tikz-qtree: better trees with TikZ

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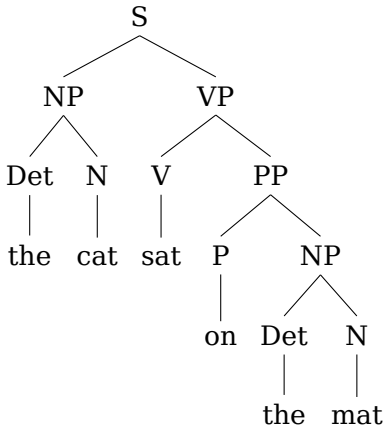
The tikz-qtree package provides a macro for drawing trees with TikZ[1] using the easy syntax of Alexis Dimitriadis' Qtree[2]. It improves on TikZ's standard tree-drawing facility by laying out tree nodes without collisions; it improves on Qtree by adding lots of features from TikZ; and it improves on pst-qtree in being usable with pdfTEX and XETEX.[3]

1 Basics

To load the package in LATEX:

```
\usepackage{tikz}
\usepackage{tikz-qtree}
```

The simplest usage is identical to Qtree:




```
\Tree [.S [.NP [.Det the ] [.N cat ] ]
          [.VP [.V sat ]
               [.PP [.P on ]
                    [.NP [.Det the ] [.N mat ] ] ] ] ]
```

Subtrees are delimited by square brackets. A subtree's root label is joined by a dot (.) to its opening bracket.[4] As in Qtree, spaces are required after every (internal or leaf) node label.

\Tree works inside or outside a tikzpicture environment, but many of the features described below require the explicit tikzpicture environment.

[1] http://sourceforge.net/projects/pgf/

[2] http://www.ling.upenn.edu/advice/latex/qtree/

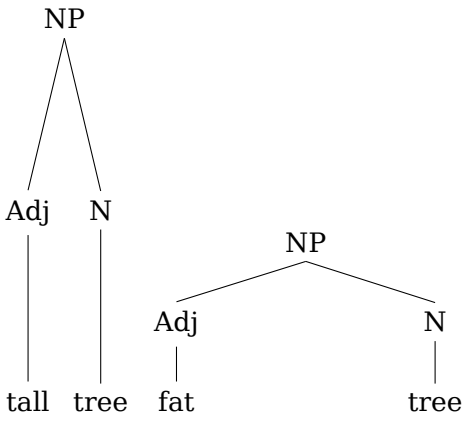
[3] Although XETEX works with pst-qtree using the xetex-pstricks package. For typesetting very large trees or a large number of trees, this may be the better option.

[4] You can also write the label after the closing bracket instead of the opening bracket, or both, or neither. Please see the Qtree documentation for details.

Options Some options for standard TikZ trees work for `\Tree` as well:

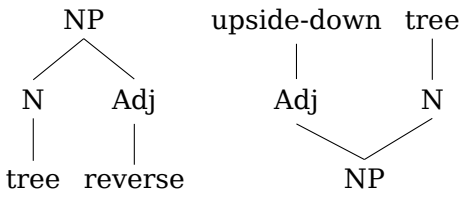
- `level distance`: vertical distance between the anchors of a parent and its children
- `sibling distance`: horizontal distance between the boundaries of sister subtrees (not the anchors of their roots, as in standard TikZ trees). Note that TikZ nodes already have some horizontal space around them (`inner xsep`, by default `0.3333em`), so even `sibling distance=0pt` leaves some room.

These are set either by writing `\tikzset{`*option*`=`*value*`}` or by writing `[`*option*`=`*value*`]` after a `\begin{tikzpicture}` or `\begin{scope}`.[5] For example:

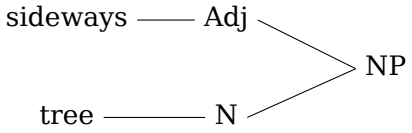



```
\begin{tikzpicture}
\tikzset{level distance=72pt}
\Tree [.NP [.Adj tall ] [.N tree ] ]
\end{tikzpicture}
%
\begin{tikzpicture}[sibling distance=72pt]
\Tree [.NP [.Adj fat ] [.N tree ] ]
\end{tikzpicture}
```

