$\LaTeX$ guide

Alden Gassert

August 29, 2018

Contents

Chapter 1

An introduction to LaTeX

1.1 Resources

In this course, all written work must be done in LaTeX. Software for composing LaTeX documents is freely available online, and there are also a number of free-to-use websites for creating collaborative LaTeX documents (useful for group assignments).

Links:

1. LaTeX wikibook: All things LaTeX.

   `http://en.wikibooks.org/wiki/LaTeX`

2. ShareLaTeX: Collaborative `.tex` documents.

   `https://www.sharelatex.com`

3. Overleaf: Another website for collaborative .tex-ing.

   `https://www.overleaf.com`

4. Detexify: Looking for a symbol but you do not know what it is called? Look up a symbol by drawing it! (Tends to be hit-or-miss, but still generally useful.)

   `http://detexify.kirelabs.org/classify.html`

5. Symbols list: More than you will ever need ever.

   `http://www.tex.ac.uk/tex-archive/info/symbols/comprehensive/symbols-a4.pdf`

6. TikZ: You might learn how to draw pictures one day...

   `http://www.texample.net/tikz/examples`

7. Acquiring LaTeX: If you are interested in obtaining LaTeX for personal use...

   `http://latex-project.org/ftp.html`

8. Writing with good practices: A reference.

   `http://www.math.illinois.edu/~dwest/grammar.html`

1.2 Modes

There are two primary *modes* in which LaTeX is written: *text mode*, and *math mode*. Text mode is used for text; write as you would in any word processor. Anything mathematical should be written in math mode. A dollar sign (`$`) is used to transition between the two modes.

Input:

```
A function $f \colon A \to \bbr$ is \emph{continuous} if for each
$\epsilon > 0$, there exists a $\delta > 0$, such that if $|x-c| < \delta$,
then $|f(x) - f(c)| < \epsilon$.
```

Output:

> A function $f\colon A \to \mathbb{R}$ is *continuous* if for each $\epsilon > 0$, there exists a $\delta > 0$, such that if $|x-c| < \delta$, then $|f(x) - f(c)| < \epsilon$.

Math mode has two styles: math can be written *in-line* (as in the example above using dollar signs) or it sectioned away from text and be *displayed*. Some symbols will be type-set differently depending on the style. You can force displayed math to appear in-line using the command `\displaystyle` (or `\ds`†) in math mode. However, if you are going to write display-style math, you might as well place it in the `align` *environment* (see the next section).

Input:

```
In-line math: $\lim_{x \to \infty} \int_1^x \frac{1}{x}\,dx$,
and forced displaystyle in-line: $\ds\lim_{x \to \infty} \int_1^x
\frac{1}{x}\,dx$.
```

Output:

> In-line math: $\lim_{x\to\infty} \int_1^x \frac{1}{x^2}\,dx$, and forced displaystyle in-line: $\displaystyle\lim_{x\to\infty} \int_1^x \frac{1}{x^2}\,dx$.

1.3 Environments

In short, an *environment* is simply a set of formatting rules that dictates how text and math are displayed. Every environment is evoked by the command `\begin{[environment]}` and ended by `\end{[environment]}`. Everything between these commands is subject to the rules of that environment.

1.3.1 Document

Every `.tex` file must contain a `document` environment. The TeX compiler will only output what you write in this environment.

```
\begin{document}
[Turn this into a pdf please!]
\end{document}
```

1.3.2 Homework, definitions, theorems, and proof

The important statements in mathematics each have their own environment; these include `defn`†, `thm`†, `prop`†, `lem`†, and `conj`†. These key words are intrinsic to my `.tex` file; if you use someone else's file, the key words used to call these environments may not be the same.

For block quotations, use the `quote` environment.

```
\begin{quote}
...
\end{quote}
```

Definition 1.3.1. A precise and unambiguous statement that gives meaning to a *key word*. Use `\emph{[key word]}` to highlight the key word.

