PUSHING MATH FORWARD WITH LUAMETATEX AND CONTEXT

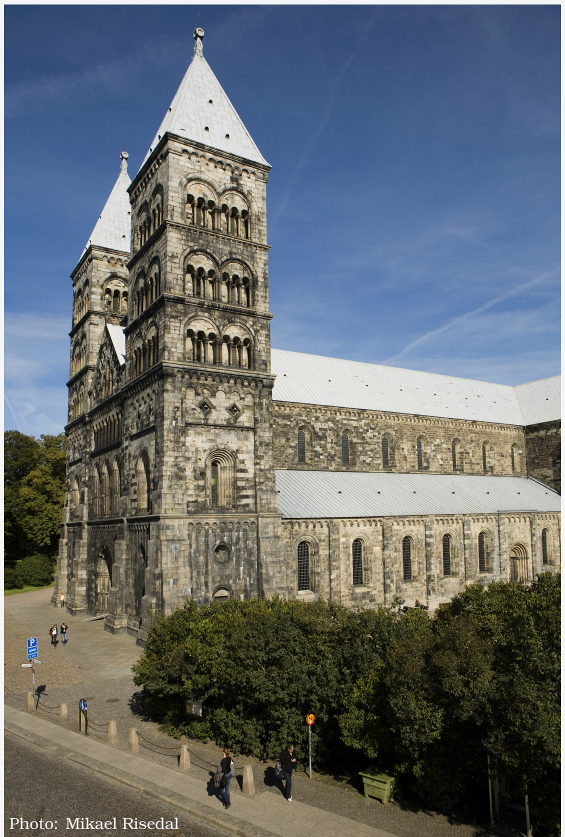


Photo: Mikael Risedal

Mikael P. Sundqvist (Lund university)

TUG 2022

Photo: Kennet Ruona

CAN YOU SPOT ANY DIFFERENCES IN THESE TWO FORMULAS?

$$a_0 = b_0 + c_0$$

$$a_0 = b_0 + c_0$$

WE TAKE A CLOSER LOOK

$$a_0 = b_0 + c_0$$

$$a_0 = b_0 + c_0$$

THERE IS AN EXTRA SPACE ADDED AFTER THE SUBSCRIPT

$$a_0 = b_0$$

ordrel relord

$$a_0 = b_0$$

ordrel relord

$$b_0 + c_0$$

ordbin binord

$$b_0 + c_0$$

ordbin binord

GUILTY: `\scriptspace`

Introduced in plain TeX, where it is set to 0.5pt. That fits with the 10pt setup in the books by D.E. Knuth.

Later formats still set `\scriptspace` to 0.5pt, independent of font size.

What should we do with `\scriptspace`?

WE CANNOT COMPLETELY REMOVE `\scriptspace`!

$$a_0b$$

$$a_0b$$

TO WHICH LETTER DOES THE SUBSCRIPT BELONG?

$$a_0 b$$

$$a_0 b$$

SOLUTION: REMOVE \scriptspace FOR SOME ATOM CLASSES

$$a_0 b_0 = c_0 + d_0$$

$$a_0 b_0 = c_0 + d_0$$

$$a_0 b_0 = c_0 + d_0$$

OVERVIEW
THE REST OF THIS TALK

Math microtypography
We give examples of recent improvements in luametaTEX and ConTEXt regarding details in formulas.

Math macrotypography
We show how to typeset some displayed formulas in ConTEXt.

Comments and todo
A very quick look at future plans.

MATH MICROTYPOGRAPHY

New atom classes
Several new classes have been defined to gain control over spacing in math.

Goodie files
We use tweaks to set up the (unicode) math fonts.

General aim
Consistent output. Simplified input, without explicit spaces like `\,` and `\!`.

OBSERVE THE SPACING IN THIS FORMULA

```
\dm{\frac{a}{b} + c = \frac{d}{e} f}
```

$$\frac{a}{b} + c = \frac{d}{e} f$$

OBSERVE THE SPACING IN THIS FORMULA

```
\dm{\frac{a}{b} + c = \frac{d}{e} f}
```

$$\frac{a}{b} + c = \frac{d}{e} f$$

DIFFERENCE: `\nulldelimiterspace`

About `\nulldelimiterspace`

Side bearing for fractions and fences.

Set to 1.2pt in plain TEX. Later formats use 1.2pt, independent of the font size.

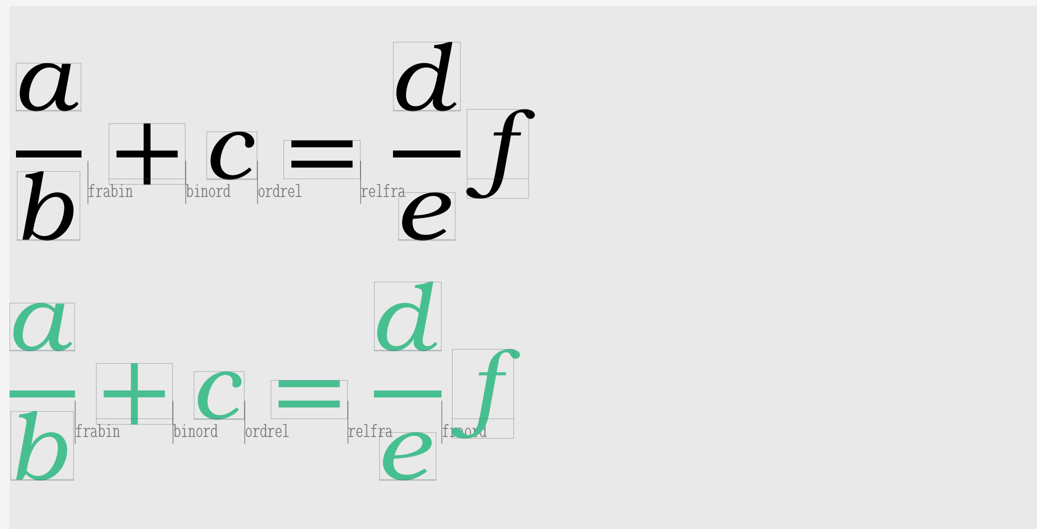
Sometimes reset to 0pt (`\big`, `\bigg`, ...).

We set `\nulldelimiterspace` to 0.0pt and control the spacing via atoms.

WE USE INTERATOM SPACES TO GAIN CONTROL

```
\dm{\frac{a}{b} + c = \frac{d}{e} f}
```

```
frabin  \medmuskip
binord  \medmuskip
ordrel  \thickmuskip
relfra  \thickmuskip
fraord  \tinymuskip
```



THE OLD MUSKIPS

THE NEW MUSKIPS

```
\thickmuskip  5mu plus 5mu
\medmuskip    4mu plus 2mu minus 4mu
\thinmuskip   3mu
```

```
\thickmuskip  5mu plus 3mu minus 1mu
\medmuskip    4mu plus 2mu minus 2mu
\thinmuskip   3mu
\tinymuskip   2mu minus 1mu
\pettymuskip  1mu minus 0.5mu
```

`\tinymuskip`

WHAT IS IT GOOD FOR?

```
\dm{a \sqrt{b} c + d \frac{e}{f} g}
```

$$a\sqrt{b}c + d\frac{e}{f}g$$

$$a\sqrt{b}\,c + d\frac{e}{f}g$$

```
\pettymuskip
```

WHAT IS IT GOOD FOR?

```
\dm{\sum_{k = 0}^{j + n} a_k = e^{a + b - c}}
```

$$\sum_{k=0}^{j+n} a_k = e^{a+b-c}$$

$$\sum_{k=0}^{j+n} a_k = e^{a+b-c}$$

THE ATOM CLASSES

Engine classes

ordinary, operator, binary, relation, open, close, punctuation, variable, active, inner, under, over, radical, fraction, middle, accent, fenced, ghost, vcenter

ConTEXt classes

imaginary, differential, exponential, ellipsis, function, digit, explicit, division, factorial, wrapped, construct, mathpunctuation, dimension, unspaced, begin, end, all, unary

