An Introduction to LaTeX

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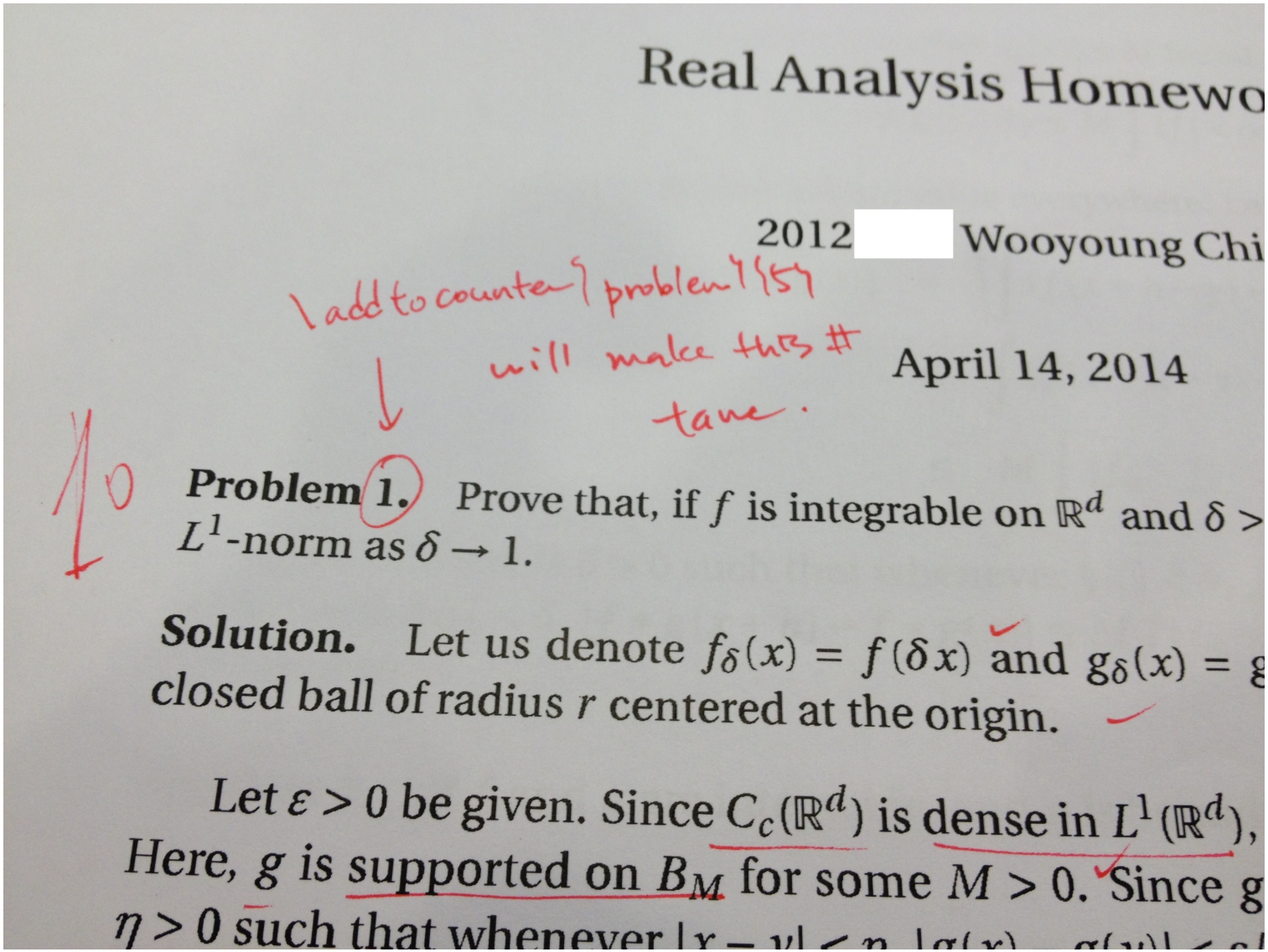
Outline

Outline

A Lesson from a Kind TA



Real Analysis Homewo

2012 Wooyoung Chi

I add to counter { problem } { 5 } will make this # tame.

April 14, 2014

Problem 1. Prove that, if f is integrable on $\mathbb{R}^d$ and $\delta >$ L^1-norm as $\delta \to 1$.

Solution. Let us denote $f_\delta(x) = f(\delta x)$ and $g_\delta(x) = g$ closed ball of radius r centered at the origin.

Let $\varepsilon > 0$ be given. Since $C_c(\mathbb{R}^d)$ is dense in $L^1(\mathbb{R}^d)$, Here, g is supported on B_M for some $M > 0$. Since g $\eta > 0$ such that whenever $|x - y| < \eta$, $|g(x) - g(y)| < \varepsilon$

What is TEX?

- Used to typeset high-quality technical manuscripts.
- Written by Donald Knuth, released in 1978.
- Example 1: A simple TEX document.
- Example 2: The source code of TEX.

The TEX Family (Examples 3–6)

	TEX	pdfTEX	XETEX	LuaTEX
Plain	tex	etex	(none)	dviluatex
	(none)	pdftex	xetex	luatex
LATEX	(none)	latex	(none)	dvilualatex
	(none)	pdflatex	xelatex	lualatex

- Output types: DVI, PDF.
- Engines: TEX, XETEX, LuaTEX.
- Formats: Plain TEX, LATEX.

The Name of the Game

- TEX is the uppercase form of $\tau\epsilon\chi$, which means both technology and art in Greek.
- TEX is pronounced ['tɛx]. The sound [x] can be found in the Korean word 흥정 [xɯŋʥʌŋ].
- That said, ['tɛk] is fine.
- LATEX is pronounced ['lɑːtɛx] or ['leɪtɛx].

