

# The package `cascade`\*

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## Abstract

The LaTeX package `cascade` provides a command `\Cascade` to do constructions to present mathematical demonstrations with successive braces for the deductions.

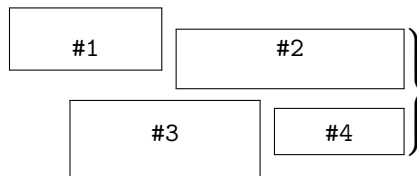
## 1 Presentation

The package `cascade` gives a command `\Cascade` which allows constructions like the following where the size of the right brace is computed on only a part of the LaTeX elements composed on the left.

$$\left. \begin{array}{l} \det(A) = \begin{vmatrix} 3 & 4 \\ -1 & 7 \end{vmatrix} \neq 0 \text{ and, therefore, } A \text{ is invertible} \\ \text{yet } AX = Y \end{array} \right\} \text{hence, } X = A^{-1}Y$$

```
\Cascade{ $\det(A) = \begin{vmatrix} 3 & 4 \\ -1 & 7 \end{vmatrix} \neq 0$ }%  
  {and, therefore,  $A$  is invertible}%  
  {}%  
  {yet  $AX=Y$ }  
hence,  $X = A^{-1}Y$ 
```

The command `\Cascade` takes its four arguments as follow :



The commands `\Cascade` can be nested as in the following example :

$$\left. \begin{array}{l} (BH) \perp (AC) \\ (OC) \perp (AC) \end{array} \right\} \text{hence } (BH) \parallel (OC) \left. \begin{array}{l} (CH) \perp (AB) \\ (OB) \perp (AB) \end{array} \right\} \text{hence } (CH) \parallel (OB) \left. \begin{array}{l} \text{hence } (BH) \parallel (OC) \\ \text{hence } (CH) \parallel (OB) \end{array} \right\} \text{hence } (OBHC) \text{ is a parallelogram}$$

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\*This document corresponds to the version 1.0 of `cascade`, at the date of 2018/04/17.

For the lisibility of such constructions, a simplified version of `\Cascade` is available, named `\ShortCascade`.

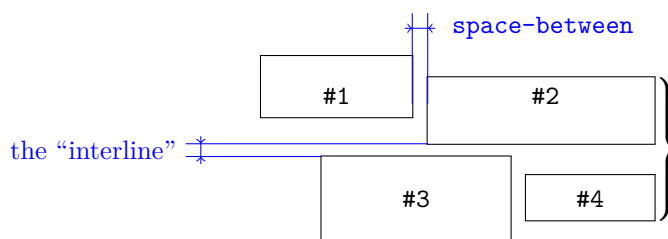
The code `\ShortCascade{X}{Y}` is merely a shortcut for the code `\Cascade{}{X}{}{Y}`.

The preceding example can be coded with two commands `\ShortCascade` and an encompassing command `\Cascade` :

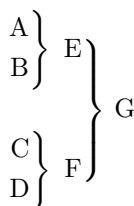
```
\Cascade{\ShortCascade{$(BH) \perp (AC)$}
          {$(OC) \perp (AC)$}}
{hence\enskip $(BH) \parallel (OC)$}
{\ShortCascade{$(CH) \perp (AB)$}
  {$(OB) \perp (AB)$}}
{hence\enskip $(CH) \parallel (OB)$}
hence $(OBHC)$ is a parallelogram
```

## 2 The options

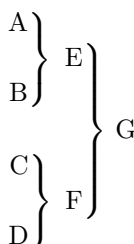
- The option `space-between` is a TeX dimension described on the following figure. Its default value is 0.5 em. It applies to the current command `\Cascade` but also to the possible nested commands.
- The option `interline` can be used to *increase* the “interline” showed in the following picture. The default value of `interline` is 0 pt and applies only to the current command `\Cascade`.
- The option `interline-all` changes the default value of `interline` used by the current command `Cascade` and all the possible nested commands `\Cascade`.



```
\Cascade[interline=4mm]{\ShortCascade{A}{B}}{E}{\ShortCascade{C}{D}}{F} G
```



```
\Cascade[interline-all=4mm]{\ShortCascade{A}{B}}{E}{\ShortCascade{C}{D}}{F} G
```



The options can also be given at the document level with the command `\CascadeOptions`. In this case, the scope of the declarations is the current TeX group (these declarations are “semi-global”).

