Using the `ccg-latex.sty` file

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To use this CCG style, please include the following line somewhere in the LaTeX preamble:

```
\usepackage{ccg-latex}
```

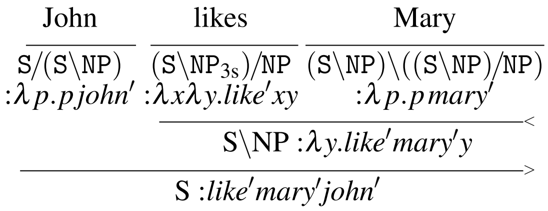
The style file `ccg-latex.sty` neither loads nor requires packages or fonts. Kerning controls for typesetting the CCG slashes, the LF's colon, and rule decorations in CCG derivations are in the `pt` unit, without the `\!` command. This is because the eye-pleasing slash distance seems to be independent of font size, at least to my eyes.

If you feel like changing it, just look for the `\kern` command.

All math is introduced by `\ensuremath` in `ccg-latex.sty`; there is no `$..$` unless you introduce it manually. I don't recommend using math without `\ensuremath` in `ccg-latex.sty`. The short form `\mymath{..}`, for 'bare math', is for that.

I demonstrate examples with increasingly high-level `ccg-latex` code, from lowest level `\cgex` to `\begin{ccg}` and `\begin{ccgg}`.

An Example with the `\cgex{n}{derivations}` command. The `\lf{}` is already in math mode. Lexical assumption lines are drawn by one command.



The ccg-latex code is:

```
\cgex{3}{John & likes & Mary\\
\cglines{3}\\
\cgf{S\fs(S\bs NP)} & \cgf{(S\bs\cgs{NP}{3s})\fs NP}
  & \cgf{(S\bs NP)\bs((S\bs NP)\fs NP)}\\
\lf{\lambda p.p\,\so{john}}
& \lf{\lambda x\lambda y.\so{like}xy} & \lf{\lambda p.p\,\so{mary}}\\
&\cgline{2}{\cgba}\\
&\cgres{2}{S\bs NP \lf{\lambda y.\so{like}\so{mary}y}}\\
\cgline{3}{\cgfa}\\
\cgres{3}{S \lf{\so{like}\so{mary}\so{john}}}
}
```

You will notice that the result of ‘likes Mary’ was typeset in a different font. That’s because `\cgres` command typesets its input in default font. Use the `\cat` command inside it to avoid that (or `\cgf`):

$$\begin{array}{cccl}
\text{John} & \text{likes} & \text{Mary} & \\
\hline
\mathtt{S/(S\backslash NP)} & \mathtt{(S\backslash NP_{3s})/NP} & \mathtt{(S\backslash NP)\backslash((S\backslash NP)/NP)} & \\
:\lambda p.p\,john' & :\lambda x\lambda y.like'xy & :\lambda p.p\,mary' & \\
\cline{2-3}
 & \multicolumn{2}{c}{\mathtt{S\backslash NP}:\lambda y.like'mary'y} & < \\
\hline
\multicolumn{3}{c}{\mathtt{S}:like'mary'john'} & >
\end{array}$$

The ccg-latex code is:

```
\cgex{3}{John & likes & Mary\\
\cglines{3}\\
\cgf{S\fs(S\bs NP)} & \cgf{(S\bs\cgs{NP}{3s})\fs NP}
  & \cgf{(S\bs NP)\bs((S\bs NP)\fs NP)}\\
\lf{\lambda p.p\,\so{john}}
& \lf{\lambda x\lambda y.\so{like}xy} & \lf{\lambda p.p\,\so{mary}}\\
&\cgline{2}{\cgba}\\
&\cgres{2}{\cat{S\bs NP}\lf{\lambda y.\so{like}\so{mary}y}}\\
% note that \cgres is by default in \cgf font
\cgline{3}{\cgfa}\\
\cgres{3}{\cat{S}\lf{\so{like}\so{mary}\so{john}}}
}
```

