

mismath  
Miscellaneous mathematical macros\*

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## 1 Introduction

According to the International Standards ISO 31-0:1992 to ISO 31-13:1992, superseded by ISO 80000-2:2009, mathematical constants  $e$ ,  $i$ ,  $\pi$  should be typeset in roman (upright shape) and not in italic (sloping shape) like variables (see [1] [2] [3] [4]). This package provides some tools to achieve this automatically.

Even though it is recommended to typeset vectors names in bold italic style [2] [4], they are often represented with arrows (especially in school documents or in physics). To draw visually appealing arrows above vectors, we use the `esvect` package by Eddie Soudrais [5]. Additionally we provide a few more macros related to vectors with

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arrows, particularly to enhance the typesetting of the norm:  $\|\overrightarrow{AB}\|$  instead of  $\mathbb{E}\mathbb{T}\mathbb{X}$  version  $\|AB\|$  which is not vertically adjusted, or worse  $\|\overline{AB}\|$ .

The package also offers other macros for:

- tensors,
- some common operator names,
- a few useful aliases,
- enhancing spacing in mathematical formulas,
- systems of equations and small matrices,
- displaymath in double columns for lengthy calculations.

To avoid compatibility issues, most of our macros will only be defined if there isn't already a command with the same name in the packages loaded before `mismath`. If a macro is already defined, a warning message will be displayed and the `mismath` definition will be ignored. If you wish to keep the existing command or the `mismath` command, you can use `\let\command\relax`, before loading `mismath`, or after. If the other command is defined with `\AtBeginDocument`, you should do the same for `\let\command\relax` and for loading `mismath`.

`[(options)]` The `mismath` package loads the `amsmath` package without any options. If you want to use `amsmath` with specific options (refer to [6]), you can include these options when calling `mismath`, or you can load `amsmath` with the desired options before loading `mismath`.

In addition `mismath` loads the `mathtools` package by Morten Høgholm and Lars Madsen [7]. This package offers numerous helpful macros and improvements of the `amsmath` package.

A recommendation, although rarely followed, is to typeset uppercase Greek letters in italic shape, similar to other variables [4]. This can be automatically achieved with packages such as `fixmath` by Walter Schmidt [8], `isomath` by Günter Milde [9] or `pm-isomath` by Claudio Beccari [10] and optionally with many others (such as `mathpazo` or `mathptmx` with the option `slantedGreek`). However this feature is not implemented here due to a conflicting rule in France, where all capital letters in mathematics are required to be typeset in upright shape<sup>1</sup>. The decision to load any of these packages is left to the user's discretion.

## 2 Usage

### 2.1 Mathematical constants

`\mathup` As for classic functions identifiers, *predefined* mathematical constants should be type-

<sup>1</sup>By using the `frenchmath` package [21], you can ensure that the recommended french rule is followed in your document.

set in upright shape (typically in roman family), even though this practice is not very common and can be tedious to adhere to. A first solution is to use the `\mathup` macro, which is superior to `\mathrm`<sup>2</sup>, for setting any math text in upright shape. For example you can use `\mathup{e}` to get the Euler’s number.

`\e`      To avoid cluttering a document that contains many occurrences of Euler’s number  
`\i` (e) or imaginary numbers (i) with `\mathup{e}` or `\mathup{i}`, the package pro-  
`\j` vides the `\e` command for Euler’s number and `\i` or `\j` for imaginary numbers. Let us  
notice that `\i` and `\j` already exist in LaTeX. In LR (left-to-right) mode, they produce  
‘i, j’ without the dot, allowing you to place accents on them. However, in mathematical  
mode, they produce the warning “LaTeX Warning: Command `\i` invalid  
in math mode on input line *<line>*”. With the new definition provided by the  
package, `\i` and `\j` will be redefined specifically for mathematical mode.

`\MathUp`      Indeed, typing a lot of backslashes for constants like e, i, or j in a document with nu-  
merous formulas can become tiresome. To alleviate this, the package proposes a power-  
ful solution with the macro `\MathUp{<char>}`. For example, when `\MathUp{e}`  
is called, any subsequent occurrence of e will automatically be set in roman (upright  
shape), without the need to type `\e` explicitly. The effect of this macro can be either  
global or local, depending on whether it is used outside or inside an environment or  
braces. Furthermore, you can call this macro in the preamble to apply the change from  
the beginning of the document. This powerful feature allows you to bring a document  
up to the standards effortlessly. In fact, `\MathUp` can be applied to any valid single  
character, offering flexibility for various use cases (another use of it with probability  
will be presented in section 2.3).

`\MathIt`      When there are other occurrences of e, i or j as variables, you can still obtain  
italicized e, i or j using  $\TeX$  commands `\mathit` or `\mathnormal`, which are use-  
ful for a single use. However, you also have the option to use the inverse switch  
`\MathIt{<char>}`, which has a global effect when used outside environments or  
braces, or a local effect when used inside them. Similar to `\MathUp`, `\MathIt` can  
be applied to any single character.

`\MathNumbers`      These macros enable you to set upright or normal (italic) typesetting for multiple  
`\MathNormal` letters in a single command. For instance, `\MathNumbers{e,i}` is equivalent to  
`\MathUp{e}\MathUp{i}`. In `\MathNumbers`, the comma separator between letters  
can be modified or removed as needed. In fact, this macro only affects the letters e,  
i, or j; it has no effect on other characters. On the other hand, `\MathNormal` can  
be utilized for probability as well (refer to section 2.3), and it accepts any comma-  
separated list of arguments. This means you can apply the normal italic math mode  
typesetting to various letters at once using `\MathNormal`.

`\pinumber[<command>]`      The mathematical constant  $\pi$  should also be typeset in upright shape (see [1],  
[2], [4]), which is different from italicized  $\pi$ . However, this recommendation is

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<sup>2</sup>The `\mathup` macro is based on `\operatorfont`, which comes from the `amsofn` package, automati-  
cally loaded by `amsmath`. In `beamer`, the default math font is sans serif, but `\mathrm` produces a font  
with serifs, which might not match the overall style of the presentation. Hence, using `\mathup` is indeed a  
better choice in `beamer` presentations to ensure that mathematical constants are typeset in upright shape  
and consistent with the default sans serif math font.

even less commonly followed compared to the one concerning  $e$  and  $i$  [1]. Several packages enable the typesetting of mathematical Greek letters in upright shape. Notably, let us mention `upgreek` [11], `mathdesign` [12] (used in the present document), `kpfonts` [14], `fourier` [15], `libertinustlmath`, `pxgreeks`, `txgreeks`, `libgreek`, etc. A special mention goes to `lgrmath` of Jean-François Burnol [16] which allows the use of any Greek LGR-encoded font in math mode. These packages provide commands like `\uppi` (`upgreek`), `\piup` (`mathdesign`, `kpfonts`, `lgrmath`), `\otherpi` (`fourier`), etc.<sup>3</sup> To preserve default italic style for lowercase Greek letters, with the exception of  $\pi$ , and to avoid the need to type a lot of `\uppi` or `\piup`, we offer the macro `\pinumber[command]`. This macro redefines `\pi` to match the optional command name provided (without a backslash), such as `\piup`, assuming that the appropriate package has been loaded beforehand.

