The `diagrams` package

If this is not already on your computer, you can download diagrams.tex from `http://www.paultaylor.eu/diagrams/`. To install it, simply rename the file diagrams.sty and put it somewhere that TEX can find it, for example, in the same directory as your TEX file. A manual dated 15 June 1997 is available on the same site.

The program supports a great variety of arrows, which automatically stretch or contract to match long labels or large objects. However it doesn't curve arrows. It allows a large number of options. For this file, I loaded it using

```
\usepackage[small,nohug,heads=vee]{diagrams}
\diagramstyle[labelstyle=\scriptstyle]
```

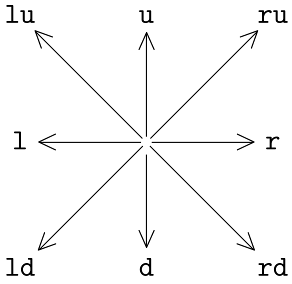
The "small" reduces the distances between objects, "nohug" stops the labels rotating with their arrows (mostly), and "heads=vee" determines the size and shape of the heads on the arrows (alternatives LaTeX, littlevee, triangle, ...). The second row makes the labels print in scriptstyle.

The syntax is similar to that of `array`, as illustrated by:

$$\begin{tikzcd}
A \arrow[r, "a"] \arrow[d, "b"] & B \arrow[d, "c"] \\
C \arrow[r, "d"] & D
\end{tikzcd}$$

```
\begin{diagram}
A         &\rTo^{a}    &B\\
\dTo_{b}  &            &\dTo_{c}\\
C         &\rTo^{d}    &D
\end{diagram}
```

Arrows are specified by a one- or two-letter prefix describing the direction, and a suffix describing the body of the arrow. For example:



$\longrightarrow$ To
$\longmapsto$ Mapsto
$\longrightarrow$ Line
$\hookrightarrow$ Into
$\twoheadrightarrow$ Onto
$\dashrightarrow$ Dotsto
$\dashrightarrow$ Dashto
$\Longrightarrow$ Implies

To invoke an arrow, combine the two, as illustrated by:

$$\begin{tikzcd}
A \arrow[r, hook] \arrow[rd, two heads] & B \arrow[d, dotted] & C \arrow[l, hook'] \arrow[ld, two heads] \\
 & D &
\end{tikzcd}$$

```
\begin{diagram}
A &\rInto   &B         &\lInto &C\\
  &\rdOnto  &\dDotsto  &\ldOnto\\
  &         &&D
\end{diagram}
```

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To add labels to arrows, place them as superscripts or subscripts on the arrow (between braces if necessary), as illustrated by:

$$\begin{tikzcd}
A \arrow[r, "u", "d"'] \arrow[dr, "u", "d"'] & B \arrow[d, "u"', "d"] & C \arrow[l, "u"', "d"] \arrow[dl, "u"', "d"] \\
& D &
\end{tikzcd}$$

```
\begin{diagram}
A &\rTo^u_d  &B         &\lTo^u_d  &C\\
  &\rdTo^u_d &\dTo^u_d &\ldTo^u_d \\
  &          &D
\end{diagram}
```

A superscript places the label above (or to the left) of an arrow. Labels can also be made to break arrows by using ˜ instead of ˆ

$$\begin{tikzcd}
A \arrow[r, "a" description] & B
\end{tikzcd}$$

```
A &\rTo~{a} &B
```

Arrows stretch to match long labels:

$$\begin{tikzcd}
A \arrow[r] \arrow[d] & B \arrow[r, "\text{very long label}"] \arrow[d] & C \arrow[d] \\
D \arrow[r] & E \arrow[r, "\text{smaller}"] & F
\end{tikzcd}$$

Notice that the lower arrow also stretched.

Arrows also stretch (or contract) to match large objects:

$$\begin{tikzcd}
A \times A \times A \times A \times A \arrow[r, "a"] \arrow[d, "b"] & B \arrow[d, "c"] \\
C \arrow[r, "d"] & D
\end{tikzcd}$$

If a diagonal arrow is to go across x cells horizontally and y cells vertically instead of the usual 2+2, this can be achieved by placing (x,y) after the arrow command, as illustrated by:

$$\begin{tikzcd}
& A \arrow[ddl, "f"'] \arrow[dr, "c" description] \arrow[drr, "d" description] \arrow[drrr, "e" description] & & & \\
& B \arrow[r] \arrow[dl] & C \arrow[r] & D \arrow[r] & E \\
F & & & &
\end{tikzcd}$$

```
\begin{diagram}
 &            &A\\
 &\ldTo(2,4)^f&&\rdTo~c\rdTo(4,2)~d\rdTo(6,2)~e\\
 &            &B&\rTo        &C&\rTo&D&\rTo&E\\
 &\ldTo\\
F
\end{diagram}
```