EXAMPLE
THE DIFFERENTIAL CLASS

```
\dm{ \int_a^b f(x) \, dx }
```

$$\int_a^b f(x) \, dx$$

opord QUAD:3.000

```
\dm{ \int_a^b f(x) \dd x }
```

$$\int_a^b f(x) \, dx$$

opord clodif

WE CAN CHANGE TO AN UPRIGHT DIFFERENTIAL

```
\dm{ \int_a^b f(x) \dd x }
```

$$\int_a^b f(x)\, dx$$

```
\setupmathematics[differentiald=upright]
```

$$\int_a^b f(x)\, \mathrm{d}x$$

THE \dd ALSO GIVES A NICE SPACING IN OTHER PLACES

```
\dm{f \dd \mu = f \dd x \wedge \dd y}

\dm{y'' + y' = \frac{\dd^2 y}{\dd x^2}
              + \frac{\dd y}{\dd x}}
```

$$f \, d\mu = f \, dx \wedge dy$$

orddif ordrel relord orddif ordbin bindif

$$y'' + y' = \frac{d^2 y}{dx^2} + \frac{dy}{dx}$$

right ordbin binord ordrel relfra frabin binfra

EXAMPLE
THE DIMENSION CLASS

```
\im{g \unit{kg m/s^2}}

\im{100 \unit{Celsius}}

\setupunit[separator=small]
\im{2 \unit{Newton meter}}
```

$$g\,\mathrm{kg}\cdot\mathrm{m/s^2}$$

orddim ordbin binord

$$100\,{}^\circ\mathrm{C}$$

digdim

$$2\,\mathrm{N\,m}$$

digdim QUAD:3.000

EXAMPLE
THE FACTORIAL CLASS

```
\dm{\binom{n}{k} = \frac{n!}{(n - k)! k!}}

\im{9!! = 9 \times 7 \times 5 \times 3 \times 1}
```

$$\binom{n}{k} = \frac{n!}{(n-k)!\,k!}$$

frarel relfra ordbin binord facord

$$9!! = 9 \times 7 \times 5 \times 3 \times 1$$

facrel reldig digbin bindig digbin bindig digbin bindig digbin bindig

EXAMPLE
THE EXPONENTIAL CLASS

Defined to have the same spacing as ordinary. In `math-ini.mkxl` we find

```
\setnewconstant \mathexponentialcode
                \mathclassvalue exponential

\copymathspacing \mathexponentialcode
                 \mathordinarycode
```

EXAMPLE
THE EXPONENTIAL CLASS

Let us add a small space between ordinary and exponential.

```
\setmathspacing
          \mathordinarycode \mathexponentialcode
          \allmathstyles \tinymuskip

\setmathspacing
          \mathexponentialcode \mathordinarycode
          \allmathstyles \tinymuskip
```

EXAMPLE
THE EXPONENTIAL CLASS

```
\dm{rs \ee^{-rs \ee^{st} tu} tu}
```

$$rse^{-rse^{st}\underset{\text{right}}{|}tu}\underset{\text{right}}{|}tu$$

$$rs\underset{\text{ordexp}}{|}e^{-rs\underset{\text{ordexp}}{|}e^{st}\underset{\text{expord}}{|}tu}\underset{\text{expord}}{|}tu$$

DIFFERENT SETUPS IN DIFFERENT MATH STYLES

```
\alldisplaystyles
\alltextstyles
\allscriptstyles
\allscriptscriptstyles
\allmathstyles
\allsplitstyles
\alluncrampedstyles
\allcrampedstyles
```

EXAMPLE
THE EXPONENTIAL CLASS

Let us decrease the space in scriptstyle.

```
\setmathspacing
          \mathexponentialcode \mathordinarycode
          \allsplitstyles \tinymuskip

\setmathspacing
          \mathexponentialcode \mathordinarycode
          \allscriptstyles \pettymuskip
```

EXAMPLE
THE EXPONENTIAL CLASS

```
\dm{rs \ee^{-rs \ee^{st} tu} tu}
```

$$rse^{-rse^{st}tu}tu$$

$$rs\,e^{-rse^{st}\,tu}\,tu$$

WE CAN ENFORCE DIFFERENT LEFTCLASS AND RIGHTCLASS

```
\dm{a +
\mathatom unpack leftclass  \mathfractioncode
                 rightclass \mathrelationcode
                 {\frac{b}{c}}
d = e }
```

$$a + \frac{b}{c} d = e$$

ordbin binfra relord ordrel relord

UNPACKING AND DISTRIBUTING SPACE ACROSS SUB-FORMULAS

```
\hbox{word word \im{ a + {\bf b + c} + \left(d + e\right) + f
      + \sqrt{g + h} + \frac{a + b}{c + d}
      = \sum_{i = 1}^{n - x - y - z} x_{i + j} } word word}
```

word word $a + \mathbf{b + c} + \left(d + e\right) + f + \sqrt{g + h} + \frac{a + b}{c + d} = \sum_{i = 1}^{n - x - y - z} x_{i + j}$ word word

```
\hbox spread 4cm {word word \im{ a + {\bf b + c} + \left(d + e\right) + f
                  + \sqrt{g + h} + \frac{a + b}{c + d}
                  = \sum_{i = 1}^{n - x - y - z} x_{i + j} } word word}
```

word   word $a \quad + \quad \mathbf{b} \quad + \quad \mathbf{c} \quad + \quad (d \quad + \quad e) \quad + \quad f \quad + \quad \sqrt{g + h} \quad + \quad \frac{a + b}{c + d} \quad = \quad \sum_{i = 1}^{n - x - y - z} x_{i + j}$ word   word

EVERY UNICODE MATH FONT HAS ITS OWN QUIRKS

$$\mathfrak{q}[f] = \int_0^\pi [f'(t)]^2\,dt$$

$$\Bigg(\bigg(\Big(\big((x^2/3)\big)\Big)\bigg)\Bigg)$$

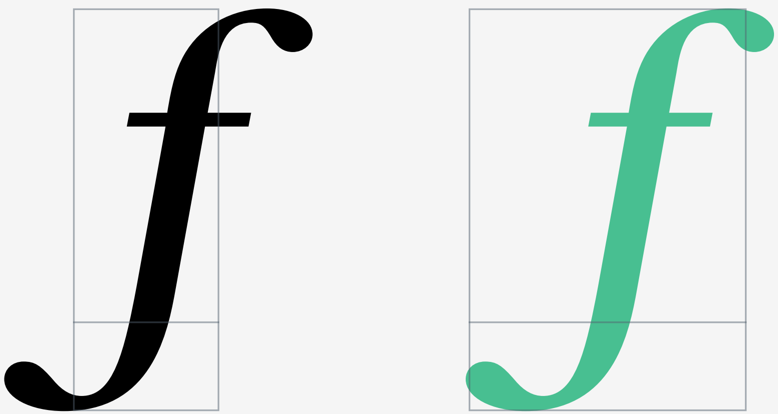
CURE
GOODIE FILES

Used to cure as much as possible, mainly via so-called *tweaks*.

Also used to set unicode *font parameters* as well as some (approx. 26) parameters that should be font dependent.

THE DIMENSION TWEAK
FIX PROBLEMATIC GLYPHS

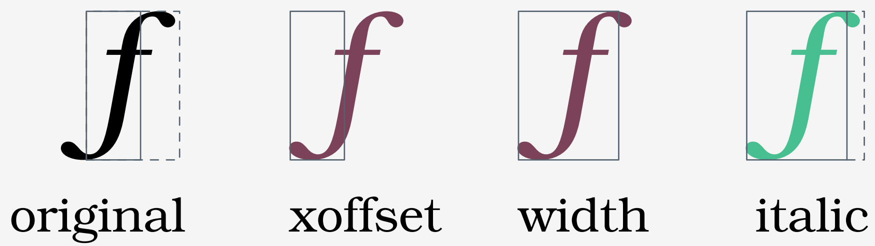
```
[0x1D453] = {
  xoffset = 0.45,
  width   = 1.85,
  italic  = 0.45,
}
```



THE TRANSFORMATIONS ARE APPLIED LIKE THIS

```
[0x1D453] = {
  xoffset = 0.45,
  width   = 1.85,
  italic  = 0.45,
}
```

xoffset shifts the glyph.
width rescales the boundingbox.
italic adds italic correction.