By using the preliminary code `\MathNumbers{ei}\pinumber[\piup]` (assuming the `mathdesign` package is loaded) you can achieve the following result:

$$e^{i\pi} = -1 \quad \text{which yields} \quad e^{i\pi} = -1.$$

When you call `\pinumber` without any argument, it defines `\pi` using the default LGR font encoding for Greek letters, resulting in the character  $\pi$ . In this case the appropriate option LGR for the `fontenc` package will be automatically loaded if the `\pinumber` command is called in the preamble (at least the first time it is used). The  $\pi$  character obtained with this setting will look the same as the one provided by Günter Milde's `textalpha` package [13]. This  $\pi$  character is particularly well-suited for use with the default Computer Modern or Latin Modern font family<sup>4</sup>.

`\itpi`      When you activate `\pinumber`, the original italic  $\pi$  is still accessible using `\itpi`.  
`\pinormal`      In fact `\pinumber` acts as a switch, enabling the upright  $\pi$ . Additionally, there is an inverse switch, `\pinormal`, which you can call anywhere to revert to the original behavior of the `\pi` command (italic  $\pi$ ).

## 2.2 Vectors (and tensors)

`\vect`      By default, the `\vect` command<sup>5</sup>, produces vectors with arrows (thanks to the `esvect` package by Eddie Soudrais<sup>6</sup>) which are more elegant than those produced by  $\TeX$ 's `\overrightarrow` command. The `esvect` package has an optional argument (a single letter between `a` and `h`) to define the desired type of arrow (see [5]). In `mismath`, `esvect` is loaded with the option `b`: `\vect{AB}` gives  $\overrightarrow{AB}$ . If you wish to use a different type of arrow, you must call `esvect` with the appropriate option *before* loading

<sup>3</sup>They also have options to typeset all the Greek lowercase letters in upright shape by default, but this is not our goal here.

<sup>4</sup>This default  $\pi$  character may not always fit well with various text fonts, especially those that are bolder or different from the default Computer Modern font. The `upgreek` package [11] provides a better  $\pi$  character with the `Symbol` option, utilizing the Adobe Symbol font. This  $\pi$  character matches well with several text fonts, such as Times.

<sup>5</sup>The definition of most macros in this package, will only take effect if the macro has not been previously defined by another package. This ensures compatibility and avoids conflicts when using the `mismath` package with other  $\TeX$  packages.

<sup>6</sup>`esvect` provides the `\vv` macro used by `\vect`.

mismatch. For example, using `\usepackage[d]{esvect}` will provide the arrows produced by default in [5].

`\boldvect` The `\vect` macro allows vector names to be typeset using bold italic font, as recommended by ISO [2] [3], instead of using arrows. By using the `\boldvect` command, you can modify the behavior of `\vect` locally or globally, depending on its placement in the document (inside or outside a group or an environment):

```
\[ \boldvect \vect{v}
    =\lambda\vect{e}_x+\mu\vect{e}_y. \]       $v = \lambda e_x + \mu e_y.$ 
```

`\boldvectcommand` By default `\boldvect` uses the `\boldsymbol` command<sup>7</sup> from the `amsbsy` package, which is automatically loaded by `amsmath`. However, you may prefer other packages that produce bold italic fonts, such as `fixmath` with the `\mathbold` command, `isomath` with `\mathbf{it}` or `bm` with the `\bm` command. To use an alternative command, redefine `\boldvectcommand`, for instance after loading `fixmath`:

```
\renewcommand\boldvectcommand{\mathbold}.
```

According to ISO rules, symbols for matrices are also in bold italic. Therefore you can use the same `\boldvectcommand` or create another alias.

`\arrowvect` At any moment, you can revert to the default behavior using the inverse switch `\arrowvect`. These switches can be placed anywhere, whether inside mathematical mode or within an environment (with a local effect) or outside (with a global effect).

`\hvect` When vectors with arrows are typeset side by side, the arrows can be set up slightly higher using `\hvect` (which places a vertical phantom box containing “t”) to avoid inelegant effects. For example, writing

- $\overrightarrow{AB} = \vec{u} + \overrightarrow{AC}$ , obtained with `\hvect{u}`, is better than  $\overrightarrow{AB} = \vec{u} + \overrightarrow{AC}$ ;
- $\vec{a} \cdot \vec{b} = 0$ , obtained with `\hvect{a}`, is better than  $\vec{a} \cdot \vec{b} = 0$ .

This adjustment ensures a more visually pleasing appearance when vectors with arrows are combined in an equation. The `\boldvect` and `\arrowvect` switches have the same effect on `\hvect` as they do on `\vect`.

`\hvec` In a similar way, `\hvec` raises the little arrow produced by the  $\TeX$  command `\vec`, to the height of the letter “t” (but `\boldvect` have no effect here):

- $\mathcal{P} = \vec{f} \cdot \vec{v}$ , obtained with `\hvec{v}`, is better than  $\mathcal{P} = \vec{f} \cdot \vec{v}$ .
- $\vec{f} = m\vec{a}$ , obtained with `\hvec{a}`, is better than  $\vec{f} = m\vec{a}$ .

`\norm` The norm of a vector is conventionally represented using the delimiters `\lVert` and `\rVert` (or `\|` unless a plus (+) or minus (-) sign follows the opening delimiter) or `\left\Vert` and `\right\Vert` for adaptive delimiters. Unfortunately, these delimiters are always vertically centered, relatively to the middle of the base line, whereas vectors with arrows are asymmetric objects. The code `\norm{\vec{h}}` raises a smaller double bar to produce  $\|\vec{h}\|$  instead of  $\|\vec{h}\|$ . Let’s notice that the height of the

<sup>7</sup>`\mathbf` produces upright bold font, even when used in combination with `\mathit`.

bars don't adjust to content, but however to context: main text, subscripts or exponents, e.g.  $e^{||\vec{a}||}$ . This macro is useful only for arguments of special height, such as  $\vec{h}$  or  $\overline{AB}$  and may give bad results in other situations.

