsetneq$	$\subsetneq$
<code>\supsetneq</code>	$\supsetneq$	$\supsetneq$
<code>\subsetneqq</code>	$\subsetneqq$	$\subsetneqq$
<code>\supsetneqq</code>	$\supsetneqq$	$\supsetneqq$

`\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  $x \leq y \quad A \subsetneq B$

StylisticSet=3, alias<sup>7</sup> Style=upint, converts integrals signs into their upright variants, see table 6 on the following page.

### 3.4 Standard L<sup>A</sup>T<sub>E</sub>X math commands

All standard L<sup>A</sup>T<sub>E</sub>X maths 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:

<sup>7</sup>These Style aliases are provided by concmath-otf.sty.

Table 6: Style=upint (+ss03)

Command	<code>\int</code>	<code>\iint</code>	<code>\iiint</code>	<code>\iiiiint</code>	<code>\oint</code>	<code>\oiint</code>	<code>\oiiint</code>	
Default	$\int$	$\iint$	$\iiint$	$\iiiiint$	$\oint$	$\oiint$	$\oiiint$	
Upright	$\int$	$\iint$	$\iiint$	$\iiiiint$	$\oint$	$\oiint$	$\oiiint$	

Command	<code>\intclockwise</code>	<code>\awint</code>	<code>\varointclockwise</code>	<code>\ointctrckwise</code>
Default	$\int$	$\int$	$\oint$	$\oint$
Upright	$\int$	$\int$	$\oint$	$\oint$

- `\wideoverbar` and `\mathunderbar`<sup>8</sup>

$$\bar{x} \quad \overline{xy} \quad \overline{xyz} \quad \overline{A \cup B} \quad \overline{A \cup (B \cap C) \cup D} \quad \underline{m+n+p}$$

- `\widehat` and `\widetilde`

$$\hat{x} \quad \widehat{xx} \quad \widehat{xxx} \quad \widehat{xxxx} \quad \widehat{xxxxx} \quad \widetilde{x} \quad \widetilde{xx} \quad \widetilde{xxx} \quad \widetilde{xxxx} \quad \widetilde{xxxxx}$$

- `\widecheck` and `\widebreve`

$$\check{x} \quad \widecheck{xxx} \quad \widecheck{xxxx} \quad \breve{x} \quad \widebreve{xxx} \quad \widebreve{xxxx}$$

- `\overparen` and `\underparen`

$$\overparen{x} \quad \overparen{xy} \quad \overparen{xyz} \quad \overparen{A \cup B} \quad \overparen{A \cup (B \cap C) \cup D} \quad \overparen{x+y} \quad \overparen{a+b+\dots+z}$$

$$\underparen{x} \quad \underparen{xz} \quad \underparen{xyz} \quad \underparen{x+z} \quad \underparen{a+b+\dots+z}$$

- `\overbrace` and `\underbrace`

$$\overbrace{a} \quad \overbrace{ab} \quad \overbrace{abc} \quad \overbrace{abcd} \quad \overbrace{abcde} \quad \overbrace{a+b+c}^3 \quad \overbrace{a+b+\dots+z}^{26}$$

$$\underbrace{a} \quad \underbrace{ab} \quad \underbrace{abc} \quad \underbrace{abcd} \quad \underbrace{abcde} \quad \underbrace{a+b+c}_3 \quad \underbrace{a+b+\dots+z}_{26}$$

<sup>8</sup>`\overline` and `\underline` are not font related, they are based on `\rule`.

- `\overbracket` and `\underbracket`

$$\overline{a} \quad \overline{ab} \quad \overline{abc} \quad \overline{abcd} \quad \overline{abcde} \quad \overbrace{a+b+c}^3 \quad \overbrace{a+b+\dots+z}^{26}$$

$$\underline{a} \quad \underline{ab} \quad \underline{abc} \quad \underline{abcd} \quad \underline{abcde} \quad \underbrace{a+b+c}_3 \quad \underbrace{a+b+\dots+z}_{26}$$

- `\overrightarrow` and `\overleftarrow`

$$\overrightarrow{v} \quad \overrightarrow{M} \quad \overrightarrow{vv} \quad \overrightarrow{AB} \quad \overrightarrow{ABC} \quad \overrightarrow{ABCD} \quad \overrightarrow{ABCDEFGH}$$

$$\overleftarrow{v} \quad \overleftarrow{M} \quad \overleftarrow{vv} \quad \overleftarrow{AB} \quad \overleftarrow{ABC} \quad \overleftarrow{ABCD} \quad \overleftarrow{ABCDEFGH}$$

