

This Way

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Mixed Normal and Bold Math
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This time we discuss how to deal with bold formula components. Depending on the field, whole formulas can be bold, or only parts of formulas, most noticeably symbols.

Internally \TeX uses a concept of families. Each family has three members: text, script and scriptscript. Fonts are bound to families. Each math symbol comes from a family and can have additional characteristics. While typesetting a formula \TeX sometimes overloads the predefined characteristics. Let's see what happens when we switch fonts.

```
\startformula
e = m c^2
\stopformula
```

```
\startformula
\bf e = m c^2
\stopformula
```

```
\startformula
e = {\bf m} c^2
\stopformula
```

Because \TeX sees text and numbers, it will apply the bold font to each component inside the scope of the font switch.

$$e = mc^2$$

$$\mathbf{e} = \mathbf{m}c^2$$

$$e = \mathbf{m}c^2$$

Special symbols behave differently as we will see in the next example.

```
\startformula
\alpha = \Gamma - 3
\stopformula
```

```
\startformula
\bf \alpha = \Gamma + x - 3
\stopformula
```

```
\startformula
\alpha = {\bf \Gamma + x} - 3
\stopformula
```

```
\startformula
\alpha = {\bf\mr \Gamma + x} - 3
\stopformula
```

In the third case \TeX will automatically change the family of the Γ into the current family (being bold) which means that we depend on the bold font having such a

symbol. This is true for the Computer Modern Roman, but not for the Palatino used in this document. An escape is using `\mr` which sets the family to zero which in this case results in a symbol being typeset, but only when the normal math text font has such a symbol, which is not always true.

$$\alpha = \Gamma - 3$$

$$\alpha = + \mathbf{x} - 3$$

$$\alpha = + \mathbf{x} - 3$$

$$\alpha = \Gamma + \mathbf{x} - 3$$

It may be clear that for typesetting bold math, we cannot rely on the `\bf` font switch. In case you wonder why we use families for text bold: by using families such text can adapt itself to situations where script fonts are needed.

For demonstrating the handling of bold math, we use a typeface that provides them: Lucida Bright. First we define a main typeface.

```
\definetypeface [mainface] [rm] [serif] [lucida] [default]
\definetypeface [mainface] [tt] [mono] [lucida] [default]
\definetypeface [mainface] [ss] [sans] [lucida] [default]
\definetypeface [mainface] [mm] [math] [lucida] [default]
```

We enable this typeface with:

```
\switchtobodyfont [mainface]
```

A simple nonsense formula now looks like:

$$x = \Gamma + \Delta + \alpha + \delta + \zeta$$

This is keyed in as:

```
\startformula
  x = \Gamma + \Delta + \alpha + \delta + \zeta
\stopformula
```

Next we define an extra typeface, one that has bold math:

```
\definetypeface [boldmath] [rm] [serif] [lucida] [default]
\definetypeface [boldmath] [tt] [mono] [lucida] [default]
\definetypeface [boldmath] [ss] [sans] [lucida] [default]
\definetypeface [boldmath] [mm] [boldmath] [lucida] [default]
```

Watch the difference between those two typefaces:

```

 $\mainface x=10 \Gamma \Delta \alpha \delta \zeta$ 
 $\boldmath x=10 \Gamma \Delta \alpha \delta \zeta$ 

```

 $x = 10\alpha\delta\zeta$
 $x = \mathbf{10\alpha\delta\zeta}$

There is a more convenient way to switch between normal and bold, as is demonstrated in the following examples:

```

\startformula
  x = \Gamma + \Delta + \alpha + \delta + \zeta
\stopformula

```

```

\startformula[mainface]
  x = \Gamma + \Delta + \alpha + \delta + \zeta
\stopformula

```

```

\startformula[boldmath]
  x = \Gamma + \Delta + \alpha + \delta + \zeta
\stopformula

```

```

\startformula[boldmath,8pt]
  x = \Gamma + \Delta + \alpha + \delta + \zeta
\stopformula

```

```

\startformula[boldmath,12pt,small]
  x = \Gamma + \Delta + \alpha + \delta + \zeta
\stopformula

```

```

\startformula[boldmath,small]
  x = \Gamma + \Delta + \alpha + \delta + \zeta
\stopformula

```

```

\startformula[boldmath,10pt]
  x = \Gamma + \Delta + \alpha + \delta + \zeta
\stopformula

```

```

\startformula[boldmath,11pt,small]
  x = \Gamma + \Delta + \alpha + \delta + \zeta
\stopformula