Same example with lower-level ccg-latex commands for lexical assumption lines, and with shorthanded type-raising notation using subscript and superscript. NB. they are typeset in math mode without needing `$..$`.

$$\begin{array}{ccc}
\text{John} & \text{likes} & \text{Mary}\\
\hline
\mathtt{NP}^{\uparrow}_{3s} & (\mathtt{S}\backslash\mathtt{NP}_{3s})/\mathtt{NP} & \mathtt{S}\backslash(\mathtt{S}/\mathtt{NP})\\
:\lambda p.p\,john' & :\lambda x\lambda y.like'xy & :\lambda p.p\,mary'\\
\cline{1-2}
\multicolumn{2}{c}{\mathtt{S}/\mathtt{NP}{:}\lambda x.like'x\,john'} & {\scriptstyle >\mathbf{B}}\\
\hline
\multicolumn{3}{c}{\mathtt{S}{:}like'mary'john'} \quad {\scriptstyle >}
\end{array}$$

The ccg-latex code is:

```
\cgex{3}{John & likes & Mary\\
% uses the alias \cat rather than \cgf above--same result
\cgul & \cgul & \cgul\\
 % manually repeats the columns for comparison with \cglines above
\cat{\cgss{NP}{3s}{\uparrow}}
& \cat{(S\bs\cgs{NP}{3s})\fs NP} & \cat{S\bs(S\fs NP)}\\
\lf{\lambda p.p\,\so{john}}
& \lf{\lambda x\lambda y.\so{like}xy} & \lf{\lambda p.p\,\so{mary}}\\
\cgline{2}{\cgfc}\\
\cgres{2}{\cat{S\fs NP}\lf{\lambda x.\so{like}x\so{john}}}\\
% note that \cgres is by default in \cgf font
\cgline{3}{\cgfa}\\
\cgres{3}{\cat{S} \lf{\so{like}\so{mary}\so{john}}}
% using \cat inside \cgres is nae problem
}
```

Although the top line produced by `\cgex` command seems like it is meant for lexical assumptions only, because of its font, you can override that for example using the `\cat` command:

$$\begin{array}{cc}
\mathtt{X}/\mathtt{Y} & \mathtt{Y}\\
\hline
\multicolumn{2}{c}{\mathtt{X}} \quad {\scriptstyle >}
\end{array}$$

Here is the `ccg-latex` code for it:

```
\cgex{2}{\cat{X\fs Y} & ~~~\cat{Y}\\
\cgline{2}{\cgfa}\\
\cgres{2}{\cat{X}}
}
```

An example with double slashes (for morphology, etc.)

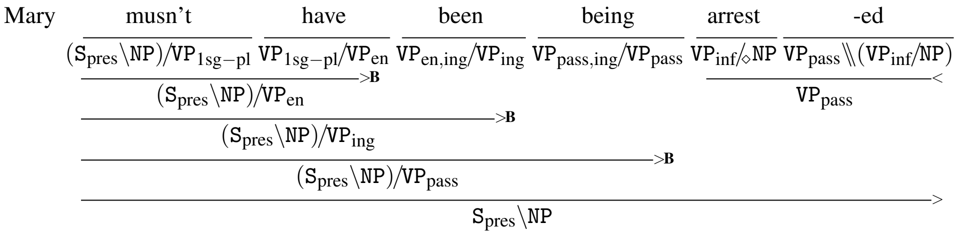
$$\dfrac{\dfrac{\text{dismiss}}{\mathtt{VP}_{\text{inf}}/\mathtt{NP} : \lambda x\lambda y.\mathit{dismiss}'\,x\,y} \quad \dfrac{\text{-ed}}{((\mathtt{S}\backslash\mathtt{NP}_{\text{agr}})/\mathtt{NP})\backslash\!\backslash(\mathtt{VP}_{\text{inf}}/\mathtt{NP}) : \lambda p\lambda x\lambda y.\mathit{past}'(P\,xy)}}{(\mathtt{S}\backslash\mathtt{NP}_{\text{agr}})/\mathtt{NP} : \lambda x\lambda y.\mathit{past}'(\mathit{dismiss}'\,x\,y)}{\scriptstyle <}$$

The ccg-latex code is below (using `\cgf` instead of `\cat`, which do the same, and native latex math for LF, which does the same as `\lf{..})`. NB. empty subscripts with no effect, if you keep changing the categories as I do).