Definitions *do not require proof.*

```
\begin{defn}
...
\end{defn}
```

Theorem 1.3.2. *Theorems are major mathematical results. Theorems, along with Propositions and Lemmas, are claims that require* proof. *Unproved claims are called* conjectures.

```
\begin{thm}
...
\end{thm}
```

Proposition 1.3.3. *Propositions are mathematical results, but they generally do not carry the same weight as a theorem. Propositions require proof.*

```
\begin{prop}
...
\end{prop}
```

Lemma 1.3.4. *Lemmas are small, often technical, results. Generally, lemmas are 'helpful facts' that are needed to prove much larger results. Lemmas require proof.*

```
\begin{lem}
...
\end{lem}
```

Claim 1.3.5. A catch-all term. Claims require proof.

```
\begin{claim}
...
\end{claim}
```

Proof. A *proof* is an irrefutable, deductive argument. Be aware that there is a significant difference between giving evidence in support of a claim and proving a claim. Examples do not constitute a proof. Proofs should be written in the `proof` environment. □

```
\begin{proof}
...
\end{proof}
```

ANSWER: For homework problems that are not proofs, use the `answer`† environment. □

```
\begin{answer}
...
\end{answer}
```

Conjecture 1.3.6. A conjecture is an unproven statement.

```
\begin{conj}
...
\end{conj}
```

Naming definitions, theorems, etc.

You can add a 'name' to a definition, theorem, etc. by placing the name in square brackets immediately following the `\begin{[environment]}` command. A few examples:

```
\begin{defn}[even]
An integer $a$ is \emph{even} if $a = 2b$ for some integer $b$.
\end{defn}
```

Definition 1.3.7 (even)**.** An integer a is *even* if $a = 2b$ for some integer b.

```
\begin{thm}[Fermat's little theorem]
If $a$ is an integer and $p$ is a prime, then $a^p \equiv a \pmod p$.
\end{thm}
```

Theorem 1.3.8 (Fermat's little theorem)**.** *If a is an integer and p is a prime, then $a^p \equiv a \pmod p$.*

Suppressing numbers

The automated numbering of definitions, theorems, etc. can be suppressed with an asterisk (`*`).

```
\begin{defn*}
This definition has no number.
\end{defn*}
```

Definition. This definition has no number.

```
\begin{lem*}[name]
This lemma has a 'name', but no number.
\end{lem*}
```

Lemma (name)**.** *This lemma has a 'name', but no number.*

1.3.3 Lists

There are a number of environments that support lists, but I will only discuss enumerate.

1. Each numbered item in the list is specified by the key word \item.
2. Numbering is automated...

$\sqrt{5}$. ...but you can customize individual items using \item[...].

3. Lists can be nested by calling enumerate again.
   (a) Again, numbering is automated.
   (b) And you can continue to nest lists.
      i. These lists may be customized further, but this should be sufficient for now.

```
\begin{enumerate}
\item Each numbered item in the list is specified by the key word \cverb;\item;.
\item Numbering is automated...
\item[$\sqrt 5$.]  ...but you can customize individual items using \cverb;\item[...];.
\item Lists can be nested by calling \everb;enumerate; again.
\begin{enumerate}
\item Again, numbering is automated.
\item And you can continue to nest lists.
\begin{enumerate}
\item These lists may be customized further, but this should be sufficient for now.
\end{enumerate}
\end{enumerate}
\end{enumerate}
```

1.3.4 Displayed equations

There are a number of environments that produce displayed math. My preferred environments are align and align*. Every line in align will be numbered; lines in align* will not.

Input:

```
\begin{align}
\sum_{n=1}^\infty \frac{1}{n^2} = \prod_{p \text{ prime}} \frac{1}{1-p^{-2}}.
\end{align}
```

Output:

$$\sum_{n=1}^\infty \frac{1}{n^2} = \prod_{p \text{ prime}} \frac{1}{1-p^{-2}}. \tag{1.1}$$

The equation is numbered (to the right of the equation) so that it may be referenced elsewhere in the document. (See the Section 1.4 regarding labels.)

The align environment allows for multiple aligned columns across the page. Columns are separated using & and new lines are designated by \\. Columns alternate between right and left aligned.