```

```

\startformula[boldmath,9pt]
  x = \Gamma + \Delta + \alpha + \delta + \zeta
\stopformula

```

Changing the bodyfont size nearly always leads to suboptimal spacing between paragraphs (and formulas).

$$x = \Gamma + \Delta + \alpha + \delta + \zeta$$

$$x = \Gamma + \Delta + \alpha + \delta + \zeta$$

$$\mathbf{x} = \mathbf{\Gamma} + \mathbf{\Delta} + \mathbf{\alpha} + \mathbf{\delta} + \mathbf{\zeta}$$

$$x = \Gamma + \Delta + \alpha + \delta + \zeta$$

$$\mathbf{x} = \mathbf{\Gamma} + \mathbf{\Delta} + \mathbf{\alpha} + \mathbf{\delta} + \mathbf{\zeta}$$

$$x = \Gamma + \Delta + \alpha + \delta + \zeta$$

$$\mathbf{x} = \mathbf{\Gamma} + \mathbf{\Delta} + \mathbf{\alpha} + \mathbf{\delta} + \mathbf{\zeta}$$

$$x = \Gamma + \Delta + \alpha + \delta + \zeta$$

$$\mathbf{x} = \mathbf{\Gamma} + \mathbf{\Delta} + \mathbf{\alpha} + \mathbf{\delta} + \mathbf{\zeta}$$

So we have normal math and completely bold math, but how about a mixed case? For that we need to add an extra typeface definition, one that extends the existing normal math one:

```
\definetypface [mainface] [mm] [bfmath] [lucida] [default]
\definetypface [boldmath] [mm] [bfmath] [lucida] [default]
```

Next we have to enable bold math. Beware: if you turn this feature on without defining fonts, you will get TeX error messages with regards to missing characters

```
\setupformulas
[method=bold]
```

```
\setupbodyfont
[mainface]
```

We will demonstrate this with another strange math example. Watch the effects of grouping.

```
\formula          {1 \beta \Gamma = \bfm 1 \beta \Gamma x' z}
\formula[mainface]{1 \beta \Gamma = \bfm 1 \beta \Gamma x' z}
\formula[boldmath]{1 \beta \Gamma = \bfm 1 \beta \Gamma x' z}
\formula[mainface]{1 \beta \Gamma = {\bfm 1 \beta \Gamma x'} z}
\formula[boldmath]{1 \beta \Gamma = {\bfm 1 \beta \Gamma x'} z}
```

This results in:

$\beta\Gamma = \beta\Gamma x'z$
 $\beta\Gamma = \beta\Gamma x'z$
 $\beta\Gamma = \beta\Gamma x'z$
 $\beta\Gamma = \beta\Gamma x'z$
 $\beta\Gamma = \beta\Gamma x'z$

For Lucida lovers, we prepared some typescripts that provide (mixed) bold math. Given that you have Lucida installed, you can try:

```

\starttext

\usetypescript[lucida]      [texnansi]
\usetypescript[lucidabfm]  [texnansi]
\usetypescript[lucidaboldmath][texnansi]

\setupformulas[method=bold]

\startformula[lucida]      1 \Gamma      \alpha x \stopformula
\startformula[lucida]      1 \Gamma {\bfm \alpha x} \stopformula
\startformula[lucidaboldmath] 1 \Gamma      \alpha x \stopformula
\startformula[lucidaboldmath] 1 \Gamma {\bfm \alpha x} \stopformula

\stoptext

```

This effectively defined two typefaces:

$\Gamma\alpha x$

$\Gamma\alpha x$

$\Gamma\alpha x$

$\Gamma\alpha x$

source code of this document

```
\usemodule[mag-01,abr-02]
```

```
\setvariables
```

```
[magazine]
[title={Mixed Normal and Bold Math},
author=Hans Hagen,
affiliation=PRAGMA ADE,
date=November 2003,
number=5]
```

```
\startbuffer[abstract]
```

This time we discuss how to deal with bold formula components. Depending on the field, whole formulas can be bold, or only parts of formulas, most noticeably symbols.

```
\stopbuffer
```

```
\starttext \setups [titlepage] \setups [title]
```

Internally `\TEX` uses a concept of families. Each family has three members: text, script and scriptscript. Fonts are bound to families. Each math symbol comes from a family and can have additional characteristics. While typesetting a formula `\TEX` sometimes overloads the predefined characteristics. Let's see what happens when we switch fonts.

```
\startbuffer
\startformula
e = m c^2
\stopformula
```

```
\startformula
\bf e = m c^2
\stopformula
```

```
\startformula
e = {\bf m} c^2
\stopformula
\stopbuffer
```

```
\typebuffer
```