- `\overrightarrow` and `\overleftarrow`

$$\overrightarrow{v} \quad \overrightarrow{M} \quad \overrightarrow{vv} \quad \overrightarrow{AB} \quad \overrightarrow{ABC} \quad \overrightarrow{ABCD} \quad \overrightarrow{ABCDEFGH}$$

$$\overleftarrow{v} \quad \overleftarrow{M} \quad \overleftarrow{vv} \quad \overleftarrow{AB} \quad \overleftarrow{ABC} \quad \overleftarrow{ABCD} \quad \overleftarrow{ABCDEFGH}$$

- `\underrightarrow` and `\underleftarrow`

$$\underrightarrow{v} \quad \underrightarrow{M} \quad \underrightarrow{vv} \quad \underrightarrow{AB} \quad \underrightarrow{ABC} \quad \underrightarrow{ABCD} \quad \underrightarrow{ABCDEFGH}$$

$$\underleftarrow{v} \quad \underleftarrow{M} \quad \underleftarrow{vv} \quad \underleftarrow{AB} \quad \underleftarrow{ABC} \quad \underleftarrow{ABCD} \quad \underleftarrow{ABCDEFGH}$$

- `\underrightarrow` and `\underleftarrow`

$$\underrightarrow{v} \quad \underrightarrow{M} \quad \underrightarrow{vv} \quad \underrightarrow{AB} \quad \underrightarrow{ABC} \quad \underrightarrow{ABCD} \quad \underrightarrow{ABCDEFGH}$$

$$\underleftarrow{v} \quad \underleftarrow{M} \quad \underleftarrow{vv} \quad \underleftarrow{AB} \quad \underleftarrow{ABC} \quad \underleftarrow{ABCD} \quad \underleftarrow{ABCDEFGH}$$

- Finally `\widearc` and `\overrightarrow` (loading `concmath-otf.sty` is required)

$$\widearc{AMB} \quad \overrightarrow{AMB}$$

### 3.5 Mathematical alphabets

- All Latin and Greek characters are available in italic, upright, bold and bold italic via the `\symit{}`, `\symup{}`, `\symbf{}` and `\symbfit{}` commands.
- Calligraphic alphabet uppercase only (commands `\symscr` or `\symcal`), also in Bold (commands `\symbfscr` or `\symbfcal`):

*ABCDEFGHIJKLMN OPQRSTUVWXYZ*  
***ABCDEFGHIJKLMN OPQRSTUVWXYZ***

- Blackboard-bold alphabet (`\symbb` or `\mathbb` command):

ABCDEFGHIJKLMN OPQRSTUVWXYZ  
 abcdefghijklmnopqrstuvwxyz 0123456789

- Fraktur alphabet, borrowed from Latin Modern:

$\mathfrak{ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz}$   
 any alphabet can be overwritten, i.e.

```
\setmathfont{Asana-Math.otf}[range=frak,Scale=MatchUppercase]
$\symfrac{ABCDEFGHIJKL...XYZ abcdefghijkl...xyz}$
```

$\mathfrak{ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz}$

- Sans-serif (Latin and Greek) and Typewriter (Latin) alphabets (commands  $\backslash\symsfup\{\}$ ,  $\backslash\symsfit\{\}$ ,  $\backslash\symsbfup\{\}$ ,  $\backslash\symsbfit\{\}$ ,  $\backslash\symtt\{\}$ ):

$\text{ABCDEFGHIJKLMabcdefghijklm NOPQRSTUVWXYZnopqrstuvwxyz}$

$\text{ABΓΔΕΖΗΘΙΚΛΜαβγδεζηθικλμ ΝΞΟΠΡΣΤΥΦΧΨΩνξοπρστυφχψω}$

$\text{ABCDEFGHIJKLMN OPQRSTUVWXYZabcdefghijklmnopqr stuvwxyz}$

### 3.6 Bold variant

In case short maths formulas have to be printed in section titles, a *limited* bold variant has been added in version 0.60. Example of usage:

```
\setmathfont{Concrete-Math-Bold.otf}[version=bold, options]
\section{\mathversion{bold} Einstein's equation  $E=mc^2$ }
```

It is also possible to use the  $\backslash\boldmath$  command if the BoldFont has been declared when defining Concrete-Math:

```
\setmathfont{Concrete-Math-Regular.otf}[BoldFont=Concrete-Math-Bold.otf]
\section{\boldmath Einstein's equation  $E=mc^2$ }
```

### 3.7 Missing symbols

concmath-otf does not aim at being as complete as STIXTwoMath-Regular or Cambria, the current glyph coverage compares with TeXGyre maths 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  $\Rightarrow$  (U+2964) in font ConcreteMath

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 `OpenType Math`.