Input:

```
\begin{align*}
    e^{i\pi} &= \sum_{n=1}^\infty\frac{(i\pi)^n}{n!}
        && \text{(Taylor series for $e^x$)} \\
    &= \sum_{n=1}^\infty \frac{\pi^{2n}}{(2n)!}
        + i\sum_{n=1}^\infty\frac{\pi^{2n+1}}{(2n+1)!}
        && \text{(rearrangement of terms)} \\
    &= \cos(\pi) + i \sin(\pi)
        && \text{(Taylor series for $\cos(x)$ and $\sin(x)$)} \\
    &= -1. && \text{(simplifying the previous expression)}
\end{align*}
```

Output:

$$\begin{aligned}
e^{i\pi} &= \sum_{n=1}^\infty\frac{(i\pi)^n}{n!} && \text{(Taylor series for e^x)} \\
&= \sum_{n=1}^\infty \frac{\pi^{2n}}{(2n)!} + i\sum_{n=1}^\infty\frac{\pi^{2n+1}}{(2n+1)!} && \text{(rearrangement of terms)} \\
&= \cos(\pi) + i \sin(\pi) && \text{(Taylor series for $\cos(x)$ and $\sin(x)$)} \\
&= -1 && \text{(simplifying the previous expression).}
\end{aligned}$$

There are four columns in this example. The first column is right aligned (and contains only $e^{i\pi}$). The second column is left aligned, lining up the '$=$' signs. The third column (right aligned) is empty because I want the explanation for each line to be lined up on the left.

1.4 Labels, links, and references

The label-reference mechanic is exceptionally useful tool for referencing the numbered items in your document. The number of any theorem, definition, equation, etc. is stored using `\label{[name]}` following the declaration of any numbered item, and can be recalled anywhere in the document using `\eqref{[name]}` for equations, and `\ref{[name]}` for all other items.

```
\begin{thm} \label{th:example theorem label}
Theorem \ref{th:example theorem label} is self-referential.
\end{thm}
\begin{align} \label{eq:example equation label}
\text{This is equation \eqref{eq:example equation label}.}
\end{align}
```

Theorem 1.4.1. *Theorem 1.4.1 is self-referential.*

$$\text{This is equation (1.2).} \tag{1.2}$$

The label-reference system is the preferred way to recall numbered items because the numbering will remain consistent even if you move these items around in your document.

1.5 Fonts

1.5.1 Text fonts

	Input	Output
Default	`ABCabc123`	ABCabc123
Bold	`\textbf{ABCabc123}`	**ABCabc123**
Italics	`\textit{ABCabc123}`	*ABCabc123*
Small capitals	`\textsc{ABCabc123}`	ABCabc123
Typewriter	`\texttt{ABCabc123}`	`ABCabc123`

1.5.2 Math fonts

	Input	Output
Default	`ABCabc123`	$ABCabc123$
Roman	`\mathrm{ABCabc123}`	$\mathrm{ABCabc123}$
Bold	`\mathbf{ABCabc123}`	$\mathbf{ABCabc123}$
Italics	`\mathit{ABCabc123}`	$\mathit{ABCabc123}$
Typewriter	`\mathtt{ABCabc123}`	$\mathtt{ABCabc123}$
Blackboard bold[1]	`\mathbb{ABC}`	$\mathbb{ABC}$
Blackboard bold (more)	`\mathbbm{abc12}`	$\mathbbm{abc12}$
Calligraphic	`\mathcal{ABC}`	$\mathcal{ABC}$
Euler script	`\EuScript{ABC}`	$\EuScript{ABC}$
Fraktur	`\mathfrak{ABCabc123}`	$\mathfrak{ABCabc123}$
Script	`\mathscr{ABC}`	$\mathscr{ABC}$

Note that some fonts are only available for certain characters.

1.5.3 Text in math mode

Text can be written in math mode using `\text{[text]}` or `\atext{[text]}`[†]. These commands are particularly useful when it is inconvenient or impossible to leave math mode.

