LaTeX for logicians

Setting tableaux using `prooftrees.sty`

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This document is work-in-progress, on the package `prooftrees.sty`, designed for setting semantic tableaux/truth-trees. The notes are relevant to v0.6. Many thanks to Clea Rees who wrote/is developing the package for patient explanations and advice!

1 Notes

For an overall guide to `prooftrees.sty` see the package documentation. These are only additional notes. Experts will note that this package invokes the immensely flexible `forest.sty` and inherits a lot of the options available in that (though the documentation for that package isn't exactly easy going). These notes are aimed at those (like me) who, inter alia, don't know too much about `forest.sty`.

1. This package for downward-branching truth-trees defines a `prooftree` environment. But so does the well-known package `bussproofs.sty`, widely used for setting Gentzen-style natural deduction trees.

   If you want to use both packages in the same document, then either load bussproofs first. Or load prooftrees with option 'tableaux':

   ```
   \usepackage[tableaux]{prooftrees}
   ```

   Either way, you can then use `prooftree` for bussproofs trees and `tableau` for prooftrees trees:

   ```
   \begin{tableau} ... \end{tableau}
   ```

2. You need to think of the output from a `tableau` environment – i.e. the lefthand column of line numbers (if used), the inner tree, the righthand column of justifications/annotations (if used) – as all one big TikZ-picture. It is typeset as a box. How that box is placed on the page depends on the surrounding environment. In other words, the placing of this box horizontally, and the amount of space before and after the box are not controlled from within the environment; rather you control them from outside `prooftrees` as you would control the placing of any picture box.

3. The documentation for `prooftrees.sty` doesn't note all the options for tweaking trees which it inherits from the package `forest.sty`. Here's one useful undocumented option.

   If you want to control the horizontal spread of a tree then you can use the option e.g.

   ```
   for tree={s sep'=10mm}
   ```

   in the preamble for the tree: for tree gets the following options to propagate to all nodes. The package default for `s sep` is much less, and produces a rather narrow, fastigate, tree.

   To determine the spread of a particular fork within a tree, you can insert a `s sep` option for the wff at the apex of the fork you want to control. See Examples 2–4.

4. Suppose you want wffs on nodes of trees to be typeset in something other than the default math mode font. For example, in my *Intro to Formal Logic*, I use upright sans serif rather than *italics* for expressions in a formal language. To avoid writing `\mathsf{...}` round every wff, then do the following. In the document preamble, or at least before the relevant tree(s), set the style option

   ```
   \forestset{
    mathsf content/.style={content
    format={\noexpand\ensuremath{\noexpand\mathsf{\forestoption{content}}}}},
    }
   ```

   and then use

   ```
   for tree={mathsf content}
   ```

   in the preamble for the tree. See Example 3.

5. You might well want a number of trees to share the same preamble: in that case put a command like

   ```
   \forestset{%
       default preamble={
       line no sep = 10mm,
       just sep=10mm,
       for tree={s sep'=10mm},
       close with=\absurd
       },
   }
   ```

   before the trees. NB the tree must still start with a preamble, even if null, as in:

```
\begin{tableau}
    {}                          %null preamble
    [...]                       %main tree-building code
\end{tableau}
```

6. Setting 'lopsided' trees and getting things to look as you want can involve various bits of trickery. Example 6 illustrates one bit of trickery with phantom nodes.

2 Examples

Example 1 A simple tree

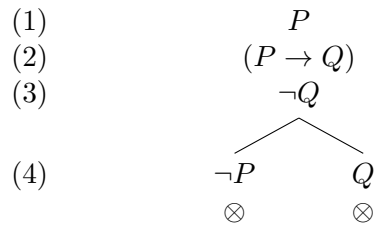
In the document preamble, use

```
\usepackage[tableaux]{prooftrees}
\renewcommand*\linenumberstyle[1]{(#1)}
```

Then define the tree as follows

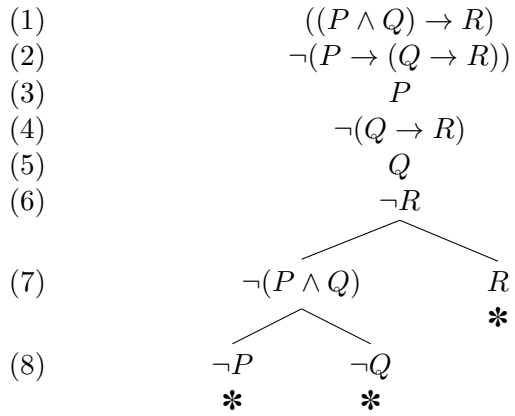
```
\begin{tableau}
{                              % begin tree preamble
    line no sep= 2cm,          % distance of tree from line numbers
    for tree={s sep'=10mm},    % control horizontal spread of branches
}                              % end tree preamble
[P
   [(P \lif Q)
      [\neg Q
         [\neg P, close]
         [Q, close]
      ]
   ]
]
\end{tableau}
```

to generate the following tree:



