# ASSIGNMENT 1 · MAT 999 · FALL 1798

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This is a 5-minute intro to LaTeXfor use in typing up homework. That is, we are not writing to formal formatting requirements, e.g. for a thesis. This file isn't exhaustive (there already are plenty of good documents on LaTeX) — instead, this is a quick sample of some frequently used symbols and formattings, in a format hopefully less intimidating than a 100-page manual. It's easy to use LaTeXto make your homework nice, so don't fear!

As you read, please look at the output (e.g. `.dvi` or `.pdf` file) as well as the source (`.tex`) so you will know what I'm talking about.

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**Problem** (1)**.** Here is what you are supposed to prove.

*Proof.* Here is where you prove it. Notice that here I didn't supply an alternate name, so I got "Proof". □

**Problem** (2)**.** Here is what you are supposed to prove.

*Here is where you specify an alternate name for your proof.* For example, I might use that to say *Proof by contradiction.* □

**Problem** (3)**.** Here is what you are supposed to prove.

*Answer.* For text, just type it in as usual. Three notable exceptions: (1) use a triple dash — here for example — (2) use `ldots` instead of just typing in three periods, i.e. . . . instead of ..., and (3) rather than using the double-quote key on your keyboard, use double backticks for open double quote and double apostrophe for close double quote. You get not "this" but "this" which looks nicer.

A blank line starts a new paragraph. Other than that, though, paragraphs are formatted for you (in particular, compare this sentence in the `.tex` file vs in the `.dvi` or `.pdf` output). *This is how you make italics.*

For mathematical content, if you want put a statement in-line like this: $G \lhd H$ then just use single dollar signs. If you want it on its own line like this:

$$G \lhd H$$

then use double dollar signs. If you have multi-line statements, you might use `eqnarray*` as follows. (Notice that the double ampersands control vertical alignment (usually, but not necessarily, you align on the equals signs), and you must use a double backslash at the end of each line in the `eqnarray*`, except optionally the last.)

*Date*: August 11, 2006.

$$\begin{aligned}(xy)^3 &= xyxyxy \\ &= xxxyyy \text{ since we have commutativity here} \\ &= x^3y^3\end{aligned}$$

For superscripts and subscripts, just use caret and underscore, e.g. $a_{i,j}^2, M_{\sigma(i)}^{p_{n_k}}$. Remember that if you have a single character, you can just put it after the caret, but if you have more than one, use curly braces. E.g. $x^12$ is not the same as $x^{12}$. Since curly braces are used for clumping, you have to escape them with a backslash if you want the curly braces to be visible: $N = \{1, 2, \ldots, n\}$.

It's considered polite to make cos, sin, log etc. upright instead of italic. E.g. $\cos(x)$ or $\cos(x)$ rather than $cos(x)$.

Notice your whitespace isn't used in math expressions, e.g. this $xyz$ looks the same as this $xyz$. But sometimes you want to insert some space — e.g. in cycle notation for permutations, compare $(123)(57)$ to $(1\,2\,3)(5\,7)$. Here are some examples of how to insert extra spacing: $xy$, $x\,y$, $x\,y$, $x\,y$, $x\quad y$, $x\qquad y$.

If you want to make a table, you can use something like this:

| $x$ | $\sqrt{x}$ | $1/x$ | lah-dee-dah |
|---|---|---|---|
| 1 | 1 | 1 | haw |
| 4 | 2 | 1/4 | haw |
| 9 | 3 | 1/9 | haw |

Sometimes, though, I use `verbatim` for pre-formatted ASCII, that is, if I have a text file that already looks the way I want it and I don't want to fuss with the tabular environment:

```
mod 13:                mod 19:                mod 1f:
02 = 0        [  0]    02 = 0        [  0]    02 = 0        [  0]
03 = 1        [  1]    03 = 1        [  1]    03 = 1        [  1]
07 = 6 7      [  3]    07 = a b      [  3]    07 = c d      [  3]
13 = 2 3 4 5  [ 15]    13 = 6 7 c d  [ 15]    13 = 6 7 a b  [ 15]
19 = 9 b d e  [ 15]    19 = 2 4 9 e  [ 15]    19 = 3 5 9 e  [ 15]
1f = 8 a c f  [  5]    1f = 3 5 8 f  [  5]    1f = 2 4 8 f  [  5]
```