`\mathbfsfit`      For tensors symbols, ISO rules recommend using sans serif bold italic, but there  
`\tensor`          is no such math alphabet in the default  $\TeX$  mathematical style. However, the `mismath` package defines this alphabet (assuming the font encoding and package you use permits it) and provides the macro `\mathbfsfit` or its alias `\tensor`. By using `\tensor{T}` you can produce ***T***.

### 2.3 Standard operator names

`\di`      The *differential* operator should be typeset in upright shape, not in italics, to distinguish it from variables (as mentioned in [1] [2] [4] [23]). To achieve this, we provide the `\di` command. Take a look at the following examples (notice the thin spaces before the d, just like with classic function's names):

$$\begin{aligned} & \left[ \iint xy \, \text{\di x} \, \text{\di y} \right] && \iint xy \, dx \, dy \\ & \left[ m \frac{\text{\di}^2 x}{\text{\di t}^2} + h \frac{\text{\di x}}{\text{\di t}} + kx = 0 \right] && m \frac{d^2x}{dt^2} + h \frac{dx}{dt} + kx = 0 \end{aligned}$$

This command can also represent *distance* (hence its name):

$$\lambda d(A, \mathcal{F}) + \mu d(B, \mathcal{H}).$$

`\P`      To refer to probability<sup>8</sup> and expectation the proper use is to typeset the capital  
`\E` letters P, E in roman just like any standard function identifier. This can be achieved with `\P` and `\E` commands.

`\Par`      The `\P` command already existed to refer to the end of paragraph symbol ¶ and has been redefined, but this symbol can still be obtained with `\Par`.

`\V`      Variance is generally denoted by `var` or `Var` (see table below), but some authors prefer to use `V`, which can be produced using `\V`.

`\MathProba`      In the same way as for e, i or j, you can use `\MathUp{P}`, `\MathUp{E}` or  
`\MathNormal` `\MathUp{V}` to avoid typing many `\P`, `\E` or `\V`. However you can also achieve this in a single command with `\MathProba`, for example `\MathProba{P, E}`. We get the inverse switch with `\MathIt` for any individual letter or `\MathNormal` for a list.

`\probastyle`      Some authors use “blackboard bold” font to represent probability, expectation and variance:  $\mathbb{P}, \mathbb{E}, \mathbb{V}$ . The `\probastyle` macro sets the appearance of `\P`, `\E` and `\V`. For instance `\renewcommand\probastyle{\mathbb}`<sup>9</sup> brings the previous “openwork” letters. The `\mathbb` command comes from `amsfonts` package (loaded by `amssymb` but also available standalone) which needs to be called in the preamble.

The following standard operator names are defined in `mismath`:

<sup>8</sup> $\TeX$  provides also `\Pr` which gives Pr.

<sup>9</sup>The effect of this redefinition is global or local to the container environment in which it is used.

<code>\adj</code>	adj	<code>\erf</code>	$\operatorname{erf}$	<code>\Re</code>	Re
<code>\Aut</code>	Aut	<code>\grad</code>	$\overrightarrow{\operatorname{grad}}$	<code>\rot</code>	$\overrightarrow{\operatorname{rot}}$
<code>\codim</code>	codim	<code>\id</code>	id	<code>\sgn</code>	sgn
<code>\Conv</code>	Conv	<code>\Id</code>	Id	<code>\sinc</code>	sinc
<code>\cov</code>	cov	<code>\im</code>	im	<code>\spa</code>	span
<code>\Cov</code>	Cov	<code>\Im</code>	Im	<code>\tr</code>	tr
<code>\curl</code>	$\overrightarrow{\operatorname{curl}}$	<code>\lb</code>	lb	<code>\var</code>	var
<code>\divg</code>	div	<code>\lcm</code>	lcm	<code>\Var</code>	Var
<code>\End</code>	End	<code>\rank</code>	rank	<code>\Zu</code>	Z

By default, operators returning vectors, `\grad` and `\curl` (or its synonym `\rot` rather used in Europe), are written with an arrow on the top. When `\boldvect` is activated, they are typeset in bold style: **grad**, **curl**, **rot**. For the variance, the covariance and the identity function, two notations are proposed, with or without a first capital letter, because both are very common. On the other hand, ‘im’ stands for the image of a linear transformation (like ‘ker’ for the kernel) whereas ‘Im’ is the imaginary part of a complex number. Please note that `\div` already exists ( $\div$ ) and `\span` is a  $\TeX$  primitive (used in `\multicolumn`); they haven’t been redefined. Therefore the provided macros are called `\divg` (divergence) and `\spa` (span of a set of vectors). Furthermore `\Z` is used to denote the set of integers (see 2.4), which is why we used `\Zu`, to designate the center of a group:  $Z(G)$  (from German Zentrum).

`\oldRe`      The `\Re` and `\Im` macros already existed to refer to real and imaginary part of  
`\oldIm` a complex number, producing outdated symbols  $\Re$  and  $\Im$ . However, they have been  
redefined according to current usage, as mentioned in the above table. Nevertheless,  
it is still possible to obtain the old symbols with `\oldRe` and `\oldIm`.

The package `mismath` also provides some (inverse) circular or hyperbolic functions, that are missing in  $\TeX$ :

<code>\arccot</code>	arccot	<code>\arsinh</code>	arsinh	<code>\arcoth</code>	arcoth
<code>\sech</code>	sech	<code>\arcosh</code>	arcosh	<code>\arsech</code>	arsech
<code>\csch</code>	csch	<code>\artanh</code>	artanh	<code>\arcsch</code>	arcsch

`\bigO`      Asymptotic comparison operators (in Landau notation) are obtained with `\bigO`  
`\bigo` or `\bigo` and `\lito` commands:  
`\lito`

$$n^2 + \mathcal{O}(n \log n) \quad \text{or} \quad n^2 + O(n \log n) \quad \text{and} \quad e^x = 1 + x + o(x^2).$$

## 2.4 A few useful aliases

In the tradition of Bourbaki and D. Knuth, proper use requires that classic sets of numbers are typeset in bold roman: **R**, **C**, **Z**, **N**, **Q**, whereas “openwork” letters ( $\mathbb{R}$ ,  $\mathbb{Z}$ , ...) are reserved for writing at the blackboard [23]. Similarly, to designate a field we use **F** or **K** (Körper in German). We get obtain these symbols with the following macros:

`\R`, `\C`, `\Z`, `\N`, `\Q`, `\F`, `\K`.

