The bussproofs-extra package*

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1 Introduction

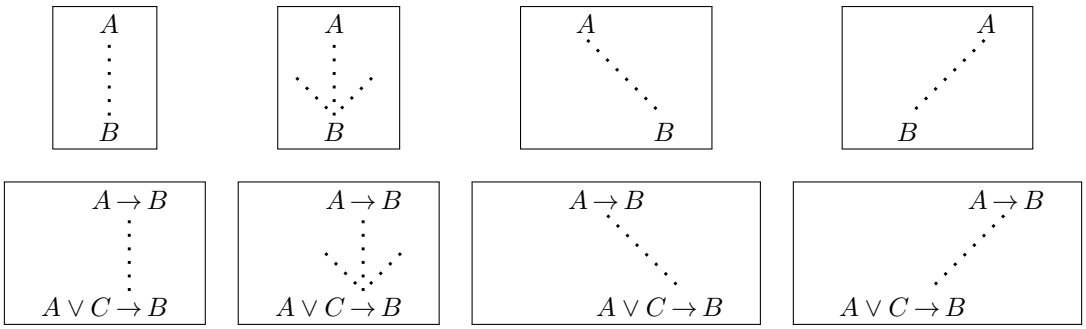
The bussproofs-extra package provides additional functionality for the proof tree typesetting package bussproofs by Sam Buss. It is experimental and tested only with v.1.1, and only in LaTeX mode with upward-growing trees. Functionality provided includes:

1. `\Deduce$` and `\DeduceC` commands, which work much like `\Infer` commands but indicate missing parts of a proof.
2. Multiple styles for typesetting the result of `\Deduce`, including
   (a) `\straightDeduce`, which produces vertical dots
   (b) `\branchDeduce`, which produces diagonal plus vertical dots
   (c) `\ddotsDeduce`, which produces diagonal dots from top left to bottom right
   (d) `\dotsdDeduce`, which produces diagonal dots from top right to bottom left
   (e) `\shortDeduce`, which is like `\straightDeduce` but half the length

   `\straightDeduce` is the default. It can be changed by redefining `\alwaysDeduce`.
3. `\LeftLineLabel` and `\RightLineLabel` commands which work like `\LeftLabel` and `\RightLabel` but place a label next to the conclusion of an inference/deduction instead of the score line.
4. `\LeftSubproofLabel` and `\RightSubproofLabel` commands which work like `\LeftLabel` and `\RightLabel` but place a label next to the entire preceding subproof with a curly brace.

Here's what these deductions look like:

*This document corresponds to bussproofs-extra 0.4, dated 2019/05/31.



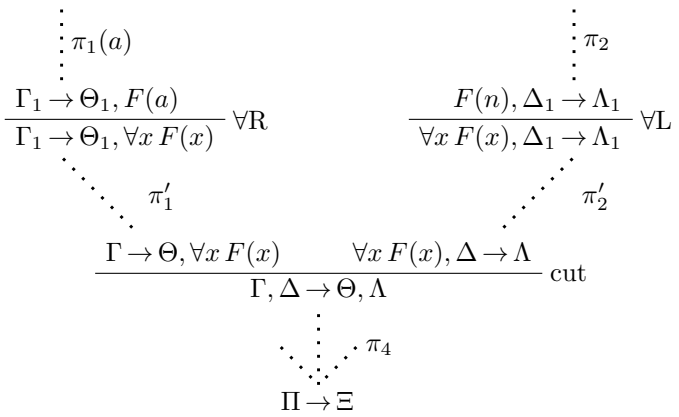
`straightDeduce` `branchDeduce` `ddotsDeduce` `dotsdDeduce`

The most up-to-date version of this package is available at the Open Logic Project github site, where you can file bug reports as well.

1.1 Example

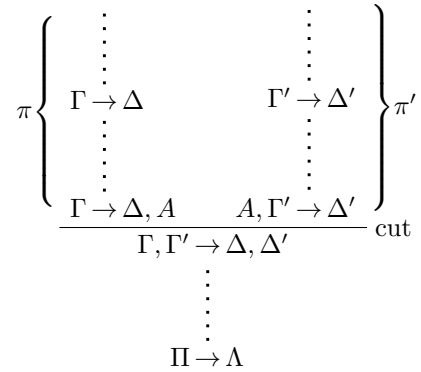
```
\begin{prooftree}
\AxiomC{}
\RightLabel{$\pi_1(a)$}
\Deduce$\Gamma_1 \fCenter \Theta_1, F(a)$
\RightLabel{$\forall$R}
\UnaryInf$\Gamma_1 \fCenter \Theta_1, \forall x\,F(x)$
\ddotsDeduce
\RightLabel{$\pi_1'$}
\Deduce$\Gamma \fCenter \Theta, \forall x\,F(x)$
\AxiomC{}
\RightLabel{$\pi_2$}
\Deduce$F(n), \Delta_1 \fCenter \Lambda_1$
\RightLabel{$\forall$L}
\UnaryInf$\forall x\,F(x), \Delta_1 \fCenter \Lambda_1$
\dotsdDeduce
\RightLabel{$\pi_2'$}
\Deduce$\forall x\,F(x), \Delta \fCenter \Lambda$
\RightLabel{cut}
\BinaryInf$\Gamma, \Delta \fCenter \Theta, \Lambda$
\RightLabel{$\pi_4$}
\branchDeduce
\Deduce$\Pi \fCenter \Xi$
\end{prooftree}
```

