# The mathtools package*

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**Abstract**

The mathtools package is an extension package to amsmath. There are two things on mathtools' agenda: 1) correct various bugs/defeciencies in amsmath until these are fixed by the $\mathcal{AMS}$ and 2) provide useful tools for mathematical typesetting, be it a small macro for typesetting a prescript or an underbraket, or entirely new display math constructs such as a `multlined` environment.

## Contents



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# 1 Introduction

Although amsmath provides many handy tools for mathematical typesetting, it is nonetheless a static package. This is not a bad thing, because what it does, it mostly does quite well and having a stable math typesetting package is "a good thing." However, amsmath does not fulfill all the needs of the mathematical part of the LaTeX community, resulting in many authors writing small snippets of code for tweaking the mathematical layout. Some of these snippets has also been posted to newsgroups and mailing lists over the years, although more often than not without being released as stand-alone packages.

The mathtools package is exactly what its name implies: tools for mathematical typesetting. It is a collection of many of these often needed small tweaks—with some big tweaks added as well. It can only do so by having harvesting newsgroups for code and/or you writing the maintainers with wishes for code to be included, so if you have any good macros or just macros that help you when writing mathematics, then don't hesitate to report them to us. We can be reached at

```
mh.ctan@gmail.com
```

This is of course also the address to use in case of bug reports.

# 2 Package loading

The mathtools package requires amsmath but is able to pass options to it as well. Thus a line like

```
\usepackage[fleqn,tbtags]{mathtools}
```

is equivalent to

```
\usepackage[fleqn,tbtags]{amsmath}
\usepackage{mathtools}
```

## 2.1 Special mathtools options

| fixamsmath | donotfixamsmathbugs |
|---|---|

The option `fixamsmath` (default) fixes two bugs in amsmath.[1] Should you for some reason not want to fix these bugs then just add the option `donotfixamsmathbugs` (if you can do it without typos). The reason for this extremely long name is that I really don't see why you wouldn't want these bugs to be fixed, so I've made it slightly difficult not to fix them.

| allowspaces | disallowspaces |
|---|---|

Sometimes amsmath gives you nasty surprises, as here where things look seemingly innocent:

```
\[
    \begin{gathered}
      [p] = 100 \\
      [v] = 200
    \end{gathered}
\]
```

Without mathtools this will result in this output:

$$= 100$$
$$[v] = 200$$

Yes, the [p] has been gobbled without any warning whatsoever.[2] This is hardly what you'd expect as an end user, as the desired output was probably something like this instead:

$$[p] = 100$$
$$[v] = 200$$

With the option `disallowspaces` (default) mathtools disallows spaces in front of optional arguments where it could possibly cause problems just as amsmath does with `\\` inside the display environments. This includes the environments `gathered` (and also those shown in § 4.5 on page 28), `aligned`, `multlined`, and the extended `matrix`-environments (§ 3.4.1 on page 14). If you however want to preserve the more dangerous standard optional spaces, simply choose the option `allowspaces`.

[1] See the online LaTeX bugs database `http://www.latex-project.org/cgi-bin/ltxbugs2html` under AMSLaTeX problem reports 3591 and 3614.

[2] amsmath thought the [p] was an optional argument, checked if it was `t` or `b` and when both tests failed, assumed it was a `c`.

# 3 Tools for mathematical typesetting

`\mathtoolsset{`⟨*key val list*⟩`}`

Many of the tools shown in this manual can be turned on and off be setting a switch to either true or false. In all cases it is done with the command `\mathtoolsset`. A typical use could be something like

```
\mathtoolsset{
  showonlyrefs,
  mathic % or mathic = true
}
```

More information on the keys later on.

## 3.1 Fine-tuning mathematical layout

Sometimes you need to tweak the layout of formulas a little to get the best result and this part of the manual describes the various macros mathtools provides for this.

### 3.1.1 A complement to `\smash`, `\llap`, and `\rlap`

| | |
|---|---|
| `\mathllap[`⟨*mathstyle*⟩`]{`⟨*math*⟩`}` | `\mathclap[`⟨*mathstyle*⟩`]{`⟨*math*⟩`}` |
| `\mathrlap[`⟨*mathstyle*⟩`]{`⟨*math*⟩`}` | `\clap{`⟨*text*⟩`}` |
| `\mathmbox{`⟨*math*⟩`}` | `\mathmakebox[`⟨*width*⟩`][`⟨*pos*⟩`]{`⟨*math*⟩`}` |

In [1], Alexander R. Perlis describes some simple yet useful macros for use in math displays. For example the display

```
\[
  X = \sum_{1\le i\le j\le n} X_{ij}
\]
```

$$X = \sum_{1\le i\le j\le n} X_{ij}$$

contains a lot of excessive white space. The idea that comes to mind is to fake the width of the subscript. The command `\mathclap` puts its argument in a zero width box and centers it, so it could possibly be of use here.

```
\[
  X = \sum_{\mathclap{1\le i\le j\le n}} X_{ij}
\]
```

$$X = \sum_{\mathclap{1\le i\le j\le n}} X_{ij}$$

For an in-depth discussion of these macros I find it better to read the article; an online version can be found at

`http://www.tug.org/TUboat/Articles/tb22-4/tb72perlS.pdf`

Note that the definitions shown in the article do not exactly match the definitions in mathtools. Besides providing an optional argument for specifying the desired math style, these versions also work around a most unfortunate TEX "feature."[3] The `\smash` macro is fixed too.

### 3.1.2 Forcing a cramped style

Posted on
`comp.text.tex`
Michael Herschorn
1992/07/21

`\cramped[`⟨*mathstyle*⟩`]{`⟨*math*⟩`}`

Let's look at another example where we have used `\mathclap`:

```
\begin{equation}\label{eq:mathclap}
  \sum_{\mathclap{a^2<b^2<c}}\qquad
  \sum_{a^2<b^2<c}
\end{equation}
```

$$\sum_{a^2<b^2<c} \qquad \sum_{a^2<b^2<c} \tag{1}$$

Do you see the difference? Maybe if I zoomed in a bit:

$$\sum_{a^2<b^2<c} \qquad \sum_{a^2<b^2<c}$$

Notice how the limit of the right summation sign is typeset in a more compact style than the left. It is because TEX sets the limits of operators in a *cramped* style. For each of TEX' four math styles (`\displaystyle`, `\textstyle`, `\scriptstyle`, and `\scriptscriptstyle`), there also exists a cramped style that doesn't raise exponents as much. Besides in the limits of operators, TEX also automatically uses these cramped styles in radicals such as `\sqrt` and in the denominators of fractions, but unfortunately there are no primitive commands that allows you to detect crampedness or switch to it.

mathtools offers the command `\cramped` which forces a cramped style in normal un-cramped math. Additionally you can choose which of the four styles you want it in as well by specifying it as the optional argument:

```
\[
  \cramped{x^2}                \leftrightarrow x^2    \quad
  \cramped[\scriptstyle]{x^2} \leftrightarrow {\scriptstyle x^2}
\]
```

$$x^2 \leftrightarrow x^2 \quad x^2 \leftrightarrow x^2$$

You may be surprised how often the cramped style can be beneficial yo your output. Take a look at this example:

[3] The faulty reboxing procedure.

```
\begin{quote}
  The 2005 Euro\TeX{} conference is held in Abbaye des
  Pr\'emontr\'es, France, marking the 16th ($2^{2^2}$) anniversary
  of both Dante and GUTenberg (the German and French \TeX{} users
  group resp.).
\end{quote}
```

> The 2005 EuroTEX conference is held in Abbaye des Prémontrés, France, marking the 16th ($2^{2^2}$) anniversary of both Dante and GUTenberg (the German and French TEX users group resp.).