The last `\cgres` is a painful reminder that if you put inline math in it using `$..$`, you will get a warning from LaTeX. Use `\lf{..}` or `\mymath{..}` instead.

```
\cgex{3}{dismiss& -ed\\
\cglines{2}\\
\cgf{\cgs{VP}{inf}\fs\cgs{NP}{}}
$:\lambda x\lambda y.\so{dismiss}\,x\,y$&
\cgf{((\cgs{S}{}\bs\cgs{NP}{agr})\fs NP)\bss(\cgs{VP}{inf}\fs NP)}
$:\lambda p\lambda x\lambda y.\so{past}(P\,xy)$\\
\cgline{2}{\cgba}\\
\cgres{2}{\cgf{(\cgs{S}{}\bs\cgs{NP}{agr})\fs\cgs{NP}{}}
\lf{\lambda x\lambda y.\so{past}(\so{dismiss}\,x\,y)}}
}
```

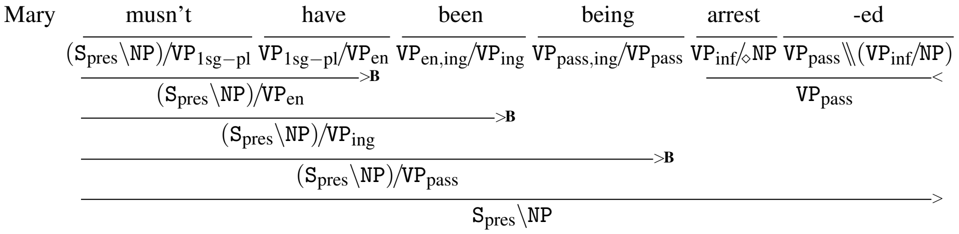
Here is one example with features galore, from Emmon Bach:



Here is the ccg-latex code:

```
{\footnotesize
Mary \cgex{6}{musn’t & have & been & being & arrest & -ed\\
  \cglines{6}\\
  \cgf{(\cgs{S}{pres}\bs NP)\fs\cgs{VP}{1sg-pl}}
  & \cgf{\cgs{VP}{1sg-pl}\fs\cgs{VP}{en}}
   &\cgf{\cgs{VP}{en,ing}\fs\cgs{VP}{ing}}
   &\cgf{\cgs{VP}{pass,ing}\fs\cgs{VP}{pass}}
   &\cgf{\cgs{VP}{inf}\fds NP}
   &\cgf{\cgs{VP}{pass}\lds(\cgs{VP}{inf}\fs NP)}\\
   \cgline{2}{\cgfc}  &&&\cgline{2}{\cgba}\\
 \cgres{2}{\cat{(\cgs{S}{pres}\bs NP)\fs\cgs{VP}{en}}}
 &&&\cgres{2}{\cgs{VP}{pass}}\\
   \cgline{3}{\cgfc}\\
 \cgres{3}{\cat{(\cgs{S}{pres}\bs NP)\fs\cgs{VP}{ing}}}\\
 \cgline{4}{\cgfc}\\
 \cgres{4}{\cat{(\cgs{S}{pres}\bs NP)\fs\cgs{VP}{pass}}}\\
 \cgline{6}{\cgfa}\\
 \cgres{6}{\cat{\cgs{S}{pres}\bs NP}}
}}
```

Same example with `\begin{ccg}{n}{data}{derivations}\end{ccg}`. No gloss line, and lexical assumption lines are drawn by default.