`\mathset` The `\mathset` command enables you to change the behavior of all these macros in a global way. By default, `\mathset` is an alias for `\mathbf`, but if you prefer open-work letters, you can simply place `\renewcommand\mathset{\mathbb}` where you want, for instance in the preamble after loading the `amssymb` package (which provides the “blackboard bold” typeface, also loaded by `amssymb`).

`\onlymathC` The macro `\onlymathC` is designed for cases when `\C` is already defined, but only in text mode (usually when loading the Russian language with `babel` or `polyglossia`). The macro preserves the original definition for text mode and allows you to use `\C` for the complex number set in math mode. For this purpose, simply call `\onlymathC` once in the preamble or anywhere in the document.

`\ds` The `\displaystyle` command is very common, so the `\ds` alias is provided. Not only it eases typing but also it makes source code more readable.

Symbols with limits behave differently for in-line formulas or for displayed equations. In the latter case, “limits” are placed under or above the symbol whereas for in-line math mode, they are placed on the right, as a subscript or exponent. Compare:  $\zeta(s) = \sum_{n=1}^{\infty} \frac{1}{n^s}$  with

$$\zeta(s) = \sum_{n=1}^{\infty} \frac{1}{n^s}.$$

`\dlim` With in-line math mode, `displaymath` behavior can be forced with `\displaystyle`  
`\ds` or its alias `\ds`. However, when using these commands, all the rest of the current  
`\dprod` mathematical environment will be set in `displaymath` mode (as shown in the previous  
`\dcup` example, where the fraction will be expanded). To limit the display style effect to  
`\dcap` the affected symbol only, similar to the `amsmath` command `\dfac`, we can use the  
following macros: `\dlim`, `\ds`, `\dprod`, `\dcup`, `\dcap`. So

$$\$ \dlim_{x \to +\infty} \frac{1}{x} \$ \quad \text{yields} \quad \lim_{x \rightarrow +\infty} \frac{1}{x}.$$

`\lbar` Large bars over expressions are obtained with `\overline` or its alias `\lbar`, to  
`\hlbar` get for instance  $\overline{z_1 z_2}$ . Similar to vectors, you can raise the bar (from the height of “h”) with the `\hlbar` command, to correct uneven bars heights.

$$\overline{z + z'} = \overline{z} + \overline{z'}, \text{ obtained with } \hlbar{z}, \text{ is better than } \overline{z + z'} = \overline{z} + \overline{z'}.$$

`\eqdef` The `\eqdef` macro writes the equality symbol topped with ‘def’ or with ‘ $\Delta$ ’ for  
`\eqdef*` `\eqdef*` (thanks to the `TeX` command `\stackrel`):

$$\$ e^{i\theta} \eqdef \cos\theta + i\sin\theta \$ \quad e^{i\theta} \stackrel{\text{def}}{=} \cos\theta + i\sin\theta$$

$$\$ e^{i\theta} \eqdef* \cos\theta + i\sin\theta \$ \quad e^{i\theta} \stackrel{\Delta}{=} \cos\theta + i\sin\theta$$

`\unbr` `\unbr` is an alias for `\underbrace`<sup>10</sup>, making source code more compact.

<sup>10</sup>The `mathtools` package by Morten Høgholm and Lars Madsen [7] provides a new and improved version of the `\underbrace` command, along with many other useful macros. It is loaded by `mismath`.



`\unbr{QAP}\mul QAP\mul \cdots\mul QAP}_{n\text{ times}}`  $(QAP)^n = \underbrace{QAP \times QAP \times \cdots \times QAP}_{n \text{ times}}$

`\iif` `\iif` is an alias for “if and only if”, to be used in text mode.

## 2.5 Improved spacing in mathematical formulas

`\then` The `\then` macro produces the symbol  $\implies$  surrounded by large spaces just like the `\txt` standard macro `\iff` does it with  $\iff$ . Similarly, the `\txt`, based on the `\text` macro from the `amstext` package (loaded by `amsmath`), leaves `em quad` spaces (`\quad`) around the text. See the following example:

`\[ \ln x=a \then x=e^a, \txt{rather than} \ln x=a \Longrightarrow x=e^a \]`  
 $\ln x = a \implies x = e^a$ , rather than  $\ln x = a \implies x = e^a$

`\mul` The multiplication symbol obtained with `\times` produces the same spacing as addition or subtraction operators, whereas division obtained with `/` is closer to its operands. This actually hides the priority of multiplication over `+` and `-`. That’s why we provide the `\mul` macro, behaving like `/` (ordinary symbol) and leaving less space around than `\times`:

$\lambda + \alpha \times b - \beta \times c$ , obtained with `\mul`, is better than  $\lambda + \alpha \times b - \beta \times c$ .

When using `\mul` before a function name or around a `\left... \right` structure, the space may be too large on one side of `\mul`. To ensure the same amount of space on both sides of `\mul`, you can use thin negative spaces `\!` or enclose the function or structure with braces:

$x \times \sin x$ , obtained with `x\mul{\sin x}`, is slightly better than  $x \times \sin x$ .  
`\sin\!{\left( \frac{\pi}{3} \right)}` `\mul 2` gives  $\sin\left(\frac{\pi}{3}\right) \times 2$  which is better than  $\sin\left(\frac{\pi}{3}\right) \times 2$ .

The thin negative space after the function name is not relative to `\mul`, but is due to the fact that spaces around a `\left... \right` structure are bigger than those produced by single parenthesis (`...`).

`\pow` In the same way, when typesetting an exponent after a closing *big* parenthesis produced by `\right)`, the exponent appears to be a little to far from the parenthesis. To address this issue, the `\pow{<expr>}{<pow>}` command is provided, which sets `<expr>` between parentheses and adjusts the positioning of the exponent `<pow>` slightly closer to the right parenthesis<sup>11</sup>. Compare:

$e^a \sim \left(1 + \frac{a}{n}\right)^n$  which may be better than  $e^a \sim \left(1 + \frac{a}{n}\right)^n$ .

`\abs` The correct typesetting of absolute value (or modular for a complex number) is achieved using `\lvert ... \rvert`, rather than `|`, as the latter doesn’t maintain proper

<sup>11</sup>This macro gives bad results with normal-sized parenthesis.

spacing in some situations (when a sign follows the open delimiter). For bars whose height has to adapt to the content, we can use `\left\vert ... \right\vert` or, more simply, the `\abs{...}` command, which is equivalent<sup>12</sup>.

