Typesetting Inference Rules

and other MATH formulas in PARragraph mode

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Abstract

This package provides macros for displaying lists of formulas that are typeset in mixed horizontal and vertical modes. The package is two-folded.

The first part is an environment `mathpar` that generalizes the math display mode to allow several formulas on the same line, and several lines in the same display. The arrangement of the sequence of formulas into lines is automatic depending on the line width and on a minimum inter-formula space and line width alike words in a paragraphs (in centerline mode). A typical application is displaying a set of type inference rules.

The second par is a macro `inferrule` to typeset inference rules themselves. Here again, both premises and conclusions are presented as list of formulas that should be displayed in almost the same way, except that the width is not fixed in advance; and the inference rule should use no more width than necessary so that other inference rules are given a chance to appear on the same line.

Although `mathpar` and `inferrule` look similar in their specification, and are often used in combination, they are in fact completely different in their implementations.

1 The mathpar environment

The mathpar environment is a "paragraph mode for formulas". It allows to typeset long list of formulas putting as many as possible on the same line:

```
\begin{mathpar}
A-Formula \and
Longer-Formula \and
And \and The-Last-One
\end{mathpar}
```

$$A-Formula \qquad Longer-Formula$$

$$And \qquad The-Last-One$$

Formulas are separated by `\and` (or equivalently by a blank line). To enforce a vertical break it sufficies to replace `\and` by `\\`.

The implementation of `mathpar` entirely relies on the paragraph mode for text. It starts a new paragraph, and a math formula within a paragraph, after adjusting the spacing and penalties for breaks. Then, it simply binds `\and` to something like `\goodbreak`.

2 The inferrule macro

The inferrule macro is designed to typeset inference rules. It should only[1] be used in math mode (or display math mode).

The basic use of the rule is

```
\inferrule
  {one \\ two \\ three \\ or \\ more \\ premisses}
  {and \\ any \\ number \\ of \\ conclusions \\ as \\ well}
```

This is the rendering on a large page

$$\frac{one \qquad two \qquad three \qquad or \qquad more \qquad premisses}{and \qquad any \qquad number \qquad of \qquad conclusions \qquad as \qquad well}$$

However, the same formula on a narrower page will automatically be typsetted like that:

$$\frac{\begin{array}{c} one \\ two \qquad three \qquad or \\ more \qquad premisses \end{array}}{\begin{array}{c} and \qquad any \qquad number \\ of \qquad conclusions \\ as \qquad well \end{array}}$$

An inference rule is mainly composed of a premisse and a conclusion. The premisse and the conclusions are both list of formulas where the elements are separated by `\\`.

Note the dissymetry between typesetting of the premisses and of conclusions where lines closer to the center are fit first.

A newline can be forced by adding an empty line `\\\\`

```
\inferrule
  {aa \\\\ bb}
  {dd \\ ee \\ ff}
```

$$\frac{\begin{array}{c} aa \\ bb \end{array}}{dd \qquad ee \qquad ff}$$

[1]Even though the basic version may work in text mode, we discourage its use in text mode; the star-version cannot be used in text-mode

2.1 Single rules

Single rules are the default mode. This are aligned on their fraction bar, as illustrated below:

$$\frac{aa \qquad bb}{ee} \qquad\qquad \frac{\begin{array}{c} aa \\ bb \qquad ee \end{array}}{ee}$$

A first optional argument is a label that will be typeset on the top left corner of the rule (see section 3 for changing typesetting of labels).

```
\inferrule [yop]
   {aa \\ bb}
   {cc}
```

$$\begin{array}{l} \textsc{Yop} \\ \dfrac{aa \qquad bb}{cc} \end{array}$$

If the premise or the conclusion is empty, then the fraction bar is not typeset and the premise or the conclusion is centered:

```
\inferrule {}{aa} +
\inferrule {aa \\\\ aa}{}
```

$$aa + \begin{array}{c} aa \\ aa \end{array}$$

Use use `{ }` instead of `{}` to get an axiom for instance:

```
\inferrule { }{aa} +
\inferrule {aa}{ }
```

$$\frac{}{aa} + \frac{aa}{}$$

2.2 Customizing

By default, lines are centerred in inference rules. However, this can be changed by either `\mprset{flushleft}` or `\mprset{center}`. For instance,

```
$$\mprset{flushleft}
  \inferrule
    {a \\ bbb \\\\ ccc \\ dd}
    {dd \\ ee \\ ff}$$
```

$$\frac{\begin{array}{l} a \qquad bb \\ ccc \qquad dddd \end{array}}{\begin{array}{l} e \qquad ff \\ gg \end{array}}$$

Note that lines are aligned independently in the premisse and the conclusion, which are both themselves centered. In particular, left alignment will not affect a single-line premisse or conclusion.

2.3 Derivation trees

To help writing cascades of rules forming a derivation, inference rules can also be aligned on their bottom line. For this, we use the star-version:

```
\inferrule*
   {\inferrule* {aa \\ bb}{cc}
    \\ dd}
   {ee}
```

$$\dfrac{\dfrac{aa \quad bb}{cc} \qquad dd}{ee}$$

In the star-version, the optional argument is richer, and uses the `keyval` package with the following options

key	**Effect for value** v
`before`	Execute v before typesetting the rule. Useful for instance to change the maximal width of the rule.
`width`	Set the width of the rule to v
`narrower`	Set the width of the rule to v times `\hsize`.
`left`	Put a label v on the left of the rule
`Left`	Idem, but as if the label had zero width.
`Right`	As `Left`, but on the right of the rule.
`right`	As `left`, but on the right of the rule.
`leftskip`	Cheat by (skip negative space) v on the left side.
`rightskip`	Cheat by v on the right side of the rule.
`vdots`	Raise the rule by v and insert vertical dots.