Input:

```
\begin{align*}
\sum_{n=1}^\infty \frac{1}{n^s} = \prod_{p \text{ prime}} \frac{1}{1-p^{-s}}
\atext{is the Euler product for $\zeta(s)$ (if $\Re(s) > 1$).}
\end{align*}
```

Output:

$$\sum_{n=1}^\infty \frac{1}{n^s} = \prod_{p \text{ prime}} \frac{1}{1-p^{-s}} \quad \text{is the Euler product of } \zeta(s) \text{ (if } \Re(s) > 1\text{).}$$

1.5.4 Key words

Key words should be highlighted using `\emph`. Visually, this has the same effect as italicizing the word (or romanizing, if the word appears in italicized text).

Input: `It's time to \emph{sing}.`

[1] How else would you write in bold on a blackboard?

Output: It's time to *sing*.
Input:

```
\textit{Bacon pancakes, makin' bacon pancakes. \\
Take some bacon and I put it in a pancake. \\
Bacon pancakes, that's what it's gonna make. \\
Ba- con pan- caaake \dotso in \emph{New York}}.
```

Output:

Bacon pancakes, makin' bacon pancakes.
Take some bacon and I put it in a pancake.
Bacon pancakes, that's what it's gonna make.
Ba- con pan- caaake … *in* New York.

https://www.youtube.com/watch?v=cUYSGojUuAU

1.6 Symbols

This is by no means an exhaustive list of symbols and commands. The intension is to provide a searchable reference of frequently used symbols. Nearly all of these commands are standard, but a few of the commands are my own (so you will only have access to these commands if you are using my `.tex` file). I have marked those commands with a dagger (†).

Unless otherwise stated, the commands are only available in math mode (the purple text must be placed between dollar signs to be displayed properly).

1.6.1 Algebraic expressions

Example		Translation
`a + b`	$a+b$	a plus b
`a - b`	$a-b$	a minus b
`a \cdot b`	$a \cdot b$	a times b (uncommon; in most cases we simply write ab)
`a \times b`	$a \times b$	Cartesian product of a and b, (also: a cross/times b)
`\frac{a}{b}`	$\frac{a}{b}$	a over (divided by) b
`a/b`	a/b	a over (divided by) b (preferred for in-line expressions when it improves readability)
`a^{n}`	a^{n}	a to the n
`a^{n^{k^{13}}}`	$a^{n^{k^{13}}}$	(nested superscripts)
`a_{n}`	a_{n}	a sub n
`a_{n_{k_{13}}}`	$a_{n_{k_{13}}}$	(nested subscripts)
`\sqrt{a}`	$\sqrt{a}$	square root of a
`\sqrt[n]{a}`	$\sqrt[n]{a}$	n-th root of a
`|a|`	$\|a\|$	absolute value of a
`\pm a`	$\pm a$	plus or minus a
`\binom{a}{b}`	$\binom{a}{b}$	a choose b
`a \pmod{p}`	$a \pmod{p}$	a mod p (a modulo p)

1.6.2 Algebraic relations

Input	Output	Example		Translation
`=`	$=$	`a = b`	$a = b$	a is equal to b
`<`	$<$	`a < b`	$a < b$	a is less than b
`\le`	$\le$	`a \le b`	$a \le b$	a is less than or equal to b
`>`	$>$	`a > b`	$a > b$	a is greater than b
`\ge`	$\ge$	`a \ge b`	$a \ge b$	a is greater than or equal to b
`\equiv`	$\equiv$	`a \equiv b`	$a \equiv b$	a is congruent to b (generally used with `\pmod`)
`\sim`	$\sim$	`a \sim b`	$a \sim b$	a is related to b
`\mid`	$\mid$	`a \mid b`	$a \mid b$	a divides b

Many of these commands can be negated using the command `\not`. Note that some symbols have special commands for negation.