Here is a matrix example:

$$\begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix} + \begin{pmatrix} 1 & 1 & 1 \\ 2 & 2 & 2 \\ 3 & 3 & 3 \end{pmatrix} = \begin{pmatrix} 2 & 3 & 4 \\ 6 & 7 & 8 \\ 10 & 11 & 12 \end{pmatrix}$$

Here is a bigger matrix:

$$M = \begin{pmatrix} a_{1,1} & a_{1,2} & \cdots & a_{n,n} \\ a_{2,1} & a_{2,2} & \cdots & a_{2,n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n,1} & a_{n,2} & \cdots & a_{n,n} \end{pmatrix}$$

For parentheses, square brackets, and curly braces wrapped around bigger stuff, use `\left(` and `\right)`. These will cause the parentheses (or brackets or braces) to be sized to fit. E.g. not

$$(\frac{123}{456})$$

but rather

$$\left(\frac{123}{456}\right).$$

Sums, products and integrals use subscripts and superscripts just like anything else:

$$F(k) = \int_{-\infty}^{\infty} e^{-i2\pi kx}\,\mathrm{d}x, \quad e^x = \sum_{n=0}^{\infty} \frac{x^n}{n!}, \quad f(x) = \prod_{\sigma\in G} \sigma(x)^{f(\sigma)}$$

Path integrals use $\oint$.

Here is itemize:

a. Here is one item.
b. Here is another item.
   Note that I have indentation here.
c. The last one.

Here is itemize with default bullets:

- Here is one item.
- Here is another item.

Here is enumerate:

(a) Here is one item.
(b) Here is one item.

Greek letters are just a backslash followed by their usual name, e.g. $\alpha$, $\beta$, $\gamma$. Uppercase them by using an uppercase name in the LaTeXsource, e.g. $\Gamma$. Note, however, that there aren't codes for some uppercase Greek letters, since they are identical to a Roman capital (e.g. capital alpha is just a capital A). Also, there's no lower-case omicron, since that's just a Roman o.

$\alpha\beta\gamma\delta\epsilon(\varepsilon)\zeta\eta\theta(\vartheta)\iota\kappa\lambda\mu\nu\xi o\pi\rho\sigma\tau\upsilon\phi(\varphi)\chi\psi\omega$.

$AB\Gamma\Delta EZH\Theta IK\Lambda MN\Xi O\Pi P\Sigma T\Upsilon\Phi X\Psi\Omega$.

Some alternate typefaces:

$\mathcal{ABCDEFGHIJKLMNOPQRSTUVWXYZ}$

$\mathfrak{ABCDEFGHIJKLMNOPQRSTUVWXYZ}$

$\mathbb{ABCDEFGHIJKLMNOPQRSTUVWXYZ}$

$\mathbf{ABCDEFGHIJKLMNOPQRSTUVWXYZ}$

$\mathbf{abcdefghijklmnopqrstuvwxyz}$

$\mathfrak{ABCDEFGHIJKLMNOPQRSTUVWXYZ}$

$\mathfrak{abcdefghijklmnopqrstuvwxyz}$

The `isomath.tex` file which I obtained from Dr. Kaliszewski (`isomath.tex` is included by this file, for example) has abbreviations for frequently used symbols such as $\mathbb{R}$. More examples: $\mathbb{C}$ $\mathbb{Q}$ $\mathbb{Z}_p$ $\mathbb{F}_p^n$ $\mathcal{S}_n$ $\mathcal{A}_n$ $\mathcal{D}_n$.

Sizes:

- tiny: Here is some text
- scriptsize: Here is some text
- footnotesize: Here is some text
- small: Here is some text
- normalsize: Here is some text
- large: Here is some text
- Large: Here is some text
- LARGE: Here is some text
- huge: Here is some text
- Huge: Here is some text

The `mathenv.tex` file, which I also obtained from Dr. Kaliszewski, has nice environments such as problem, proof, answer, etc. as used above.