Here is an example of a complex derivation:

$$\textsc{Total}\;\dfrac{\textsc{Foo}\;\dfrac{\begin{array}{c}\dfrac{bb \quad \begin{array}{c}a \quad a\\ cc\end{array} \quad dd}{ee}\;\textsc{Bar}\\ \vdots\end{array} \quad ff \quad gg}{hh} \qquad \dfrac{\begin{array}{c}\mathrm{XX}\\ uu \quad vv\end{array}}{ww}}{(1)}$$

and its code

```
\inferrule* [left=Total]
  {\inferrule* [Left=Foo]
     {\inferrule* [Right=Bar,
                    leftskip=2em,rightskip=2em,vdots=1.5em]
```

```
        {a \\ a \\\\ bb \\ cc \\ dd}
        {ee}
      \\ ff \\ gg}
    {hh}
\\
\inferrule* [lab=XX]{uu \\ vv}{ww}}
{(1)}
```

2.4 Implementation

The main macro in the implementation of inference rules is the one that either premises and conclusions. The macros uses two box-registers one `hbox` for typesetting each line and one `vbox` for collecting lines. The premise appears as a list with `\\` as separator. Each element is considered in turn typeset in a `hbox` in display math mode. Its width is compare to the space left on the current line. If the box would not fit, the current horizontal line is transferred to the vertical box and emptied. Then, the current formula can safely be added to the horizontal line (if it does not fit, nothing can be done). When moved to the vertical list, lines are aligned on their center (as if their left-part was a left overlapped). At the end the vbox is readjusted on the right.

This description works for conclusions. For premises, the elements must be processes in reverse order and the vertical list is simply built upside down.

3 Other Options

The package also defines `\infer` as a shortcut for `\inferrule` but only if it is not previously defined.

The package uses `\TirName` and `RefTirName` to typeset labels, which can safely be redefined by the user. The former is used for defining occurrences (*ie.* in rule `\inferrule`) while the latter is used for referencing (*ie.* in the star-version).

The vertical space in `mathpar` is adjusted by `\MathparLineskip`. To restore the normal paragraph parameters in mathpar mode (for instance for some inner paragraph), use the command `\MathparNormalpar`. The environment uses `\MathparBindings` to rebind `\\`, `and`, and `\par`. You can redefine thus command to change the default bindings or add your own.

4 Examples

See the source of this documentation —the file `mathpartir.tex`— for full examples.

5 HEVEA compatibility

The package also redefines `\hva` to do noting in both mathpar environment and in inference rules.

In HeVeA, `\and` will always produce a vertical break in mathpar environment; to obtain a horizontal break, use `\hva \and` instead. Conversely, `\\` will always produce a horizontal break in type inference rules; to obtain a vertical break, use `\hva \\` instead.

For instance, by default the following code,

```
\begin{mathpar}
\inferrule* [Left=Foo]
  {\inferrule* [Right=Bar,width=8em,
               leftskip=2em,rightskip=2em,vdots=1.5em]
     {a \\ a \\ bb \\ cc \\ dd}
     {ee}
   \\ ff \\ gg}
  {hh}
\and
\inferrule* [lab=XX]{uu \\ vv}{ww}
\end{mathpar}
```

which typesets in TEX as follows,

$$\textsc{Foo}\ \dfrac{\begin{array}{c}\dfrac{\begin{array}{c} a \quad a \\ bb \quad cc \quad dd\end{array}}{ee}\ \textsc{Bar} \\ \vdots\end{array} \quad ff \quad gg}{hh} \qquad\qquad \begin{array}{l}\mathrm{XX}\\ \dfrac{uu \quad vv}{ww}\end{array}$$

would appear as follows with the compatible HEVEA mode:

$$\textsc{Foo}\ \dfrac{\dfrac{a \quad a \quad bb \quad cc \quad dd}{ee}\ \textsc{Bar} \quad ff \quad gg}{hh}$$

$$\begin{array}{l}\mathrm{XX}\\ \dfrac{uu \quad vv}{ww}\end{array}$$

To obtain (almost) the same rendering as in TEX, it could be typed as

```
\begin{mathpar}
\inferrule* [Left=Foo]
  {\inferrule* [Right=Bar,width=8em,
               leftskip=2em,rightskip=2em,vdots=1.5em]
     {a \\ a \hva \\ bb \\ cc \\ dd}
```

```
      {ee}
    \\ ff \\ gg}
   {hh}
\hva \and
\inferrule* [lab=XX]{uu \\ vv}{ww}
\end{mathpar}
```

Actually, it would be typeset and follows with the compatible HEVEA mode:

$$\textsc{Foo}\ \dfrac{\dfrac{bb \qquad \overset{a \qquad a}{cc} \qquad dd}{ee}\ \textsc{Bar} \qquad\qquad ff \qquad gg}{hh} \qquad\qquad \overset{\text{XX}}{\dfrac{uu \qquad vv}{ww}}$$