Input	Output
`\ne`	$\ne$
`\not <`	$\not<$
`\not\le`	$\not\le$
`\not >`	$\not>$
`\not\ge`	$\not\ge$
`\not\equiv`	$\not\equiv$
`\nsim`	$\nsim$
`\nmid`	$\nmid$

1.6.3 Braces, Brackets, Parentheses, etc.

<table>
<tr><th>Input</th><th>Output</th></tr>
<tr><td><code>(a,b)</code></td><td>(a,b)</td></tr>
<tr><td><code>[a,b]</code></td><td>$[a,b]$</td></tr>
<tr><td><code>|a,b|</code></td><td>$|a,b|$</td></tr>
<tr><td><code>\|a,b\|</code> or <code>\mags</code>† <code>{a,b}</code></td><td>$\|a,b\|$</td></tr>
<tr><td><code>\{a,b\}</code> or <code>\set</code>† <code>{a,b}</code></td><td>$\{a,b\}$</td></tr>
<tr><td><code>\langle a,b \rangle</code> or <code>\gens</code>† <code>{a,b}</code></td><td>$\langle a,b \rangle$</td></tr>
<tr><td><code>\lfloor a,b \rfloor</code> or <code>\floor</code>† <code>{\frac{a}{b}}</code></td><td>$\left\lfloor \frac{a}{b} \right\rfloor$</td></tr>
</table>

Resizing delimiters

These symbols can be automatically resized using the `\left` and `\right` commands.

Input: `\left\{ \floor{ \left( a^n \right)^{n^2} }^{\frac{1}{2n-1}} \right\}`
Output:

$$\left\{ \left\lfloor \left(a^n \right)^{n^2} \right\rfloor^{\frac{1}{2n-1}} \right\}$$

The `\left` and `\right` commands do not need to take the same delimiters, but they do have to be paired. A period `.` can be used to produce one-sided delimiters.

Input:

```
\begin{align*}
\int_a^b x\,dx = \left. \frac{x^2}{2} \right|_a^b
\end{align*}
```

Output:

$$\int_a^b x\,dx = \left. \frac{x^2}{2} \right|_a^b$$

1.6.4 Dots

The `\dots` command is pretty much all you need (even in text mode). There are also more specific commands, but for the most part you should not need anything more than `\ldots` and `\cdots`.

	Command	Example	
Comma separated lists	`\dotsc`	`1, 2, 3, \dotsc, 9`	$1, 2, 3, \dotsc, 9$
Lower dots	`\ldots`	`1, 2, 3, \ldots,9`	$1, 2, 3, \ldots, 9$
Binary expressions	`\dotsb`	`1 + 2 + \dotsb + 9`	$1 + 2 + \dotsb + 9$
Centered dots	`\cdots`	`1 + 2 + \cdots + 9`	$1 + 2 + \cdots + 9$
Multiplication (binary)	`\cdot`	`a \cdot b`	$a \cdot b$
Multiplication	`\dotsm`	`1 \cdot 2 \cdot 3 \dotsm 9`	$1 \cdot 2 \cdot 3 \dotsm 9$
Otherwise [wide ellipsis]	`\dotso`	`a, b, c, \dotso, z`	a, b, c, . . . , z
Vertical dots	`\vdots`		$\vdots$
Diagonal dots	`\ddots`		$\ddots$

1.6.5 Functional notation

Input	Output	Example		Translation
`\to`	$\to$	`f \colon A \to B`	$f\colon A \to B$	f is a map from A to B
`\into`†	$\hookrightarrow$	`f \colon A \into B`	$f\colon A \hookrightarrow B$	f is an injective map from A to B (f maps A into B)
`\onto`†	$\twoheadrightarrow$	`f \colon A \onto B`	$f\colon A \twoheadrightarrow B$	f is a surjective map from A to B (f maps A onto B)
`\isom`†	$\xrightarrow{\sim}$	`f \colon A \isom B`	$f\colon A \xrightarrow{\sim} B$	f is a bijective map from A to B (f is an isomorphism from A to B)
`\circ`	$\circ$	`f \circ g`	$f \circ g$	f composed with g
`\mapsto`	$\mapsto$	`x \mapsto f(x)`	$x \mapsto f(x)$	x is mapped to $f(x)$
`f\inv†(x)`	$f^{-1}(x)$	`\sin\inv(\theta)`	$\sin^{-1}(\theta)$	f inverse, arcsine theta

Defining functions:

Input: `f \colon A \to B`

Output: $f\colon A \to B$

Input:

```
\begin{align*}
f \colon A &\to B \\
x &\mapsto f(x)
\end{align*}
```

Output:

$$\begin{align*} f \colon A &\to B \\ x &\mapsto f(x) \end{align*}$$

Remark 1.6.1. Use `\colon` (not `:`) for proper spacing.