**Lemma.** *Here is an example of the lemma environment.*

*Proof.* Here is your proof of your lemma. Notice the nice little white box which lets people know you're done. □

Here are several symbols: $a \cdot b$, $a \circ b$, $a \pm b$, $a < b$, $a \not< b$, $a \leq b$, $a > b$, $a \not> b$, $a \geq b$, $a = b$, $a \neq b$, $a \gg b$, $a \ll b$, $a/b$, $\frac{a}{b}$, $\binom{a}{b}$, $\left(\frac{a}{b}\right)$, $\left(\frac{a}{b}\right)$. Notice that you can put `not` in front of many operators to negate them.

$y = \sqrt{x}$, $y = \sqrt[3]{x}$, $y = \sqrt[4]{x}$, $f : A \to B$, $x \mapsto y$, $A \leftarrow B$, $A \leftrightarrow B$, $A \hookrightarrow B$, $A \leftrightarrow B$, $\lfloor x \rfloor$, $\lceil x \rceil$.

$|A|$, $a \mid b$, $a \nmid b$, $A\overline{BCD}E$, $\underbrace{A \times \ldots \times A}_{r \text{ times}}$, $\overbrace{A \times \ldots \times A}^{r \text{ times}}$, $A \cap B$, $A \cup B$, $A \setminus B$, $A \wedge B$, $A \subset B$, $A \subseteq B$, $\langle x \rangle$, $A \times B$, $A \otimes B$, $A \oplus B$, $A \lhd B$, $A \rhd B$, $A \trianglelefteq B$, $A \trianglerighteq B$, $A \ltimes B$, $A \rtimes B$, $x \in A$, $x \notin A$, $A \not\subseteq B$, $(\mathbb{Z}_p, \oplus)$, $(\mathbb{Z}_p, \odot)$, $A \sim B$, $A \simeq B$, $A \cong B$, $A \approx B$, $a \equiv b \pmod{p}$, $a \not\equiv b \pmod{p}$.

Math mode: $\acute{a}$, $\bar{a}$, $\breve{a}$, $\check{a}$, $\ddot{a}$, $\dot{a}$, $\grave{a}$, $\hat{a}$, $\boldsymbol{a}$, $\tilde{a}$, $X/\sim$, $\tau_\sim$, $\Delta$, $\nabla$.

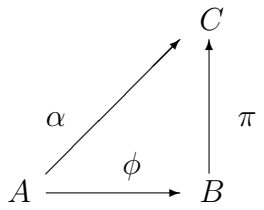
Text mode: ä, á, ȧ, ā, â, à, à, ő, å, ă, ă, ã.

Prüfer, Erdős, Čech, Kløve, Ostergård, polynôme, théorème, naïve, limaçon, Großencharacter, \$2.56.

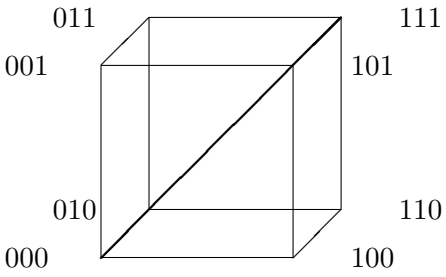
$$(a)\big(b\big)\Big(c\Big)\Big(d\Big)\Big(e\Big)$$

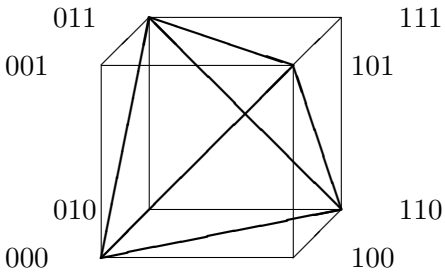
$$x_i = \begin{cases} m_{d_i,k}, & \text{if } d_i > 0 \\ 1, & \text{if } i = k \\ 0, & \text{otherwise} \end{cases}$$

Here is an example of using the picture environment. Note (see the LaTeX source) that the run and rise arguments to the line and vector commands (in parentheses) must be integers between -6 and 6. The length argument (in curly braces) may be any floating-point number. However, it signifies the length of the horizontal projection, not the length of the hypotenuse. (For vertical lines, i.e. (0,1) or (0,-1), it is the line length.)




Here is another example:




For more symbols, Google for `lshort.pdf`, and/or see the Computing link at `math.asu.edu`.