THE FIXPRIMES TWEAK
TUNE PRIMES

$$f'(t) \neq u'(t)$$

$$f'(t) \neq u'(t)$$

THE SIZE OF THE INTEGRAL SIGN

DisplayOperatorMinHeight

$$\int h(x) = \int \frac{f(x)}{g(x)}$$

$$\int h(x) = \int \frac{f(x)}{g(x)}$$

Default value for Bonum is 1300.

We set it to 1800.

IN SOME FONTS (LIKE BONUM) INTEGRALS CAN HAVE MANY SIZES

```
\startintegral[bottom={a},top={b}]
  \frac{ 1 + \frac{ f_1(x) }{ f_2(x) } }
       { 1 + \frac{ f_3(x) }{ f_4(x) } } \dd x
\stopintegral
```

$$\int_a^b \frac{1+\frac{f_1(x)}{f_2(x)}}{1+\frac{f_3(x)}{f_4(x)}} dx$$

OOH NO, WE CAN ALSO SET THE SIZE EXPLICITLY

```
\int[size=50pt] f(x) \dd x
```

$$\int f(x)\,dx$$

LIMITS OF THE INTEGRALS

NoLimitSubFactor, NoLimitSupFactor

$$\int_{\Omega} = \int_{a}^{b}$$

$$\int_{\Omega} = \int_{a}^{b}$$

THE LOWER CASE FRAKTUR ALPHABET IN BONUM IS TOO SMALL

abcdefghijklmnopqrstuvwzyz

𝔞 𝔟 𝔠 𝔡 𝔢 𝔣 𝔤 𝔥 𝔦 𝔧 𝔨 𝔩 𝔪 𝔫 𝔬 𝔭 𝔮 𝔯 𝔰 𝔱 𝔲 𝔳 𝔴 𝔷 𝔶 𝔷

*A*𝔄*B*𝔅*C*ℭ*a*𝔞*b*𝔟*y*𝔶

WE RESIZE THE WHOLE ALPHABET IN THE DIMENSIONS TWEAK

```
["lowercasefraktur"] = {
  width    = 1.25,
  extend   = 1.25,
  height   = 1.15,
  depth    = 1.15,
  squeeze  = 1.15,
},
```

$$A\mathfrak{A}B\mathfrak{B}C\mathfrak{C}a\mathfrak{a}b\mathfrak{b}y\mathfrak{y}$$

$$A\mathfrak{A}B\mathfrak{B}C\mathfrak{C}a\mathfrak{a}b\mathfrak{b}y\mathfrak{y}$$

THE LOWER CASE SCRIPT ALPHABET IN BONUM IS ALSO TOO SMALL

```
["lowercasescript"] = {
  width    = 1.2,
  extend   = 1.2,
  height   = 1.2,
  depth    = 1.2,
  squeeze  = 1.2,
},
```

$A\mathscr{A}B\mathscr{B}C\mathscr{C}a\mathscr{a}b\mathscr{b}y\mathscr{y}$

$A\mathscr{A}B\mathscr{B}C\mathscr{C}a\mathscr{a}b\mathscr{b}y\mathscr{y}$

WITHOUT GOODIE FILE

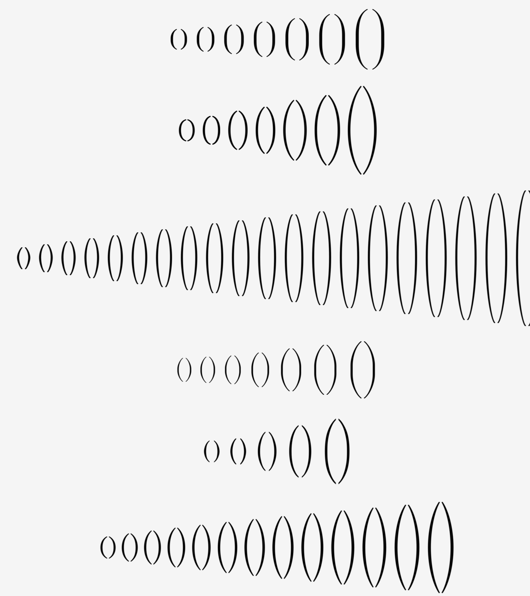
WITH GOODIE FILE

$$\mathfrak{q}[f] = \int_0^\pi [f'(t)]^2 \, dt$$

$$\mathfrak{q}[f] = \int_0^\pi [f'(t)]^2 \, dt$$

THE UNICODE MATH FONTS HAVE DIFFERENT NUMBER OF DELIMITERS

Bonum	7
Cambria	7
Garamond Math	20
Latin Modern	7
Lucida	5
Stix two	13



WHICH SIZES SHOULD WE USE FOR \big, \Big, \bigg, \Bigg?

1	step 1
2	step 2
3	htdp*1.33^n
4	size*1.33^n
5	lfg file

Sizes can be specified in the goodie file

```
\setupmathfence[alternative=5]
```

In the Bonum goodie file we have

```
bigslots = {
    1, 3, 5, 7
},
```

All sizes are still available via fences.

FONT (ALTERNATIVE 1): 1, 2, 3, 4

GOODIE (ALTERNATIVE 5): 1, 3, 5, 7

```
\im{\Biggl( \biggl(  \Bigl(  \bigl( (x^2/3)
     \bigr)  \Bigr) \biggr) \Biggr)}
```

$$\Biggl(\biggl(\Bigl(\bigl((x^2/3)\bigr)\Bigr)\biggr)\Biggr)$$

$$\Biggl(\biggl(\Bigl(\bigl((x^2/3)\bigr)\Bigr)\biggr)\Biggr)$$

THE KERNS TWEAK WORKS ON INDIVIDUAL GLYPHS

```
\im{x^2/F__1_2(x) - a_1/b^^2}
```

```
[0x2F] = {
    topleft     = -0.2,
    bottomright = -0.2,
}, -- solidus
```

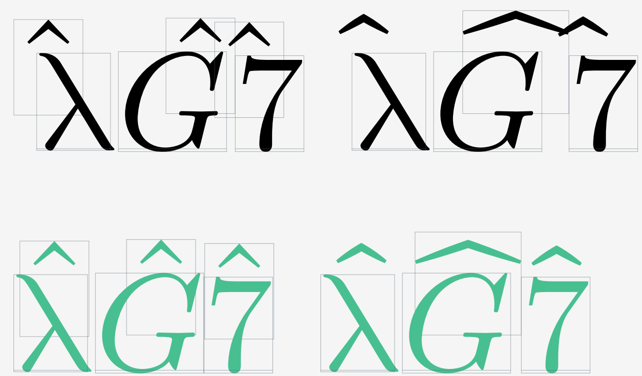
$$x^2/{}_1F_2(x) - a_1/{}^2b$$

$$x^2/{}_1F_2(x) - a_1/{}^2b$$

THE DIMENSION TWEAK
TUNE THE ACCENTS

```
[0x00302] = {
  yoffset = -0.075,
  all = true },
  -- widehat
```

SOME GLYPHS NEEDED
A MORE DRASTIC FIX



MATH MACROTYPOGRAPHY
CONSTRUCTING MATH FORMULAS

The main formula environment

`\startformula \stopformula`

All kind of alignments

`\startalign \stopalign`

Numbered equations

`\startplaceformula \stopplaceformula`

We give lots of examples.

