

3 More on inline formulas

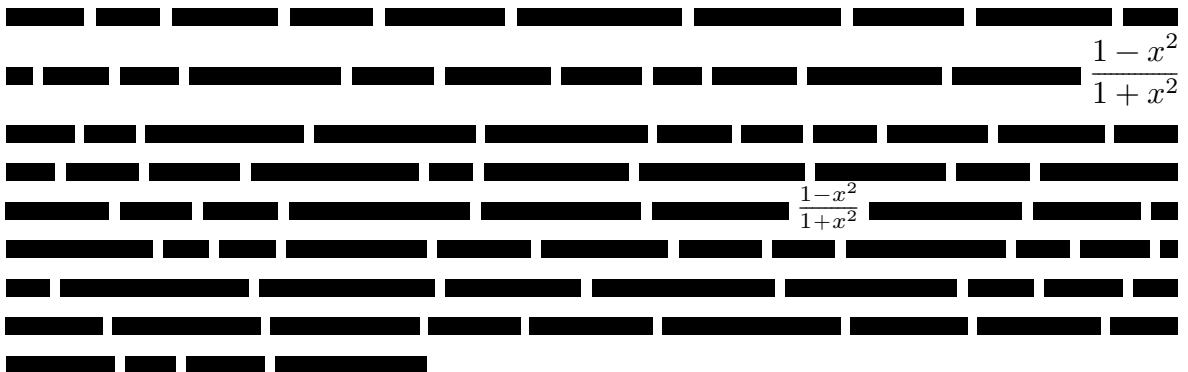
3.1 Introduction

We have discussed the building blocks of mathematical formulas in quite some detail. Now it is time to discuss formulas as a whole, and their interplay with the surrounding text and paragraphs. We will first discuss how to prevent inline formulas from being too tall, by slashing fractions. This does not really have to do so much with ConTeXt but is rather some general advice to prevent lines from spreading. In connection with this we will however also present the profiling mechanism in ConTeXt that sometimes can prevent lines from spreading, even though the lines are slightly too tall. Our second main focus will be on breaking paragraphs into lines, and the question on if and how one should break formulas.

3.2 Slashing fractions

It is a bit difficult to typeset fractions, in particular in inline formulas. We will therefore give many examples with some general advice, partly inspired by the 29(!) pages long discussion on fractions in [Lan61]. Before we start, let us show what we want to avoid.

```
\simulatewords [n=20,m=30,min=2,max=6,hyphen=none]
\dm{\frac{1 - x^2}{1 + x^2}}
\simulatewords [n=20,m=30,min=2,max=6,hyphen=none]
\im{\frac{1 - x^2}{1 + x^2}}
\simulatewords [n=30,m=40,min=2,max=6,hyphen=none]
```



The first example shows a fraction $\frac{1 - x^2}{1 + x^2}$ where the numerator and denominator are each a long string of black bars. This causes the lines to spread significantly. The second example shows a fraction $\frac{1 - x^2}{1 + x^2}$ where the numerator and denominator are each a long string of black bars, but the fraction is rendered in a smaller font size, making it more cluttered.

In this example, the first fraction is too big to be in an inline formula. It is so big that it forces the lines to spread. In the second fraction, the content is too cluttered. The general advice we will give is to slash complicated fraction in inline formulas.

```
\simulatewords [n=10,m=15,min=2,max=6,hyphen=none]
\im{(1 - x^2)/(1 + x^2)}
\simulatewords [n=20,m=30,min=2,max=6,hyphen=none]
```



The example shows a fraction $(1 - x^2)/(1 + x^2)$ where the numerator and denominator are each a long string of black bars. The fraction is rendered in a smaller font size, making it more cluttered.



Below, we will only show the output of examples, together with comments and some general advice. We give suggestions both for display and inline formulas. It is often more difficult to get the inline version correct, and, as mentioned, we will often use a fraction slash instead of a fraction bar, i.e. we will slash the fractions.

In our first example we have fractions with numbers only. In display style math these can be set slightly smaller with `\tfrac`. In text style math they will automatically get the correct smaller size with `\frac`.