Input:

```
\begin{align*}
f \colon \mathbb{R} &\to \mathbb{R} \\
x &\mapsto x^2
\end{align*}
```

Output:

$$\begin{align*} f \colon \mathbb{R} &\to \mathbb{R} \\ x &\mapsto x^2 \end{align*}$$

Translation: f is the function from the real numbers to the real numbers that maps x to x^2. (In other words, $f(x) = x^2$.)

Input:

```
\begin{align*}
f \colon \mathbb{Z} &\to \mathbb{F}_p \\
a &\mapsto a \bmod p
\end{align*}
```

Output:

$$\begin{align*} f \colon \mathbb{Z} &\to \mathbb{F}_p \\ a &\mapsto a \bmod p \end{align*}$$

Translation: f is the function from the integers to the finite field of order p that maps a to the reduction of a modulo p.

1.6.6 Greek alphabet

Math mode commands for Greek letters.

	Capital	Lowercase	Variant
A, α	`\mathrm{A}`	`\alpha`	
B, β	`\mathrm{B}`	`\beta`	
Γ, γ	`\Gamma`	`\gamma`	
Δ, δ	`\Delta`	`\delta`	
E, ϵ, ε	`\mathrm{E}`	`\epsilon`	`\varepsilon`
Z, ζ	`\mathrm{Z}`	`\zeta`	
H, η	`\mathrm{H}`	`\eta`	
Θ, θ, ϑ	`\Theta`	`\theta`	`\vartheta`
I, ι	`\mathrm{I}`	`\iota`	
K, κ	`\mathrm{K}`	`\kappa`	
Λ, λ	`\Lambda`	`\lambda`	
M, μ	`\mathrm{M}`	`\mu`	
N, ν	`\mathrm{N}`	`\nu`	
Ξ, ξ	`\Xi`	`\xi`	
O, o	`\mathrm{O}`	`\mathrm{o}`	
Π, π, ϖ	`\Pi`	`\pi`	`\varpi`
P, ρ, ϱ	`\mathrm{P}`	`\rho`	`\varrho`
Σ, σ, ς	`\Sigma`	`\sigma`	`\varsigma`
T, τ	`\mathrm{T}`	`\tau`	
Υ, υ	`\Upsilon`	`\upsilon`	
Φ, ϕ, φ	`\Phi`	`\phi`	`\varphi`
X, χ	`\mathrm{X}`	`\chi`	
Ψ, ψ	`\Psi`	`\psi`	
Ω, ω	`\Omega`	`\omega`	

1.6.7 Large symbols

Symbols, as they appear in the `align` environment (or other similar environments). These symbols will be displayed differently if they are used in-line.

Input	Output	Example		Translation
`\sum`	$\sum$	`\sum_{n=1}^{\infty} n^{-s}`	$\displaystyle\sum_{n=1}^{\infty} n^{-s}$	the sum, from 1 to infinity, of n to the minus s
`\prod`	$\prod$	`\prod_{k=1}^{n} k`	$\displaystyle\prod_{k=1}^{n} k$	the product of the first n natural numbers
`\bigcup`	$\bigcup$	`\bigcup_{i=1}^{\infty} A_i`	$\displaystyle\bigcup_{i=1}^{\infty} A_i$	the union, from 1 to infinity, of the A_i
`\bigcap`	$\bigcap$	`\bigcap_{i=1}^{n} A_i`	$\displaystyle\bigcap_{i=1}^{n} A_i$	the intersection, from 1 to n, of the A_i

