LaTeX Tips

Adjusting margins

The `geometry` package can be used to adjust margins. For example, this document uses the following options:

```
\usepackage[lmargin=2cm,rmargin=2.5cm,tmargin=3cm,bmargin=2cm]{geometry}
```

The align environment

If you have a long equation that you want to split up over multiple lines, you can use the `align` or `align*` environment. They are the same except that `align` includes equation numbers, whereas `align*` does not. For example, you can typeset the equation[1]

$$\begin{aligned} x^5 - 5x^4 + 2x^3 - 10x^2 - x + 5 &= (x-5)(x^4 + 2x^2 - 1) \\ &= (x-5)((x^2)^2 + 2x^2 - 1) \\ &= (x-5)(x^2 + 1 + \sqrt{2})(x^2 + 1 - \sqrt{2}) \end{aligned}$$

using the code

```
\begin{align*}
x^5 - 5x^4 + 2x^3 - 10x^2 - x + 5 &= (x-5)(x^4 + 2x^2 - 1) \\
                                  &= (x-5)((x^2)^2 + 2x^2 - 1) \\
                                  &= (x-5)(x^2+1+\sqrt{2})(x^2+1-\sqrt{2})
\end{align*}
```

The ampersands tell the `align*` environment what you want aligned, and the backslashes force line breaks; as always, the whitespace in the code is irrelevant. For example,

```
\begin{align*}
x^5 - 5x^4 + 2x^3 - 10x^2 - x + 5
   &= (x-5)(x^4 + 2x^2 - 1) \\
   &= (x-5)((x^2)^2 + 2x^2 - 1) \\
   &= (x-5)(x^2+1+\sqrt{2})(x^2+1-\sqrt{2})
\end{align*}
```

would produce the same output.

Dot for multiplication

If you want to use a dot to denote multiplication, the command is `\cdot`. For example, `$2\cdot3=6$` produces $2 \cdot 3 = 6$. Do not use an asterisk to denote multiplication.

[1] Note that we do not repeat the left-hand side on each line.

The "divides" symbol

The symbol for "divides" is `\mid`. Note the difference between the following:

- Bad: `$a | b$` produces $a|b$, which does not have correct spacing between symbols.
- Good: `$a \mid b$` produces $a \mid b$, which is correct.

The "does not divide" symbol

The symbol for "does not divide is `\nmid`. (This requires the `amssymb` package.) Do not use `\not\mid`, which can come out wrong:

- Bad: `$a \not\mid b$` produces $a \not| b$.
- Good: `$a \nmid b$` produces $a \nmid b$.

Big parentheses

If you need to put parentheses around an expression that takes up a lot of vertical space, it would look ugly to have your tall formula breaking out of regular-sized parentheses:

$$(\sum_{i=1}^{n} u_i v_i)^2 \leq (\sum_{i=1}^{n} u_i^2)(\sum_{i=1}^{n} v_i^2).$$

This inequality[2] looks much nicer if the parentheses are large enough to contain what they're supposed to contain:

$$\left(\sum_{i=1}^{n} u_i v_i\right)^2 \leq \left(\sum_{i=1}^{n} u_i^2\right)\left(\sum_{i=1}^{n} v_i^2\right).$$

The easiest way to accomplish this is by using `\left(` and `\right)`, which automatically resizes your parentheses as appropriate. For example, the left-hand side above is produced using

```
\left(\sum_{i=1}^n u_i v_i\right)^2
```

Note that `\left` and `\right` also work with other bracketing symbols, such as square brackets or absolute values.

Binomial coefficients

Binomial coefficients can be typeset using the `\binom` command, which requires the `\amsmath` package. For example,

$$\binom{5}{2} = \frac{5!}{2!3!} = \frac{120}{12} = 10$$

is typeset using

```
\[\binom{5}{2} = \frac{5!}{2!3!} = \frac{120}{12} = 10\]
```

[2]The famous Cauchy-Schwarz inequality

Function composition

The $\circ$ symbol for function composition can be typeset using `\circ`. For example,

$$g \circ f \colon R \to T$$

is typeset using

```
\[g \circ f \colon R \to T\]
```

"Implies" arrow

You should rarely use symbols like $\Rightarrow$ in serious writing. They are meant to be used as symbols in formal logic, not because you're too lazy to write the word "implies" in the middle of a sentence. In the unlikely event that you have an appropriate opportunity to use one, you have a few options:

- $A \Rightarrow B$, typeset using `A \Rightarrow B`.
- $A \Longrightarrow B$, typeset using `A \Longrightarrow B`.
- $A \implies B$, typeset using `A \implies B`.

"There exists" and "For all"

As with the arrow for implies, you should rarely use these symbols in formal writing; you certainly should not use them to replace words in the middle of a sentence. The command for $\exists$ is `\exists` and the command for $\forall$ is `\forall`.

Blackboard bold

Familiar sets such as $\mathbb{Z}$, $\mathbb{R}$, and $\mathbb{C}$ are commonly written in "blackboard bold" typeface. For example, $\mathbb{Z}$ is typeset using `\mathbb{Z}`.

Custom commands

If you're going to type something frequently, you might want a shortcut for it. For example, I usually define `\Z` to mean `\mathbb{Z}`. The command for this is `\newcommand{\Z}{\mathbb{Z}}`. After defining the command, I can write `\Z` to produce $\mathbb{Z}$.

Integers modulo m

The set $\mathbb{Z}/m\mathbb{Z}$ is typeset by `\Z/m\Z`, using the command `\Z` defined in the previous section. If I had not defined `\Z` earlier, I would need to write out `\mathbb{Z}/m\mathbb{Z}` instead.

Math mode

Remember that mathematical symbols should be written in math mode. Note the difference between f (`f`) and f (`$f$`), or the difference between -1 (`-1`) and -1 (`$-1$`). Incorrectly using f or -1 in place of f or -1 is an unnecessary distraction for the reader.

Colons

If you use a colon in math mode, you get a symbol with equal spacing on both sides: for example `$[L : K]$` produces $[L : K]$. However, for many uses of the colon, you don't want space on both sides; you want it immediately after the previous symbol, just as in ordinary text. For this, you use the `\colon` command. For example, `$f\colon R \to S$` produces $f\colon R \to S$, which is correct. If you incorrectly use `$f: R \to S$`, you get $f : R \to S$, which looks wrong.