The `grow=`*direction* and `grow'=`*direction* options control the orientation of trees just as for standard TikZ trees. However, *direction* must be one of `up`, `down`, `left`, or `right`. The difference between `grow` and `grow'` is that `grow` places children counterclockwise with respect to their parent and `grow'` places them clockwise:




```
\begin{tikzpicture}[grow'=down]
\Tree [.NP [.Adj reverse ] [.N tree ] ]
\end{tikzpicture}
%
\begin{tikzpicture}[grow'=up]
\Tree [.NP [.Adj upside-down ] [.N tree ] ]
\end{tikzpicture}
```




```
\begin{tikzpicture}[grow=left]
\tikzset{level distance=60pt,sibling distance=18pt}
\tikzset{execute at begin node=\strut}
\Tree [.NP [.Adj sideways ] [.N tree ] ]
\end{tikzpicture}
```

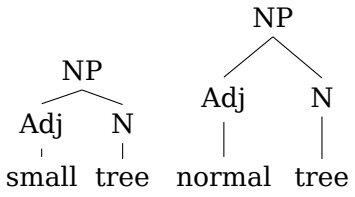
Note that in sideways trees, `level distance` is horizontal and `sibling distance` is vertical. Sideways trees do take a little extra adjusting to look right, since the defaults are geared towards vertically growing trees. The meaning of the option `execute at begin node=\strut` is, before typesetting the label of every node, insert the command `\strut`, which is an invisible box that maximizes the height and depth of the node.

[5] Allowing options after `\Tree` would have made sense, but there would be no way to disambiguate the two uses of square brackets.

Styles TikZ lets you define *styles* which encapsulate multiple options:

```
\tikzset{small/.style={level distance=20pt,sibling distance=0pt}}
```

Then the option `small` causes the options in its definition to be used:

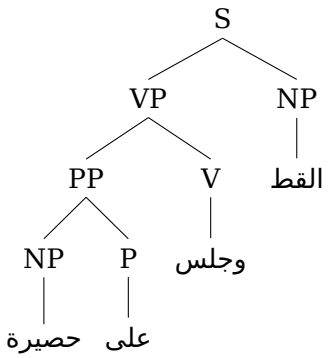



```
\begin{tikzpicture}[small]
\Tree [.NP [.Adj small ] [.N tree ] ]
\end{tikzpicture}
%
\begin{tikzpicture}
\Tree [.NP [.Adj normal ] [.N tree ] ]
\end{tikzpicture}
```

The following TikZ styles are automatically applied inside trees, providing a hook for you to change the appearance of particular kinds of tree parts:

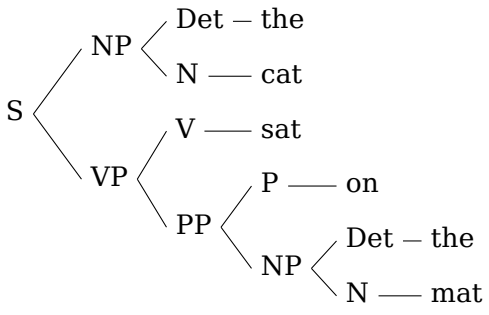
- `every tree node` to every (internal and leaf) node (default: `anchor=base`)
- `every internal node` to every internal node
- `every leaf node` to every leaf node
- `edge from parent` to every edge (default: `draw`)

The options for nodes and edges are all handled by TikZ and are described in detail in the TikZ documentation. For example, if you have a font named `\ar` and want to set all the leaf labels in this font:



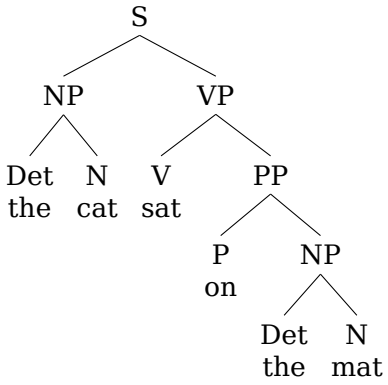

```
\begin{tikzpicture}
\tikzset{grow'=down}
\tikzset{every leaf node/.style={font=\ar}}
\Tree [.S [.NP القط ]
          [.VP [.V وجلس ]
               [.PP [.P على ] [.NP حصيرة ] ] ] ]
\end{tikzpicture}
```

You can make the nodes in a sideways tree line up on their left edge using `anchor=base west`:



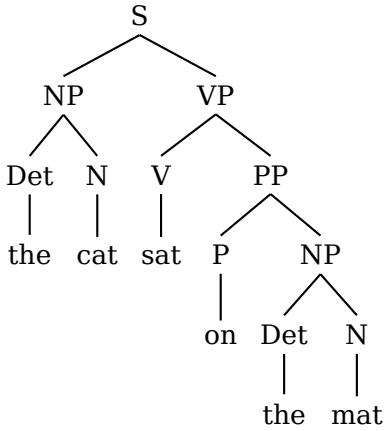

```
\begin{tikzpicture}
\tikzset{grow'=right,level distance=32pt}
\tikzset{execute at begin node=\strut}
\tikzset{every tree node/.style={anchor=base west}}
\Tree [.S [.NP [.Det the ] [.N cat ] ]
          [.VP [.V sat ]
               [.PP [.P on ]
                    [.NP [.Det the ] [.N mat ] ] ] ] ]
\end{tikzpicture}
```

In Qtree, it was allowed to use a line break (\\) inside a node. TikZ nodes by default don't allow this, but the `align` option (in PGF/TikZ version 2.1 or later) enables it as a side effect:[6]



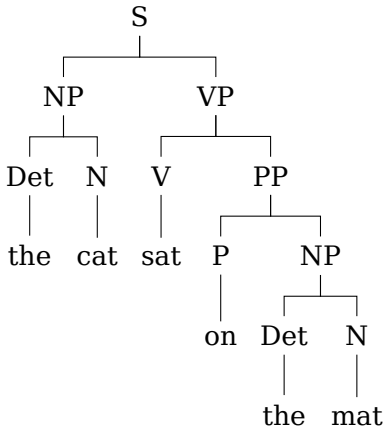

```
\begin{tikzpicture}
\tikzset{every tree node/.style={align=center,anchor=north}}
\Tree [.S [.NP Det\\the N\\cat ]
          [.VP V\\sat
               [.PP P\\on
                    [.NP Det\\the N\\mat ] ] ] ]
\end{tikzpicture}
```

You can also define a style for all the edges in a tree. For example, if you want the edges to be a little darker:




```
\begin{tikzpicture}
\tikzset{edge from parent/.style={draw,thick}}
\Tree [.S [.NP [.Det the ] [.N cat ] ]
          [.VP [.V sat ]
               [.PP [.P on ]
                    [.NP [.Det the ] [.N mat ] ] ] ] ]
\end{tikzpicture}
```

The `draw` option is necessary, as by default they will not be drawn. As a more complex example, edges have an `edge from parent path` option which lets you change the shape of the edge. Its value is a TikZ path expressed in terms of `\tikzparentnode`, the parent node, and `\tikzchildnode`, the child node.




```
\begin{tikzpicture}
\tikzset{edge from parent/.style=
  {draw,
   edge from parent path={(\tikzparentnode.south)
                          -- +(0,-8pt)
                          -| (\tikzchildnode)}}}
\Tree [.S [.NP [.Det the ] [.N cat ] ]
          [.VP [.V sat ]
               [.PP [.P on ]
                    [.NP [.Det the ] [.N mat ] ] ] ] ]
\end{tikzpicture}
```

[6] Thanks to Alan Munn for figuring this out. Prior to PGF/TikZ version 2.1, the fix was to use the options `text width=2em,text centered`.

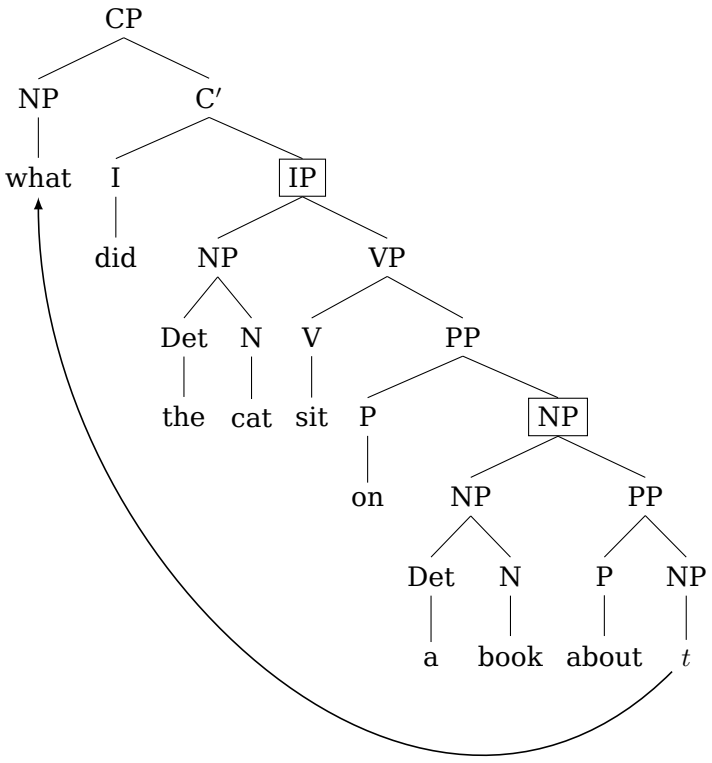
2 Embedding TikZ nodes

Inside a `\Tree`, in place of a node label, you can use a TikZ `\node` command.[7]