Because `\TEX` sees text and numbers, it will apply the bold font to each component inside the scope of the font switch.

source code of this document

```
\getbuffer
```

Special symbols behave differently as we will see in the next example.

```
\startbuffer
\startformula
\alpha = \Gamma - 3
\stopformula

\startformula
\bf \alpha = \Gamma + x - 3
\stopformula

\startformula
\alpha = {\bf \Gamma + x} - 3
\stopformula
```

```
\startformula
\alpha = {\bf\mr \Gamma + x} - 3
\stopformula
\stopbuffer
```

```
\typebuffer
```

In the third case `\TEX\` will automatically change the family of the `$$\Gamma$` into the current family (being bold) which means that we depend on the bold font having such a symbol. This is true for the Computer Modern Roman, but not for the Palatino used in this document. An escape is using `\type {\mr}` which sets the family to zero which in this case results in a symbol being typeset, but only when the normal math text font has such a symbol, which is not always true.

```
\getbuffer
```

It may be clear that for typesetting bold math, we cannot rely on the `\type {\bf}` font switch. In case you wonder why we use families for text bold: by using families such text can adapt itself to situations where script fonts are needed.

For demonstrating the handling of bold math, we use a typeface that provides them: Lucida Bright. First we define a main typeface.

source code of this document

```
\startbuffer
\definetypeface [mainface] [rm] [serif] [lucida] [default]
\definetypeface [mainface] [tt] [mono] [lucida] [default]
\definetypeface [mainface] [ss] [sans] [lucida] [default]
\definetypeface [mainface] [mm] [math] [lucida] [default]
\stopbuffer
```

```
\typebuffer \getbuffer
```

We enable this typeface with:

```
\startbuffer
\switchtobodyfont [mainface]
\stopbuffer
```

```
\typebuffer
```

A simple nonsense formula now looks like:

```
\startbuffer
\startformula
  x = \Gamma + \Delta + \alpha + \delta + \zeta
\stopformula
\stopbuffer
```

```
\start \switchtobodyfont [mainface] \getbuffer \stop
```

This is keyed in as:

```
\typebuffer
```

Next we define an extra typeface, one that has bold math:

```
\startbuffer
\definetypeface [boldmath] [rm] [serif] [lucida] [default]
\definetypeface [boldmath] [tt] [mono] [lucida] [default]
\definetypeface [boldmath] [ss] [sans] [lucida] [default]
\definetypeface [boldmath] [mm] [boldmath] [lucida] [default]
\stopbuffer
```

```
\typebuffer \getbuffer
```

Watch the difference between those two typefaces:

source code of this document

```

\startbuffer
 $\Gamma \Delta \alpha \delta \zeta$ 
 $\Gamma \Delta \alpha \delta \zeta$ 
\stopbuffer

\typebuffer

\startlines
\switchtobodyfont[mainface] \getbuffer
\stoptypes

```

There is a more convenient way to switch between normal and bold, as is demonstrated in the following examples:

```

\startbuffer
\startformula
 $x = \Gamma + \Delta + \alpha + \delta + \zeta$ 
\stopformula

\startformula[mainface]
 $x = \Gamma + \Delta + \alpha + \delta + \zeta$ 
\stopformula

\startformula[boldmath]
 $x = \Gamma + \Delta + \alpha + \delta + \zeta$ 
\stopformula

\startformula[boldmath,8pt]
 $x = \Gamma + \Delta + \alpha + \delta + \zeta$ 
\stopformula

\startformula[boldmath,12pt,small]
 $x = \Gamma + \Delta + \alpha + \delta + \zeta$ 
\stopformula

\startformula[boldmath,small]
 $x = \Gamma + \Delta + \alpha + \delta + \zeta$ 
\stopformula

\startformula[boldmath,10pt]
 $x = \Gamma + \Delta + \alpha + \delta + \zeta$ 
\stopformula

```

source code of this document

```
\startformula[boldmath,11pt,small]
  x = \Gamma + \Delta + \alpha + \delta + \zeta
\stopformula
```

```
\startformula[boldmath,9pt]
  x = \Gamma + \Delta + \alpha + \delta + \zeta
\stopformula
\stopbuffer
```

```
\typebuffer
```

