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:
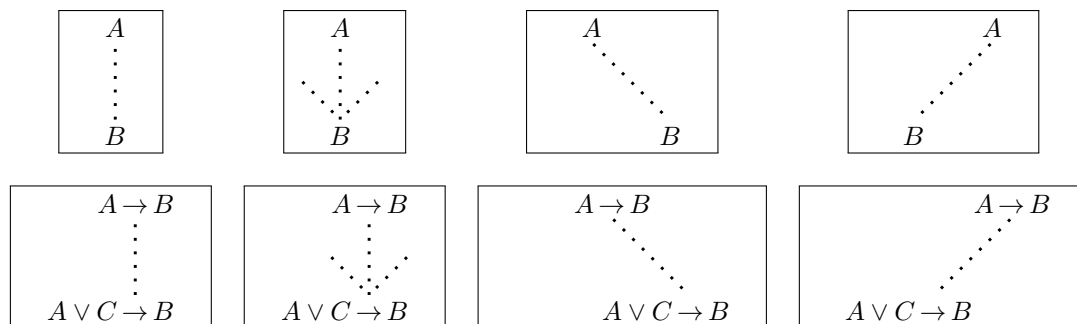
1. `\Deduce$` and `\DeduceC` commands, which work much like `\Infer` commands but indicate missing parts of a proof.

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:

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[*]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:

$$
\begin{array}{cc}
\begin{array}{c}
\vdots\;\pi_1(a)\\[2pt]
\dfrac{\Gamma_1 \to \Theta_1, F(a)}{\Gamma_1 \to \Theta_1, \forall x\,F(x)}\;\forall\mathrm{R}\\[4pt]
\vdots\;\pi_1'
\end{array}
&
\begin{array}{c}
\vdots\;\pi_2\\[2pt]
\dfrac{F(n), \Delta_1 \to \Lambda_1}{\forall x\,F(x), \Delta_1 \to \Lambda_1}\;\forall\mathrm{L}\\[4pt]
\vdots\;\pi_2'
\end{array}
\end{array}
$$

$$
\dfrac{\Gamma \to \Theta, \forall x\,F(x) \qquad \forall x\,F(x), \Delta \to \Lambda}{\Gamma, \Delta \to \Theta, \Lambda}\;\text{cut}
$$

$$
\vdots\;\pi_4
$$

$$
\Pi \to \Xi
$$

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}
```

$$
\pi\left\{
\begin{array}{cc}
\vdots & \vdots\\
\Gamma \to \Delta & \Gamma' \to \Delta'\\
\vdots & \vdots\\
\end{array}
\right\}\pi'
$$

$$
\dfrac{\Gamma \to \Delta, A \qquad A, \Gamma' \to \Delta'}{\Gamma, \Gamma' \to \Delta, \Delta'}\;\text{cut}
$$

$$
\vdots
$$

$$
\Pi \to \Lambda
$$

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

$$
\cfrac{
  \cfrac{
    \cfrac{
      \begin{array}{c} S_1 \\ S_2 \end{array}\ \cfrac{\Gamma \to \Delta}{A, \Gamma \to \Delta, B}\ \begin{array}{c} S_1 \\ S_2 \end{array}
    }{\vdots}
  }{S_3\ \ \Pi \to \Lambda}
  \qquad
  \cfrac{
    \cfrac{
      \begin{array}{c} S_1' \\ S_2' \end{array}\ \cfrac{A}{A \vee B}
    }{\vdots}
  }{S_3'\ \ C}
}{S_4\ \ \cfrac{\Pi \to \Lambda}{\Pi \to \Lambda}\ S_5}
$$

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.