SIMPLE FORMULAS HAVE AT MOST ONE VERB

```
\startformula
  \left\lVert P(\lambda) - P(\lambda_{0}) \right\rVert
    _{L^2(\Gamma)\to H^{5/2}(\Omega)}
  \leq C \left\lvert \lambda - \lambda_{0} \right\rvert
\stopformula
```

$$\left\lVert P(\lambda) - P(\lambda_{0}) \right\rVert_{L^2(\Gamma)\to H^{5/2}(\Omega)} \leq C \left\lvert \lambda - \lambda_{0} \right\rvert$$

$$\Gamma(z) = -\frac{1}{2i\sin \pi z}\int_{\infty}^{(0+)} (-t)^{z-1} e^{-t}\, dt$$

$$\frac{1}{2}a_0 + (a_1 \cos x + b_1 \sin x) + (a_2 \cos 2x + b_2 \sin 2x) + \ldots$$

SIMPLE FORMULAS MIGHT BE TOO LONG TO FIT ON THE LINE

```
\startformula[split=no]
  \iint K(xy) f(x) g(y) \dd x \dd y
  \leq \phi(p^{-1})
  \left[\int x^{p-2}f(x)^p \dd x\right]^{1/p}
  \left[\int g(y)^q \dd y \right]^{1/q}
\stopformula
```

$$\iint K(xy)\, f(x)\, g(y)\, dx\, dy \leq \phi(p^{-1}) \left[\int x^{p-2} f(x)^p\, dx\right]^{1/p} \left[\int g(y)^q\, dy\right]^{1/q}$$

FORMULAS SPLIT BY DEFAULT AND EACH LINE IS MIDALIGNED

```
\startformula[split=text]% default
  \iint K(xy) f(x) g(y) \dd x \dd y
  \leq \phi(p^{-1})
  \left[\int x^{p-2}f(x)^p \dd x\right]^{1/p}
  \left[\int g(y)^q \dd y \right]^{1/q}
\stopformula
```

$$\iint K(xy)\, f(x)\, g(y)\, dx\, dy \leq$$
$$\phi(p^{-1}) \left[\int x^{p-2} f(x)^p\, dx\right]^{1/p} \left[\int g(y)^q\, dy\right]^{1/q}$$

THE DIFFERENT SPLIT OPTIONS

text (default)
Allows the formula to split across lines, but not over pages.

page
Allows the formula to split across lines and pages.

no
No splitting. The formula is in a box.

Penalty-driven. You can use your own.

FLUSH LEFT WITH `align=flushleft` BREAK MANUALLY WITH `\breakhere`

```
\startformula[align=flushleft]
  \iint K(xy) f(x) g(y) \dd x \dd y \breakhere
  \leq \phi(p^{-1})
  \left[\int x^{p-2}f(x)^p \dd x\right]^{1/p}
  \left[\int g(y)^q \dd y \right]^{1/q}
\stopformula
```

$$\iint K(xy)\, f(x)\, g(y)\, dx\, dy$$
$$\leq \phi(p^{-1}) \left[\int x^{p-2} f(x)^p\, dx\right]^{1/p} \left[\int g(y)^q\, dy\right]^{1/q}$$

PUSH A LINE WITH \skiphere

```
\startformula[align=flushleft]
  \skiphere[1em] \iint K(xy) f(x) g(y) \dd x \dd y \breakhere
  \skiphere[5em] \leq \phi(p^{-1})
  \left[\int x^{p-2}f(x)^p \dd x\right]^{1/p}
  \left[\int g(y)^q \dd y \right]^{1/q}
\stopformula
```

$$\iint K(xy)\, f(x)\, g(y)\, dx\, dy$$

$$\leq \phi(p^{-1}) \left[\int x^{p-2} f(x)^p\, dx\right]^{1/p} \left[\int g(y)^q\, dy\right]^{1/q}$$

THE DIFFERENT ALIGN OPTIONS

middle (default)
Midalign each line in the formula.

flushleft
Flush each line left.

flushright
Flush each line right.

slanted
First line flush left, second line flush right. The rest midaligned.

FOR OUR EXAMPLE IT IS MORE NATURAL TO USE `align=slanted`

```
\startformula[align=slanted]
  \iint K(xy) f(x) g(y) \dd x \dd y
  \breakhere
  \leq \phi(p^{-1})
  \left[\int x^{p-2}f(x)^p \dd x\right]^{1/p}
  \left[\int g(y)^q \dd y \right]^{1/q}
\stopformula
```

$$\iint K(xy)\, f(x)\, g(y)\, dx\, dy \\ \leq \phi(p^{-1}) \left[\int x^{p-2} f(x)^p\, dx\right]^{1/p} \left[\int g(y)^q\, dy\right]^{1/q}$$

WITH A SMALL MARGIN IT LOOKS FINE

```
\startformula[align=slanted,margin=1em]
  \iint K(xy) f(x) g(y) \dd x \dd y
  \breakhere
  \leq \phi(p^{-1})
  \left[\int x^{p-2}f(x)^p \dd x\right]^{1/p}
  \left[\int g(y)^q \dd y \right]^{1/q}
\stopformula
```

$$\iint K(xy)\, f(x)\, g(y)\, dx\, dy$$
$$\leq \phi(p^{-1}) \left[\int x^{p-2} f(x)^p\, dx\right]^{1/p} \left[\int g(y)^q\, dy\right]^{1/q}$$

WE CAN DEFINE OUR OWN SLANTED FORMULA TYPE

```
\defineformula[multline][
    align=slanted,
]

\startmultlineformula[margin=1em]
  \iint K(xy) f(x) g(y) \dd x \dd y
  \breakhere
  \leq \phi(p^{-1})
  \left[\int x^{p-2}f(x)^p \dd x\right]^{1/p}
  \left[\int g(y)^q \dd y \right]^{1/q}
\stopmultlineformula
```

$$\iint K(xy)\, f(x)\, g(y)\, dx\, dy$$

$$\leq \phi(p^{-1}) \left[\int x^{p-2} f(x)^p\, dx\right]^{1/p} \left[\int g(y)^q\, dy\right]^{1/q}$$

NOTE: IN THE CODE WE ONLY NEED TO BREAK LINES

```
\startmultlineformula
  2\pi i \iint \bar{\partial} \phi(z) f(z) \dd z \wedge \dd \bar{z} \breakhere
  = \iint \fenced[brace]{ \int_{\partial D}
    \bar{\partial} \phi(z) (\zeta - z)^{-1} f(\zeta) \dd \zeta }
    \dd z \wedge \dd \bar{z} \breakhere
  + \iint \fenced[brace]{ \iint_D \bar{\partial} \phi(z)
    (\zeta - z)^{-1} g(\zeta) \dd \zeta \wedge \dd \bar{\zeta} }
    \dd z\wedge \dd\bar{z}
\stopmultlineformula
```

$$\begin{multline} 2\pi i \iint \bar{\partial}\phi(z)\, f(z)\, dz \wedge d\bar{z} \\ = \iint \left\{ \int_{\partial D} \bar{\partial}\phi(z)\, (\zeta - z)^{-1} f(\zeta)\, d\zeta \right\} dz \wedge d\bar{z} \\ + \iint \left\{ \iint_D \bar{\partial}\phi(z)\, (\zeta - z)^{-1} g(\zeta)\, d\zeta \wedge d\bar{\zeta} \right\} dz \wedge d\bar{z} \end{multline}$$

IN CHAIN FORMULAS IT IS OFTEN USEFUL TO ALIGN THE VERBS

```
\startformula
  \tfrac{1}{2}( p^2 \abs{x} + \abs{x} p^2 )
  \alignhere
  = \abs{x} p \abs{x}^{-1} p \abs{x}
    - \tfrac{1}{2} \abs{x} ( \laplace \abs{x}^{-1} ) \abs{x}
  \breakhere
  = \abs{x} p \abs{x}^{-1} p \abs{x}
    - \tfrac{1}{2} \abs{x} 4 \pi \delta(0) \abs{x}
  \breakhere
  = \abs{x} p \abs{x}^{-1} p \abs{x}
\stopformula
```

$$\begin{aligned}\tfrac{1}{2}(p^2|x| + |x|\,p^2) &= |x|\,p|x|^{-1}\,p|x| - \tfrac{1}{2}|x|\,(\Delta|x|^{-1})\,|x| \\ &= |x|\,p|x|^{-1}\,p|x| - \tfrac{1}{2}|x|\,4\pi\delta(0)\,|x| \\ &= |x|\,p|x|^{-1}\,p|x|\end{aligned}$$

THE SAME FORMULA CAN BE SET WITH ALIGNMENTS

```
\startformula
\startalign
  \NC \tfrac{1}{2}( p^2 \abs{x} + \abs{x} p^2 )
      \EQ \abs{x} p \abs{x}^{-1} p \abs{x}
          - \tfrac{1}{2} \abs{x} ( \laplace \abs{x}^{-1} ) \abs{x} \NR
  \NC \EQ \abs{x} p \abs{x}^{-1} p \abs{x}
          - \tfrac{1}{2} \abs{x} 4 \pi \delta(0) \abs{x} \NR
  \NC \EQ \abs{x} p \abs{x}^{-1} p \abs{x} \NR
\stopalign
\stopformula
```

$$\begin{aligned}
\tfrac{1}{2}(p^2|x| + |x|p^2) &= |x|\,p|x|^{-1}\,p|x| - \tfrac{1}{2}|x|\,(\Delta|x|^{-1})\,|x| \\
&= |x|\,p|x|^{-1}\,p|x| - \tfrac{1}{2}|x|\,4\pi\delta(0)\,|x| \\
&= |x|\,p|x|^{-1}\,p|x|
\end{aligned}$$