`\lfrac` The `\lfrac` macro behaves like `\frac` but with thicker spaces around the arguments, making the corresponding fraction bar slightly longer:

$$\left[ \overline{\lfrac{\bar{z}_1 - \bar{z}_2}{\bar{z}_1 + \bar{z}_2}} \right]$$

`[ibrackets]` Open intervals are commonly represented with parenthesis, e.g.  $(0, +\infty)$ , but sometimes square brackets are used, especially in French mathematics:  $]0, +\infty[$ . In that specific case, the space around the square brackets is often inappropriate, as in the expression  $x \in ]0, +\infty[$ . To address this issue, we have redefined the brackets in the `ibrackets` package [22] which can be optionally<sup>13</sup> loaded by `mismath` using the `ibrackets` package option<sup>14</sup>.

Simply type `\in ]-\pi, 0[ \cup ]2\pi, 3\pi[` to get

$$x \in ]-\pi, 0[ \cup ]2\pi, 3\pi[ \quad \text{with } \text{ibrackets},$$

instead of  $x \in ]-\pi, 0[ \cup ]2\pi, 3\pi[$  without `ibrackets`.

In our code, the symbols `[` and `]` are not defined by default as delimiters. Therefore, a line break could occur between the two brackets. However, it is always possible to transform them into delimiters using `\left` and `\right`.

With the `ibrackets` package, brackets are set as “active” characters, behaving like ordinary characters in most cases. However, when a bracket is *immediately* followed by a `+` or `-` character, it becomes an open delimiter. Therefore, when the left bound contains an operator sign, *you don't have to leave a space between the first bracket and the sign*, otherwise, the spaces surrounding the operator will be too large. For example if you write `\in ]-\infty, 0]`, it yields  $x \in ]-\infty, 0]$  instead of  $x \in ]-\infty, 0]$ . Conversely, when dealing with algebraic expressions involving intervals, *you must leave a blank space between the second bracket and the +/- operations*. For instance `[a, b] + [c, d]` yields  $[a, b] + [c, d]$  but `[a, b] + [c, d]` yields  $[a, b] + [c, d]$ .

Besides, there are other approaches, for example the `\interval` macro from the `interval` package [17], or `\DeclarePairedDelimiters` from the `mathtools` package [7] (but the latter is incompatible with `ibrackets` for managing brackets).

## 2.6 Environments for systems of equations and small matrices

`system` The `system` environment, defined in the `mismath` package, is used to represent a

<sup>12</sup>Another solution is to define `\abs` using the `\DeclarePairedDelimiter` command from the `mathtools` package [7].

<sup>13</sup>This functionality is optional because it causes errors when using a command defined by `\DeclarePairedDelimiter` [7] with square brackets.

<sup>14</sup>It is the only option specific to the `mismath` package.



`spmatrix` The `amsmath` package offers several environments to typeset matrices : For example, the `pmatrix` environment surrounds the matrix with parenthesis, and the `smallmatrix` environment creates a smaller matrix suitable for insertion within a text line. We provide a combination of these both functionalities with the `spmatrix` environment: `\vec{u}\begin{spmatrix}-1\\2\end{spmatrix}` yielding  $\vec{u}\begin{pmatrix}-1 \\ 2\end{pmatrix}$ .

The `mathtools` package enhances the `amsmath` matrix environments and also provides a small matrix environment with parenthesis: `psmallmatrix`. Moreover, with the starred version `\begin{psmallmatrix*}[\langle col \rangle]`, you can choose the alignment inside the columns (`c`, `l` or `r`). However, the space before the left parenthesis is unfortunately too narrow compared to the space inside the parenthesis. To illustrate this, consider the following comparison:  $\vec{u}\begin{pmatrix}-1 \\ 2\end{pmatrix}$  (using `mismath`'s `spmatrix`) vs.  $\vec{u}\begin{psmallmatrix} -1 \\ 2 \end{psmallmatrix}$  (using `mathtools` `psmallmatrix`).

For typesetting various kinds of matrices, let's mention the excellent `nicematrix` package by François Pantigny [20].

## 2.7 Displaymath in double columns

`mathcols` The `mathcols` environment allows you to arrange “long” calculations in double columns, separated with a central rule, as shown in the following example. However, to use this feature, the `multicol` package must be loaded in the preamble. The `mathcols` environment activates mathematical mode in display style and with an aligned environment.

$$\begin{array}{l|l}
 \frac{1}{2 \times \left(\frac{1}{4}\right)^n + 1} \geq 0.999 & \iff 4^n \geq 1998 \\
 \iff 1 \geq 1.998 \left(\frac{1}{4}\right)^n + 0.999 & \iff n \ln 4 \geq \ln(1998) \\
 \iff 0.001 \geq \frac{1.998}{4^n} & \iff n \geq \frac{\ln(1998)}{\ln 4} \approx 5.4 \\
 & \iff n \geq 6
 \end{array}$$

`\changeacol` The `\changeacol` macro is used to switch to the next column, and an alignment within the column is done using the classic delimiters `&` to separate entries and `\\` to start a new row.

```

\begin{mathcols}
  & \frac{1}{2 \mul {\pow{\frac{1}{4}}{n}} + 1} \geq 0.999 \\
  \iff & 1 \geq 1.998 \pow{\frac{1}{4}}{n} + 0.999 \\
  \iff & 0.001 \geq \frac{1.998}{4^n} \\
\changeacol
  & \iff 4^n \geq 1998 \\
  & \iff n \ln 4 \geq \ln(1998) \\
  & \iff n \geq \frac{\ln(1998)}{\ln 4} \approx 5.4 \\
  & \iff n \geq 6
\end{mathcols}

```

## 2.8 Deprecated commands

Here is a summary table of the deprecated commands that were used until version 2.2. These commands are still functional and will be maintained for the time being, but they do produce a warning message. They used to work only in the preamble, affecting the entire document globally, and lacked an inverse switch. As a result, these deprecated commands are now being replaced by the more versatile and powerful `\MathUp` macro, which can be used anywhere in the document or preamble and has an inverse switch `\MathIt`.

Deprecated command	New alternative
<code>\enumber</code>	<code>\MathUp{e}</code>
<code>\inumber</code>	<code>\MathUp{i}</code>
<code>\jnumber</code>	<code>\MathUp{j}</code>
<code>\PEupright</code>	<code>\MathUp{P}\MathUp{E}</code>

You can also utilize `\MathNumbers` instead of `\MathUp` with an argument containing all the constants you want to be typeset in roman (among ‘e, i, j’). Additionally `\MathProba{P,E}` can be used instead of `\MathUp{P}\MathUp{E}`, and you can include V in its argument to refer to variance.

