The package \texttt{cascade}\textsuperscript{*}

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Abstract

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

1 Presentation

The package \texttt{cascade} gives a command \texttt{\textbackslash 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.

\[
\text{det}(A) = \begin{vmatrix} 3 & 4 \\ -1 & 7 \end{vmatrix} \neq 0 \quad \text{and, therefore, } A \text{ is inversible}
\]

yet \(AX = Y\) hence, \(X = A^{-1}Y\)

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

The command \texttt{\textbackslash Cascade} takes its four arguments as follow:

\[
\begin{array}{cccc}
\texttt{#1} & \texttt{#2} \\
\texttt{#3} & \texttt{#4} \\
\end{array}
\]

The commands \texttt{\textbackslash Cascade} can be nested as in the following example:

\[
\begin{array}{ccc}
(BH) \perp (AC) \\
(OC) \perp (AC) \\
(CH) \perp (AB) \\
(OB) \perp (AB) \\
\end{array}
\]

\{hence (BH) \parallel (OC)\}

\{hence (CH) \parallel (OB)\}

\{hence (OBHC) is a parallelogram\}

\textsuperscript{*}This document corresponds to the version 1.01 of \texttt{cascade}, at the date of 2018/07/12.
For the legibility of such constructions, a simplified version of \texttt{\textbackslash Cascade} is available, named \texttt{\textbackslash ShortCascade}. The code \texttt{\textbackslash ShortCascade}\{X\}\{Y\} is merely a shortcut for the code \texttt{\textbackslash Cascade}\{}\{}\{X\}\{Y\}.

The preceding example can be coded with two commands \texttt{\textbackslash ShortCascade} and an encompassing command \texttt{\textbackslash Cascade}:

\texttt{\textbackslash Cascade}\{\texttt{\textbackslash ShortCascade}\{(BH) \perp (AC)\}}\{\texttt{\textbackslash \textsl{hence}}\{(BH) \parallel (OC)\}\}
\texttt{\textbackslash ShortCascade}\{(CH) \perp (AB)\}}\{\texttt{\textsl{hence}}\{(CH) \parallel (OB)\}\}

\texttt{\textbackslash \textsl{hence}} \{(OBHC)\} is a parallelogram

2 The options

- The option \texttt{space-between} is a \texttt{TeX} dimension described on the following figure. Its default value is 0.5 em. It applies to the current command \texttt{\textbackslash Cascade} but also to the possible nested commands.

- The option \texttt{interline} can be used to \textit{increase} the “interline” showed in the following picture. The default value of \texttt{interline} is 0 pt and applies only to the current command \texttt{\textbackslash Cascade}.

- The option \texttt{interline-all} changes the default value of \texttt{interline} used by the current command \texttt{\textbackslash Cascade} and all the possible nested commands \texttt{\textbackslash Cascade}.
The options can also be given at the document level with the command \texttt{\CascadeOptions}. In this case, the scope of the declarations is the current TeX group (these declarations are “semi-global”).

3 Technical remark

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

\[
\left.\begin{aligned}
& A = \sqrt{a^2+b^2} \\
& B = \frac{ax+b}{cx+d}
\end{aligned}\right\}
\]

\[
\ShortCascade{\displaystyle A = \sqrt{a^2+b^2} \quad B = \frac{ax+b}{cx+d}}
\]

The package \texttt{cascade} constructs the braces with the classical pair \texttt{\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 \texttt{expl3}).

\[
\intstepinline:nnnn 6 1 {17} { \left.\hbox{\vrule height #1 mm}\right\}$quad}
\]
4 Implementation

\RequirePackage{l3keys2e}
\ProvidesExplPackage{cascade}{\myfiledate}{\myfileversion}{Easy presentation of demonstrations in cascades}
\RequirePackage{xparse}

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).

\cs_if_free:NT \spread@equation {
\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.

\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.

\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.

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

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

\keys_define:nn {cascade/command}

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

\dim_set:N = \l_@@_interline_dim,
\value_required:n = true ,

The option interline-all will change the value of interline for all the commands \Cascade, even the nested commands.
interline-all .code:n = { \dim_set:Nn \l_@@_interline_all_dim {#1} \dim_set:Nn \l_@@_interline_dim {#1} },
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.

space-between .dim_set:N = \l_@@_space_between_dim,
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).

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

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

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

\NewDocumentCommand \Cascade {O{} mmmm}
{\if_mode_math:
 \msg_error:nn {cascade} {Cascade~in~math~mode}
 \fi:
 \mode_leave_vertical:
 \group_begin:
 \spread@equation
 \dim_set_eq:NN \l_@@_interline_dim \l_@@_interline_all_dim
 \keys_set:nn {cascade/command} {#1}
 \box_clear_new:N \l_@@_box_one
 \box_clear_new:N \l_@@_box_two
 \box_clear_new:N \l_@@_box_three
 \box_clear_new:N \l_@@_box_four
 \bbox_set:Nn \l_@@_box_one {#2}
 \bbox_set:Nn \l_@@_box_two {#3}
 \bbox_set:Nn \l_@@_box_three {#4}
 \bbox_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.

\dim_zero_new:N \l_@@_top_dim
\dim_set:Nn \l_@@_top_dim
{\dim_max:nn \c_zero_dim
 {\bbox_ht:N \l_@@_box_one - \bbox_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.

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

We do the \texttt{\textbackslash smash[t]} of box #1 and the \texttt{\textbackslash smash[b]} of box #3.

\begin{verbatim}
\box_set_ht:Nn \l_@@_box_one \c_zero_dim
\box_set_dp:Nn \l_@@_box_three \c_zero_dim
\end{verbatim}

We can now construct the box.

\begin{verbatim}
vbox:n
{\skip_vertical:N \l_@@_top_dim
 \vbox_top:n
 \hbox:n
 \vcenter {
  \halign{\hfil##}{
    \tl_if_empty:nF {#2}{\box_use_drop:N \l_@@_box_one \\}
    \skip_horizontal:n \l_@@_space_between_dim
    \box_use_drop:N \l_@@_box_two \strut} \\
    \noalign{\skip_vertical:n \l_@@_interline_dim}
    \hbox:n{\tl_if_empty:nF {#4}{\box_use_drop:N \l_@@_box_three \\}
    \skip_horizontal:n \l_@@_space_between_dim
    \box_use_drop:N \l_@@_box_four \strut} \\
  }
  \right} \\
  \left}\$
}
\skip_vertical:N \l_@@_bottom_dim

\group_end:
\end{verbatim}

\texttt{\textbackslash msg_new:nnn \{cascade\}}
\texttt{\textbackslash \{\textbackslash cascade\}}
\texttt{\textbackslash \{\textbackslash \shortcascade\}}

\shortcascade The command \texttt{\shortcascade} is a version simplified of \texttt{\cascade} with only two arguments.

\begin{verbatim}
\NewDocumentCommand \shortcascade {O{}mm}{\cascade[#1]{#2}{#3}}
\end{verbatim}