NOTICE THE \alignhere AND textdistance=8em

```
\startformula[textdistance=8em]
  \alignhere
    \left( x^2   +  y^2   +  z^2   +  w^2   \right)
    \left((x')^2 + (y')^2 + (z')^2 + (w')^2 \right) \breakhere
  = \left(xx' + yy' + zz' + ww' \right)^2   \breakhere \skiphere[1]
    + \left(xy' - x'y + wz' - zw' \right)^2 \breakhere \skiphere[2]
    + \left(xz' - zx' + yw' - wy' \right)^2 \breakhere \skiphere[3]
    + \left(xw' - wx' + zy' - yz' \right)^2
\stopformula
```

$$
\begin{aligned}
&\left(x^2+y^2+z^2+w^2\right)\left((x')^2+(y')^2+(z')^2+(w')^2\right) \\
&\qquad\qquad\qquad = (xx'+yy'+zz'+ww')^2 \\
&\qquad\qquad\qquad\qquad + (xy'-x'y+wz'-zw')^2 \\
&\qquad\qquad\qquad\qquad\qquad + (xz'-zx'+yw'-wy')^2 \\
&\qquad\qquad\qquad\qquad\qquad\qquad + (xw'-wx'+zy'-yz')^2
\end{aligned}
$$

WE CAN GET SOME HELP TO SEE WHAT IS GOING ON

```
\enabletrackers[math.autohang]
```

$$
\begin{aligned}
\text{A}\,(x^2 + y^2 + z^2 + w^2)\left((x')^2 + (y')^2 + (z')^2 + (w')^2\right)
&\text{B} = (xx' + yy' + zz' + ww')^2 \\
&\text{B}\quad \text{S 1} + (xy' - x'y + wz' - zw')^2 \\
&\text{B}\qquad \text{S 2} + (xz' - zx' + yw' - wy')^2 \\
&\text{B}\qquad\quad \text{S 3} + (xw' - wx' + zy' - yz')^2
\end{aligned}
$$

A SLIGHTLY MORE ADVANCED CHAIN FORMULA

$$\begin{aligned}
&P'(iy_1, \ldots, iy_n, i\eta_k) \\
&\quad = (ir)^{k-1}\left[P_k'\left(z_1, \ldots, z_n, \frac{\eta_k}{r}\right)\right. \\
&\qquad\qquad\qquad \left. + \frac{1}{ir}P_{k-1}'\left(z_1, \ldots, z_n, \frac{\eta_k}{r}\right) + \ldots\right] \\
&\quad = (ir)^{k-1} P_k'\left(z_1, \ldots, z_n, \frac{\eta_k}{r}\right) + O(r^{k-2})
\end{aligned}$$

A SLIGHTLY MORE ADVANCED CHAIN FORMULA

$$
\begin{aligned}
P'(iy_1, \ldots, iy_n, i\eta_k) &= (ir)^{k-1}\left[P_k'\left(z_1, \ldots, z_n, \frac{\eta_k}{r}\right)\right.\\
&\qquad\left. + \frac{1}{ir}P_{k-1}'\left(z_1, \ldots, z_n, \frac{\eta_k}{r}\right) + \ldots\right]\\
&= (ir)^{k-1}\,P_k'\left(z_1, \ldots, z_n, \frac{\eta_k}{r}\right) + O(r^{k-2})
\end{aligned}
$$

THE INPUT IS NOT COMPLICATED

```
\startformula[textdistance=2em]
  \alignhere
    P'(iy_1, \ldots, iy_n, i\eta_k)
  \breakhere
  = (ir)^{k-1} \left[
    P_k' \left( z_ 1, \ldots, z_n, \frac{\eta_k}{r} \right)
    \breakhere
    \skiphere[4]
    + \frac{1}{ir}P_{k-1}'
      \left( z_ 1, \ldots, z_n, \frac{\eta_k}{r} \right)
    + \ldots
    \right]
  \breakhere
  = (ir)^{k-1}
      P_k'\left( z_ 1, \ldots, z_n, \frac{\eta_k}{r} \right)
    + O(r^{k-2})
\stopformula
```

OBSERVE: FENCES CAN BE BROKEN OVER SEVERAL LINES

$$\begin{aligned} &P'(iy_1, \dots, iy_n, i\eta_k) \\ &\quad = (ir)^{k-1}\Bigg[P'_k\left(z_1, \dots, z_n, \frac{\eta_k}{r}\right) \\ &\qquad\qquad + \frac{1}{ir}P'_{k-1}\left(z_1, \dots, z_n, \frac{\eta_k}{r}\right) + \dots\Bigg] \\ &\quad = (ir)^{k-1}P'_k\left(z_1, \dots, z_n, \frac{\eta_k}{r}\right) + O(r^{k-2}) \end{aligned}$$

WE CAN MANUALLY SET THE SIZES OF DELIMITERS

```
\startformula
    \fenced[parenthesis]{ 1 + \frac{1}{n}   }^n
    \fenced[parenthesis]{ 1 - \frac{1}{n}   }^n
  = \fenced[parenthesis]{ 1 - \frac{1}{n^2} }^n
\stopformula
\startformula
    \fenced[parenthesis]           { 1 + \frac{1}{n}   }^n
    \fenced[parenthesis]           { 1 - \frac{1}{n}   }^n
  = \fenced[parenthesis][size=bigg]{ 1 - \frac{1}{n^2} }^n
\stopformula
```

$$\left(1+\frac{1}{n}\right)^n\left(1-\frac{1}{n}\right)^n=\left(1-\frac{1}{n^2}\right)^n$$

$$\left(1+\frac{1}{n}\right)^n\left(1-\frac{1}{n}\right)^n=\biggl(1-\frac{1}{n^2}\biggr)^n$$

THE SIZE OF THE DELIMITERS CAN ALSO BE SET WITH \F

```
\startformula
    \left( 1 + \frac{1}{n}   \right)^n
    \left( 1 - \frac{1}{n}   \right)^n
  = \left( 1 - \frac{1}{n^2} \right)^n
\stopformula
\startformula
       \left( 1 + \frac{1}{n}   \right)^n
       \left( 1 - \frac{1}{n}   \right)^n
  = \F3\left( 1 - \frac{1}{n^2} \right)^n
\stopformula
```

$$\left(1 + \frac{1}{n} \right)^n \left(1 - \frac{1}{n} \right)^n = \left(1 - \frac{1}{n^2} \right)^n$$

$$\left(1 + \frac{1}{n} \right)^n \left(1 - \frac{1}{n} \right)^n = \left(1 - \frac{1}{n^2} \right)^n$$

WE CAN DEFINE OUR OWN DELIMITERS

```
\definemathfence[Set][brace][
  middle="7C,
  command=yes,
]

\startformula
  \mathbb{Q}(\sqrt{d}) = \Set{ u + v \sqrt{d} \fence u,v\in\mathbb{Q} }
\stopformula
```

$$\mathbb{Q}(\sqrt{d}) = \left\{ u + v\sqrt{d} \,\middle|\, u, v \in \mathbb{Q} \right\}$$

WE CAN USE STRUTS TO CONTROL VERTICAL SPACING IN FRACTIONS

```
\ruledhbox{\dm{\frac[strut=no]    {1 + x}{1 + x^2}}}
\ruledhbox{\dm{\frac[strut=tight]{1 + x}{1 + x^2}}}
\ruledhbox{\dm{\frac[strut=yes]  {1 + x}{1 + x^2}}}
\ruledhbox{\dm{\frac[strut=math] {1 + x}{1 + x^2}}}
\ruledhbox{\dm{\frac[strut=text] {1 + x}{1 + x^2}}}
```

$$\frac{1+x}{1+x^2} \quad \frac{1+x}{1+x^2} \quad \frac{1+x}{1+x^2} \quad \frac{1+x}{1+x^2} \quad \frac{1+x}{1+x^2}$$