### 3 Technical remark

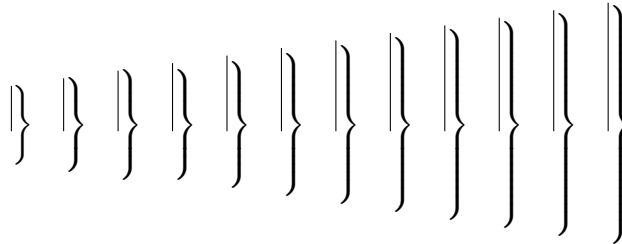
The package `\Cascade` is designed to give by default results similar to the those given by the environments of `amsmath` — and `mathtools` — especially `{aligned}`.

|   |  |
|---|--|
| <code>\[ \left. \begin{aligned}</code>    |  |
| <code>&amp; A = \sqrt{a^2+b^2} \\\</code> | $A = \sqrt{a^2 + b^2} \left\{ \right.$ |
| <code>&amp; B = \frac{ax+b}{cx+d}</code>  | $B = \frac{ax + b}{cx + d}$            |
| <code>\end{aligned} \right\}</code>       |  |

|  |  |
|--|--|
| <code>\ShortCascade{\\$ \displaystyle A = \sqrt{a^2+b^2} \\$}</code> | $A = \sqrt{a^2 + b^2} \left\{ \right.$ |
| <code>\\$ B = \dfrac{ax+b}{cx+d} \\$}</code>                         | $B = \frac{ax + b}{cx + d}$            |

The package `cascade` constructs the braces with the classical pair `\left-\right` of TeX. However, the extensible delimiters, in TeX, cannot take all sizes. We give, in the following example, the braces obtained when surrounding vertical rules from 6 mm to 17 mm (the code is in `expl3`).

```
\int_step_inline:nnnn 6 1 {17} { \$\left.\hbox{\vrule height #1 mm}\right\}\$ \quad }
```



## 4 Implementation

```

1 \RequirePackage{l3keys2e}
2 \ProvidesExplPackage
3   {cascade}
4   {\myfiledate}
5   {\myfileversion}
6   {Easy presentation of demonstrations in cascades}

7 \RequirePackage{xparse}

```

`\spread@equation` We will use the command `\spread@equation` of `amsmath` to increase the interline in the commands `\Cascade`. When used, this command becomes no-op (in the current TeX group).

Nevertheless, we want the extension `cascade` available without `amsmath`. That's why we give a definition of `\spread@equation` (this definition will be loaded only if `amsmath` — or `mathtools` — has not been loaded yet).

```

8 \cs_if_free:NT \spread@equation
9   {\cs_set_protected:Npn \spread@equation
10     {\openup\jot
11       \cs_set_protected:Npn \spread@equation {}}}

```

Don't put `\cs_set_eq:NN \spread@equation \prog_do_nothing:` in the last line because this would raise errors with nested environments.

The dimension `\l_@@_interline_dim` will be the value of the vertical space added between the two boxes connected by the brace.

```
12 \dim_new:N \l_@@_interline_dim
```

The dimension `\l_@@_interline_all_dim` is the default value of `\l_@@_interline_dim`. This default value can be modified with the option `interline-all`. Therefore, when modified in the options of a command `\Cascade`, this value will affect all the possible nested commands.

```
13 \dim_new:N \l_@@_interline_all_dim
```

The dimension `\l_@@_space_between_dim` is the horizontal space inserted between the two elements of the same row of the construction.

```
14 \dim_new:N \l_@@_space_between_dim
15 \dim_set:Nn \l_@@_space_between_dim {0.5 em}
```

The set of keys `cascade/command` will be used for the commands `\Cascade`.

```
16 \keys_define:nn {cascade/command}
17   {

```

The option `interline` is the vertical space added between the two items connected by a brace.

```
18   interline          .dim_set:N          = \l_@@_interline_dim,
19   interline          .value_required:n = true ,

```

The option `interline-all` will change the value of `interline` for all the commands `\Cascade`, even the nested commands.

```

20 interline-all      .code:n          = { \dim_set:Nn \l_@@_interline_all_dim {#1}
21                                     \dim_set:Nn \l_@@_interline_dim {#1} },
22 interline-all      .value_required:n = true,

```

The option `space-between` is the horizontal space inserted between the two elements of the same row of the construction.

```

23 space-between      .dim_set:N          = \l_@@_space_between_dim,
24 space-between      .value_required:n = true}