Typesetting on a grid is generally considered quite desirable, but as the second line of the example shows, the exponents of 2 causes the line to be too tall for the normal value of `\baselineskip`, so TEX inserts a `\lineskip` (normal value is 1.0pt). In order to circumvent the problem, we can force a cramped style so that the exponents aren't raised as much:

```
\begin{quote}
  The 2005 Euro\TeX{} ... 16th ($\cramped{2^{2^2}}$) ...
\end{quote}
```

> The 2005 EuroTEX conference is held in Abbaye des Prémontrés, France, marking the 16th ($2^{2^2}$) anniversary of both Dante and GUTenberg (the German and French TEX users group resp.).

| | |
|---|---|
| `\crampedllap[`⟨*mathstyle*⟩`]{`⟨*math*⟩`}` | `\crampedclap[`⟨*mathstyle*⟩`]{`⟨*math*⟩`}` |
| `\crampedrlap[`⟨*mathstyle*⟩`]{`⟨*math*⟩`}` | |

The commands `\crampedllap`, `\crampedclap`, and `\crampedrlap` are identical to the three `\mathXlap` commands described earlier except the argument is typeset in cramped style. You need this in order to typeset (1) correctly while still faking the width of the limit.

```
\begin{equation*}\label{eq:mathclap-b}
  \sum_{\crampedclap{a^2<b^2<c}}
  \tag{\ref{eq:mathclap}*}
\end{equation*}
```

$$\sum_{a^2<b^2<c} \tag{1*}$$

Of course you could just type

```
\sum_{\mathclap{\cramped{a^2<b^2<c}}}
```

but it has one major disadvantage: In order for `\mathXlap` and `\cramped` to get the right size, TEX has to process them four times, meaning that nesting them as shown above will cause TEX to typeset $4^2$ instances before choosing the right one. In this situation however, we will of course need the same style for both commands so it makes sense to combine the commands in one, thus letting TEX make the choice only once rather than twice.

### 3.1.3 Smashing an operator

Feature request by Lars Madsen 2004/05/04

`\smashoperator[`⟨*pos*⟩`]{`⟨*operator with limits*⟩`}`

Above we shoved how to get LaTeX to ignore the width of the subscript of an operator. However this approach takes a lot of extra typing, especially if you have a wide superscript, meaning you have to put in `\crampedclap` in both sub- and superscript. To make things easier, mathtools provides a `\smashoperator` command, which simply ignores the width of the sub- and superscript. It also takes an optional argument, `l`, `r`, or `lr` (default), denoting which side of the operator should be ignored (smashed).

```
\[
  V = \sum_{1\le i\le j\le n}^{\infty} V_{ij}                  \quad
  X = \smashoperator{\sum_{1\le i\le j\le n}^{3456}} X_{ij}    \quad
  Y = \smashoperator[r]{\sum\limits_{1\le i\le j\le n}} Y_{ij} \quad
  Z = \smashoperator[l]{\mathop{T}_{1\le i\le j\le n}} Z_{ij}
\]
```

$$V = \sum_{1\le i\le j\le n}^{\infty} V_{ij} \quad X = \sum_{1\le i\le j\le n}^{3456} X_{ij} \quad Y = \sum_{1\le i\le j\le n} Y_{ij} \quad Z = \mathop{T}_{1\le i\le j\le n} Z_{ij}$$

Note that `\smashoperator` always sets its argument in display style and with limits even if you have used the `nosumlimits` option of amsmath. If you wish, you can use shorthands for `_` and `^` such as `\sb` and `\sp`.

### 3.1.4 Adjusting limits of operators

Feature request by Lars Madsen 2004/07/09

`\adjustlimits{`⟨*operator*$_1$⟩`}_{`⟨*limit*$_1$⟩`} {`⟨*operator*$_2$⟩`}_{`⟨*limit*$_2$⟩`}`

When typesetting two consecutive operators with limits one often wishes the limits of the operators were better aligned. Look closely at these examples:

```
\[
  \text{a)} \lim_{n\to\infty} \max_{p\ge n} \quad
  \text{b)} \lim_{n\to\infty} \max_{p^2\ge n} \quad
  \text{c)} \lim_{n\to\infty} \sup_{p^2\ge nK} \quad
  \text{d)} \limsup_{n\to\infty} \max_{p\ge n}
\]
```

$$\text{a)} \lim_{n\to\infty} \max_{p\ge n} \quad \text{b)} \lim_{n\to\infty} \max_{p^2\ge n} \quad \text{c)} \lim_{n\to\infty} \sup_{p^2\ge nK} \quad \text{d)} \limsup_{n\to\infty} \max_{p\ge n}$$

a) looks okay, but b) is not quite as good because the second limit ($p^2 \ge n$) is significantly taller than the first ($n \to \infty$). With c) things begin to look really bad, because the second operator has a descender while the first doesn't, and finally we have d) which looks just as bad as c). The command `\adjustlimits` is useful in these cases, as you can just put it in front of these consecutive operators and it'll make the limits line up.

```
\[
```

```
  \text{a)} \adjustlimits\lim_{n\to\infty} \max_{p\ge n} \quad
  \text{b)} \adjustlimits\lim_{n\to\infty} \max_{p^2\ge n} \quad
  \text{c)} \adjustlimits\lim_{n\to\infty} \sup_{p^2\ge nK} \quad
  \text{d)} \adjustlimits\limsup_{n\to\infty} \max_{p\ge n}
\]
```

$$\text{a)} \lim_{n\to\infty} \max_{p\ge n} \quad \text{b)} \lim_{n\to\infty} \max_{p^2\ge n} \quad \text{c)} \lim_{n\to\infty} \sup_{p^2\ge nK} \quad \text{d)} \limsup_{n\to\infty} \max_{p\ge n}$$

The use of `\sb` instead of _ is allowed.

## 3.2 Controlling tags

In this section various tools for altering the appearance of tags are shown. All of the tools here can be used at any point in the document but they should probably be affect the whole document, so the preamble is the best place to issue them.

### 3.2.1 The appearance of tags

| |
|---|
| `\newtagform{`⟨*name*⟩`}[`⟨*inner_format*⟩`]{`⟨*left*⟩`}{`⟨*right*⟩`}` |
| `\renewtagform{`⟨*name*⟩`}[`⟨*inner_format*⟩`]{`⟨*left*⟩`}{`⟨*right*⟩`}` |
| `\usetagform{`⟨*name*⟩`}` |

Altering the layout of equation numbers in amsmath is not very user friendly (it involves a macro with three @'s in its name), so mathtools provides an interface somewhat reminiscent of the page style concept. This way you can define several different tag forms and then choose the one you prefer.