Example 2 Another simple tree

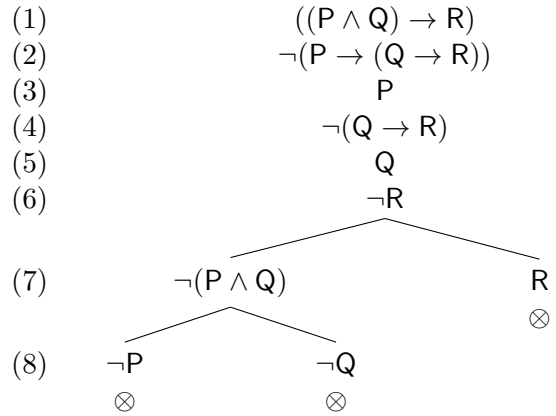
```
\begin{tableau}
{
    line no sep= 2cm,
    for tree={s sep'=10mm},
    close with=\absurd              %use pre-defined absurdity sign
}
[((P \land Q) \lif R)
   [\neg(P \lif (Q \lif R))
      [P
         [\neg(Q \lif R)
            [Q
               [\neg R
                  [\neg(P \land Q)
                     [\neg P, close]
                     [\neg Q, close]
                  ]
                  [R, close
                  ]
               ]
            ]
         ]
      ]
   ]
]
\end{tableau}
```



Example 3 Changing the font for wffs

```
\forestset{
 mathsf content/.style={content
format={\noexpand\ensuremath{\noexpand\mathsf{\forestoption{content}}}}},
}

\begin{tableau}
{for tree={mathsf content,s sep'=20mm}}
[((P \land Q) \lif R)
   [\neg(P \lif (Q \lif R))
      [P
         [\neg(Q \lif R)
            [Q
               [\neg R
                  [\neg(P \land Q)
                     [\neg P, close
                     ]
                     [\neg Q, close
                     ]
                  ]
                  [R, close]
               ]
            ]
         ]
      ]
   ]
]
\end{tableau}
```



Example 4 With justifications, cross-references hand coded

```
\begin{tableau}
{
    line no sep= 1.5cm,
    just sep= 1.5cm,                    % Set separation of justification
    for tree={s sep'=10mm},
    close with=\absurd
}
[((P \land Q) \lif R),                  just={Premiss}
   [\neg(P \lif (Q \lif R)),            just={Negated conclusion}
      [P,                               just={From (2)}
         [\neg(Q \lif R),               just={From (2)}
            [Q,                         just={From (4)}
               [\neg R, s sep=30mm,     just={From (4)}  %Note "s sep" to
                                                         %spread fork below
                  [\neg(P \land Q),     just={Alternatives from (1)}
                     [\neg P, close,    just={Alternatives from (7)}
                     ]
                     [\neg Q, close
                     ]
                  ]
                  [R, close]
               ]
            ]
         ]
      ]
   ]
]
\end{tableau}
```

(1) $((P \land Q) \to R)$ — Premiss
(2) $\neg(P \to (Q \to R))$ — Negated conclusion
(3) P — From (2)
(4) $\neg(Q \to R)$ — From (2)
(5) Q — From (4)
(6) $\neg R$ — From (4)

(7) $\neg(P \land Q)$ | R ✻ — Alternatives from (1)

(8) $\neg P$ ✻ | $\neg Q$ ✻ — Alternatives from (7)

Example 5 With justifications, cleverer cross-references

```
\begin{tableau}
{
    line no sep= 1.5cm,
    just sep= 1.5cm,
    for tree={s sep'=10mm},
    just refs right,                    % Set where crossreferences go
    close with=\absurd
}
[((P \land Q) \lif R),                  just={Premiss}, name=Prem
   [\neg(P \lif (Q \lif R)),            just={Negated conclusion}, name=NegConc
      [P,                               just={From: NegConc}
         [\neg(Q \lif R),               just={From: NegConc},name=Alice
            [Q,                         just={From: Alice}
               [\neg R, s sep=30mm,     just={From: Alice}
                  [\neg(P \land Q),     just={Alternatives from: Prem},name=Bertie
                     [\neg P, close,    just={Alternatives from: Bertie}
                     ]
                     [\neg Q, close
                     ]
                  ]
                  [R, close]
               ]
            ]
         ]
      ]
   ]
]
\end{tableau}
```

(1) $((P \land Q) \to R)$ Premiss
(2) $\neg(P \to (Q \to R))$ Negated conclusion
(3) P From 2
(4) $\neg(Q \to R)$ From 2
(5) Q From 4
(6) $\neg R$ From 4

(7) $\neg(P \land Q)$ | R ✻ Alternatives from 1

(8) $\neg P$ ✻ | $\neg Q$ ✻ Alternatives from 7

Example 6 Tree with phantom nodes with edges drawn

```
\forestset{%
    vertical/.style={                          %define style for phantom node
                                               %with vertical edge drawn from it
    before drawing tree={not ignore edge, edge=draw},
  },
}

\begin{tableau}
    {line no sep= 1.5cm,
    just sep= 1.5cm,
    for tree={s sep'=10mm},
    close with=\absurd
}
    [((P \land Q) \lor R),                     just={Premiss}
        [\neg\neg(\neg P \lor \neg R),         just={Negated conclusion}
            [(\neg P \lor \neg R),             just={From (2)}
                [(P \land Q),                  just={Alternatives from (1)}
                    [P,                        just={From (4)}
                        [Q,                    just={From (4)}
                            [\neg P,close]
                            [\neg R,           just={Alternatives from (3)}
                ]]]]
                [R
                [, vertical                 %phantom node but with edge
                        [, vertical         %phantom node but with edge
                            [\neg P]            %and now we have two
                            [\neg R,close]      %brances added
     ]]]]]]
\end{tableau}
```