Another example to illustrate the above rules:

$$\begin{tikzcd}
T \arrow[dr, "(x{,}y)" description] \arrow[drr, "x"] \arrow[ddr, "y"'] & & \\
& X \times_Z Y \arrow[r, "p"'] \arrow[d, "q"] & X \arrow[d, "f"] \\
& Y \arrow[r, "g"] & Z
\end{tikzcd}$$

```
\begin{diagram}
T&&&&\\
 &\rdTo~{(x,y)}\rdTo(4,2)^x\rdTo(2,4)_y&&&\\
 &  &X\times_ZY&\rTo_p&X\\
 &  &\dTo_q    &      &\dTo_f\\
 &  &Y         &\rTo^g&Z
\end{diagram}
```

It is possible to introduce curved arrows into a diagram if you first define them using the picture environment:

```
\newcommand{\lift}[2]{%
\setlength{\unitlength}{1pt}
\begin{picture}(0,0)(0,0)
\put(0,{#1}){\makebox(0,0)[b]{${#2}$}}
\end{picture}
}

\newcommand{\lowerarrow}[1]{%
\setlength{\unitlength}{0.03\DiagramCellWidth}
\begin{picture}(0,0)(0,0)
\qbezier(-28,-4)(0,-18)(28,-4)
\put(0,-14){\makebox(0,0)[t]{$\scriptstyle {#1}$}}
\put(28.6,-3.7){\vector(2,1){0}}
\end{picture}
}

\newcommand{\upperarrow}[1]{%
\setlength{\unitlength}{0.03\DiagramCellWidth}
\begin{picture}(0,0)(0,0)
\qbezier(-28,11)(0,25)(28,11)
\put(0,21){\makebox(0,0)[b]{$\scriptstyle {#1}$}}
\put(28.6,10.7){\vector(2,-1){0}}
\end{picture}
}
```

$$\begin{tikzcd}
A \arrow[r, bend left, "\alpha"] \arrow[r, bend right, "\beta"'] \arrow[r, phantom, "\Downarrow \lambda"] & B.
\end{tikzcd}$$

```
\begin{diagram}[w=3em]
A  & \upperarrow{\alpha}
\lift{-2}{\ \ \Downarrow{\lambda}}
\lowerarrow{\beta} & B.
\end{diagram}
```

The following two diagrams were produced with the “heads=littlevee” and “heads=LaTeX” options.

$$\begin{tikzcd}
\texttt{lu} & \texttt{u} & \texttt{ru} \\
\texttt{l} & {} \arrow[ul] \arrow[u] \arrow[ur] \arrow[l] \arrow[r] \arrow[dl] \arrow[d] \arrow[dr] & \texttt{r} \\
\texttt{ld} & \texttt{d} & \texttt{rd}
\end{tikzcd}
\qquad
\begin{tikzcd}
\texttt{lu} & \texttt{u} & \texttt{ru} \\
\texttt{l} & {} \arrow[ul] \arrow[u] \arrow[ur] \arrow[l] \arrow[r] \arrow[dl] \arrow[d] \arrow[dr] & \texttt{r} \\
\texttt{ld} & \texttt{d} & \texttt{rd}
\end{tikzcd}$$

To my eyes, the “vee” option gives heads that are too large, the “littlevee” option gives heads that don’t fit correctly on the shaft, and the “LaTeX” option gives arrows that don’t match the inline arrows.

Finally, an example from the manual:

```
\begin{diagram}[heads=LaTeX]
A         &\pile{\rTo^f\\ \puncture\quad\scriptstyle{\alpha}\\ \rTo_g} &B\\
\dTo^h\dashv\uTo_k&                                                  & \\
C         &                                                          & \\
\end{diagram}
```

$$\begin{tikzcd}
A \arrow[r, shift left=2, "f"] \arrow[r, shift right=2, "g"'] \arrow[r, phantom, "\alpha"] \arrow[d, shift right=2, "h"'] \arrow[d, phantom, "\dashv"] & B \\
C \arrow[u, shift right=2, "k"'] &
\end{tikzcd}$$

According to the manual: “Permission is now granted for [the software’s] use for the production of academic research and textbooks, journals and conference proceedings, subject to the conditions that

- acknowledgement be given as above,
- an up-to-date version of the package be used for the final production,
- and one copy of the book be sent to me on publication in lieu of royalty, at the above address.

Use by commercial organisations is considered (for this purpose) to be academic if the results are intended for publication in an academic forum, concern pure research and do not relate to any particular commercial product.

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