Here is the ccg-latex code:

```
{\footnotesize
Mary
\begin{ccg}{6}{musn't & have & been & being & arrest & -ed}
  {\cgf{(\cgs{S}{pres}\bs NP)\fs\cgs{VP}{1sg-pl}}
  & \cgf{\cgs{VP}{1sg-pl}\fs\cgs{VP}{en}}
   &\cgf{\cgs{VP}{en,ing}\fs\cgs{VP}{ing}}
   &\cgf{\cgs{VP}{pass,ing}\fs\cgs{VP}{pass}}
   &\cgf{\cgs{VP}{inf}\fds NP}
   &\cgf{\cgs{VP}{pass}\lds(\cgs{VP}{inf}\fs NP)}\\
   \cgline{2}{\cgfc}  &&&\cgline{2}{\cgba}\\
 \cgres{2}{\cat{(\cgs{S}{pres}\bs NP)\fs\cgs{VP}{en}}}
 &&&\cgres{2}{\cgs{VP}{pass}}\\
   \cgline{3}{\cgfc}\\
 \cgres{3}{\cat{(\cgs{S}{pres}\bs NP)\fs\cgs{VP}{ing}}}\\
 \cgline{4}{\cgfc}\\
 \cgres{4}{\cat{(\cgs{S}{pres}\bs NP)\fs\cgs{VP}{pass}}}\\
 \cgline{6}{\cgfa}\\
 \cgres{6}{\cat{\cgs{S}{pres}\bs NP}}
}
\end{ccg}
}
```

Another example, to show glossing in the beginning. The end gloss is typeset by `\mc`, for multi-column, centered.

It uses `\begin{ccgg}{n}{data}{gloss}{derivations}\end{ccgg}`.

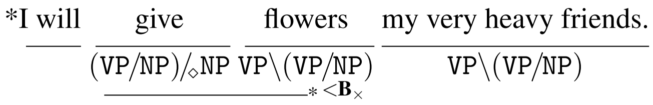
$$\begin{array}{ccc}
\text{ver-dir} & \text{-t} & \text{-ti.}\\
\text{give-caus} & \text{-caus} & \text{-past}\\
\hline
\mathtt{VP}_{\mathrm{inf}}\backslash\mathtt{NP}_{\mathrm{dat}}\backslash\mathtt{NP}_{\mathrm{dat}}\backslash\mathtt{NP}_{\mathrm{acc}} & (\mathtt{S}\backslash\mathtt{NP}_{\mathrm{nom}}\backslash\mathtt{NP}_{\mathrm{case}})\backslash\mathtt{VP}_{\mathrm{inf}} & \\
:\lambda x\lambda y\lambda z.\mathit{give}'yxz & :\lambda p\lambda x\lambda y.\mathit{cause}'(px)y & \\
\hline
\multicolumn{2}{c}{\mathtt{S}\backslash\mathtt{NP}_{\mathrm{nom}}\backslash\mathtt{NP}_{\mathrm{dat}}\backslash\mathtt{NP}_{\mathrm{dat}}\backslash\mathtt{NP}_{\mathrm{acc}}} & {\scriptstyle <\mathbf{B}^3}\\
\multicolumn{2}{c}{:\lambda x_1\lambda x_2\lambda x_3\lambda x_4\lambda x_5.\mathit{cause}_{\mathit{1,2}}{}'(\mathit{cause}'_{1,2}(\mathit{give}'x_1x_2x_3)x_4)x_5} & \\
\multicolumn{3}{c}{\text{‘made to let give’, from Turkish}}
\end{array}$$