WE CAN DEFINE OUR OWN FRACTION TYPE CONSTRUCTIONS

```
\definemathfraction[christoffel][left="7B,right="7D,rule=no, strut=math]
\definemathfraction[legendre]   [left="28,right="29,rule=yes,strut=math]

\startformula
  \christoffel{l}{jk} = \Gamma^^^{l}_{jk}(x)
    \mtp{,}
  \legendre{a}{p} \equiv a^{\frac[strut=no]{1}{2}(p-1)}(\mod p)
\stopformula
```

$$\left\{ {l \atop jk} \right\} = \Gamma^{l}{}_{jk}(x), \quad \left(\frac{a}{p}\right) \equiv a^{\frac{1}{2}(p-1)} (\mod p)$$

ALIGNMENTS

```
\startformula
  \startalign
    \NC 1001 \EQ 357 \cdot 2 + 287 \NR
    \NC 357  \EQ 287 \cdot 1 + 70  \NR
    \NC 287  \EQ 70 \cdot 4 + 7   \NR
    \NC 70   \EQ 7  \cdot 10      \NR
  \stopalign
\stopformula
```

$$\begin{aligned} 1001 &= 357 \cdot 2 + 287 \\ 357 &= 287 \cdot 1 + 70 \\ 287 &= 70 \cdot 4 + 7 \\ 70 &= 7 \cdot 10 \end{aligned}$$

WE CAN GET TWO ALIGN GROUPS WITH `m=2`

```
\startformula
\startalign[m=2, n=2, align={1:right, 2:left}, distance=2em]
  \NC  \frac{1}{\zeta(s)}
    \EQ \sum_{n = 1}^{+\infty} \frac{\mu(n)}{n^s}
  \NC  \frac{\zeta(s - 1)}{\zeta(s)}
    \EQ \sum_{n = 1}^{+\infty} \frac{\phi(n)}{n^s}   \NR
  \NC\relax [\zeta(s)]^2
    \EQ \sum_{n = 1}^{+\infty} \frac{\tau(n)}{n^s}
  \NC  \zeta(s) \zeta(s - 1)
    \EQ \sum_{n = 1}^{+\infty} \frac{\sigma(n)}{n^s} \NR
\stopalign
\stopformula
```

PLAYING WITH THE `distance` KEY WE GET DIFFERENT LAYOUTS

`distance=2em`

$$\frac{1}{\zeta(s)} = \sum_{n=1}^{+\infty} \frac{\mu(n)}{n^s} \qquad\qquad \frac{\zeta(s-1)}{\zeta(s)} = \sum_{n=1}^{+\infty} \frac{\phi(n)}{n^s}$$

$$[\zeta(s)]^2 = \sum_{n=1}^{+\infty} \frac{\tau(n)}{n^s} \qquad\qquad \zeta(s)\zeta(s-1) = \sum_{n=1}^{+\infty} \frac{\sigma(n)}{n^s}$$

`distance=0em plus 1fil`

$$\frac{1}{\zeta(s)} = \sum_{n=1}^{+\infty} \frac{\mu(n)}{n^s} \qquad\qquad\qquad\qquad \frac{\zeta(s-1)}{\zeta(s)} = \sum_{n=1}^{+\infty} \frac{\phi(n)}{n^s}$$

$$[\zeta(s)]^2 = \sum_{n=1}^{+\infty} \frac{\tau(n)}{n^s} \qquad\qquad\qquad\qquad \zeta(s)\zeta(s-1) = \sum_{n=1}^{+\infty} \frac{\sigma(n)}{n^s}$$

CASES

```
\startformula
  a_n =
    \startcases
      \NC \cos  ( 2^{n-1}\arccos a_1 )
      \NC \left(\abs{a_1} \leq 1\right) \NR
      \NC \cosh ( 2^{n-1}\arcosh a_1 )
      \NC \left(\abs{a_1} \geq 1\right) \NR
    \stopcases
\stopformula
```

$$a_n = \begin{cases} \cos(2^{n-1} \arccos a_1) & (|a_1| \leq 1) \\ \cosh(2^{n-1} \operatorname{arcosh} a_1) & (|a_1| \geq 1) \end{cases}$$

SIMPLE ALIGNS

COLLECTING EQUATIONS

```
\definemathsimplealign[collected][
  left={\startmathfenced[sesac]},
  right=\stopmathfenced,
  align={1:right,2:left},
  strut=yes,
]
```

COLLECTING EQUATIONS

```
\startformula
  \startcollected
    \NC x \NC = r \cos \phi \sin \theta \NR
    \NC y \NC = r \sin \phi \sin \theta \NR
    \NC z \NC = r \cos \theta           \NR
  \stopcollected
\stopformula
```

$$\left.\begin{aligned} x &= r\cos\phi\sin\theta \\ y &= r\sin\phi\sin\theta \\ z &= r\cos\theta \end{aligned}\right\}$$

TAGS AND SHORT LINES

```
From X and Y it follows that
\startformula
  v(0,t)   = u(0,t) - \widetilde{u}(0)     = 1 - \tilde{u}(0)
  \breakhere[left]{and}
  v(\pi,t) = u(\pi,t) - \widetilde{u}(\pi) = 2 - \tilde{u}(\pi).
\stopformula
This means that \dots
```

From X and Y it follows that

$$v(0,t) = u(0,t) - \tilde{u}(0) = 1 - \tilde{u}(0)$$

and $$v(\pi,t) = u(\pi,t) - \tilde{u}(\pi) = 2 - \tilde{u}(\pi).$$

This means that …

TAGS AND SHORT LINES

```
From X and Y it follows that
\startformula
  \startalign[n=1,text:2={and}]
    \NC v(0,t)   = u(0,t)   - \widetilde{u}(0)   = 1 - \tilde{u}(0)   \NR
    \NC v(\pi,t) = u(\pi,t) - \widetilde{u}(\pi) = 2 - \tilde{u}(\pi).\NR
  \stopalign
\stopformula
This means that \dots
```

From X and Y it follows that

$$v(0,t) = u(0,t) - \tilde{u}(0) = 1 - \tilde{u}(0)$$

and $$v(\pi,t) = u(\pi,t) - \tilde{u}(\pi) = 2 - \tilde{u}(\pi).$$

This means that …

NUMBERING EQUATIONS

```
\startplaceformula
  \startformula
    \Gamma(z) = - \frac{1}{2 i \sin \pi z}
    \int_{\infty}^{(0+)} (-t)^{z - 1} e^{-t} \dd t
  \stopformula
\stopplaceformula
```

$$\Gamma(z) = -\frac{1}{2i \sin \pi z} \int_{\infty}^{(0+)} (-t)^{z-1} e^{-t} \, dt \qquad (1)$$

FOR SPLIT FORMULAS THE NUMBER IS PLACED AFTER THE LAST LINE

$$
\begin{aligned}
&P'(iy_1, \dots, iy_n, i\eta_k) \\
&\qquad = (ir)^{k-1}\left[P'_k\left(z_1, \dots, z_n, \frac{\eta_k}{r}\right)\right. \\
&\qquad\qquad\qquad\qquad \left. + \frac{1}{ir}P'_{k-1}\left(z_1, \dots, z_n, \frac{\eta_k}{r}\right) + \dots\right] \\
&\qquad = (ir)^{k-1}P'_k\left(z_1, \dots, z_n, \frac{\eta_k}{r}\right) + O(r^{k-2})
\end{aligned}
\tag{1}
$$

IT IS POSSIBLE TO MOVE THE NUMBER TO THE LEFT

```
\setupformula[location=left]
```

(1) $$\Gamma(z) = -\frac{1}{2i\sin\pi z}\int_{\infty}^{(0+)}(-t)^{z-1}e^{-t}\,dt$$

(2) $$\begin{aligned} P'(iy_1,\dots,iy_n,i\eta_k) \\ &= (ir)^{k-1}\left[P'_k\left(z_1,\dots,z_n,\frac{\eta_k}{r}\right)\right. \\ &\qquad \left. + \frac{1}{ir}P'_{k-1}\left(z_1,\dots,z_n,\frac{\eta_k}{r}\right) + \dots\right] \\ &= (ir)^{k-1}P'_k\left(z_1,\dots,z_n,\frac{\eta_k}{r}\right) + O(r^{k-2}) \end{aligned}$$

NUMBERED ALIGNMENTS

```
\startplaceformula
\startformula\startalign
  \NC \sin\alpha + \sin\beta
    \EQ 2\sin\frac{\alpha + \beta}{2} \cos\frac{\alpha - \beta}{2} \NR[eq:1]
  \NC \cos\alpha + \cos\beta
    \EQ 2\cos\frac{\alpha + \beta}{2} \cos\frac{\alpha - \beta}{2} \NR[eq:2]
\stopalign\stopformula
\stopplaceformula
See \eqref[eq:1].
```

$$\sin\alpha + \sin\beta = 2\sin\frac{\alpha + \beta}{2} \cos\frac{\alpha - \beta}{2} \tag{1}$$

$$\cos\alpha + \cos\beta = 2\cos\frac{\alpha + \beta}{2} \cos\frac{\alpha - \beta}{2} \tag{2}$$

See (1).

