Logic Symbols

First, note that the fonts are different. I tend to use this particular font — TEX Gyre Adventor — for text. Check out the preamble in `logicsymbols.tex` to see how I change the font.

This document presents the basic propositional and predicate logic symbols we use, as well as an environment you can use to format "two-column" proofs. To begin, here is a truth table showing one of DeMorgan's laws:

p	q	$\neg p$	$\neg q$	$p \vee q$	$\neg(p \vee q)$	$\neg p \wedge \neg q$	$\neg(p \vee q) \iff \neg p \wedge \neg q$
T	T	F	F	T	F	F	T
T	F	F	T	T	F	F	T
F	T	T	F	T	F	F	T
F	F	T	T	F	T	T	T

This shows the basic logic operations and, or and not, as well as the biconditional "if and only if." Check out the source code to see the commands for the symbols. Note they are all in math mode.

Here's one more table showing an if-then proposition.

p	q	$\neg p$	$(\neg p) \vee q$	$p \to q$	$(\neg p) \vee q \iff p \to q$
T	T	F	T	T	T
T	F	F	F	F	T
F	T	T	T	T	T
F	F	T	T	T	T

Next are the universal and existential quantifiers, $\forall$ and $\exists$. They are always followed by a variable and eventually a propositional function, such as in $\forall x\, P(x)$, $\exists y\, Q(y)$ and $\forall x \exists y\, R(x, y)$.
Note: It's common to add a small (thin) space between the quantifier variable and the function; see the source to see how that's done.

Next, here's an example of the `\align` environment, which combines math mode with a two-column layout, which is very handy for proofs. For this example, we'll revisit the Socrates example from the book:

All men are mortal. Socrates is a man. Therefore, Socrates is mortal.

To turn this into logical statements, let $H(x)$ be "x is a (hu)man" and let $M(x)$ represent "x is mortal." Then, we have two premises:

1. $\forall x\,(H(x) \to M(x))$ — for all entities x, if x is human, then x is mortal.
2. $H(\mathtt{Socrates})$ — Socrates is a human.

Here is the proof that Socrates is mortal. Again, check out the source code.

$\forall x\,(H(x) \to M(x))$	Premise 1	(1)
$H(\mathtt{Socrates}) \to M(\mathtt{Socrates})$	(1), Universal Instantiation	(2)
$H(\mathtt{Socrates})$	Premise 2	(3)
$\therefore M(\mathtt{Socrates})$	(2) and (3), *modus ponens*	(4)

Some notes about this example:

- In the `\align` environment, every line is numbered. You can refer to these numbers elsewhere in the document. To do so, add labels and references; see the example in the math mode documents.
  Note: I manually referred to lines `1`, `2` and `3`. That always works, but can be tedious with a large document.
- Use an ampersand (`&`) to switch from column 1 to column 2.
- Use two backslashes to end a line. It is not necessary to end the last line.
- I used `\qquad` to add space between the columns. Try removing it and render the document to see what it's like without the space.
- `\hline` draws a horizontal line across the page above the current line, which is useful at the end of the proof.
- There is also an `\align*` environment which is identical to `\align`, except the lines are not numbered. Sometimes that is preferable (but probably not for our purposes here).

Finally, there is the one more logic operator, the *exclusive or*, often abbreviated as *xor*. Its symbol is a plus sign inside a circle. Here is a short example, demonstrating that exclusive or is the opposite of if and only if:

p	q	$p \oplus q$	$p \iff q$
T	T	F	T
T	F	T	F
F	T	T	F
F	F	F	T