A LaTeX template

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1 Basic use

Just type in words. The LaTeX will handle the typesetting. The words will use the default font. The command `\emph{text}` will emphasize the word *text*. In usual context, it behaves as `\textit`, but see how does it behave in an italic context: *this is in italic, while a* text *is emphasized*. To obtain **bold** words, use `\textbf`.

Skipping one or more lines will start a new paragraph with indentation. If you do not want the indentation, put `\noindent` at the beginning of the paragraph. If you start a new line without skip, then you are still in the same paragraph.
The command `\\` will start a new line without leave the current paragraph.

See This article for how to change paragraph spacing. Note that how I create a hyperlink to a URL. It has a color since I used `colorlinks=true` in `\hypersetup`.

You can use defined commands such as `\LaTeX` to input some symbols. However, math symbols should be putted in math environments. The basic math environment is the *in-line math mode*: `$...$`. There are also *display math modes*: `\[...\]`, for example:

$$5 + 7 = 12.$$

2 Math symbols

There are many predefined some math symbols and I also have defined some. The following is a non-complete list of math symbols which will be used in this course.

- Subsets: $A \subset B$, $A \subseteq B$, and $A \subsetneq B$.
- Union $A \cup B$, intersection $A \cap B$, set minus $A \setminus B$, and quotient set A/B.
- Use `\Set` to create a set: {elements} or {elements | conditions}. The star `*` in `\Set*` means that the brackets will be scaled automatically to match the size of its context. See the followings:

  $$\{(x, y, z) \in \mathbb{Z}^3 \mid x^p + y^p = z^p\}, \qquad \left\{ \frac{a + b\sqrt{5}}{2} \,\middle|\, a, b \in \mathbb{Z} \right\}.$$

  Note that how `\text` allows we to input text in math mode. Be aware that there is no space between math symbols and the contents of `\text`: see $this$.

- Fractions: `\tfrac` (in-line fraction), `\frac` (display fraction), and `\cfrac` (continued fraction).

$$\tfrac{1}{a_1+\frac{1}{a_2+\cdots}}, \frac{1}{a_1+\frac{1}{a_2+\cdots}}, \cfrac{1}{a_1+\cfrac{1}{a_2+\cdots}}.$$

- The set of Natural numbers $\mathbb{N}$, the set of integers $\mathbb{Z}$, the set of rational numbers $\mathbb{Q}$, the set of real numbers $\mathbb{R}$, and the set of complex numbers $\mathbb{C}$.
- The identity map id, the projection map pr, and the restriction map res.
- The abstract value $|\cdot|$, the norm $\|\cdot\|$, the ceil $\lceil\cdot\rceil$, and the floor $\lfloor\cdot\rfloor$. They have star-variant and different size variants. See the followings:

$$|\tfrac{a}{b}|, \left|\tfrac{a}{b}\right|, |\tfrac{a}{b}|, \left|\tfrac{a}{b}\right|, \left|\tfrac{a}{b}\right|, \left|\tfrac{a}{b}\right|,$$

- Sum `\sum` and product `\prod`. $\sum_{i=1}^{n} a_n$, $\prod_{i=1}^{n} a_n$,

$$\sum_{i=1}^{n} a_n, \qquad \prod_{i=1}^{n} a_n$$

  Compare the in-line ones and the display ones.
  Aside: `\quad` and `\qquad` display some spaces, which is useful since the math mode ignores the spaces.
- Inner product (a, b).
- Vectors $\mathbf{u}$, $\mathbf{v}$, $\mathbf{x}$.
- Math fonts: `\mathcal` $\mathcal{A}$, `\mathscr` $\mathscr{A}$, `\mathfrak` $\mathfrak{A}$, `\mathbb` $\mathbb{A}$, and `\mathbf` $\mathbf{A}$.

3 Equations

There are many equation environments for different purposes.

1. The `equation` provides an equation with numbers.

$$A + B = C. \tag{0.1}$$

   Here I `\label` this equation, so we can refer to it using `\cref`. See: eq. (0.1).

2. The star-variant `equation*` is the same as `\[...\]`.
3. One can use `split` in side an equation to input aligned multiline equations.

$$\begin{aligned} A &= \frac{\pi r^2}{2} \\ &= \tfrac{1}{2}\pi r^2. \end{aligned} \tag{0.2}$$

   You can put more than ones in the same `equation`:

$$\begin{aligned} A &= \frac{\pi r^2}{2} \\ &= \tfrac{1}{2}\pi r^2. \end{aligned} \qquad \text{and} \qquad \begin{aligned} V &= \frac{4\pi r^3}{3} \\ &= \tfrac{4}{3}\pi r^3. \end{aligned} \tag{0.3}$$

4. The `align` environment: multi equations with alignments.

$$\square = \square \tag{0.4}$$
$$\square = \square \tag{0.5}$$

   It also has a star-variant which has no numbers.

5. There is a `\MoveEqLeft` command move the equation in this line slightly left (can be specified with `[number]`).

$$\begin{aligned} &\boxed{\text{Long first line}} \\ &= \boxed{\text{2nd line}} \\ &\vdots \\ &= \boxed{\text{last line}} \end{aligned}$$

   (see the code for more details such as the use of `\vdotswithin{=}`)

6. There is also many `cases` environments:

$$f(x) = \begin{cases} \sum_{i=1}^{n} a_i(x) & = \text{condition 1}, \\ \frac{1}{x} & = \text{condition 2}. \end{cases} \qquad f(x) = \begin{cases} \sum_{i=1}^{n} a_i(x) & = \text{condition 1}, \\ \frac{1}{x} & = \text{condition 2}. \end{cases}$$

   The `cases` and `cases*` provide in-line formulas, while the following `dcases` and `dcases*` provide display mode:

$$f(x) = \begin{cases} \displaystyle\sum_{i=1}^{n} a_i(x) & = \text{condition 1}, \\ \dfrac{1}{x} & = \text{condition 2}. \end{cases} \qquad f(x) = \begin{cases} \displaystyle\sum_{i=1}^{n} a_i(x) & = \text{condition 1}, \\ \dfrac{1}{x} & = \text{condition 2}. \end{cases}$$

4 Lists

There are three lists: `itemize`, `enumerate`, and `description`

itemize the list in section 2 is such a one;

enumerate the list in section 3 is such a one;

description this list is such a one.

Tag indeed, one can change any the tag of any item in any kind of list as what I do in this list.

One can also change the numbering of a `enumerate` list as follows:

(a). abaaba

(b). balbla

5 Environments

There are many theorem-like environments. We will mainly use `problem` and `solution`. Here is an example

Problem 1. This is a problem.

Solution. This should be your solution.

For your convenience, I have already let equations and lemmas be numbered within problems. See this

$$\boxed{\text{This is an equation}} \tag{1.1}$$

and this

Lemma 1.2. *A lemma used to solve Problem 1.*

When the `solution` environment ends, there will be a QED mark: □

6 Compile

You can use pdfLaTeX as the compiler, which is also the default one for many online editors. Note that to obtain correct cross-references, you may need to compile the source twice.

READ the .tex file to see how this document is made and start your LaTeX journey by playing with this one.
You will learn more (on both math symbols and typesetting) as the course proceeding.