NUMBERED ALIGNMENTS

```
\startplaceformula[eq:trig]
\startformula\startalign
  \NC \sin\alpha + \sin\beta
    \EQ 2\sin\frac{\alpha + \beta}{2} \cos\frac{\alpha - \beta}{2} \NR[a]
  \NC \cos\alpha + \cos\beta
    \EQ 2\cos\frac{\alpha + \beta}{2} \cos\frac{\alpha - \beta}{2} \NR[b]
\stopalign\stopformula
\stopplaceformula
See \eqref[eq:trig].
```

$$\sin\alpha + \sin\beta = 2\sin\frac{\alpha+\beta}{2}\cos\frac{\alpha-\beta}{2} \quad (1.a)$$

$$\cos\alpha + \cos\beta = 2\cos\frac{\alpha+\beta}{2}\cos\frac{\alpha-\beta}{2} \quad (1.b)$$

See (1).

NUMBERED ALIGNMENTS

```
\startplaceformula
\startformula\startalign
  \NC \sin\alpha + \sin\beta
    \EQ 2\sin\frac{\alpha + \beta}{2} \cos\frac{\alpha - \beta}{2} \NR[t:a][a]
  \NC \cos\alpha + \cos\beta
    \EQ 2\cos\frac{\alpha + \beta}{2} \cos\frac{\alpha - \beta}{2} \NR[t:b][b]
\stopalign\stopformula
\stopplaceformula
See \eqref[t:b].
```

$$\sin\alpha + \sin\beta = 2\sin\frac{\alpha + \beta}{2} \cos\frac{\alpha - \beta}{2} \quad (1.a)$$

$$\cos\alpha + \cos\beta = 2\cos\frac{\alpha + \beta}{2} \cos\frac{\alpha - \beta}{2} \quad (1.b)$$

See (1.b).

COLLECT EQUATIONS ONE NUMBER

```
\startplaceformula
  \startformula
    \startcollected
      \NC P_1 + (P_2 + P_3) \NC = (P_1 + P_2) + P_3  \NR
      \NC P_1 (P_2 P_3)     \NC = (P_1 P_2) P_3      \NR
      \NC P_1 (P_2 + P_3)   \NC =  P_1 P_2 + P_1 P_3 \NR
    \stopcollected
  \stopformula
\stopplaceformula
```

$$\left.\begin{aligned} P_1 + (P_2 + P_3) &= (P_1 + P_2) + P_3 \\ P_1 (P_2 P_3) &= (P_1 P_2) P_3 \\ P_1 (P_2 + P_3) &= P_1 P_2 + P_1 P_3 \end{aligned}\right\} \quad (1)$$

SUBFORMULAS

```
\startsubformulas
\startplaceformula
\startformula
  X_p(\alpha f + \beta g) = \alpha (X_p f) + \beta (X_p g)
\stopformula
\stopplaceformula
\startplaceformula
\startformula
  X_p(f g) = (X_p f) g(p) + f(p) (X_p g)
\stopformula
\stopplaceformula
\stopsubformulas
```

$$X_p(\alpha f + \beta g) = \alpha (X_p f) + \beta (X_p g) \tag{1.a}$$

$$X_p(f g) = (X_p f)\, g(p) + f(p)\, (X_p g) \tag{1.b}$$

TYPESETTING MATRICES

```
\startformula
  \startmatrix
    \NC 1   \NC 1   \NC 1   \NR
    \NC x   \NC y   \NC z   \NR
    \NC x^2 \NC y^2 \NC z^2 \NR
  \stopmatrix
\stopformula
```

$$\begin{matrix} 1 & 1 & 1 \\ x & y & z \\ x^2 & y^2 & z^2 \end{matrix}$$

ROWS LEFT OUT FROM MATRICES SET WITH FILLERS

```
\startformula
  \startmatrix[left={\left(},right={\right)}]
    \NC c_{11} \NC c_{12} \NC \ldots \NC  c_{1n}  \NR
    \NC c_{21} \NC c_{22} \NC \ldots \NC  c_{2n}  \NR
    \HF                                           \NR
    \NC c_{m1} \NC c_{m2} \NC \ldots \NC  c_{mn}  \NR
  \stopmatrix
\stopformula
```

$$\begin{pmatrix} c_{11} & c_{12} & \ldots & c_{1n} \\ c_{21} & c_{22} & \ldots & c_{2n} \\ . \quad . & . \quad . & . \quad . & . \quad . \\ c_{m1} & c_{m2} & \ldots & c_{mn} \end{pmatrix}$$

BLOCK MATRICES
LINES BETWEEN ROWS AND COLUMNS

```
\startformula
  \startmatrix[left={\left[},right={\right]}]
    \NC A \VL B \NR
    \HL
    \NC C \VL D \NR
  \stopmatrix
\stopformula
```

$$\left[\begin{array}{c|c} A & B \\ \hline C & D \end{array}\right]$$

BORDER MATRICES

```
\startformula
  \startmatrix[left={\left(},right={\right)}]
    \TT {\bi a} \TT {\bi b} \TT {\bi c} \TT {\bi d} \NR
    \NC a_{1}   \NC b_{1}   \NC c_{1}   \NC d_{1}   \NR
    \NC a_{2}   \NC b_{2}   \NC c_{2}   \NC d_{2}   \NR
    \NC a_{3}   \NC b_{3}   \NC c_{3}   \NC d_{3}   \NR
  \stopmatrix
\stopformula
```

$$\begin{matrix} \boldsymbol{a} & \boldsymbol{b} & \boldsymbol{c} & \boldsymbol{d} \end{matrix}$$
$$\begin{pmatrix} a_1 & b_1 & c_1 & d_1 \\ a_2 & b_2 & c_2 & d_2 \\ a_3 & b_3 & c_3 & d_3 \end{pmatrix}$$

DEFINE NEW MATRIX TYPES AND SIMPLE WAY OF TYPING MATRICES

```
\definemathmatrix[determinant][
  left={\left\lvert},
  right={\right\rvert},
  simplecommand=determinant,
  align={all:right},
]

\startformula
  \determinant{ 1, 2, 3 ; 4, -5, 6 ; 7, 8, 9 }
\stopformula
```

$$\begin{vmatrix} 1 & 2 & 3 \\ 4 & -5 & 6 \\ 7 & 8 & 9 \end{vmatrix}$$

COMMENTS AND TODO

Documentation
I write a math manual. Hans documents the more technical parts.

Finetuning
We need to fine tune tweaks and parameters.

Feedback
Other ConTEXt users need to test and give feedback.