As an example let's try to define a tag form which puts the equation number in square brackets. First we define a brand new tag form:

```
\newtagform{brackets}{[}{]}
```

Then we activate it:

```
\usetagform{brackets}
```

The result is then

$$E \neq mc^3 \tag{2}$$

Similarly you could define a second version of the brackets that prints the equation number in bold face instead

```
\newtagform{brackets2}[\textbf]{[}{]}
\usetagform{brackets2}
\begin{equation}
  E \neq m c^3
\end{equation}
```

$$E \neq mc^3 \qquad [\mathbf{3}]$$

When you reference an equation with `\eqref`, the tag form in effect at the time of referencing controls the formatting, so be careful if you use different tag forms throughout your document.

If you want to renew a tag form, then use the command `\renewtagform`. Should you want to return to the standard setting then choose

```
\usetagform{default}
```

### 3.2.2 Showing only referenced tags

| showonlyrefs = `true`\|`false` |
|---|
| showmanualtags = `true`\|`false` |
| `\refeq{`⟨*label*⟩`}` |

An equation where the tag is produced with a manual `\tag*` shouldn't be referenced with the normal `\eqref` because that would format it according to the current tag format. Using just `\ref` on the other hand may not be a good solution either as the argument of `\tag*` is always set in upright shape in the equation and you may be referencing it in italic text. In the example below, the command `\refeq` is used to avoid what could possibly lead to confusion in cases where the tag font has very different form in upright and italic shape (here we switch to Palatino in the example):

```
\begin{quote}\renewcommand*\rmdefault{ppl}\normalfont\itshape
\begin{equation*}
  a=b \label{eq:example}\tag*{Q\&A}
\end{equation*}
See \ref{eq:example} or is it better with \refeq{eq:example}?
\end{quote}
```

$$a = b \qquad \text{Q\&A}$$

*See Q&A or is it better with* Q&A*?*

Another problem sometimes faced is the need for showing the equation numbers for only those equations actually referenced. In mathtools this can be done by setting the key showonlyrefs to either true or false by using `\mathtoolsset`. You can also choose whether or not to show the manual tags specified with `\tag` or `\tag*` by setting the option showmanualtags to true or false.[4] For both keys just typing the name of it chooses true as shown in the following example.

```
\mathtoolsset{showonlyrefs,showmanualtags}
\usetagform{brackets}
```

[4] I recommend setting showmanualtags to true, else the whole idea of using `\tag` doesn't really make sense, does it?

```
\begin{gather}
  a=a \label{eq:a} \\
  b=b \label{eq:b} \tag{**}
\end{gather}
This should refer to the equation containing $a=a$: \eqref{eq:a}.
Then a switch of tag forms.
\usetagform{default}
\begin{align}
  c&=c \label{eq:c} \\
  d&=d \label{eq:d}
\end{align}
This should refer to the equation containing $d=d$: \eqref{eq:d}.
\begin{equation}
  e=e
\end{equation}
Back to normal.\mathtoolsset{showonlyrefs=false}
\begin{equation}
  f=f
\end{equation}
```

$$a = a \tag{4}$$
$$b = b \tag{**}$$

This should refer to the equation containing $a = a$: [4]. Then a switch of tag forms.

$$c = c$$
$$d = d \tag{5}$$

This should refer to the equation containing $d = d$: (5).

$$e = e$$

Back to normal.

$$f = f \tag{6}$$

Note that this feature only works if you use `\eqref` or `\refeq` to reference your equations.

When using showonlyrefs it might be usefull to be able to actually add a few equation numbers without directly refering to them.

Feature request by Rasmus Villemoes 2008/03/26

`\noeqref{`⟨*label,label,...*⟩`}`

The syntax is somewhat similar to `\nocite`.

**BUG 1:** Unfortunately the use of the showonlyref introduce a bug within amsmath's typesetting of formula versus equation number. This bug manifest itself by allowing formulas to be typeset close to or over the equation number. Currently no general fix is known, other than making sure that ones formulas are not long enough to touch the equation number.

To make a long story stort, amsmath typesets its math environments twice, one time for measuring and one time for the actual typesetting. In the measuring part, the width of the equation number is recorded such that the formula or the equation number can be moved (if necessary) in the typesetting part. When showonlyref is enabled, the width of the equation number depend on whether or not this number is refered to. To determine this, we need to know the current label. But the current label is *not* known in the measuring phase. Thus the measured width is always zero (because no label equals not refered to) and therefore the typesetting phase does not take the equation number into account.

**BUG 2:** Currently there is a bug between showonlyrefs and the ntheorem package, then the ntheorem option thmmarks is active. The shown equation numbers may come out wrong (seems to be multiplied by 2). The easiest fix is to add the following line

```
\usepackage[overload,ntheorem]{empheq}
```

before loading ntheorem. The empheq package fixes some problems with ntheorem and lets mathtools get correct access to the equation numbers again.

## 3.3 Extensible symbols

The number of horizontally extensible symbols in standard LaTeX and amsmath is somewhat low. This part of the manual describes what mathtools does to help this situation.

### 3.3.1 Arrow-like symbols

| | |
|---|---|
| `\xleftrightarrow[`⟨*sub*⟩`]{`⟨*sup*⟩`}` | `\xRightarrow[`⟨*sub*⟩`]{`⟨*sup*⟩`}` |
| `\xLeftarrow[`⟨*sub*⟩`]{`⟨*sup*⟩`}` | `\xLeftrightarrow[`⟨*sub*⟩`]{`⟨*sup*⟩`}` |
| `\xhookleftarrow[`⟨*sub*⟩`]{`⟨*sup*⟩`}` | `\xhookrightarrow[`⟨*sub*⟩`]{`⟨*sup*⟩`}` |
| `\xmapsto[`⟨*sub*⟩`]{`⟨*sup*⟩`}` | |

Extensible arrows are part of amsmath in the form of the commands

`\xrightarrow[`⟨*subscript*⟩`]{`⟨*superscript*⟩`}` and
`\xleftarrow[`⟨*subscript*⟩`]{`⟨*superscript*⟩`}`

But what about extensible versions of say, `\leftrightarrow` or `\Longleftarrow`? It turns out that the above mentioned extensible arrows are the only two of their kind defined by amsmath, but luckily mathtools helps with that. The extensible arrow-like symbols in mathtools follow the same naming scheme as the ones in amsmath so to get an extensible `\Leftarrow` you simply do a

```
\[
  A \xLeftarrow[under]{over} B
\]
```

$$A \xleftrightharpoons[under]{over} B$$

| | |
|---|---|
| `\xrightharpoondown[`⟨*sub*⟩`]{`⟨*sup*⟩`}` | `\xrightharpoonup[`⟨*sub*⟩`]{`⟨*sup*⟩`}` |
| `\xleftharpoondown[`⟨*sub*⟩`]{`⟨*sup*⟩`}` | `\xleftharpoonup[`⟨*sub*⟩`]{`⟨*sup*⟩`}` |
| `\xrightleftharpoons[`⟨*sub*⟩`]{`⟨*sup*⟩`}` | `\xleftrightharpoons[`⟨*sub*⟩`]{`⟨*sup*⟩`}` |

mathtools also provides the extensible harpoons shown above. They're taken from [6].