`\node [`*options*`] (`*name*`) {`*label*`};`

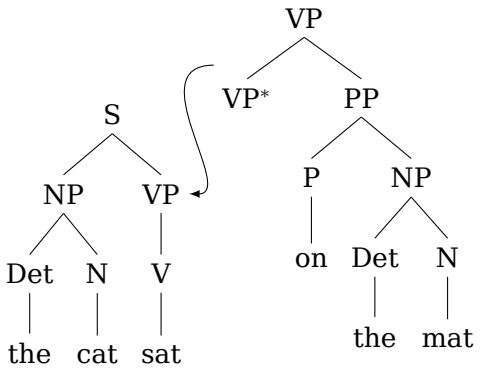
Don't forget the terminating semicolon. The [*options*], which are optional, let you change the appearance of the node; for example, the `draw` option draws a border around the node. The (*name*), which is also optional, can be used for drawing lines/arrows to/from the node.

```
\begin{tikzpicture}
\Tree [.CP [.NP \node(wh){what}; ]
           [.C$'$ [.I did ]
                  [.\node[draw]{IP};
                    [.NP [.Det the ] [.N cat ] ]
                    [.VP [.V sit ]
                         [.PP [.P on ]
                              [.\node[draw]{NP};
                                [.NP [.Det a ] [.N book ] ]
                                [.PP [.P about ] [.NP \node(t){$t$}; ] ] ] ] ] ] ] ]
\draw[semithick,->] (t)..controls +(south west:5) and +(south:5) .. (wh);
\end{tikzpicture}
```



[7] `\Tree` specifically watches out for the token `\node`; do not use `\path node` or other equivalents.

You can also refer to the whole subtree rooted at the node named *name* using `\subtreeof{`*name*`}`:



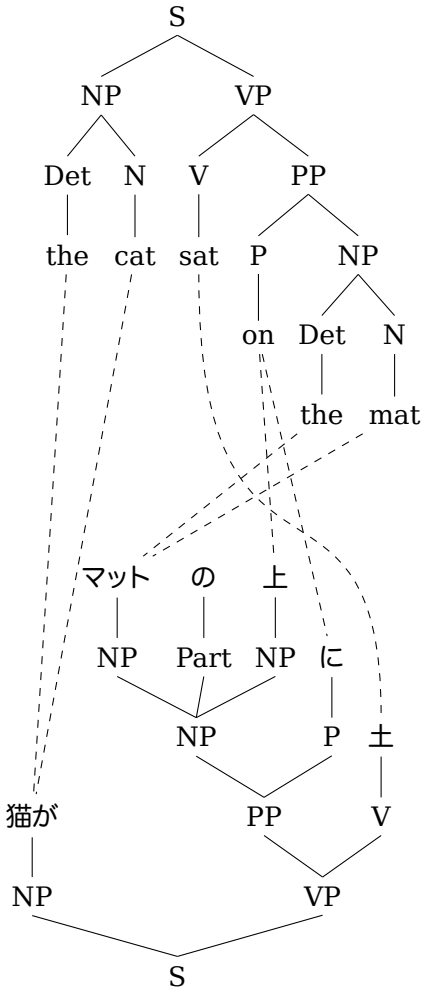

```
\begin{tikzpicture}
\Tree [.S [.NP [.Det the ] [.N cat ] ]
          [.\node(site){VP}; [.V sat ] ] ]
\begin{scope}[shift={(1in,0.5in)}]
\Tree [.\node(root){VP}; VP$^\ast$
                          [.PP [.P on ]
                               [.NP [.Det the ] [.N mat ] ] ] ]

\end{scope}

\draw[->](\subtreeof{root}.140) ..
  controls +(west:1) and +(east:1) .. (site);

\end{tikzpicture}
```