HOW SHOULD WE TREAT PUNCTUATION IN MATH?

```
\startformula
  p = \frac{\partial \phi}{\partial x},\quad
  q = \frac{\partial \phi}{\partial y},\quad
  r = \frac{\partial \phi}{\partial z}.
\stopformula
```

$$p = \frac{\partial \phi}{\partial x},\quad q = \frac{\partial \phi}{\partial y},\quad r = \frac{\partial \phi}{\partial z}.$$

MATHTEXTPUNCTUATION IS USED TO SEPARATE FORMULAS

```
\startformula
  p = \frac{\partial \phi}{\partial x}\mtp{,}
  q = \frac{\partial \phi}{\partial y}\mtp{,}
  r = \frac{\partial \phi}{\partial z}\mtp{.}
\stopformula
```

$$p = \frac{\partial \phi}{\partial x}, \quad q = \frac{\partial \phi}{\partial y}, \quad r = \frac{\partial \phi}{\partial z}.$$

WE CAN ALREADY TODAY COLLECT SEVERAL FORMULAS

```
\startformulas
  \startformula
    p = \frac{\partial \phi}{\partial x}\mtp{,}
  \stopformula
  \startformula
    q = \frac{\partial \phi}{\partial y}\mtp{,}
  \stopformula
  \startformula
    r = \frac{\partial \phi}{\partial z}\mtp{.}
  \stopformula
\stopformulas
```

$$p = \frac{\partial \phi}{\partial x}, \qquad q = \frac{\partial \phi}{\partial y}, \qquad r = \frac{\partial \phi}{\partial z}.$$

CAN WE HAVE UNARY OPERATORS? YES WE CAN (EXPERIMENTAL!)

```
As \im{x} tends to \im{-1} or as \im{x} tends to \im{\um 1}.\par
But \im{x = 2 - 1}.\par
As \im{x} tends to \im{+\infty} or as \im{x} tends to \im{\up\infty}.\par
Define \im{a-b} as \im{a+\um b}.\par
\im{\pi = 3 \pm 0.2 = 3 \una{\pm} 0.2 = 3 \upm 0.2}.\par
Not \im{\sim 10^3} but \im{\una{\sim} 10^3}.
```

As x tends to -1 or as x tends to -1.
But $x = 2 - 1$.
As x tends to $+\infty$ or as x tends to +∞.
Define $a - b$ as $a +$ -b.
$\pi = 3 \pm 0.2 = 3{\pm}0.2 =$ 3±0.2.
Not $\sim 10^3$ but ~10^3.

PARAGRAPH CONSTRUCTIONS

```
\startformula
  \left\{ \mparagraph{Quaternion algebras\par over $\rationals$ up to\par
                      isomorphism} \right\}
  \alignhere \leftrightarrow
  \left\{ \mparagraph{Finite subsets of\par places of $\rationals$ of\par
                      even cardinality} \right\}
  \breakhere \leftrightarrow
  \F2\left\{ \mparagraph{\im{D\in\integers_{>0}} squarefree} \right\}
\stopformula
```

$$\left\{\begin{array}{c}\text{Quaternion algebras}\\ \text{over } \mathbb{Q} \text{ up to}\\ \text{isomorphism}\end{array}\right\} \leftrightarrow \left\{\begin{array}{c}\text{Finite subsets of}\\ \text{places of } \mathbb{Q} \text{ of}\\ \text{even cardinality}\end{array}\right\}$$

$$\leftrightarrow \left\{ D \in \mathbb{Z}_{>0} \text{ squarefree} \right\}$$

PARAGRAPH CONSTRUCTIONS WITH A FRAME

```
\startformula
  \left\{ \mparagraph{Quaternion algebras\par over $\rationals$ up to\par
                      isomorphism} \right\}
  \alignhere \leftrightarrow
  \left\{ \mparagraph[frame=on,background=color,backgroundcolor=color1,offset=1dk]
                     {Finite subsets of\par places of $\rationals$ of\par
                      even cardinality} \right\}
  \breakhere \leftrightarrow
  \F2\left\{ \mparagraph{\im{D\in\integers_{>0}} squarefree} \right\}
\stopformula
```

$$\left\{ \begin{array}{c}\text{Quaternion algebras}\\ \text{over } \mathbb{Q} \text{ up to}\\ \text{isomorphism}\end{array} \right\} \leftrightarrow \left\{ \boxed{\begin{array}{c}\text{Finite subsets of}\\ \text{places of } \mathbb{Q} \text{ of}\\ \text{even cardinality}\end{array}} \right\}$$

$$\leftrightarrow \left\{ D \in \mathbb{Z}_{>0} \text{ squarefree} \right\}$$

DECORATING MATRICES USING METAFUN

```
\connectboxanchors[right][right][text={\small\im{-5}}]{one}{two}

\startformula
  \bmatrix {
    1,2,3,\mathboxanchored{one}{4};
    5,6,7,\mathboxanchored{two}{8}
  }
\stopformula
```

$$\begin{bmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \end{bmatrix} \quad -5$$

THEOREM ENVIRONMENT
AMS STYLE

```
\defineenumeration[theorem][
    alternative=serried,
    width=fit,
    distance=0.5em,
    text=Theorem,
    style=italic,
    title=yes,
    titlestyle=normal,
    prefix=yes,
    headcommand=\groupedcommand{}{.},
]
```

EXAMPLE THEOREM

```
\starttheorem
  Let \im{b} be a Laurent polynomial with a zero \im{t_0 \in \mathbf{T}} of
  order \im{\alpha}. Then there exists a positive constant \im{C}, independent
  of \im{n}, such that \im{\lVert T_n^{-1}(b) \rVert_2 \geq C n^{\alpha}}
  for all \im{n \in \naturalnumbers}.
\stoptheorem
```

Theorem 1. *Let b be a Laurent polynomial with a zero $t_0 \in \mathbf{T}$ of order α. Then there exists a positive constant C, independent of n, such that $\lVert T_n^{-1}(b) \rVert_2 \geq C n^{\alpha}$ for all $n \in \mathbb{N}$.*

EXAMPLE
THEOREM WITH TITLE

```
\starttheorem[title={Pomp}]
  If \im{\beta \in \integers_{+}}, then
  \startformula
    T(\xi_{-\beta}) \in \mathcal{B}\F1\left[\ell^2(\beta), \ell^2\right]
    \breakhere[left]{and}
    T(\eta_{-\beta}) \in \mathcal{B}\F1\left[\ell^2, \ell^2(-\beta)\right]\mtp{.}
  \stopformula
\stoptheorem
```

Theorem 2 (Pomp). *If* $\beta \in \mathbb{Z}_+$, *then*

$$T(\xi_{-\beta}) \in \mathcal{B}[\ell^2(\beta), \ell^2]$$

and $$T(\eta_{-\beta}) \in \mathcal{B}[\ell^2, \ell^2(-\beta)].$$

THEOREM ENVIRONMENT CHICAGO STYLE

```
\defineenumeration[theorem][
    alternative=serried,
    width=fit,
    text=Theorem,
    style=italic,
    title=yes,
    prefix=yes,
    indenting=yes,
    headstyle={\sc},
    headindenting=yes,
    titlestyle=normal,
]
```

EXAMPLE THEOREM

```
\starttheorem
  Let \im{b} be a Laurent polynomial with a zero \im{t_0 \in \mathbf{T}} of
  order \im{\alpha}. Then there exists a positive constant \im{C}, independent
  of \im{n}, such that \im{\lVert T_n^{-1}(b) \rVert_2 \geq C n^{\alpha}}
  for all \im{n \in \naturalnumbers}.
\stoptheorem
```

THEOREM 3. *Let b be a Laurent polynomial with a zero $t_0 \in \mathbf{T}$ of order α. Then there exists a positive constant C, independent of n, such that $\lVert T_n^{-1}(b) \rVert_2 \geq C n^{\alpha}$ for all $n \in \mathbb{N}$.*

EXAMPLE
THEOREM WITH TITLE

```
\starttheorem[title={Pomp}]
  If \im{\beta \in \integers_{+}}, then
  \startformula
    T(\xi_{-\beta}) \in \mathcal{B}\F1\left[\ell^2(\beta), \ell^2\right]
    \breakhere[left]{and}
    T(\eta_{-\beta}) \in \mathcal{B}\F1\left[\ell^2, \ell^2(-\beta)\right]\mtp{.}
  \stopformula
\stoptheorem
```

THEOREM 4 (Pomp). *If* $\beta \in \mathbb{Z}_+$, *then*

$$T(\xi_{-\beta}) \in \mathcal{B}[\ell^2(\beta), \ell^2]$$

and

$$T(\eta_{-\beta}) \in \mathcal{B}[\ell^2, \ell^2(-\beta)].$$

QUESTIONS, COMMENTS CONTACT

Thanks
Hans Hagen
My family for their patience
All the nice people in the TeX SE chat

Install ConTEXt lmtx
https://www.pragma-ade.nl/install.htm

Contact me
mickep@gmail.com