### 3.3.2 Braces and brackets

LaTeX defines other kinds of extensible symbols like `\overbrace` and `\underbrace`, but sometimes you may want another symbol, say, a bracket.

| |
|---|
| `\underbracket[`⟨*rule thickness*⟩`] [`⟨*bracket height*⟩`]{`⟨*arg*⟩`}` |
| `\overbracket[`⟨*rule thickness*⟩`] [`⟨*bracket height*⟩`]{`⟨*arg*⟩`}` |

The commands `\underbracket` and `\overbracket` are inspired by [6], although the implementation here is slightly different. Used without the optional arguments the bracket commands produce this:

```
$\underbracket {foo\ bar}_{baz}$
```
$\underbracket{foo\ bar}_{baz}$

```
$\overbracket {foo\ bar}^{baz}$
```
$\overbracket{foo\ bar}^{baz}$

The default rule thickness is equal to that of `\underbrace` (app. 5/18 ex) while the default bracket height is equal to app. 0.7 ex. These values give really pleasing results in all font sizes, but feel free to use the optional arguments. That way you may get "beauties" like

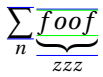
```
\[
  \underbracket[3pt]{xxx\  yyy}_{zzz} \quad \text{and} \quad
  \underbracket[1pt][7pt]{xxx\  yyy}_{zzz}
\]
```

$$\underbracket[3pt]{xxx\ yyy}_{zzz} \quad \text{and} \quad \underbracket[1pt][7pt]{xxx\ yyy}_{zzz}$$

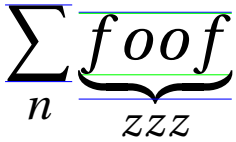
| | |
|---|---|
| `\underbrace{`⟨*arg*⟩`}` | `\LaTeXunderbrace{`⟨*arg*⟩`}` |
| `\overbrace{`⟨*arg*⟩`}` | `\LaTeXoverbrace{`⟨*arg*⟩`}` |

The standard implementation of the math operators `\underbrace` and `\overbrace` in LaTeX has some deficiencies. For example, all lengths used internally are *fixed* and optimized for 10 pt typesetting. As a direct consequence thereof, using font sizes other than 10 will produce less than optimal results. Another unfortunate feature is the size

of the braces. In the example below, notice how the math operator `\sum` places its limit compared to `\underbrace`.



The blue lines indicate the dimensions of the math operator and the green lines the dimensions of $foof$. As you can see, there seems to be too much space between the brace and the $zzz$ whereas the space between brace and $foof$ is okay. Let's see what happens when we use a bigger font size:



Now there's to little space between the brace and the $zzz$ and also too little space between the brace and the $foof$. If you use Computer Modern you'll actually see that the $f$ overlaps with the brace! Let's try in `\footnotesize`:

Here the spacing above and below the brace is quite excessive.

As `\overbrace` has the exact same problems, there are good reasons for mathtools to make redefinitions of `\underbrace` and `\overbrace`. These new versions work equally well in all font sizes and fixes the spacing issues and apart from working with the default Computer Modern fonts, they also work with the packages mathpazo, pamath, fourier, eulervm, cmbright, and mathptmx. If you use the ccfonts to get the full Concrete fonts, the original version saved under the names `\LaTeXunderbrace` and `\LaTeXoverbrace` are better, due to of the special design of the Concrete extensible braces. In that case you should probably just add the lines

```
\let\underbrace\LaTeXunderbrace
\let\overbrace\LaTeXoverbrace
```

to your preamble after loading mathtools which will restore the original definitions of `\overbrace` and `\underbrace`.

## 3.4 New mathematical building blocks

In this part of the manual, various mathematical environments are described.

### 3.4.1 Matrices

```
\begin{matrix*} [⟨col⟩] ⟨contents⟩ \end{matrix*}
\begin{pmatrix*}[⟨col⟩] ⟨contents⟩ \end{pmatrix*}
\begin{bmatrix*}[⟨col⟩] ⟨contents⟩ \end{bmatrix*}
\begin{Bmatrix*}[⟨col⟩] ⟨contents⟩ \end{Bmatrix*}
\begin{vmatrix*}[⟨col⟩] ⟨contents⟩ \end{vmatrix*}
\begin{Vmatrix*}[⟨col⟩] ⟨contents⟩ \end{Vmatrix*}
```

Feature request by Lars Madsen 2004/04/05

All of the amsmath `matrix` environments center the columns by default, which is not always what you want. Thus mathtools provides a starred version for each of the original environments. These starred environments take an optional argument specifying the alignment of the columns, so that

```
\[
  \begin{pmatrix*}[r]
    -1 & 3 \\
    2  & -4
  \end{pmatrix*}
\]
```

yields

$$\begin{pmatrix*}[r] -1 & 3 \\ 2 & -4 \end{pmatrix*}$$

The optional argument (default is `[c]`) can be any column type valid in the usual `array` environment.

While we are at it, we also provide fenced versions of the `smallmatrix` environment, To keep up with the naming of the large matrix environments, we provide both a starred and a non-starred version. Since `smallmatrix` is defined in a different manner than the `matrix` environment, the option to say `smallmatrix*` *has* to be either `c`, `l` *or* `r`. The default is `c`, which can be changed globally using the smallmatrix-align=⟨*c,l or r*⟩.

```
\begin{smallmatrix*} [⟨col⟩] ⟨contents⟩ \end{smallmatrix*}
\begin{psmallmatrix} ⟨contents⟩ \end{psmallmatrix}
\begin{psmallmatrix*}[⟨col⟩] ⟨contents⟩ \end{psmallmatrix*}
\begin{bsmallmatrix} ⟨contents⟩ \end{bsmallmatrix}
\begin{bsmallmatrix*}[⟨col⟩] ⟨contents⟩ \end{bsmallmatrix*}
\begin{Bsmallmatrix} ⟨contents⟩ \end{Bsmallmatrix}
\begin{Bsmallmatrix*}[⟨col⟩] ⟨contents⟩ \end{Bsmallmatrix*}
\begin{vsmallmatrix} ⟨contents⟩ \end{vsmallmatrix}
\begin{vsmallmatrix*}[⟨col⟩] ⟨contents⟩ \end{vsmallmatrix*}
\begin{Vsmallmatrix} ⟨contents⟩ \end{Vsmallmatrix}
\begin{Vsmallmatrix*}[⟨col⟩] ⟨contents⟩ \end{Vsmallmatrix*}
smallmatrix-align = ⟨c,l or r⟩
smallmatrix-inner-space = \,
```

Feature provided by Rasmus Villemoes 2011/01/17

```
\[
\begin{bsmallmatrix}    a & -b \\ -c & d \end{bsmallmatrix}
\begin{bsmallmatrix*}[r] a & -b \\ -c & d \end{bsmallmatrix*}
\]
```

yields

$$\begin{bmatrix} a & -b \\ -c & d \end{bmatrix}\begin{bmatrix} a & -b \\ -c & d \end{bmatrix}$$

Inside the `Xsmallmatrix` construction a small space is inserted between the fences and the contents, the size of it can be changed using smallmatrix-align=⟨*some spacing command*⟩, the default is `\,`.