Display: $\frac{11}{19} + \frac{3}{19}\sqrt{5} - \frac{1}{19}\sqrt{7} - \frac{2}{19}\sqrt{5}\sqrt{7}$

Inline: $\frac{11}{19} + \frac{3}{19}\sqrt{5} - \frac{1}{19}\sqrt{7} - \frac{2}{19}\sqrt{5}\sqrt{7}$

If there is a fraction with only numbers, we can still set it with `\tfrac`, as in the first example below. This also applies if there are more terms with numeric fractions, as in the polynomial in the second example. If, however, there are some non-numeric fractions, as in the third example, we suggest to set that fraction ($a/5$ in the example) in display style. Then it is also natural to set the other fraction ($\frac{1}{8}$ in the example) in display style. Note that we have slashed $a/5$ but not $\frac{1}{8}$ in the inline version. One could argue that it looks better with $1/8$ as well.

Display: $\frac{1}{24}(L^2 + 4\pi^2) \quad \frac{3}{5}x^2 + 2x + \frac{1}{8} \quad \frac{a}{5}x^2 + 2x + \frac{1}{8}$

Inline: $\frac{1}{24}(L^2 + 4\pi^2) \quad \frac{3}{5}x^2 + 2x + \frac{1}{8} \quad (a/5)x^2 + 2x + \frac{1}{8}$

With integer fractions in front of a big symbol, like an integral, big parentheses, or a sum, there is no meaning in keeping the fractions small in display math.

Display: $\frac{1}{2} \int_0^2 f(\theta) d\theta \quad \frac{3}{5} \left(\frac{a}{b} - 1 \right) \quad \frac{1}{2} \sum_{k=1}^{+\infty} \frac{1}{k^2}, \quad \frac{1}{2} \log\left(\frac{x}{y}\right)$

Inline: $\frac{1}{2} \int_0^2 f(\theta) d\theta \quad \frac{3}{5} (a/b - 1) \quad \frac{1}{2} \sum_{k=1}^{+\infty} 1/k^2 \quad \frac{1}{2} \log(x/y)$

Here we have letter fractions that are simple in the sense that both numerator and denominator only has one term. Since there are letters, we shall not use a smaller style. This fixes the look in the display style. In text style, we must slash. The reason is that we do not want high fractions that forces a larger total line height, and we do not want to make the symbols smaller.

Display: $\frac{1}{2\pi} \quad x' = \frac{x}{|x|} \quad \frac{dy}{dx} \quad \left[\frac{n^2}{4} \right]$

Inline: $1/2\pi \quad x' = x/|x| \quad dy/dx \quad [n^2/4] \text{ or } [\frac{1}{4}n^2]$

In the first example we slash and get $1/2\pi$. Could this be mixed up with $\frac{1}{2}\pi$? Yes, probably. But, if we think about how we read the formula out, “one over two π ”,

it makes sense to write $1/2\pi$. In cases where you want or need to, you can insert parentheses and write $1/(2\pi)$.

There is not much to say about the second and third examples. For the fourth, we can choose between $\lfloor n^2/4 \rfloor$ and $\lfloor \frac{1}{4}n^2 \rfloor$ (the fraction here is set with `\frac`). The important point is that the formulas does not change the height of the line.

$$\text{Display: } \frac{\Gamma(\beta_1)\Gamma(\beta_2) \dots \Gamma(\beta_n)}{\Gamma(\beta_1 + \beta_2 + \dots + \beta_n)} \qquad \frac{1}{\zeta(s)} \sum_{n=1}^{+\infty} \frac{\mu(n)}{n^s}$$

$$\text{Inline: } \Gamma(\beta_1)\Gamma(\beta_2) \dots \Gamma(\beta_n)/\Gamma(\beta_1 + \beta_2 + \dots + \beta_n) \quad [1/\zeta(s)] \sum_{n=1}^{+\infty} \mu(n)/n^s$$

With the examples above we only want to emphasize that the same idea apply even if the expressions in the fractions are a bit more complicated. If they get too long, however, they should be displayed. These two formulas are border cases.

In the second example we have two fractions that are both slashed, independently of each other. Note the added square brackets in the first of them.

$$\text{Display: } \frac{1}{2\pi i} \frac{\partial f}{\partial x_j} \qquad \frac{\sin^2 tu}{u^2} \qquad \frac{1}{d_x} (\Lambda * \mathcal{M})$$

$$\text{Inline: } (1/2\pi i) \partial f / \partial x_j \quad (\sin^2 tu)/u^2 \quad (1/d_x) (\Lambda * \mathcal{M})$$

In these examples we have inserted parentheses when slashing the fractions. We need no parentheses around the numerator (in the third example there are already parentheses, and we must not remove them!).

