

1 Theorems, Definitions, Remarks, Propositions, etc.

1.1 The newtheorem command

Most mathematics papers have theorems, lemmas, propositions, definitions, etc. and most papers would like to number those things in some way. \LaTeX has a method for declaring these called

```
\newtheorem
```

In the preamble (!!) you put the command:

```
\newtheorem{theorem}{Theorem}
```

Here `theorem` is your name that you'd like to use in the document to refer to the thing by and `Theorem` is the name that \LaTeX will display in the output file. Then in the body you can type

```
\begin{theorem}.....  
\end{theorem}
```

An example preamble might include the following commands:

```
\newtheorem{theorem}{Theorem}  
\newtheorem{corollary}[theorem]{Corollary}  
\newtheorem{definition}{Definition}  
\newtheorem{example}[definition]{Example}
```

Add these four lines to your preamble. Then in the body, put in some theorems, corollaries, definitions and examples. Each thing will have the form

```
\begin{thing} Type some words or math  
\end{thing}
```

Exercise: Can you tell what the difference is between the corollaries and the definitions? How is the numbering different between those two?

1.2 The newenvironment command

Most people like their proofs to have a certain format. Maybe they should all start with the word “Proof” in boldface and end with a square symbol (\square). Or maybe you want to have the entire proof in italics (probably not!). Whatever it is, you can use the `\newenvironment` command to set up the format and it will be applied the same way throughout your document. Put the following line in your preamble:

```
\newenvironment{proof}{\textbf{Proof:}}{\hfill $\square$}
```

Then in the body, after a theorem, you can write

```
\begin{proof}  la la la here is my proof.
\end{proof}
```

L^AT_EX it up and see what you get.

2 Labelling and Referring to Numbered items

If you have numbered equations, theorems, list items, etc. in your document, you may wish to refer to those equations later. To do this you use `\label` to name the item and `\ref` to refer to it later.

Example:

A very important equation due to Pythagoras and his followers is:

```
\begin{equation}\label{pythag}
a^2+b^2=c^2
\end{equation}
```

Everybody’s favorite trig identity is

```
\begin{equation}\label{trig}
\sin^2 \theta + \cos^2 \theta =1
\end{equation}
```

You may not realize that Equation `\ref{pythag}` and Equation `\ref{trig}` are actually equivalent.

A very important equation due to Pythagoras and his followers is:

$$a^2 + b^2 = c^2 \tag{1}$$

Everybody's favorite trig identity is

$$\sin^2 \theta + \cos^2 \theta = 1 \tag{2}$$

You may not realize that Equation 1 and Equation 2 are actually equivalent.

When you have added or changed labels and references, you must hit the \LaTeX button twice to make sure the references come up correctly.

When you label a thing, you type the command `\label{name}` just to the right of the `\begin{thing}` without any spaces. For example,

```
\begin{equation}\label{goodequation} ....\end{equation}
```

```
\begin{theorem}\label{greatthm}.....\end{theorem}
```

```
\begin{enumerate}
  \item\label{superproblem} .....
  \item\label{anotherproblem}.....
\end{enumerate}
```

Then you can refer to these things by the names that you gave them anywhere in the document (including before the things actually appear). Remember to hit the \LaTeX button twice!!! When you use `ref` and `label`, \LaTeX requires two passes through the document to make sure all the cross-references are correct.

3 New Definitions in the Preamble

Sometimes there are certain \LaTeX commands that one types over and over again in a certain article. If those commands are particular unwieldy or irritating to type, you can shorten them by making up your own abbreviation. The command is `\newcommand` and it goes in the preamble. The format is `\newcommand{\abbreviation}{\what it abbreviates}`. For example, the following are from my preamble in a document for a Number Theory class:

```
\newcommand{\ds}{\displaystyle} %\displaystyle forces equations to be written large

\newcommand{\lcm}{\mathrm{lcm}\mbox{ }} %writes lcm in math mode using a text font
\newcommand{\leg}[2]{\left(\frac{#1}{#2}\right)} %gives the Legendre symbol
\newcommand{\mod}{\mathrm{mod}\mbox{ }} %writes mod in math mode using a text font

\newcommand{\zzz}{\mathbb{Z}} %writes the symbol for the integers
\newcommand{\nnn}{\mathbb{N}} %writes the symbol for the naturals
\newcommand{\rrr}{\mathbb{R}} %writes the symbol for the reals
\newcommand{\qqq}{\mathbb{Q}} %writes the symbol for the rationals
```

Now, in the body, you can type the abbreviated command. When L^AT_EX processes the document, it will replace the abbreviated command by exactly what appears in the second brackets. So, whenever I type `\ds`, L^AT_EX just treats it as if it really said `\displaystyle`. Notice that all of the commands above are things that belong in math mode. That means I can use those abbreviations only in math mode. Now, in the body I could write

For all $p \in \mathbb{N}$, $\text{\leg{p-1}{p}=n(\text{mod } m)}$.
 Furthermore, $\text{\ds\sum_{\theta \in \mathbb{R}} \theta} = \infty$.

For all $p \in \mathbb{N}$, $\left(\frac{p-1}{p}\right) = n(\text{mod } m)$. Furthermore, $\sum_{\theta \in \mathbb{R}} \theta = \infty$.

Notice especially the command `\leg`. It has a [2] after it, which means it has 2 inputs. Those inputs are always listed as #1 and #2 in the definition. Another example of this is from my dissertation:

```
\newcommand{\bohr}[1]{\#1^\{\sharp}}
```

Here is a silly example:

```
\newcommand{\faves}[5]{I love \textbf{\#1}, \textit{\#2}, \textsf{\#3}, \textsl{\#4}, \textsc{\#5}}
```

Then in the body I could type

```
\faves{Ice Cream}{Chocolate}{Peanut Butter}{Veronica Mars}{Kittens}
```

I love **Ice Cream**, *Chocolate*, Peanut Butter, *Veronica Mars*, KITTENS