As an extra trick the fences will behave as open and closing fences inconstract to their auto-scaling nature.[5]

### 3.4.2 The `multlined` environment

| | |
|---|---|
| `\begin{multlined}[`⟨*pos*⟩`][`⟨*width*⟩`]` ⟨*contents*⟩ `\end{multlined}` | |
| `\shoveleft[`⟨*dimen*⟩`]{`⟨*arg*⟩`}` | `\shoveright[`⟨*dimen*⟩`]{`⟨*arg*⟩`}` |
| firstline-afterskip = ⟨*dimen*⟩ | lastline-preskip = ⟨*dimen*⟩ |
| multlined-width = ⟨*dimen*⟩ | multlined-pos = c\|b\|t |

Some of the amsmath environments exist in two forms: an outer and an inner environment. One example is the pair `gather` & `gathered`. There is one important omission on this list however, as there is no inner `multlined` environment, so this is where mathtools steps in.

One might wonder what the sensible behavior should be. We want it to be an inner environment so that it is not wider than necessary, but on the other hand we would like to be able to control the width. The current implementation of `multlined` handles both cases. The idea is this: Set the first line flush left and add a hard space after it; this space is governed by the firstline-afterskip key. The last line should be set flush right and preceded by a hard space of size lastline-preskip. Both these hard spaces have a default value of `\multlinegap`. Here we use a 't' in the first optional argument denoting a top-aligned building block (the default is 'c').

```
\[
  A = \begin{multlined}[t]
        \framebox[4cm]{first} \\
        \framebox[4cm]{last}
      \end{multlined} B
\]
```

$$A = \boxed{\text{first}} \quad B$$
$$\boxed{\text{last}}$$

Note also that `multlined` gives you access to an extended syntax for `\shoveleft` and `\shoveright` as shown in the example below.

[5] `\left` and `\right` does *not* produce open an closing fences, thus the space before or after may be too large. Inside this construction they behave.

```
\[
  \begin{multlined}
    \framebox[.65\columnwidth]{First line}        \\
    \framebox[.5\columnwidth]{Second line}        \\
    \shoveleft{L+E+F+T}                           \\
    \shoveright{R+I+G+H+T}                        \\
    \shoveleft[1cm]{L+E+F+T}                      \\
    \shoveright[\widthof{$R+I+G+H+T$}]{R+I+G+H+T} \\
    \framebox[.65\columnwidth]{Last line}
  \end{multlined}
\]
```

$$\boxed{\text{First line}}$$
$$\boxed{\text{Second line}}$$
$$L+E+F+T$$
$$R+I+G+H+T$$
$$L+E+F+T$$
$$R+I+G+H+T$$
$$\boxed{\text{Last line}}$$

You can also choose the width yourself by specifying it as an optional argument:

```
\[
  \begin{multlined}[b][7cm]
    \framebox[4cm]{first} \\
    \framebox[4cm]{last}
  \end{multlined} = B
\]
```

$$\begin{multlined}[b][7cm]\boxed{\text{first}}\\ \boxed{\text{last}}\end{multlined} = B$$

There can be two optional arguments (position and width) and they're interchangeable.

### 3.4.3 More `cases`-like environments

| | |
|---|---|
| `\begin{dcases}` | ⟨*math_column*⟩ & ⟨*math_column*⟩ `\end{dcases}` |
| `\begin{dcases*}` | ⟨*math_column*⟩ & ⟨*text_column*⟩ `\end{dcases*}` |
| `\begin{rcases}` | ⟨*math_column*⟩ & ⟨*math_column*⟩ `\end{rcases}` |
| `\begin{rcases*}` | ⟨*math_column*⟩ & ⟨*text_column*⟩ `\end{rcases*}` |
| `\begin{drcases}` | ⟨*math_column*⟩ & ⟨*math_column*⟩ `\end{drcases}` |
| `\begin{drcases*}` | ⟨*math_column*⟩ & ⟨*text_column*⟩ `\end{drcases*}` |
| `\begin{cases*}` | ⟨*math_column*⟩ & ⟨*text_column*⟩ `\end{cases*}` |

Feature request by Lars Madsen 2004/07/01

Anyone who have tried to use an integral in the regular `cases` environment from ams-

math will have noticed that it is set as

$$a = \begin{cases} E = mc^2 & \text{Nothing to see here} \\ \int x - 3\,dx & \text{Integral is text style} \end{cases}$$

mathtools provides two environments similar to `cases`. Using the `dcases` environment you get the same output as with `cases` except that the rows are set in display style.

```
\[
  \begin{dcases}
    E = m c^2     & c \approx 3.00\times 10^{8}\,\mathrm{m}/\mathrm{s} \\
    \int x-3\, dx & \text{Integral is display style}
  \end{dcases}
\]
```

$$\begin{cases} E = mc^2 & c \approx 3.00 \times 10^{8}\,\mathrm{m/s} \\ \int x - 3\,dx & \text{Integral is display style} \end{cases}$$

Additionally the environment `dcases*` acts just the same, but the second column is set in the normal roman font of the document.[6]

```
\[
  a= \begin{dcases*}
    E = m c^2     & Nothing to see here \\
    \int x-3\, dx & Integral is display style
  \end{dcases*}
\]
```

$$a = \begin{cases} E = mc^2 & \text{Nothing to see here} \\ \int x - 3\,dx & \text{Integral is display style} \end{cases}$$

The environments `rcases`, `rcases*`, `drcases` and `drcases*` are equivalent to `cases` and `dcases`, but here the brace is placed on the right instead of on the left.

### 3.4.4 Emulating indented lines in alignments

Feature provided by Lars Madsen 2008/06/05

`\MoveEqLeft[`⟨*number*⟩`]`

In [7], Ellen Swanson recommends that when ever one has a long displayed formula, spannig several lines, and it is unfeasible to align against a relation within the first line, then all lines in the display should be aligned at the left most edge of the first line, and all subsequent lines should be indented by 2em (or if needed by a smaller amount). That is we are talking about displayes that end up looking like this

$$\boxed{\text{Long first line}}$$
$$= \boxed{\text{2nd line}}$$
$$\leq \ldots$$

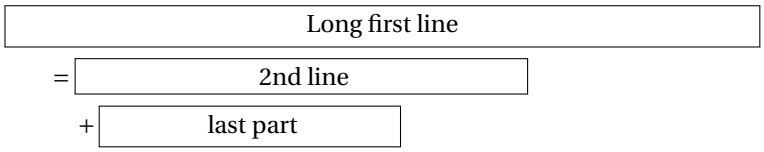
[6] Or rather: it inherits the font characteristics active just before the `dcases*` environment.