$$\text{Display: } \frac{1}{2}(a+b) \text{ or } \frac{a+b}{2}$$

$$\text{Inline: } \frac{1}{2}(a+b) \text{ or } (a+b)/2$$

In cases like these you have the freedom to choose, but be consistent throughout your document.

$$\text{Display: } \sqrt{\frac{v dv}{\sigma \sigma}}$$

$$\text{Inline: } \sqrt{v/\sigma} dv/\sigma$$

Square roots work as parentheses, so you do not need to insert any when slashing.

$$\text{Display: } \frac{1}{n+1} \qquad w = \frac{az+b}{cz+d} \qquad \frac{F(t_i) - F(t_{i-1})}{t_i - t_{i-1}}$$

$$\text{Inline: } 1/(n+1) \quad w = (az+b)/(cz+d) \quad [F(t_i) - F(t_{i-1})]/(t_i - t_{i-1})$$

When slashing fractions that are not simple (i.e. where the numerator and/or the denominator have more than one term), we will need to add parentheses. Note the square brackets in the third example above.

$$\text{Display: } \frac{1}{n+1} B_{n+1}(x) \quad \frac{n!}{(n-2j)!(2j)!!} \quad \frac{B_1}{1+x} - \frac{B_2}{2(1+x)^2}$$

$$\text{Inline: } [1/(n+1)] B_{n+1}(x) \quad n!/[(n-2j)!(2j)!!] \quad B_1/(1+x) - B_2/[2(1+x)^2]$$

In the first example the square brackets must be there. One could question them in the second example if one reads it as “ n -factorial over ...”. If hesitant, add parentheses. The third example consists of two terms, one where we only need ordinary parentheses, and one where we also need square brackets. The last term could equally well have been written as $-\frac{1}{2} B_2/(1+x)^2$.

$$\text{Display: } \frac{1}{(2\pi i)^k} \int_{\nu+x} \mathcal{U}\varphi$$

$$\text{Inline: } [1/(2\pi i)^k] \int_{\nu+x} \mathcal{U}\varphi \text{ or } (2\pi i)^{-k} \int_{\nu+x} \mathcal{U}\varphi$$

The fraction above can be slashed as we first show, which leads to extra brackets. It is perhaps better in cases like this to simply get rid of the fraction by writing $1/(2\pi i)^k$ as $(2\pi i)^{-k}$.

$$\text{Display: } a^{\frac{3}{5}} \quad a^{b/2} = a^{\frac{1}{2}b} \quad w^{(N+2)/(N-2)} \quad L^{Np/(N-2)} \quad \left(\int_{\Omega} |f|^p d\mu \right)^{1/p}$$

$$\text{Inline: } a^{3/5} \quad a^{b/2} \quad w^{(N+2)/(N-2)} \quad L^{Np/(N-2)} \quad \left(\int_{\Omega} |f|^p d\mu \right)^{1/p}$$

Fractions in exponents and indices are set more or less as if they were set on the line, but with smaller sizes. This is taken care of automatically.

$$\text{Bad: } e^{\frac{\ell_{\gamma_1}(X) + \ell_{\gamma_2}(X)}{2}} \quad \text{Better: } e^{\frac{1}{2}[\ell_{\gamma_1}(X) + \ell_{\gamma_2}(X)]} \quad \text{Better: } \exp\left\{\frac{1}{2}[\ell_{\gamma_1}(X) + \ell_{\gamma_2}(X)]\right\}$$

The first example above is too cluttered. It gets slightly better if we take the $\frac{1}{2}$ out as a factor, but even better if we avoid the exponential form altogether and write the exponential function as `exp`. We end this long list with examples by reminding you that it is also possible to use a slash in display math.

$$\text{Display: } \mathcal{M}_{g,n} = \mathcal{T}_{g,n}(L)/\text{Mod}_{g,n} \quad \left(\frac{az+b}{cz+d} \right) / \left(\frac{ez+f}{gz+h} \right)$$

$$\text{Inline: } \mathcal{M}_{g,n} = \mathcal{T}_{g,n}(L)/\text{Mod}_{g,n} \quad [(az+b)/(cz+d)] / [(ez+f)/(gz+h)]$$

3.3 What do others say on the breaking of inline formulas?

The breaking of inline formulas over several lines is an interesting and rather complex topic. In fact, it should not be something that the user should need to have in mind while typing, but it is good to know something about it. Let us therefore start with a small historical background.

The simplest rule is to be found in [CBB54]: “Undisplayed formulae (that is, formulae run in as part of the text) must never be broken at the end of a line.”