```
3 \newdimen\CenterCorrection
4 \newdimen\DiagCorrection
```

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

```
5 \newbox\myBoxLLL
6 \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).

```
 7 \tikzset{
 8     deduceLine/.style = {line width=1.1pt, loosely dotted}}
 9
10 \def\straightDeduce{%
11   \gdef\fDeduce{\tikz\draw[deduceLine] (0,0) -- (0,1);}
12   \global\DiagCorrection=0pt
13   \ignorespaces
14 }
15
16 \def\shortDeduce{%
17   \gdef\fDeduce{\tikz\draw[deduceLine] (0,0) -- (0,.5);}
18   \global\DiagCorrection=0pt
19   \ignorespaces
20 }
21
22 \def\branchDeduce{%
23   \gdef\fDeduce{\begin{tikzpicture}
24       \draw[deduceLine] (0,0) -- (0,1);
25       \draw[deduceLine] (-.5,.5) -- (0,0);
26       \draw[deduceLine] (.5,.5) -- (0,0);
27   \end{tikzpicture}}
28   \global\DiagCorrection=0pt
29   \ignorespaces
30 }
31
32 \def\ddotsDeduce{%
```

```
33  \gdef\fDeduce{\begin{tikzpicture}
34      \draw[deduceLine] (0,1) -- (1,0);
35  \end{tikzpicture}}
36  \setbox\myBoxA=\hbox{\fDeduce}
37  \global\DiagCorrection=-\wd\myBoxA
38  \ignorespaces
39 }
40
41 \def\dotsdDeduce{%
42  \gdef\fDeduce{\begin{tikzpicture}
43      \draw[deduceLine] (1,1) -- (0,0);
44  \end{tikzpicture}}
45  \setbox\myBoxA=\hbox{\fDeduce}
46  \global\DiagCorrection=\wd\myBoxA
47  \ignorespaces
48 }
```

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.

```
49 \def\alwaysDeduce{\straightDeduce}
50 \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.

```
51 \def\Deduce$#1\fCenter#2${%
52      \prepUnary%
53      \buildConclusion{#1}{#2}%
54      \setbox\myBoxA=\hbox{\fCenter}%
55      \global\CenterCorrection=-.5\wd\myBoxA
56      \joinDeduce%
57      \resetInferenceDefaults%
58      \ignorespaces%
59 }
60
61 \def\DeduceC#1{
62      \prepUnary%
63      \buildConclusionC{#1}%
64      \global\CenterCorrection=0pt
65      \joinDeduce%
66      \resetInferenceDefaults%
67      \ignorespaces%
68 }
```

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.

```
69
70 \def\joinDeduce{%
71     \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

```
72     \ifnum\curCenter<\newCenter%
73         \displace=\newCenter%
74         \advance \displace by -\curCenter%
75         \kernUpperBox%
76     \else%
77         \displace=\curCenter%
78         \advance \displace by -\newCenter%
79         \kernLowerBox%
80     \fi%
```

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

```
81     \ifnum\DiagCorrection<0%
82         \displace=-\DiagCorrection
83         \kernLowerBox%
84     \else
85         \displace=\DiagCorrection
86         \kernUpperBox%
87     \fi%
88     \advance\curCenter by-.5\DiagCorrection
```

Now we draw the deduction.

```
89     \buildDeduce%
```

Put the deduction and labels into a box.

```
90     \buildScoreLabels%
```

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

```
91     \ifx\rootAtBottomFlag\myTrue%
92         \buildRootBottom%
93     \else%
94         \buildRootTop%
95     \fi%
96     \global \curScoreStart=\newScoreStart%
97     \global \curScoreEnd=\newScoreEnd%
98     \global \curCenter=\newCenter%
99 }
```

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

```
100
101 \def\buildDeduce{%
102     \global\setbox \myBoxD =%
103         \hbox{\fDeduce}%
104     \displace = \wd\myBoxD % find width of vdots
```

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

```
105     \global\curScoreStart = \curCenter%
106     \global\advance\curScoreStart by -.5\displace%
107     \global\curScoreEnd = \curCenter%
108     \global\advance\curScoreEnd by .5\displace%
109     \global\advance\curScoreStart by\CenterCorrection
110     \global\advance\curScoreEnd by\CenterCorrection
111 }
```