Traditionally one could do this by starting subsequent lines by `&\qquad ...`, but that is tedious. Instead the example above was made using `\MoveEqLeft`:

```
\begin{align*}
  \MoveEqLeft \framebox[10cm][c]{Long first line}\\
  & = \framebox[6cm][c]{ \hphantom{g} 2nd line}\\
  & \leq \dots
\end{align*}
```

`\MoveEqLeft` is placed instead of the `&` on the first line, and will effectively *move* the entire first line `[`⟨*number*⟩`]` of ems to the left (default is 2). If you choose to align to the right of the relation, use `\MoveEqLeft[3]` to accommodate the extra distance to the alignment point:

```
\begin{align*}
  \MoveEqLeft[3] \framebox[10cm][c]{Part 1}\\
   = {} & \framebox[8cm][c]{2nd line}\\
        & + \framebox[4cm][c]{ last part}
\end{align*}
```




### 3.4.5 Boxing a single line in an alignment

Evolved from a request by Merciadri Luca 2010/06/28 on comp.text.tex

The `amsmath` package provie the `\boxed` macro to box material in math mode. But this of course will not work if the box should cross an alignment point. We provide a macro that can.

`\Aboxed{`⟨*left hand side* & *right hand side*⟩`}`

Example

```
\begin{align*}
  \Aboxed{ f(x) & = \int h(x)\, dx} \\
                & = g(x)
\end{align*}
```

Resulting in:

$$\boxed{f(x) = \int h(x)\,dx}$$
$$= g(x)$$

### 3.4.6 Adding arrows between lines in an alignment

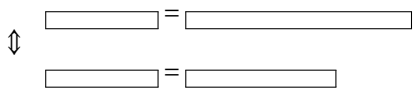
Evolved from a request by Christian Bohr-Halling 2004/03/31 on dk.edb.tekst

```
\ArrowBetweenLines[⟨symbol⟩]
\ArrowBetweenLines*[⟨symbol⟩]
```

To add, say ⇳ between two lines in an alignment use `\ArrowBetweenLines` and the `alignat` environment:

```
\begin{alignat*}{2}
  && \framebox[1.5cm]{} &= \framebox[3cm]{}\\
  \ArrowBetweenLines % \Updownarrow is the default
  && \framebox[1.5cm]{} &= \framebox[2cm]{}
\end{alignat*}
```

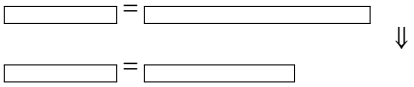
resulting in



Note the use of `&&` starting each *regular* line of math. For adding the arrow on the right, use `\ArrowBetweenLines*[`⟨*symbol*⟩`]`, and end each line of math with `&&`.

```
\begin{alignat*}{2}
  \framebox[1.5cm]{} &= \framebox[3cm]{}  &&\\
  \ArrowBetweenLines*[\Downarrow]
  \framebox[1.5cm]{} &= \framebox[2cm]{}  &&
\end{alignat*}
```

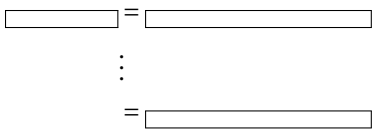
resulting in



Feature request by Bruno Le Floch (and many others) 2011/01/25

### 3.4.7 Centered `\vdots`

If one want to mark a vertical continuation, there is the `\vdots` command, but combine this with an alignment and we get something rather suboptimal



It would be nice to have (1) a `\vdots` centered within the width of another symbol, and (2) a construction similar to `\ArrowBetweenLines` that does not take up so much space. We provide both.

| |
|---|
| `\vdotswithin{`⟨*symbol*⟩`}` |
| `\shortvdotswithin{`⟨*symbol*⟩`}` |
| `\shortvdotswithin*{`⟨*symbol*⟩`}` |
| `\MTFlushSpaceAbove` |
| `\MTFlushSpaceBelow` |
| shortvdotsadjustabove = ⟨*length*⟩ |
| shortvdotsadjustbelow = ⟨*length*⟩ |

Two examples in one

```
\begin{align*}
  a &= b               \\
    & \vdotswithin{=} \\
    & = c               \\
    \shortvdotswithin{=}
    & = d
\end{align*}
```

yielding

$$\begin{aligned} a &= b \\ &\vdots \\ &= c \\ &\vdots \\ &= d \end{aligned}$$

Thus `\vdotswithin{=}` create a box corersponding to `{}={}` and typeset a $\vdots$ centered inside it. When doing this as a normal line in an alignment leaves us with excessive space which `\shortvdotswithin{=}` takes care with for us.

`\shortvdotswithin{=}` corresponds to

```
\MTFlushSpaceAbove
& \vdotswithin{=} \\
\MTFlushSpaceBelow
```

whereas `\shortvdotswithin*{=}` is the case with `\vdotswithin{=} & \\`. This also means one cannot write more on the line when using `\shortvdotswithin` or the starred version. But one can de-construct the macro and arrive at

```
\begin{alignat*}{3}
  A&+ B &&= C &&+ D \\
  \MTFlushSpaceAbove
  &\vdotswithin{+} &&&& \vdotswithin{+}
  \MTFlushSpaceBelow
  C &+ D &&= Y &&+K
\end{alignat*}
```

yielding

$$\begin{array}{c} A+B=C+D \\ \vdots \quad\quad \vdots \\ C+D=Y+K \end{array}$$

If one has the need for such a construction.

The de-spaced version does support the `spreadlines` environment. The actual amount of space being *flushed* above and below can be controlled by the user using the two options indicated. Their original values are `2.15\origjot` and `\origjot` respectively (`\origjot` is usually 3pt).

## 3.5 Short intertext

Posted on
comp.text.tex
Gabriel Zachmann and
Donald Arseneau
2000/05/12–13

`\shortintertext{`⟨*text*⟩`}`

amsmath provides the command `\intertext` for interrupting a multi line display while still maintaining the alignment points. However the spacing often seems quite excessive as seen below.

```
\begin{align}
  a&=b \intertext{Some text}
  c&=d
\end{align}
```

$$a = b \tag{7}$$

Some text

$$c = d \tag{8}$$

Using the command `\shortintertext` alleviates this situation somewhat:

```
\begin{align}
  a&=b \shortintertext{Some text}
  c&=d
\end{align}
```

$$a = b \tag{9}$$

Some text

$$c = d \tag{10}$$

## 3.6 Paired delimiters

Feature request by
Lars Madsen
2004/06/25

`\DeclarePairedDelimiter{⟨cmd⟩}{⟨left_delim⟩}{⟨right_delim⟩}`

In the amsmath documentation it is shown how to define a few commands for typesetting the absolute value and norm. These definitions are:

```
\newcommand*\abs[1]{\lvert#1\rvert}
\newcommand*\norm[1]{\lVert#1\rVert}
```

While they produce correct horizontal spacing you have to be careful about the vertical spacing if the argument is just a little taller than usual as in

$$|\frac{a}{b}|$$

Here it won't give a nice result, so you have to manually put in either `\left`–`\right` pair or a `\bigl`–`\bigr` pair. Both methods mean that you have to delete your `\abs` command, which may not sound like an ideal solution.