1.6.8 Logical symbols

Input	Output	Example		Translation
`\implies`†	$\Rightarrow$	`X \implies Y`	$X \Rightarrow Y$	X implies Y
`\impliedby`†	$\Leftarrow$	`X \impliedby Y`	$X \Leftarrow Y$	X is implied by Y
`\iff`†	$\Leftrightarrow$	`X \iff Y`	$X \Leftrightarrow Y$	X if and only if Y
`\contradiction`†	$\Rightarrow\Leftarrow$			contradiction
`\neg`	$\neg$	`\neg X`	$\neg X$	not X (negate X) also...
`\sim`	$\sim$	`\sim X`	$\sim X$	it is not true that X
`\land`	$\land$	`X \land Y`	$X \land Y$	X and Y
`\lor`	$\lor$	`X \lor Y`	$X \lor Y$	X or Y
`\forall`	$\forall$	`\forall a \in A`	$\forall a \in A$	for all elements in A
`\exists`	$\exists$	`\exists b \in B`	$\exists b \in B$	there exists a b in B
`!`	!	`\exists !b \in B`	$\exists ! b \in B$	there exists a unique b in B

1.6.9 Quotation marks

The left quotation key is used to produce appropriate facing quotation marks.

Input	Output
`"Quotation marks always face right."`	”Quotation marks always face right.”
`‘Use the left-facing mark...’`	‘Use the left-facing mark...’
`` ``...for left-facing quotation marks." ```	“...for left-facing quotation marks.”

1.6.10 Set notation

Defining sets:

Input: `A = \{ [elements] : [conditions]\}`

Output: $A = \{[elements] : [conditions]\}$

Remark 1.6.2. Use `:` (not `\colon`) for proper spacing.

Example:

Input: `\mathbb{N} = \{ a \in \mathbb{Z} : a > 0 \}`

Output: $\mathbb{N} = \{a \in \mathbb{Z} : a > 0\}$

Translation: The natural numbers are the set of elements in the integers that are greater than. (The natural numbers are the set of positive integers.)

Example:

Input: `\mathbb{Q} = \left\{ \frac{a}{b} : a,b \in \mathbb{Z}, b \ne 0 \right\}`

Output: $\mathbb{Q} = \left\{ \frac{a}{b} : a,b \in \mathbb{Z}, b \ne 0 \right\}$

Translation: The rational numbers are the set of numbers of the form a/b, where a and b are integers, and b is non-zero.

Input	Output	Example		Translation
`\in`	$\in$	`a \in A`	$a \in A$	a is an element of A
`\subseteq`	$\subseteq$	`A \subseteq B`	$A \subseteq B$	A is a subset of B
`\subset`	$\subset$	`A \subset B`	$A \subset B$	A is a proper subset of B
`\supseteq`	$\supseteq$	`A \supseteq B`	$A \supseteq B$	A contains B (as a subset)
`\supset`	$\supset$	`A \supset B`	$A \supset B$	A contains B as a proper subset
`=`	$=$	`A = B`	$A = B$	A is equal to B
`\cong`	$\cong$	`A \cong B`	$A \cong B$	A is isomorphic to B
`\cup`	$\cup$	`A \cup B`	$A \cup B$	A union B
`\cap`	$\cap$	`A \cap B`	$A \cap B$	A intersect B
`-`	$-$	`A-B`	$A - B$	A (set) minus B (i.e. the elements of A that are not in B)
`|`	$\vert$	`|A|`	$\vert A\vert$	cardinality of A
`\scr`† `P(A)`	$\mathscr{P}(A)$			the power set of A
`A^c`	A^c			the complement of A (also: `\overline{A}` $\overline{A}$)
`\varnothing`	$\varnothing$	`\{\} = \varnothing`	$\{\} = \varnothing$	$\{\}$ is the empty set (also: `\emptyset` $\emptyset$)

Negations:

Input	Output
`\notin`	$\notin$
`\not\subseteq`	$\not\subseteq$
`\not\subset`	$\not\subset$
`\not\supseteq`	$\not\supseteq$
`\not\supset`	$\not\supset$

1.6.11 Special symbols

Most of these commands are valid in both math mode and text mode.