produces this:

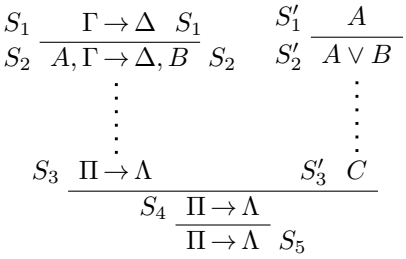


It is also possible to label entire subproofs on the left and on the right.

```
\begin{prooftree}
\AxiomC{}
\Deduce$\Gamma \fCenter \Delta$
\LeftLineLabel{$S_1$}
\Deduce$\Gamma \fCenter \Delta, A$
\LeftSubproofLabel{$\pi$}
\AxiomC{}
\Deduce$\Gamma' \fCenter \Delta'$
\LeftLineLabel{$S_2$}
\Deduce$A, \Gamma' \fCenter \Delta'$
\RightSubproofLabel{$\pi'$}
\RightLabel{cut}
\LeftLineLabel{$S_3$}
\BinaryInf$\Gamma, \Gamma' \fCenter \Delta, \Delta'$
\Deduce$\Pi \fCenter \Lambda$
\end{prooftree}
```



The `\LeftLineLabel` and `\RightLineLabel` commands add labels to the sequent or formula produced by the following `\Axiom`, `\XxxxInf`, and `\Deduce` command.



If the sequent or formula is itself a premise of an `\XxxInf` command and the conclusion is longer, this may produce a less than optimal result, as the label is produced before the score line below (compare the left and right labels of the top left sequent above). In that case you may want to insert extra space using `\phantom`, or use `\makebox` and the `\widthof` command of the `calc` package for the `XxxC` variants of the commands (see the top right formula below) as in the `\Axiom` commands below.

```
\begin{prooftree}
   \LeftLineLabel{$S_1$}
   \RightLineLabel{$S_1$}
   \Axiom$\phantom{A, {}}\Gamma \fCenter \Delta$
   \LeftLineLabel{$S_2$}
   \RightLineLabel{$S_2$}
   \UnaryInf$A, \Gamma \fCenter \Delta, B$
   \LeftLineLabel{$S_3$}
   \Deduce$\Pi \fCenter \Lambda$
   \LeftLineLabel{$S_1'$}
   \AxiomC{\makebox[\widthof{$A \lor B$}][c]{$A$}}
   \LeftLineLabel{$S_2'$}
   \UnaryInfC{$A \lor B$}
   \LeftLineLabel{$S_3'$}
   \DeduceC{$C$}
   \LeftLineLabel{$S_4$}
   \BinaryInf$\Pi \fCenter \Lambda$
   \RightLineLabel{$S_5$}
   \UnaryInf$\Pi \fCenter \Lambda$
\end{prooftree}
```

2 Implementation

2.1 Setup

We require bussproofs (obviously) and and tikz for drawing things.

```
1 \RequirePackage{bussproofs}
2 \RequirePackage{tikz}
```

2.2 Dimensions and boxes

bussproofs aligns sequents at the right end of the sequent arrow, so we need to remember by how much to correct to get deductions to the middle of sequents. For `\ddotsDeduce` and `\dotsdDeduce` (diagonal) styles, the upper and lower sequents will be displaced.

```
\newdimen\CenterCorrection
\newdimen\DiagCorrection
```

We need two boxes to hold the left and right line labels.

```
\newbox\myBoxLLL
\newbox\myBoxRLL
```