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`.

```
112
113 \def\LeftLineLabel#1{%
114   \global\def\displayLeftLineLabel{%
115     {#1\hskip\labelSpacing}}
116   \ignorespaces}
117
118 \def\RightLineLabel#1{%
119   \global\def\displayRightLineLabel{%
120     {\hskip\labelSpacing #1}}
121   \ignorespaces}
122
123 \global\let\displayLeftLineLabel\relax
124 \global\let\displayRightLineLabel\relax
```

3.2   Subproof Labels

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

```
125
126 \def\LeftSubproofLabel#1{%
127   \global\setbox\curBox =
128   \hbox{\vbox to \ht\curBox{%
129       \vfil
130       \llap{#1$\left\{\vrule height .5\ht\curBox width 0pt\right.$}%
131       \vfil}\box\curBox}%
```

```
132 }
133
134 \def\RightSubproofLabel#1{%
135     \displace=\ht\curBox
136     \global\setbox\curBox =
137     \hbox{\box\curBox\vbox to \displace{%
138         \vfil
139         \rlap{$\left.\vrule height .5\displace width 0pt\right\}$#1}%
140         \vfil}}%
141 }
```

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

```
142 \def\resetInferenceDefaults{%
143     \global\def\theHypSeparation{\defaultHypSeparation}%
144     \global\setbox\myBoxLL=\hbox{\defaultLeftLabel}%
145     \global\setbox\myBoxRL=\hbox{\defaultRightLabel}%
146     \global\def\buildScore{\alwaysBuildScore}%
147     \global\def\theScoreFiller{\alwaysScoreFiller}%
148     % reset line labels to nothing %bpextra
149     \global\let\displayLeftLineLabel\relax %bpextra
150     \global\let\displayRightLineLabel\relax %bpextra
151     % reset to defaul deduce style %bpextra
152     \alwaysDeduce %bpextra
153     \gdef\hypKernAmt{0pt}% Restore to zero kerning.
154 }
155
156 \def\Axiom$#1\fCenter#2${%
157     % Get level and correct names set.
158     \prepAxiom%
159     % Define the boxes
160     % bpextra -- add line labels
161     \setbox\myBoxA=\hbox{$\mathord{#1}\fCenter\mathord{\relax}$}%
162     \setbox\myBoxB=\hbox{$#2$}% %bpextra
163     \setbox\myBoxLLL=\hbox{\displayLeftLineLabel}% %bpextra
164     \setbox\myBoxRLL=\hbox{\displayRightLineLabel}% %bpextra
165     \global\setbox\curBox=%
166         \hbox{\unhcopy\myBoxLLL%bpextra
167         \hskip\ScoreOverhangLeft\relax
168         \unhcopy\myBoxA
169         \unhcopy\myBoxB
170         \hskip\ScoreOverhangRight
171         \unhcopy\myBoxRLL}%bpextra
172     % Set the relevant dimensions for the boxes
173     \global\curScoreStart=0pt \relax
174     \global\curScoreEnd=\wd\curBox \relax
175     \global\curCenter=\wd\myBoxA \relax %bpextra
```

```
176      \global\advance \curCenter by \ScoreOverhangLeft%
177      % bpextra adjust by dimensions of labels
178      \global\advance \curCenter by \wd\myBoxLLL%bpextra
179      \global\advance\curScoreStart by \wd\myBoxLLL%bpextra
180      \global\advance\curScoreEnd by -\wd\myBoxRLL%bpextra
181      % reset line labels to nothing %bpextra
182      \global\let\displayLeftLineLabel\relax %bpextra
183      \global\let\displayRightLineLabel\relax %bpextra
184      \ignorespaces
185 }
186
187 \def\AxiomC#1{        % Note argument not in math mode
188      % Get level and correct names set.
189      \prepAxiom%
190          % Define the box.
191      \setbox\myBoxA=\hbox{#1}%
192      \setbox\myBoxLLL=\hbox{\displayLeftLineLabel}% %bpextra
193      \setbox\myBoxRLL=\hbox{\displayRightLineLabel}% %bpextra