Changing the bodyfont size nearly always leads to suboptimal spacing between paragraphs (and formulas).

```
\start \switchtobodyfont[mainface] \getbuffer \stop
```

So we have normal math and completely bold math, but how about a mixedcase? For that we need to add an extra typeface definition, one that extends the existing normal math one:

```
\startbuffer
\defintypeface [mainface] [mm] [bfmath] [lucida] [default]
\defintypeface [boldmath] [mm] [bfmath] [lucida] [default]
\stopbuffer
```

```
\typebuffer \getbuffer
```

Next we have to enable bold math. Beware: if you turn this feature on without defining fonts, you will get `\TEX\` error messages with regards to missing characters

```
\startbuffer
\setupformulas
  [method=bold]
```

```
\setupbodyfont
  [mainface]
\stopbuffer
```

```
\typebuffer
```

We will demonstrate this with another strange math example. Watch the effects of grouping.

source code of this document

```

\startbuffer
\formula          {1 \beta \Gamma = \bfm 1 \beta \Gamma x' z}
\formula[mainface]{1 \beta \Gamma = \bfm 1 \beta \Gamma x' z}
\formula[boldmath]{1 \beta \Gamma = \bfm 1 \beta \Gamma x' z}
\formula[mainface]{1 \beta \Gamma = {\bfm 1 \beta \Gamma x'} z}
\formula[boldmath]{1 \beta \Gamma = {\bfm 1 \beta \Gamma x'} z}
\stopbuffer

```

```
\typebuffer
```

This results in:

```

\startlines
\setupformulas[method=bold] \switchtobodyfont[mainface] \getbuffer
\stoptext

```

For Lucida lovers, we prepared some typescripts that provide (mixed) bold math. Given that you have Lucida installed, you can try:

```

\startbuffer
\starttext

\usetypscript[lucida]          [texnansi]
\usetypscript[lucidabfm]      [texnansi]
\usetypscript[lucidaboldmath][texnansi]

\setupformulas[method=bold]

\startformula[lucida]          1 \Gamma          \alpha x \stopformula
\startformula[lucida]          1 \Gamma {\bfm \alpha x} \stopformula
\startformula[lucidaboldmath]  1 \Gamma          \alpha x \stopformula
\startformula[lucidaboldmath]  1 \Gamma {\bfm \alpha x} \stopformula

```

```

\stoptext
\stopbuffer

```

```
\typebuffer
```

This effectively defined two typefaces:

```

\getbuffer

\setups [listing] \setups [lastpage] \stoptext

```

source code of this document

the 1990s, the number of people with a university degree has increased in all countries, but the increase has been most dramatic in the Netherlands.

There are several reasons for the increase in the number of people with a university degree. First, the number of people who go to university has increased. Second, the number of people who complete a university degree has increased. Third, the number of people who have a university degree but do not work in a university-related job has increased.

The increase in the number of people with a university degree has led to a change in the structure of the labour market. The number of jobs that require a university degree has increased, while the number of jobs that do not require a university degree has decreased. This has led to a higher demand for people with a university degree.

The increase in the number of people with a university degree has also led to a change in the way that people work. The number of people who work full-time has increased, while the number of people who work part-time has decreased. This has led to a higher demand for full-time workers.

The increase in the number of people with a university degree has also led to a change in the way that people are paid. The number of people who are paid a high salary has increased, while the number of people who are paid a low salary has decreased. This has led to a higher demand for high-skilled workers.

The increase in the number of people with a university degree has also led to a change in the way that people are trained. The number of people who are trained in a university has increased, while the number of people who are trained in a vocational school has decreased. This has led to a higher demand for university-trained workers.

The increase in the number of people with a university degree has also led to a change in the way that people are educated. The number of people who are educated in a university has increased, while the number of people who are educated in a vocational school has decreased. This has led to a higher demand for university-educated workers.

The increase in the number of people with a university degree has also led to a change in the way that people are employed. The number of people who are employed in a university has increased, while the number of people who are employed in a vocational school has decreased. This has led to a higher demand for university-employed workers.

The increase in the number of people with a university degree has also led to a change in the way that people are organized. The number of people who are organized in a university has increased, while the number of people who are organized in a vocational school has decreased. This has led to a higher demand for university-organized workers.

The increase in the number of people with a university degree has also led to a change in the way that people are managed. The number of people who are managed in a university has increased, while the number of people who are managed in a vocational school has decreased. This has led to a higher demand for university-managed workers.