2.3 Deduce Styles

The following commands set the style for the next `\Deduce` command. `\straightDeduce` produces a simple vertical line of dots, and `\shortDeduce` a line of half that length. `\branchDeduce` produces centered branching (Takeuti/Gentzen-style) dots, `\ddotsDeduce` left-to-right diagonal dots, and `\dotsdDeduce` right-to-left diagonal dots. They do this by redefining the `\fDeduce` command which produces the dots and sets up the dimensions. The TikZ style `deduceLine` is used as argument to the `\draw` command and can be redefined for other line styles as well (e.g., smaller dots or closer spacing).

```
\tikzset{
    deduceLine/.style = {line width=1.1pt, loosely dotted}}

\def\straightDeduce{%
  \gdef\fDeduce{\tikz\draw[deduceLine] (0,0) -- (0,1);}
  \global\DiagCorrection=0pt
  \ignorespaces
}

\def\shortDeduce{%
  \gdef\fDeduce{\tikz\draw[deduceLine] (0,0) -- (0,.5);}
  \global\DiagCorrection=0pt
  \ignorespaces
}

\def\branchDeduce{%
  \gdef\fDeduce{\begin{tikzpicture}
      \draw[deduceLine] (0,0) -- (0,1);
      \draw[deduceLine] (-.5,.5) -- (0,0);
      \draw[deduceLine] (.5,.5) -- (0,0);
  \end{tikzpicture}}
  \global\DiagCorrection=0pt
  \ignorespaces
}

\def\ddotsDeduce{%
```

```
  \gdef\fDeduce{\begin{tikzpicture}
      \draw[deduceLine] (0,1) -- (1,0);
  \end{tikzpicture}}
  \setbox\myBoxA=\hbox{\fDeduce}
  \global\DiagCorrection=-\wd\myBoxA
  \ignorespaces
}

\def\dotsdDeduce{%
  \gdef\fDeduce{\begin{tikzpicture}
      \draw[deduceLine] (1,1) -- (0,0);
  \end{tikzpicture}}
  \setbox\myBoxA=\hbox{\fDeduce}
  \global\DiagCorrection=\wd\myBoxA
  \ignorespaces
}
```

The `\alwaysDeduce` command is used to (re)set the deduce style to a default and is executed every time a deduction is typeset. It can be redefined to change the default deduce style.

```
\def\alwaysDeduce{\straightDeduce}
\straightDeduce
```

2.4 `\Deduce$` and `\DeduceC`

`\Deduce$` and `\DeduceC` are the commands to actually produce the deductions. They are used and work just like `\UnaryInf$` and `\UnaryInfC`.

```
\def\Deduce$#1\fCenter#2$${%
    \prepUnary%
    \buildConclusion{#1}{#2}%
    \setbox\myBoxA=\hbox{\fCenter}%
    \global\CenterCorrection=-.5\wd\myBoxA
    \joinDeduce%
    \resetInferenceDefaults%
    \ignorespaces%
}

\def\DeduceC#1{
    \prepUnary%
    \buildConclusionC{#1}%
    \global\CenterCorrection=0pt
    \joinDeduce%
    \resetInferenceDefaults%
    \ignorespaces%
}
```

3 Typesetting the Deduction

`\joinDeduce` aligns and joins `\curBox` and `\myBoxC` into a single `vbox`. `\curBox` holds the upper proof, `\curScoreStart` is distance to where the line below the premise would start, `\curScoreCenter` is distance from left edge of score to the alignment point, and `\curScoreEnd` is width of the score line.

```
\def\joinDeduce{%
    \global\advance\curCenter by -\hypKernAmt%
```

If center of premise is left of center of conclusion move upper box to right by difference, else move lower box right by difference

```
    \ifnum\curCenter<\newCenter%
        \displace=\newCenter%
        \advance \displace by -\curCenter%
        \kernUpperBox%
    \else%
        \displace=\curCenter%
        \advance \displace by -\newCenter%
        \kernLowerBox%
    \fi%
```

For `\ddotsDeduce`, move lower box right; for `\dotsdDeduce`, move upper box right; then set `\curCenter` to align with horizontal center of dots.

```
    \ifnum\DiagCorrection<0%
        \displace=-\DiagCorrection
        \kernLowerBox%
    \else
        \displace=\DiagCorrection
        \kernUpperBox%
    \fi%
    \advance\curCenter by-.5\DiagCorrection
```

Now we draw the deduction.

```
    \buildDeduce%
```

Put the deduction and labels into a box.

```
    \buildScoreLabels%
```

Put everything into a new box and compute the dimensions for the next `\Deduce` or `\XxxxInf`.

```
    \ifx\rootAtBottomFlag\myTrue%
        \buildRootBottom%
    \else%
        \buildRootTop%
    \fi%
    \global \curScoreStart=\newScoreStart%
    \global \curScoreEnd=\newScoreEnd%
    \global \curCenter=\newCenter%
}
```