In version 2.3 we attempted to replace these deprecated commands with package options based on `keyval`. However, we found that this method was less efficient and have decided to abandon it. As a result, the command `\mismathset` is now obsolete. Additionally, the command, `\paren`, which was used before version 2.0, is no longer supported.

## 3 Implementation

```
1 \newif\ifmm@ibrackets % initialized to false
2 \DeclareOption{ibrackets}{\mm@ibracketstrue}
3 \DeclareOption*{\PassOptionsToPackage{\CurrentOption}{amsmath}}
4 \ProcessOptions \relax
5 \@ifpackageloaded{amsmath}{}{\RequirePackage{amsmath}}
6 \@ifpackageloaded{mathtools}{}{\RequirePackage{mathtools}}
7 \@ifpackageloaded{esvect}{}{\RequirePackage[b]{esvect}}
8 \RequirePackage{ifthen}
9 \RequirePackage{xparse} % for \NewDocumentCommand
10 \RequirePackage{xspace}
11 \RequirePackage{iftex}
12 \ifmm@ibrackets\RequirePackage{ibrackets}\fi
13
```

The above conditional packages loading prevents “option clash” errors in case these packages have been previously loaded previously with different options.

`\bslash` The `\bslash` macro originates from Frank Mittelbach’s `doc.sty` package. It can be employed in other documents as an alternative to `\textbackslash`, especially in

situations where `\textbackslash` does not work correctly, such as inside warning messages.

```
14{\catcode'\|=\z@ \catcode'\=12 |gdef|bslash{\}} % \bslash command
15
```

`\mm@warning`      The next three internal macros serve as meta commands for conditionally defining  
`\mm@macro`          macros while providing a warning message if the macro already exists. These macros  
`\mm@operator`      can be useful in other packages as well.

```
16 \newcommand\mm@warning[1]{
17   \PackageWarningNoLine{mismath}{
18     Command \bslash #1 already exist and will not be redefined}
19 }
20 \newcommand\mm@macro[2]{
21   \@ifundefined{#1}{
22     \expandafter\def\csname #1\endcsname{#2}
23   }{\mm@warning{#1}}
24 }
25 \NewDocumentCommand\mm@operator{0{#3}mm}{%
26   \@ifundefined{#1}{
27     \DeclareMathOperator{#2}{#3}
28   }{\mm@warning{#1}}
29 }
30
```

To produce the correct upright shape font when working with the beamer package, you don't have to use `\mathrm` but rather `\mathup` (based on `\operatorfont` from the `amsopn` package). This command also works fine with other sans serif fonts like `cmbright`.

Moreover for beamer, which changes the default font family (sans serif) `\e`, `\i`, `\j` have no effect without `\AtBeginDocument`.

`\AtBeginDocument` is also necessary to redefine `\i` when calling the `hyperref` package which overwrites the `\i` definition.

```
31 \providecommand{\mathup}[1]{\operatorfont #1} % also in kpfonts
32 \mm@macro{e}{\mathup{e}}
33 \AtBeginDocument{\let\oldi\i \let\oldj\j
34   \renewcommand{\i}{\TextOrMath{\oldi}{\mathup{i}}}
35   \renewcommand{\j}{\TextOrMath{\oldj}{\mathup{j}}} }
36
```

The following macros are switches that transform any chosen letter in math mode to roman or italic style. These switches can be used anywhere in the document or preamble. To obtain a letter in roman style instead of italic, we need to change the mathcode digit that represents the font family: 1 to 0.

For example, except for `Lua $\TeX$` , mathcode of the 'e' letter is: 'e="7165 (decimal 29029), with the second digit '1' indicating "italic" style. To get a roman 'e', we need to change its mathcode to "7065.

When used in the preamble, it is necessary to call `\AtBeginDocument` for using with the beamer package. In the preamble, `\math@family{#1}{0}` is equivalent to `\DeclareMathSymbol{#1}{\mathalpha}{operators}'{#1}`.

```

37 \newcount\mm@charcode
38 \newcount\mm@charclass
39 \newcount\mm@charfam
40 \newcount\mm@charslot
41
42 \newcommand*\math@family[2]{%
43   \mm@charfam=#2
44   \ifluatex
45     \mm@charclass=\Umathcharclass'#1
46     %\mm@charfam=\Umathcharfam'#1
47     \mm@charslot=\Umathcharslot'#1
48     \Umathcode'#1= \mm@charclass \mm@charfam \mm@charslot
49   \else
50     \mm@charcode=\mathcode'#1
51     % extract charclass
52     \@tempcnta=\mm@charcode
53     \divide\@tempcnta by "1000
54     \multiply\@tempcnta by "1000 % charclass
55     \mm@charclass=\@tempcnta
56     % extract charslot
57     \@tempcnta=\mm@charcode
58     \@tempcntb=\mm@charcode
59     \divide\@tempcnta by "100
60     \multiply\@tempcnta by "100 % charclass + charfam
61     \advance\@tempcntb by -\@tempcnta % charslot
62     \mm@charslot=\@tempcntb
63     % construct charcode
64     \mm@charcode=\mm@charclass
65     \multiply\mm@charfam by "100
66     \advance\mm@charcode by \mm@charfam
67     \advance\mm@charcode by \mm@charslot
68     \mathcode'#1=\mm@charcode
69   \fi
70 }
71
72 \newcommand*\MathFamily[2]{%
73   \ifx\@onlypreamble\@notprerr
74     \math@family{#1}{#2}
75   \else % before \begin{document}
76     \AtBeginDocument{\math@family{#1}{#2}}
77   \fi
78 }
79
80 \newcommand*\MathUp[1]{\MathFamily{#1}{0}}
81 \newcommand*\MathIt[1]{\MathFamily{#1}{1}}
82

```

With a similar approach we could also create additional macros to set any letter in bold or sans serif. However, there is no default family number associated with these typefaces. The family number depends on the font package being loaded and may vary

depending on specific `\DeclareSymbolFont` used. Therefore, setting letters in bold or sans serif requires additional consideration and may not have a straightforward solution.