With the command `\DeclarePairedDelimiter` you can combine all these features in one easy to use command. Let's show an example:

```
\DeclarePairedDelimiter\abs{\lvert}{\rvert}
```

This defines the command `\abs` just like in the amsmath documentation but with a few additions:

- A starred variant: `\abs*` produces delimiters that are preceded by `\left` and `\right` resp.:

  ```
  \[
    \abs*{\frac{a}{b}}
  \]
  ```

  $$\left|\frac{a}{b}\right|$$

- A variant with an optional argument: `\abs[⟨size_cmd⟩]`, where ⟨*size_cmd*⟩ is either `\big`, `\Big`, `\bigg`, or `\Bigg` (if you have any bigggger versions you can use them too).

  ```
  \[
    \abs[\Bigg]{\frac{a}{b}}
  \]
  ```

  $$\Bigg|\frac{a}{b}\Bigg|$$

Feature provided by
Lars Madsen
2010/06/15

`\DeclarePairedDelimiterX{⟨cmd⟩}[⟨num args⟩]{⟨left_delim⟩}{⟨right_delim⟩}{⟨code⟩}`
`\delimsize`

Sometimes `\DeclarePairedDelimiter` just is not enough. One might want to have the capabilities of `\DeclarePairedDelimiter`, but also want a macro the takes more than one argument.

`\DeclarePairedDelimiterX` extends the features of `\DeclarePairedDelimiter` such that the user will get a macro which is fenced off at either end, plus the capability to provide the code for what ever the macro should do within these fences.

Inside the ⟨*code*⟩ part, the macro `\delimsize` refer to the size of the outer fences. It can then be used inside ⟨*code*⟩ to scale any inner fences.

In this setting `\DeclarePairedDelimiter{⟨cmd⟩}{⟨left_delim⟩}{⟨right_delim⟩}` is the same thing as

`\DeclarePairedDelimiterX{⟨cmd⟩}[1]{⟨left_delim⟩}{⟨right_delim⟩}{#1}`

Let us do some examples. First we want to prepare a macro for inner products, with two arguments such that we can hide the character separating the arguments (a journal style might require a semi-colon, so we will save a lot of hand editing). This can be done via

```
\DeclarePairedDelimiterX\innerp[2]{\langle}{\rangle}{#1,#2}
```

More interestingly we can refer to the size inside the ⟨*code*⟩. Here we do a weird three argument 'braket'

```
\DeclarePairedDelimiterX\brakket[3]{\langle}{\rangle}%
{#1\,\delimsize\vert\,#2\,\delimsize\vert\,#3}
```

Then we can get

```
\[
\innerp*{A}{ \frac{1}{2} } \quad
\brakket[\Big]{B}{\sum_{k} f_k}{C}
\]
```

$$\left\langle A, \frac{1}{2} \right\rangle \quad \left\langle B \middle| \sum_{k} \middle| C \right\rangle$$

## 3.7 Special symbols

This part of the manual is about special symbols. So far only one technique is covered, but more will come.

### 3.7.1 Left and right parentheses

`\lparen  \rparen`

When you want a big parenthesis or bracket in a math display you usually just type

```
\left( ... \right)  or  \left[ ... \right]
```

LaTeX also defines the macro names `\lbrack` and `\rbrack` to be shorthands for the left and right square bracket resp., but doesn't provide similar definitions for the parentheses. Some packages need command names to work with[7] so mathtools defines the commands `\lparen` and `\rparen` to represent the left and right parenthesis resp.

### 3.7.2 Vertically centered colon

Posted on
comp.text.tex
Donald Arseneau
2000/12/07

| centercolon = `true`\|`false` |
|---|
| `\vcentcolon`  `\ordinarycolon` |

When trying to show assignment operations as in $a := b$, one quickly notices that the colon is not centered on the math axis as the equal sign, leading to an odd-looking output. The command `\vcentcolon` is a shorthand for such a vertically centered colon, and can be used as in `$a \vcentcolon= b$` and results in the desired output: $a :\!= b$. for now

Typing `\vcentcolon` every time is quite tedious, so one can use the key centercolon to make the colon active instead.

```
\mathtoolsset{centercolon}
\[
  a := b
\]
\mathtoolsset{centercolon=false}
```

$$a := b$$

In this case the command `\ordinarycolon` typesets an ... ordinary colon (what a surprise).

**Warning:** centercolon *does not* work with languages that make use of an active colon, most notably French. Sadly the `babel` package does not distinguish between text and math when it comes to active characters. Nor does it provide any hooks to deal with math. So currently no general solution exists for this problem.

| | | | |
|---|---|---|---|
| `\coloneqq` | `\Coloneqq` | `\coloneq` | `\Coloneqq` |
| `\eqqcolon` | `\Eqqcolon` | `\eqcolon` | `\Eqcolon` |
| `\colonapprox` | `\Colonapprox` | `\colonsim` | `\Colonsim` |
| `\dblcolon` | | | |

The font packages txfonts and pxfonts provides various symbols that include a vertically centered colon but with tighter spacing. For example, the combination := exists as the symbol `\coloneqq` which typesets as := instead of :=. The primary disadvantage of using these fonts are the support packages' lack of support for amsmath (and thus mathtools) and worse yet, the side-bearings are way too tight; see [4] for examples. If

[7] The empheq package needs command names for delimiters in order to make auto-scaling versions.

you're not using these fonts, mathtools provides the symbols for you. Here are a few examples:

```
\[
  a \coloneqq b \quad c \Colonapprox d \quad e \dblcolon f
\]
```

$$a \coloneqq b \quad c \Colonapprox d \quad e \dblcolon f$$

### 3.7.3 A few missing symbols

Most provided math font sets are missing the symbols `\nuparrow` and `\ndownarrow` (i.e. negated up- and downarrow) plus a 'big' version of `\times`. Therefore we will provide constructed versions of these whenever they are not already available.

```
\nuparrow
\ndownarrow
\bigtimes
```

*Note:* that these symbols are constructed via features from the graphicx package, and thus may not display correctly in most DVI previewers. Also note that `\nuparrow` and `\ndownarrow` are constructed via `\nrightarrow` and `\nleftarrrow` respectively, so these needs to be present. Usually this is done via amssymb, but some packages may be incompatible with amssymb so the user will have to load amssymb or a similar package, that provides `\nrightarrow` and `\nleftarrow`, themselves.

With those requirements in place, we have

```
\[
   \lim_{a\ndownarrow 0} f(a) \neq \bigtimes_n X_n \qquad
   \frac{ \bigtimes_{k=1}^7 B_k \nuparrow \Omega }{2}
\]
```

$$\lim_{a\ndownarrow 0} f(a) \neq \bigtimes_n X_n \qquad \frac{\bigtimes_{k=1}^{7} B_k \nuparrow \Omega}{2}$$

# 4 A tribute to Michael J. Downes

Michael J. Downes (1958–2003) was one of the major architects behind amsmath and member of the LaTeX Team. He made many great contributions to the TeX community; not only by the means of widely spread macro packages such as amsmath but also in the form of actively giving advice on newsgroups. Some of Michael's macro solutions on the newsgroups never made it into publicly available macro packages although they certainly deserved it, so mathtools tries to rectify this matter. The macros described in this section are either straight copies or heavily inspired by his original postings.

