This Way

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Mixed Normal and Bold Math

Hans Hagen
PRAGMA ADE

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 noticably 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.

$$e = mc^2$$

$$\mathbf{e = mc^2}$$

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

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.

$$\alpha = \Gamma - 3$$

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

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

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

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 = 10$\boldsymbol{\alpha\delta\zeta}$

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 alway leads to suboptimal spacing between paragraphs (and formulas).

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

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

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

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

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:

```
\definetypeface [mainface] [mm] [bfmath] [lucida] [default]
\definetypeface [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:

$1\beta\Gamma$ = $\mathbf{1\beta\Gamma x' z}$
$1\beta\Gamma$ = $\mathbf{1\beta\Gamma x' z}$
$\mathbf{1\beta\Gamma = 1\beta\Gamma x' z}$
$1\beta\Gamma$ = $\mathbf{1\beta\Gamma x'}$z
$\mathbf{1\beta\Gamma = 1\beta\Gamma x' z}$

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:

$1\Gamma\alpha x$

$1\Gamma\mathbf{\alpha x}$

$\mathbf{1\Gamma\alpha x}$

$\mathbf{1\Gamma\alpha x}$

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 noticably 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.

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\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.

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\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

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$\Gamma$ into the current family (being bold) which means that we
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Computer Modern Roman, but not for the Palatino used in this
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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
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For demonstrating the handling of bold math, we use a typeface that
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```
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\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
$\mainface x=10 \Gamma \Delta \alpha \delta \zeta$
$\boldmath x=10 \Gamma \Delta \alpha \delta \zeta$
\stopbuffer

\typebuffer

\startlines
\switchtobodyfont[mainface] \getbuffer
\stoplines

There is a more convenient way to switch between normal and bold,
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\startbuffer
\startformula
  x = \Gamma + \Delta + \alpha + \delta + \zeta
\stopformula

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

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

source code of this document

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\startformula[boldmath,11pt,small]
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\startformula[boldmath,9pt]
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\stopformula
\stopbuffer

\typebuffer
```

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

```
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```

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:

```
\startbuffer
\definetypeface [mainface] [mm] [bfmath] [lucida] [default]
\definetypeface [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

```
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\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:

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For Lucida lovers, we prepared some typescripts that provide (mixed)
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\starttext

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\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
\stopbuffer

\typebuffer

This effectively defined two typefaces:

\getbuffer

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

source code of this document