In addition to `\MathUp` and `\MathIt`, we also offer the following two commands to set a group of letters in roman typeface: one for for mathematical constants, among ‘e, i, j’, and the other for probability operators, among or ‘P, E, V’.

```
83 \newcommand*\MathNumbers[1]{%
84   \in@{e}{#1} \ifin@ \MathUp{e} \fi
85   \in@{i}{#1} \ifin@ \MathUp{i} \fi
86   \in@{j}{#1} \ifin@ \MathUp{j} \fi
87 }
88
89 \newcommand*\MathProba[1]{%
90   \in@{P}{#1} \ifin@ \MathUp{P} \fi
91   \in@{E}{#1} \ifin@ \MathUp{E} \fi
92   \in@{V}{#1} \ifin@ \MathUp{V} \fi
93 }
94
```

`\apply` With the inverse global switch `\MathNormal`, you can apply the normal (italic) style on any comma-separated list of characters. This is achieved using the `\apply` macro, for example `\apply\macro{arg1 , arg2}` expands to `\macro{arg1}\macro{arg2}`. So using `\apply\MathUp{e , i , j}` is equivalent to `\MathUp{e}\MathUp{i}\MathUp{j}`. I discovered this powerful macro on [Tex RSSing.com](http://TexRSSing.com) by searching for “TeX How to iterate over a comma separated list?” The answer was provided by a user named “wipet” on 2021/02/26. I don’t know who is wipet but I am grateful for his contribution, as this macro allows us to accomplish the task that usual loop instructions like `\@for` or `\foreach` cannot achieve due to errors like “! Improper alphabetic constant”. For instance, if you try `\def\letter{A} \MathUp{\letter}` it will fail because the control sequence `\letter` is not considered as the single character ‘A’.

```
95 \def\apply#1#2{\apply@#1#2,\apply@,}
96 \def\apply@#1#2,{\ifx\apply@#2\empty
97   \else #1{#2}\afterfi@\apply@#1}\fi}
98 \def\afterfi@#1#2\fi{\fi#1}
99
100 \newcommand*\MathNormal[1]{% list argument
101   \apply\MathIt{#1}
102 }
103
```

The following commands are deprecated but still work. They were intended to set some letters in upright shape in math mode, but only worked in the preamble. This is now managed by the more powerful `\MathUp` command, and the old commands are maintained for compatibility reasons.

```
104 \newcommand{\enumber}{%
105   \PackageWarning{mismath}{Command \string\enumber\space
106     is deprecated, \MessageBreak
```



```

107     use \bslash MathUp{e} instead}
108   \MathUp{e}
109 }
110 \newcommand{\inumber}{%
111   \PackageWarning{mismath}{Command \string\inumber\space
112     is deprecated, \MessageBreak
113     use \bslash MathUp{i} instead}
114   \MathUp{i}
115 }
116 \newcommand{\jnumber}{%
117   \PackageWarning{mismath}{Command \string\jnumber\space
118     is deprecated, \MessageBreak
119     use \bslash MathUp{j} instead}
120   \MathUp{j}
121 }
122 \newcommand{\PEupright}{%
123   \PackageWarning{mismath}{Command \string\PEupright\space
124     is deprecated, \MessageBreak
125     use \bslash MathUp{P} and \bslash MathUp{R} instead}
126   \MathUp{P}\MathUp{E}
127 }
128

```

The Greek letter pi must be handled differently. The switches are called `\pinumber` and `\pinormal`. When given without an argument, `\pinumber` uses the LGR font encoding. A particularity of the fontenc package is that it can be loaded several times with different options without triggering an “option clash” error.

```

129 \newcommand*\pinumber[1][{}]{
130   \@ifundefined{itpi}{\let\itpi\pi}{}
131   \ifthenelse{\equal{#1}{}}{
132     \ifx\@onlypreamble\@notprerr
133       \@ifundefined{savedpi}{
134         \PackageWarning{mismath}{%
135           \bslash pinumber without argument\MessageBreak
136           must be used in the preamble first\MessageBreak
137           to load LGR fontenc for upright pi}
138       }{\let\pi\savedpi}
139     \else % in the preamble
140       \RequirePackage[LGR,T1]{fontenc}
141       \DeclareSymbolFont{UpGr}{LGR}{lmr}{m}{n}
142       \let\pi\relax
143       \DeclareMathSymbol{\pi}\mathalpha{UpGr}{"70}
144       \let\savedpi\pi
145     \fi
146   }{
147     \@ifundefined{#1}{
148       \PackageWarning{mismath}{%
149         Value #1 must be a valid
150         command name\MessageBreak for pinumber,
151         but command \bslash #1\space

```

```

152             is undefined.\MessageBreak
153             Perhaps a missing package}
154     }{\renewcommand{\pi}{%
155         \csname #1\endcsname}
156     }
157 }
158 }
159
160 \newcommand{\pinormal}{\@ifundefined{itpi}{\let\pi\itpi}}
161

```

And now the commands for vectors (and tensors).

```

162 \newboolean{arrowvect}
163 \setboolean{arrowvect}{true}
164 \newcommand{\arrowvect}{\setboolean{arrowvect}{true}}
165 \newcommand{\boldvect}{\setboolean{arrowvect}{false}}
166 \newcommand{\boldvectcommand}{\boldsymbol} % from amsbsy package
167 \mm@macro{vect}{\ifthenelse{\boolean{arrowvect}}{
168     \vv}{\boldvectcommand}} % doesn't work well with \if... \fi
169 \newcommand*{\hvect}[1]{\vect{\vphantom{t}#1}}
170 \newcommand*{\hvec}[1]{\vec{\vphantom{t}#1}}
171
172 \newcommand*{\@norm}[1]{
173     \mbox{\raisebox{1.75pt}{\small$\bigl\Vert$}} #1
174     \mbox{\raisebox{1.75pt}{\small$\bigr\Vert$}} }
175 % works better than with relative length
176 \newcommand*{\@@norm}[1]{
177     \mbox{\footnotesize\raisebox{1pt}{\small$\Vert$}} #1
178     \mbox{\footnotesize\raisebox{1pt}{\small$\Vert$}} }
179 \newcommand*{\@@@norm}[1]{
180     \mbox{\tiny\raisebox{1pt}{\small$\Vert$}} #1
181     \mbox{\tiny\raisebox{1pt}{\small$\Vert$}} }
182 \@ifundefined{norm}{\providecommand*{\norm}[1]{
183     \mathchoice{\@norm{#1}}{\@norm{#1}}{\@norm{#1}}{\@@@norm{#1}}
184     }
185     }{\mm@warning{norm}} % bad result with libertine1math
186
187 \DeclareMathAlphabet{\mathbfsfit}{\encodingdefault}{\sfdefault}{bx}{it}
188 \newcommand{\tensor}{\mathbfsfit} % isomath uses \mathsfbfit
189