## 4.1 Mathematics within italic text

Posted on
comp.text.tex
Michael J. Downes
1998/05/14

| mathic = true\|false |
|---|

TEX usually takes care of italic corrections in text, but fails when it comes to math. If you use the LATEX inline math commands \( and \) you can however work around it by setting the key mathic to true as shown below.

```
\begin{quote}\itshape
Compare these lines: \par
\mathtoolsset{mathic} % or \mathtoolsset{mathic=true}
Subset of \(V\) and subset of \(A\). \par
\mathtoolsset{mathic=false}
Subset of \(V\) and subset of \(A\).
\par
\end{quote}
```

*Compare these lines:*
*Subset of $V$ and subset of $A$.*
*Subset of $V$ and subset of $A$.*

## 4.2 Left sub/superscripts

Posted on
comp.text.tex
Michael J. Downes
2000/12/20

| \prescript{⟨*sup*⟩}{⟨*sub*⟩}{⟨*arg*⟩} | prescript-sup-format = ⟨*cmd*⟩ |
|---|---|
| prescript-sub-format = ⟨*cmd*⟩ | prescript-arg-format = ⟨*cmd*⟩ |

Sometimes one wants to put a sub- or superscript on the left of the argument. The \prescript command does just that:

```
\[
  {}^{4}_{12}\mathbf{C}^{5+}_{2}          \quad
  \prescript{14}{2}{\mathbf{C}}^{5+}_{2}  \quad
  \prescript{4}{12}{\mathbf{C}}^{5+}_{2}  \quad
  \prescript{14}{}{\mathbf{C}}^{5+}_{2}   \quad
  \prescript{}{2}{\mathbf{C}}^{5+}_{2}
\]
```

$$ {}^{4}_{12}\mathbf{C}^{5+}_{2} \quad {}^{14}_{2}\mathbf{C}^{5+}_{2} \quad {}^{4}_{12}\mathbf{C}^{5+}_{2} \quad {}^{14}\mathbf{C}^{5+}_{2} \quad {}_{2}\mathbf{C}^{5+}_{2} $$

The formatting of the arguments is controlled by three keys. This silly example shows you how to use them:

```
\newcommand*\myisotope[3]{%
  \begingroup % to keep changes local. We cannot use a brace group
              % as it affects spacing!
    \mathtoolsset{
      prescript-sup-format=\mathit,
      prescript-sub-format=\mathbf,
```

```
      prescript-arg-format=\mathrm,
    }%
  \prescript{#1}{#2}{#3}%
  \endgroup
}
\[
  \myisotope{A}{Z}{X}\to \myisotope{A-4}{Z-2}{Y}+
  \myisotope{4}{2}{\alpha}
\]
```

$$\prescript{A}{Z}{\mathrm{X}} \to \prescript{A-4}{Z-2}{\mathrm{Y}} + \prescript{4}{2}{\alpha}$$

## 4.3 Declaring math sizes

Posted on
comp.text.tex
Michael J. Downes
2002/10/17

`\DeclareMathSizes{`⟨*dimen*⟩`}{`⟨*dimen*⟩`}{`⟨*dimen*⟩`}{`⟨*dimen*⟩`}`

If you don't know about `\DeclareMathSizes`, then skip the rest of this text. If you do know, then all that is needed to say is that with mathtools it is patched so that all regular dimension suffixes are now valid in the last three arguments. Thus a declaration such as

```
\DeclareMathSize{9.5dd}{9.5dd}{7.5dd}{6.5dd}
```

will now work (it doesn't in standard LaTeX). When this bug has been fixed in LaTeX, this fix will be removed from mathtools.

## 4.4 Spreading equations

Posted on
comp.text.tex
Michael J. Downes
2002/10/17

`\begin{spreadlines}{`⟨*dimen*⟩`}` ⟨*contents*⟩ `\end{spreadlines}`

The spacing between lines in a multi line math environment such as `gather` is governed by the dimension `\jot`. The `spreadlines` environment takes one argument denoting the value of `\jot` inside the environment:

```
\begin{spreadlines}{20pt}
Large spaces between the lines.
\begin{gather}
  a=b\\
  c=d
\end{gather}
\end{spreadlines}
Back to normal spacing.
\begin{gather}
  a=b\\
  c=d
\end{gather}
```

Large spaces between the lines.

$$a = b \tag{11}$$

$$c = d \tag{12}$$

Back to normal spacing.

$$a = b \tag{13}$$
$$c = d \tag{14}$$

## 4.5 Gathered environments

```
\begin{lgathered}[⟨pos⟩] ⟨contents⟩ \end{lgathered}
\begin{rgathered}[⟨pos⟩] ⟨contents⟩ \end{rgathered}
\newgathered{⟨name⟩}{⟨pre_line⟩}{⟨post_line⟩}{⟨after⟩}
\renewgathered{⟨name⟩}{⟨pre_line⟩}{⟨post_line⟩}{⟨after⟩}
```

Posted on
comp.text.tex
Michael J. Downes
2001/01/17

In a document set in `fleqn`, you might sometimes want an inner `gathered` environment that doesn't center its lines but puts them flush left. The `lgathered` environment works just like the standard `gathered` except that it flushes its contents left:

```
\begin{equation}
  \begin{lgathered}
    x=1,\quad x+1=2 \\
    y=2
  \end{lgathered}
\end{equation}
```

$$\begin{lgathered} x = 1, \quad x + 1 = 2 \\ y = 2 \end{lgathered} \tag{15}$$

Similarly the `rgathered` puts it contents flush right.

More interesting is probably the command `\newgathered`. In this example we define a gathered version that centers the lines and also prints a star and a number at the left of each line.

```
\newcounter{steplinecnt}
\newcommand\stepline{\stepcounter{steplinecnt}\thesteplinecnt}
\newgathered{stargathered}
            {\llap{\stepline}$*$\quad\hfil}% \hfil for centering
            {\hfil}%                        \hfil for centering
            {\setcounter{steplinecnt}{0}}%  reset counter
```

With these definitions we can get something like this:

```
\begin{gather}
  \begin{stargathered}
```

```
    x=1,\quad x+1=2 \\
    y=2
  \end{stargathered}
\end{gather}
```

$$\begin{aligned} 1* \quad & x=1, \quad x+1=2 \\ 2* \quad & y=2 \end{aligned} \tag{16}$$

`\renewgathered` renews a gathered environment of course.

In all fairness it should be stated that the original concept by Michael has been extended quite a bit in mathtools. Only the end product of `lgathered` is the same.

### 4.6 Split fractions

Posted on
comp.text.tex
Michael J. Downes
2001/12/06

`\splitfrac{`⟨*numer*⟩`}{`⟨*denom*⟩`}` `\splitdfrac{`⟨*numer*⟩`}{`⟨*denom*⟩`}`

These commands provide split fractions e.g., multi line fractions:

```
\[
  a=\frac{
      \splitfrac{xy + xy + xy + xy + xy}
                {+ xy + xy + xy + xy}
    }
    {z}
  =\frac{
      \splitdfrac{xy + xy + xy + xy + xy}
                 {+ xy + xy + xy + xy}
    }
    {z}
\]
```

$$a=\frac{\splitfrac{xy+xy+xy+xy+xy}{+xy+xy+xy+xy}}{z}=\frac{\splitdfrac{xy+xy+xy+xy+xy}{+xy+xy+xy+xy}}{z}$$

## References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