Another example for machine translation people:




```
\begin{tikzpicture}
\Tree [.S [.NP [.Det \node(e1){the}; ]
               [.N \node(e2){cat}; ] ]
          [.VP [.V \node(e3){sat}; ]
               [.PP [.P \node(e4){on}; ]
                    [.NP [.Det \node(e5){the}; ]
                         [.N \node(e6){mat}; ] ] ] ] ]

\begin{scope}[yshift=-5in,grow'=up]
\tikzset{every leaf node/.style={font=\ja}}
\Tree [.S [.NP \node(j1){猫が}; ]
          [.VP [.PP [.NP [.NP \node(j2){マット}; ]
                         [.Part \node(j3){の}; ]
                         [.NP \node(j4){上}; ] ]
                    [.P \node(j5){に}; ] ]
               [.V \node(j6){土}; ] ] ]
\end{scope}

\begin{scope}[dashed]
\draw (e1)--(j1);
\draw (e2)--(j1);
\draw (e3)..controls +(south:5) and +(north:4)..(j6);
\draw (e4)--(j4);
\draw (e4)--(j5);
\draw (e5)--(j2);
\draw (e6)--(j2);
\end{scope}

\end{tikzpicture}
```

3 Explicit edges

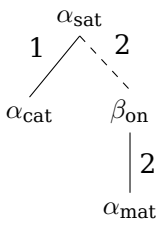
The edge from a parent to a child node is normally automatically drawn for you, but you can do it yourself with an `\edge` command *before* the corresponding child node. It is similar to the TikZ `edge from parent` command.[8]

```
\edge [options];
```

Again, don't forget the semicolon. The [*options*], which are optional, let you change the appearance of the edge. You can also add an edge label:

```
\edge [options] node [options] {label};
```

Typically one will use the `auto` option for edge labels, which places the label to the side of the edge.



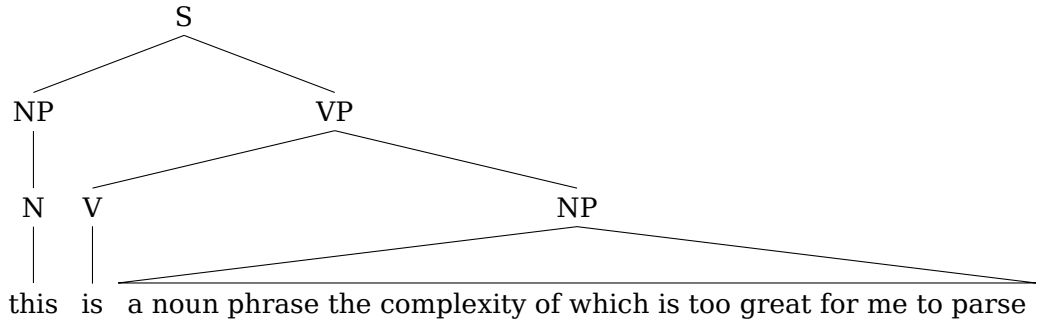

```
\newcommand{\initial}[1]{\ensuremath{\alpha_{\textrm{\scriptsize #1}}}}
\newcommand{\auxiliary}[1]{\ensuremath{\beta_{\textrm{\scriptsize #1}}}}

\begin{tikzpicture}[level distance=36pt,sibling distance=12pt]
\Tree [.\initial{sat}
        \edge node[auto=right]{1}; \initial{cat}
        \edge[dashed] node[auto=left]{2};
        [.\auxiliary{on}
          \edge node[auto=left]{2}; \initial{mat} ] ]
\end{tikzpicture}
```

The fact that `auto=left` draws a label on the right and `auto=right` draws a label on the left makes sense if you think about the tree growing from the root to the leaves.

There is a predefined style that draws a "roof" over a node, like Qtree's `\qroof`:

```
\begin{tikzpicture}[level distance=36pt]
\Tree [.S [.NP [.N this ] ]
          [.VP [.V is ]
               [.NP \edge[roof]; {a noun phrase
                                  the complexity of which
                                  is too great for me to parse} ] ] ]
\end{tikzpicture}
```



[8] Except that a TikZ `edge from parent` comes after the child node. I thought it was more logical to put it before.

4 Qtree compatibility

For basic trees, `tikz-qtree` can be used as a drop-in replacement for Qtree, but most of Qtree's advanced features are either not accessed in the same way in `tikz-qtree` or not implemented at all. There is a package `tikz-qtree-compat` which can be loaded to improve compatibility. Supported so far are:

- Superscripts and subscripts outside of math mode, and `\automath`
- The `\0`, `\1`, and `\2` commands, and `\qtreeprimes`
- The `\qroof` command

For unsupported commands, warning messages are printed, but at least your file should compile.

Acknowledgements

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Contact

Please send suggestions to `chiang@isi.edu`.