```

Classic identifiers are presented below.

```

190 \mm@macro{di}{\mathop{}}!\mathup{d}}
191 \newcommand\probastyle{}
192 \let\Par\Par % end of paragraph symbol
193 \renewcommand{\P}{\operatorname{\probastyle{P}}}
194 \mm@macro{E}{\operatorname{\probastyle{E}}}
195 \mm@macro{V}{\operatorname{\probastyle{V}}}
196
197 \mm@operator{\adj}{adj}

```

```

198 \mm@operator{\Aut}{Aut}
199 \mm@operator{\codim}{codim}
200 \mm@operator{\Conv}{Conv}
201 \mm@operator{\cov}{cov}
202 \mm@operator{\Cov}{Cov}
203 \mm@macro{curl}{\operatorname{\vect{\mathup{curl}}}}
204 \mm@operator[divg]{\divg}{div}
205 \mm@operator{\End}{End}
206
207 \mm@operator{\erf}{erf}
208 \mm@macro{grad}{\operatorname{\vect{\mathup{grad}}}}
209 \mm@operator{id}{id} % mathop or mathord ?
210 \mm@operator{Id}{Id}
211 \mm@operator{im}{im}
212 \let\oldIm\Im \renewcommand{\Im}{\operatorname{Im}}
213 \mm@operator{lb}{lb}
214 \mm@operator{lcm}{lcm}
215
216 \mm@operator{rank}{rank}
217 \let\oldRe\Re \renewcommand{\Re}{\operatorname{Re}}
218 \mm@macro{rot}{\operatorname{\vect{\mathup{rot}}}}
219 \mm@operator{sgn}{sgn}
220 \mm@operator{sinc}{sinc}
221 \mm@operator[spa]{\spa}{span}
222 \mm@operator{tr}{tr}
223 \mm@operator{var}{var}
224 \mm@operator{Var}{Var}
225 \mm@operator[Zu]{\Zu}{Z}
226
227 \mm@operator{arccot}{arccot}
228 \mm@operator{sech}{sech}
229 \mm@operator{csch}{csch}
230 \mm@operator{arsinh}{arsinh}
231 \mm@operator{arcosh}{arcosh}
232 \mm@operator{artanh}{artanh}
233 \mm@operator{arcoth}{arcoth}
234 \mm@operator{arsech}{arsech}
235 \mm@operator{arcsch}{arcsch}
236
237 \mm@operator[big0]{\big0}{\mathcal{0}}
238 \mm@operator[bigo]{\bigo}{0}
239 \mm@operator[lito]{\lito}{o}
240

```

And finally we present the remaining macros.

With Cyrillic languages, the command `\C` may already be defined (only for text mode). Thus, it will not be redefined by `mismath`. However, one may still want to use our `\C` macro only for math mode without interfering the definition of the text `\C`, therefore the `\onlymathC` macro.

```

241 \mm@macro{mathset}{\mathbf}

```

```

242 \mm@macro{R}{\mathset{R}}
243 \mm@macro{C}{\mathset{C}}
244 \providecommand\onlymathC{\let\oldC\C
245   \renewcommand{C}{\TextOrMath{\oldC}{\mathset{C}}}} }
246 \mm@macro{N}{\mathset{N}}
247 \mm@macro{Z}{\mathset{Z}}
248 \mm@macro{Q}{\mathset{Q}}
249 \mm@macro{F}{\mathset{F}}
250 \mm@macro{K}{\mathset{K}}
251
252 \mm@macro{ds}{\displaystyle}
253 \mm@macro{dlim}{\lim\limits}
254 \mm@macro{dsum}{\sum\limits}
255 \mm@macro{dprod}{\prod\limits}
256 \mm@macro{dcup}{\bigcup\limits}
257 \mm@macro{dcap}{\bigcap\limits}
258
259 \mm@macro{lbar}{\overline}
260 \@ifundefined{hlbar}{
261   \providecommand*\hlbar[1]{\overline{\vphantom{t}#1}}}{
262   \mm@warning{hlbar} }
263 \newcommand\@eqdef{\stackrel{\mathup{def}}{=}}
264 \newcommand\@eqdef{\stackrel{\mathrm{\Delta}}{=}}
265 \mm@macro{eqdef}{\ifstar{\@eqdef}{\@eqdef}}
266 \mm@macro{unbr}{\underbrace}
267 \mm@macro{iif}{if and only if\xspace}
268
Above, we have used \mathrm before \Delta in case of defining capital Greek letters
in italics (for example with the fixmath package). The use of \mbox{} ensures that
the space produced by \ in the \then macro is not suppressed in tables.
269 \mm@macro{then}{\ \Longrightarrow \ \mbox{} }
270 \@ifundefined{txt}{
271   \providecommand*\{txt}[1]{\quad\text{#1}\quad} }{
272   \mm@warning{txt} }
273 \mm@macro{mul}{\mathord{\times}}
274 \@ifundefined{pow}{
275   \providecommand*\{pow}[2]{\left( #1 \right)^{\!#2}} }{
276   \mm@warning{pow} }
277 \@ifundefined{abs}{
278   \providecommand*\{abs}[1]{\left\vert#1\right\vert} }{
279   \mm@warning{abs} }
280 \@ifundefined{lfrac}{
281   \providecommand*\{lfrac}[2]{\frac{\;#1\;}{\;#2\;}} }{
282   \mm@warning{lfrac} }
283
284 \newcommand{\systemstretch}{1.2}
285 \newcommand{\systemsep}{\medspace}
286 \newenvironment{system}[1][1]{
287   \renewcommand{\arraystretch}{\systemstretch}

```

```

288   \setlength{\arraycolsep}{0.15em}
289   \left\{\begin{array}{@{\systemsep}#1@{}} %
290 }\end{array}\right.}
291
292 \newenvironment{spmatrix}{
293   \left(\begin{smallmatrix}
294 }\end{smallmatrix}\right)}
295
296 \newenvironment{mathcols}{% needs multicol package
297   \renewcommand{\columnseprule}{0.1pt}
298   \begin{multicols}{2}
299     \par\noindent\hfill
300     \begin{math}\begin{aligned}\displaystyle
301 }{%
302     \end{aligned}\end{math} \hfill\mbox{}
303   \end{multicols}
304 }
305 \newcommand{\change col}{%
306   \end{aligned}\end{math} \hfill\mbox{}
307   \par\noindent\hfill
308   \begin{math}\begin{aligned}\displaystyle
309 }

```

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