194      \global\setbox\curBox =%
195          \hbox{\unhcopy\myBoxLLL%bpextra
196              \hskip\ScoreOverhangLeft\relax%
197              \unhcopy\myBoxA
198              \hskip\ScoreOverhangRight\relax
199              \unhcopy\myBoxRLL}% %bpextra
200      % Set the relevant dimensions for the boxes
201          \global\curScoreStart=0pt \relax
202          \global\curScoreEnd=\wd\curBox \relax
203          \global\curCenter=.5\wd\myBoxA \relax %bpextra
204          \global\advance \curCenter by \ScoreOverhangLeft%
205      % bpextra adjust by dimensions of labels
206      \global\advance \curCenter by \wd\myBoxLLL%bpextra
207      \global\advance\curScoreStart by \wd\myBoxLLL%bpextra
208      \global\advance\curScoreEnd by -\wd\myBoxRLL%bpextra
209      % reset line labels to nothing %bpextra
210      \global\let\displayLeftLineLabel\relax %bpextra
211      \global\let\displayRightLineLabel\relax %bpextra
212      \ignorespaces
213 }
214
215 \def\buildConclusion#1#2{% Build lower sequent w/ center at \fCenter position.
216      % Define the boxes
217          \setbox\myBoxA=\hbox{$\mathord{#1}\fCenter\mathord{\relax}$}%
218          \setbox\myBoxB=\hbox{$#2$}%
219          \setbox\myBoxLLL=\hbox{\displayLeftLineLabel}% %bpextra
220          \setbox\myBoxRLL=\hbox{\displayRightLineLabel}% %bpextra
221      % Put them together in \myBoxC
222      \setbox\myBoxC =%
223          \hbox{\unhcopy\myBoxLLL%bpextra
224          \hskip\ScoreOverhangLeft\relax%
225      \unhcopy\myBoxA\unhcopy\myBoxB
```

```
226        \hskip\ScoreOverhangRight
227        \unhcopy\myBoxRLL}% %bpextra
228    % Calculate the center of the \myBoxC string.
229    \newScoreStart=0pt \relax%
230    \newCenter=\wd\myBoxA \relax%
231    \advance \newCenter by \ScoreOverhangLeft%
232    \newScoreEnd=\wd\myBoxC%
233    % bpextra adjust by dimensions of labels
234    \global\advance\newCenter by \wd\myBoxLLL%bpextra
235    \global\advance\newScoreStart by \wd\myBoxLLL%bpextra
236    \global\advance\newScoreEnd by -\wd\myBoxRLL%bpextra
237    % reset line labels to nothing %bpextra
238    \global\let\displayLeftLineLabel\relax %bpextra
239    \global\let\displayRightLineLabel\relax %bpextra
240 }
241
242 \def\buildConclusionC#1{% Build lower sequent w/o \fCenter present.
243        % Define the box.
244    \setbox\myBoxA=\hbox{#1}%
245    \setbox\myBoxLLL=\hbox{\displayLeftLineLabel}% %bpextra
246    \setbox\myBoxRLL=\hbox{\displayRightLineLabel}% %bpextra
247 \setbox\myBoxC =%
248        \hbox{\unhcopy\myBoxLLL%bpextra
249            \hskip\ScoreOverhangLeft\relax%
250            \unhcopy\myBoxA
251            \hskip\ScoreOverhangRight
252            \unhcopy\myBoxRLL}%bpextra
253    % Calculate kerning to line up centers
254    \newScoreStart=0pt \relax%
255    \newCenter=.5\wd\myBoxA \relax% bpextra
256    \newScoreEnd=\wd\myBoxC%
257        \advance \newCenter by \ScoreOverhangLeft%
258    % bpextra adjust by dimensions of labels
259    \global\advance\newCenter by \wd\myBoxLLL%bpextra
260    \global\advance\newScoreStart by \wd\myBoxLLL%bpextra
261    \global\advance\newScoreEnd by -\wd\myBoxRLL%bpextra
262    % reset line labels to nothing %bpextra
263    \global\let\displayLeftLineLabel\relax %bpextra
264    \global\let\displayRightLineLabel\relax %bpextra
265 }
```

Change History