`\buildDeduce` does for `\DeduceX` what `\buildInf` does for `\XxxInf`: put the deduction bit (dots) into a box and set the dimensions properly.

```
\def\buildDeduce{%
    \global\setbox \myBoxD =%
        \hbox{\fDeduce}%
    \displace = \wd\myBoxD % find width of vdots
```

set start and end of current score to left and right of the box holding the deduction.

```
    \global\curScoreStart = \curCenter%
    \global\advance\curScoreStart by -.5\displace%
    \global\curScoreEnd = \curCenter%
    \global\advance\curScoreEnd by .5\displace%
    \global\advance\curScoreStart by\CenterCorrection
    \global\advance\curScoreEnd by\CenterCorrection
}
```

3.1 Line Labels

`\LeftLineLabel` and `\RightLineLabel` set the label to place to the left or right, respectively, of the conclusion of the next `\Axiom`, `\XxxInf` or `\Deduce` command. They are aligned with the text produced by `\LeftLabel` and `\RightLabel` (i.e., the distance to the line is `\ScoreOverhang` + `\labelSpacing`.

```
\def\LeftLineLabel#1{%
  \global\def\displayLeftLineLabel{%
    {#1\hskip\labelSpacing}}
  \ignorespaces}

\def\RightLineLabel#1{%
  \global\def\displayRightLineLabel{%
    {\hskip\labelSpacing #1}}
  \ignorespaces}

\global\let\displayLeftLineLabel\relax
\global\let\displayRightLineLabel\relax
```

3.2 Subproof Labels

Sometimes you'd like to lable entire subproofs. This is done with commands `\LeftSubproofLabel` and `\RightSubproofLabel`.

```
\def\LeftSubproofLabel#1{%
  \global\setbox\curBox =
  \hbox{\vbox to \ht\curBox{%
      \vfil
      \llap{#1$\left\{\vrule height .5\ht\curBox width 0pt\right.$}%
      \vfil}\box\curBox}%
```

```
}

\def\RightSubproofLabel#1{%
  \displace=\ht\curBox
  \global\setbox\curBox =
  \hbox{\box\curBox\vbox to \displace{%
      \vfil
      \rlap{$\left.\vrule height .5\displace width 0pt\right\}$#1}%
      \vfil}}%
}
```