```

The set of keys `cascade/global` will be used for the command `\CascadeOptions` (which fixes the options at a “global” level).

```

25 \keys_define:nn {cascade/global}
26 {interline-all    .dim_set:N          = \l_@@_interline_all_dim,
27 interline-all     .value_required:n = true,
28 space-between      .dim_set:N          = \l_@@_space_between_dim,
29 space-between      .value_required:n = true}

```

**\CascadeOptions** The command `\CascadeOptions` is the command to set the options of the `cascade` at the document level (these options are set in a local way in the sense of the TeX groups).

```

30 \NewDocumentCommand \CascadeOptions {m}
31 {\keys_set:nn {cascade/global} {#1}}

```

**\Cascade** The command `\Cascade` is the main command of this package.

```

32 \NewDocumentCommand \Cascade {0{ } mmmm}
33 { \if_mode_math:
34   \msg_error:nn {cascade} {Cascade-in-math-mode}
35   \fi:
36   \mode_leave_vertical:
37   \group_begin:
38   \spread@equation
39   \dim_set_eq:NN \l_@@_interline_dim \l_@@_interline_all_dim
40   \keys_set:nn {cascade/command} {#1}
41   \box_clear_new:N \l_@@_box_one
42   \box_clear_new:N \l_@@_box_two
43   \box_clear_new:N \l_@@_box_three
44   \box_clear_new:N \l_@@_box_four
45   \hbox_set:Nn \l_@@_box_one {#2}
46   \hbox_set:Nn \l_@@_box_two {#3}
47   \hbox_set:Nn \l_@@_box_three {#4}
48   \hbox_set:Nn \l_@@_box_four {#5}

```

The dimension `\l_@@_top_dim` is the space that we will have to add before the main construction to make up for the “`\smash[t]`” of the box #1.

```

49   \dim_zero_new:N \l_@@_top_dim
50   \dim_set:Nn \l_@@_top_dim
51     {\dim_max:nn \c_zero_dim
52      {\box_ht:N \l_@@_box_one - \box_ht:N \l_@@_box_two}}

```

The dimension `\l_@@_bottom_dim` is the space that we will have to add after the main construction to make up for the “`\smash[b]`” of the box #3.

```

53   \dim_zero_new:N \l_@@_bottom_dim
54   \dim_set:Nn \l_@@_bottom_dim
55     {\dim_max:nn \c_zero_dim

```

```
56 {\box_dp:N \l_@@_box_three - \box_dp:N \l_@@_box_four}}
```

We do the “\smash[t]” of box #1 and the “\smash[b]” of box #3.

```
57 \box_set_ht:Nn \l_@@_box_one \c_zero_dim
58 \box_set_dp:Nn \l_@@_box_three \c_zero_dim
```

We can now construct the box.

```
59 \vbox:n
60 {\skip_vertical:N \l_@@_top_dim
61 \vbox_top:n
62 {\hbox:n
63 {\$\left.
64 \vcenter {\halign{\hfil##\cr
65 \hbox:n{\tl_if_empty:nF {#2}
66 {\box_use_drop:N \l_@@_box_one
67 \skip_horizontal:n \l_@@_space_between_dim}
68 \box_use_drop:N \l_@@_box_two \strut} \cr
69 \noalign{\skip_vertical:n \l_@@_interline_dim}
70 \hbox:n{\tl_if_empty:nF {#4}
71 {\box_use_drop:N \l_@@_box_three
72 \skip_horizontal:n \l_@@_space_between_dim}
73 \box_use_drop:N \l_@@_box_four \strut} \cr
74 }
75 }
76 \right\}}$
77 }
78 \skip_vertical:N \l_@@_bottom_dim
79 }
80 }
81 \group_end:
82 }
```

```
83 \msg_new:nnn {cascade}
84 {Cascade~in~math~mode}
85 {The~commands~\token_to_str:N \Cascade\
86 and~\token_to_str:N \ShortCascade\
87 should~be~used~in~text~mode~only.~However,~you~can~
88 go~on~for~this~time.}
```

**\ShortCascade** The command \ShortCascade is a version simplified of \Cascade with only two arguments.

```
89 \NewDocumentCommand \ShortCascade {0{}}mm}
90 {\Cascade[#1]{#2}{#3}}
```