Here is the ccg-latex code:

```
\begin{ccgg}{3}{ver-dir & -t & -ti.}{give{-caus} & {-caus} & {-past}}
{
\cgf{\cgs{VP}{inf}\bs\cgs{NP}{dat}\bs\cgs{NP}{dat}\bs\cgs{NP}{acc}}
& \cgf{(S\bs\cgs{NP}{nom}\bs\cgs{NP}{case})\bs\cgs{VP}{inf}}\\
\lf{\lambda x\lambda y\lambda z.\so{give}yxz}
& \lf{\lambda p\lambda x\lambda y.\so{cause}(px)y}\\
\cgline{2}{\cgbc$^3$}\\
\cgres{2}{\cat{S\bs\cgs{NP}{nom}\bs\cgs{NP}{dat}\bs
\cgs{NP}{dat}\bs\cgs{NP}{dat}\bs\cgs{NP}{acc}}}\\
\cgres{2}{\lf{\lambda x_1\lambda x_2\lambda x_3\lambda x_4\lambda x_5.
\so{cause_{1,2}}
(\sos{cause}{1,2}(\so{give}x_1x_2x_3)x_4)x_5}}\\[1ex]
\mc{3}{‘made to let give’, from Turkish}
}
\end{ccgg}
```

Note that subscripted semantic objects such as $\mathit{cause}_{\mathit{1,2}}{}'$ are better typeset as $\mathit{cause}'_{1,2}$ using `\sos` (for ‘semantic object, subscripted’), rather than `\so`.

An example with slash modalities and the non-derivability indicator (*):



Code:

```
\begin{ccg}{4}{*I~will& give& flowers& my~very~heavy~friends.}
{
&\cat{(VP\fs NP)\fds NP}&\cat{VP\bs(VP\fs NP)}&\cat{VP\bs(VP\fs NP)}\\
&\badline{2}{\cgbx}
}
\end{ccg}
```

Some examples to show slash distancing by `pt` unit for categories in subscript:

If you use `ccg-latex` for category name spacing you will get:

John [should]$_{\mathtt{(S\backslash NP)//IV}}$ walk the dog.
John [wants]$_{\mathtt{(S\backslash\backslash NP)/VP}}$ to walk the dog.
Mary [believes]$_{\mathtt{(S\backslash NP)/_{\diamond}S}}$ that John walked the dog.

And some big ones by ccg-latex:

$\mathtt{(S\backslash_{\times}NP)/_{\diamond}IV}$
$\mathtt{(S\backslash\backslash NP)/VP}$
$\mathtt{(S\backslash NP)//S}$

and bigger ones:

$$\mathtt{(S\backslash_{\times}NP)/_{\diamond}IV}$$
$$\mathtt{(S\backslash\backslash NP)/VP}$$
$$\mathtt{(S\backslash NP)//S}$$

Here is the native LaTeX math rendering of above without `ccg-latex` to compare spacing in various sizes:

$$(S\backslash_{\times}NP)/_{\diamond}IV$$
$$(S\backslash\backslash NP)/VP$$
$$(S\backslash NP)//S$$

John [should]$_{(S\backslash NP)//IV}$ walk the dog.
John [wants]$_{(S\backslash\backslash NP)/VP}$ to walk the dog.
Mary [believes]$_{(S\backslash NP)/_{\diamond}S}$ that John walked the dog.

Check the code:

```
{\Large
$(S\backslash_\times NP)/_{\diamond}IV$\medskip

$(S\backslash\backslash NP)/VP$\medskip

$(S\backslash NP)// S$}\bigskip


John [should]$_{\scriptstyle (S\backslash NP)//IV}$  walk the dog.

John [wants]$_{\scriptstyle (S\backslash\backslash NP)/ VP}$ to walk the dog.

Mary [believes]$_{\scriptstyle (S\backslash NP)/_{\diamond}S}$ that John walked the dog.
```

It generates.

$$(S\backslash_\times NP)/_{\diamond}IV$$

$$(S\backslash\backslash NP)/VP$$

$$(S\backslash NP)//S$$

John [should]$_{(S\backslash NP)//IV}$ walk the dog.
John [wants]$_{(S\backslash\backslash NP)/VP}$ to walk the dog.
Mary [believes]$_{(S\backslash NP)/_{\diamond}S}$ that John walked the dog.

Not pretty.