Input	Output	Comment
`\#`	#	
`\$`	$	
`\%`	%	
`\^{}`	^	text mode only
`\&`	&	
`\_`	_	
`\{`	{	
`\}`	}	
`\textgreater`	>	
`\textless`	<	
`\textbackslash`	\	
`\backslash`	$\backslash$	math mode only

1.7 Color

1.7.1 Colored text and text boxes

Colored text is created using `{\color{[color]} [text] }` (also `\textcolor{[color]}{[text]}`). Here are a few key words for colors in the colors they generate.

blue	gray	Navy	red
Brown brown	Green green	Orange orange	Silver
Cyan cyan	Magenta magenta	pink	Yellow yellow
Gold	Maroon	Purple purple	YellowGreen

Capitalization matters![2]

Backgrounds are colored using `\colorbox{[color]}{[text]}`.

blue		gray		Navy		red	
Brown	brown	Green	green	Orange	orange	Silver	
Cyan	cyan	Magenta	magenta	pink		Yellow	yellow
Gold		Maroon		Purple	purple	YellowGreen	

And, of course, black and white.

The commands `\color`, `\textcolor`, and `\colorbox` work in both math and text mode.

1.7.2 Mixing colors

Shades of colors can be specified using the command `[color!#]`, where the number determines the percentage of that color used in the mix. When only one color is specified, the remainder of the mixture is white.

Input	Output	% blue (box)	% white (box)
`\colorbox{blue!100}{\color{red!0}red}`	red	100	0
`\colorbox{blue!90}{\color{red!10}red}`	red	90	10
`\colorbox{blue!80}{\color{red!20}red}`	red	80	20
`\colorbox{blue!70}{\color{red!30}red}`	red	70	30
`\colorbox{blue!60}{\color{red!40}red}`	red	60	40
`\colorbox{blue!50}{\color{red!50}red}`	red	50	50
`\colorbox{blue!40}{\color{red!60}red}`	red	40	60
`\colorbox{blue!30}{\color{red!70}red}`	red	30	70
`\colorbox{blue!20}{\color{red!80}red}`	red	20	80
`\colorbox{blue!10}{\color{red!90}red}`	red	10	90
`\colorbox{blue!0}{\color{red!100}red}`	red	0	100

More than one color can be specified as inputs as long as the colors are separated by "percent". The last color is always used to fill out the mixture.

[2] Why do some names have two colors? It's a long story.
http://en.wikipedia.org/wiki/Cyan#Cyan_on_the_web_and_in_printing

Input	Output	% Cyan	% Magenta
`\colorbox{Cyan!0!Magenta}{text}`	text	0	100
`\colorbox{Cyan!10!Magenta}{text}`	text	10	90
`\colorbox{Cyan!20!Magenta}{text}`	text	20	80
`\colorbox{Cyan!30!Magenta}{text}`	text	30	70
`\colorbox{Cyan!40!Magenta}{text}`	text	40	60
`\colorbox{Cyan!50!Magenta}{text}`	text	50	50
`\colorbox{Cyan!60!Magenta}{text}`	text	60	40
`\colorbox{Cyan!70!Magenta}{text}`	text	70	30
`\colorbox{Cyan!80!Magenta}{text}`	text	80	20
`\colorbox{Cyan!90!Magenta}{text}`	text	90	10
`\colorbox{Cyan!100!Magenta}{text}`	text	100	0

The reason why I put "percent" in quotation marks is because when mixing more than two colors, the numbers may not be what you expect.

Input	Output	% red	% blue	% yellow
`\colorbox{red!50!blue!66!yellow}{text}`	text	33	33	34
`\colorbox{red!33!blue!33!yellow}{text}`	text	11	22	67

Input	Output	% red	% blue	% white
`\colorbox{red!50!blue}{text}`	text	50	50	0
`\colorbox{red!50!blue!50}{text}`	text	25	25	50
`\colorbox{red!33!blue!33!white!33}{text}`	text	4	7	89

However if you want to be this specific about blending colors, you might as well use `rgb`, `html`, or one of the other standard conventions for specifying colors. (See the LaTeX Wikibook for details.)

† These commands are unique to my `.tex` file.