3.3 Patched commands from **bussproofs**

Some commands from bussproofs.sty have to be redefined to include `bussproofs-extra` functionality. Added/changed lines are indicated by a `%bpextra` comment

```
\def\resetInferenceDefaults{%
    \global\def\theHypSeparation{\defaultHypSeparation}%
    \global\setbox\myBoxLL=\hbox{\defaultLeftLabel}%
    \global\setbox\myBoxRL=\hbox{\defaultRightLabel}%
    \global\def\buildScore{\alwaysBuildScore}%
    \global\def\theScoreFiller{\alwaysScoreFiller}%
    % reset line labels to nothing %bpextra
    \global\let\displayLeftLineLabel\relax %bpextra
    \global\let\displayRightLineLabel\relax %bpextra
    % reset to defaul deduce style %bpextra
    \alwaysDeduce %bpextra
    \gdef\hypKernAmt{0pt}% Restore to zero kerning.
}

\def\Axiom$#1\fCenter#2${%
    % Get level and correct names set.
    \prepAxiom%
    % Define the boxes
    % bpextra -- add line labels
    \setbox\myBoxA=\hbox{$\mathord{#1}\fCenter\mathord{\relax}$}%
    \setbox\myBoxB=\hbox{$#2$}% %bpextra
    \setbox\myBoxLLL=\hbox{\displayLeftLineLabel}% %bpextra
    \setbox\myBoxRLL=\hbox{\displayRightLineLabel}% %bpextra
    \global\setbox\curBox=%
         \hbox{\unhcopy\myBoxLLL%bpextra
         \hskip\ScoreOverhangLeft\relax
         \unhcopy\myBoxA
         \unhcopy\myBoxB
         \hskip\ScoreOverhangRight
         \unhcopy\myBoxRLL}%bpextra
    % Set the relevant dimensions for the boxes
    \global\curScoreStart=0pt \relax
    \global\curScoreEnd=\wd\curBox \relax
    \global\curCenter=\wd\myBoxA \relax %bpextra
```

```
    \global\advance \curCenter by \ScoreOverhangLeft%
    % bpextra adjust by dimensions of labels
    \global\advance \curCenter by \wd\myBoxLLL%bpextra
    \global\advance\curScoreStart by \wd\myBoxLLL%bpextra
    \global\advance\curScoreEnd by -\wd\myBoxRLL%bpextra
    % reset line labels to nothing %bpextra
    \global\let\displayLeftLineLabel\relax %bpextra
    \global\let\displayRightLineLabel\relax %bpextra
    \ignorespaces
}

\def\AxiomC#1{      % Note argument not in math mode
    % Get level and correct names set.
    \prepAxiom%
        % Define the box.
    \setbox\myBoxA=\hbox{#1}%
    \setbox\myBoxLLL=\hbox{\displayLeftLineLabel}% %bpextra
    \setbox\myBoxRLL=\hbox{\displayRightLineLabel}% %bpextra
    \global\setbox\curBox =%
        \hbox{\unhcopy\myBoxLLL%bpextra
            \hskip\ScoreOverhangLeft\relax%
            \unhcopy\myBoxA
            \hskip\ScoreOverhangRight\relax
            \unhcopy\myBoxRLL}% %bpextra
    % Set the relevant dimensions for the boxes
        \global\curScoreStart=0pt \relax
        \global\curScoreEnd=\wd\curBox \relax
        \global\curCenter=.5\wd\myBoxA \relax %bpextra
        \global\advance \curCenter by \ScoreOverhangLeft%
    % bpextra adjust by dimensions of labels
    \global\advance \curCenter by \wd\myBoxLLL%bpextra
    \global\advance\curScoreStart by \wd\myBoxLLL%bpextra
    \global\advance\curScoreEnd by -\wd\myBoxRLL%bpextra
    % reset line labels to nothing %bpextra
    \global\let\displayLeftLineLabel\relax %bpextra
    \global\let\displayRightLineLabel\relax %bpextra
    \ignorespaces
}

\def\buildConclusion#1#2{% Build lower sequent w/ center at \fCenter position.
    % Define the boxes
        \setbox\myBoxA=\hbox{$\mathord{#1}\fCenter\mathord{\relax}$}%
        \setbox\myBoxB=\hbox{$#2$}%
        \setbox\myBoxLLL=\hbox{\displayLeftLineLabel}% %bpextra
        \setbox\myBoxRLL=\hbox{\displayRightLineLabel}% %bpextra
    % Put them together in \myBoxC
    \setbox\myBoxC =%
          \hbox{\unhcopy\myBoxLLL%bpextra
          \hskip\ScoreOverhangLeft\relax%
        \unhcopy\myBoxA\unhcopy\myBoxB
```

```
        \hskip\ScoreOverhangRight
        \unhcopy\myBoxRLL}% %bpextra
    % Calculate the center of the \myBoxC string.
    \newScoreStart=0pt \relax%
    \newCenter=\wd\myBoxA \relax%
    \advance \newCenter by \ScoreOverhangLeft%
    \newScoreEnd=\wd\myBoxC%
    % bpextra adjust by dimensions of labels
    \global\advance\newCenter by \wd\myBoxLLL%bpextra
    \global\advance\newScoreStart by \wd\myBoxLLL%bpextra
    \global\advance\newScoreEnd by -\wd\myBoxRLL%bpextra
    % reset line labels to nothing %bpextra
    \global\let\displayLeftLineLabel\relax %bpextra
    \global\let\displayRightLineLabel\relax %bpextra
}

\def\buildConclusionC#1{% Build lower sequent w/o \fCenter present.
        % Define the box.
    \setbox\myBoxA=\hbox{#1}%
    \setbox\myBoxLLL=\hbox{\displayLeftLineLabel}% %bpextra
    \setbox\myBoxRLL=\hbox{\displayRightLineLabel}% %bpextra
\setbox\myBoxC =%
        \hbox{\unhcopy\myBoxLLL%bpextra
            \hskip\ScoreOverhangLeft\relax%
            \unhcopy\myBoxA
            \hskip\ScoreOverhangRight
            \unhcopy\myBoxRLL}%bpextra
    % Calculate kerning to line up centers
    \newScoreStart=0pt \relax%
    \newCenter=.5\wd\myBoxA \relax% bpextra
    \newScoreEnd=\wd\myBoxC%
        \advance \newCenter by \ScoreOverhangLeft%
    % bpextra adjust by dimensions of labels
    \global\advance\newCenter by \wd\myBoxLLL%bpextra
    \global\advance\newScoreStart by \wd\myBoxLLL%bpextra
    \global\advance\newScoreEnd by -\wd\myBoxRLL%bpextra
    % reset line labels to nothing %bpextra
    \global\let\displayLeftLineLabel\relax %bpextra
    \global\let\displayRightLineLabel\relax %bpextra
}
```

Change History

v0.4

General: Better implementation of line labels; add shortDeduce; style deduce lines 1