Basic Format of a LATEX Document

```
\documentclass{amsart}

\begin{document}
\title{...}
\author{...}
\date{\today}
\begin{abstract}
...
\end{abstract}
\maketitle

...
\end{document}
```

Exercise 1

Copy `exercise_1.pdf` using LATEX.

Control Sequences

Example of control sequences: `\TeX` for TEX, and `\%` for %.

- Control word (`\TeX`): \ + one or more letters.
  - TEXnician: `\TeX nician`.
  - Use `\TeX\␣` or `\TeX{}␣` for a space after TEX.
- Control symbol (`\%`): \ + one nonletter.

A couple more examples of control words:

- Use `\LaTeX` for LATEX.
- Use `\today` for May 13, 2022(today's date).

Parameters

Some control sequences have a parameter.

- The letter immediately following a control sequence is the first parameter by default
  - Use `\^o` for ô.
  - Use `\H o` for ő.
- Use `{...}` for a longer parameter.
  - Use `\emph{Hello}` for an emphasized *Hello*.
  - Use `\footnote{World!}` for a footnote.[1]
  - One can use `\H{o}` for ő.

[1] World!

Special Characters

- Typeset diacritics and special characters as follows:

ò	\`o	ó	\'o	ô	\^o	õ	\~o
ō	\=o	ȯ	\.o	ö	\"o	ç	\c c
ŏ	\u o	ǒ	\v o	ő	\H o	ǫ	\c o
o̩	\d o	o̲	\b o	o͡o	\t oo		
œ	\oe	Œ	\OE	æ	\ae	Æ	\AE
å	\aa	Å	\AA				
ø	\o	Ø	\O	ł	\l	Ł	\L
ı	\i	ȷ	\j	¡	!`	¿	?`

- #, $, %, ;, &, _, {, }, ~, and \ have special functions in TEX.

```
\# \$ \% \^{} \& \_ \{ \} \~{}
\textbackslash
```

$ % ^ & _ { } ~ \

Changing the Type Style

- `\textit{Italic shape}`: *Italic shape.*
- `\textsc{Small caps shape}`: SMALL CAPS SHAPE.
- `\textbf{Boldface series}`: **Boldface series.**
- `\texttt{Typewriter family}`: `Typewriter family`

Quotes and Dashes

- Use ` and `` for opening quotation marks.

```
``Please press the `x' key.''
```

“Please press the ‘x’ key.”

- Not all dashes are equal!

```
daughter-in-law, X-rated\\
pages 13--67\\
yes---or no? \\
$0$, $1$ and $-1$
```

daughter-in-law, X-rated
pages 13–67
yes—or no?
0, 1 and −1

Exercise 2

Copy `exercise_2.pdf` using LATEX.

Sectioning

- Use `\section{...}` to start a section.
- There are also `\subsection` and `\subsubsection`.

Exercise 3

Copy `exercise_3.pdf` using LATEX.

Outline

Types of Formulas

There are two types of math formulas:

- Inline formulas: use `$x = (x_1,x_2)$` for $x = (x_1, x_2)$.
- Displayed formulas: use `\[x^3+y^3=z^3.\]` for

$$x^3 + y^3 = z^3.$$

Consider a displayed formula as a part of a sentence.

Note that spaces are ignored in the *math mode*.

Basic Constructs

- Use `n=1,2,\dots` for $n = 1, 2, \ldots$, and `x_1+\dots+x_n` for $x_1 + \cdots + x_n$.
- Use `{...}` for longer super/subscripts: `a_{n-1}z^{n-1}+\dots+a_0` for $a_{n-1}z^{n-1} + \cdots + a_0$.
- Use `\alpha`, `\beta`, `\Gamma`, `\Delta`, ... for α, β, Γ, Δ, ...
- Use `\log`, `\sin`, `\max`, `\det`, ... for $\log$, $\sin$, $\max$, $\det$, ...
- Use `\sqrt{2}` for $\sqrt{2}$, and `\sqrt[3]{x}` for $\sqrt[3]{x}$.
- Use `\overline{z^2+1}` for $\overline{z^2 + 1}$.

Math Mode Accents

The commands for accents are different in math mode.

$\hat{a}$	\hat{a}	$\check{a}$	\check{a}	$\tilde{a}$	\tilde{a}
$\grave{a}$	\grave{a}	$\dot{a}$	\dot{a}	$\ddot{a}$	\ddot{a}
$\bar{a}$	\bar{a}	$\vec{a}$	\vec{a}	$\widehat{AAA}$	\widehat{AAA}
$\acute{a}$	\acute{a}	$\breve{a}$	\breve{a}	$\widetilde{AAA}$	\widetilde{AAA}
$\mathring{a}$	\mathring{a}				

Some Common Symbols

$\le$	\le	$\ge$	\ge	$\neq$	\ne	$\equiv$	\equiv
$\emptyset$	\emptyset	$\subset$	\subset	$\supset$	\supset	$\cup$	\cup
$\cap$	\cap	$\vee$	\vee	$\wedge$	\wedge	$\approx$	\approx
$\in$	\in	$\mid$	\mid	$\perp$	\perp	$\cdot$	\cdot
$\times$	\times	$\pm$	\pm	$\setminus$	\setminus	$\circ$	\circ

Placing `\not` before a relation symbol negates it:

$\not\subset$	\not\subset	$\not\equiv$	\not\equiv
$\not\approx$	\not\approx	$\not\in$	\not\in

Exercise 4

Copy the first section of `math_exercises.pdf`.

Fractions and Binomial Coefficients

Use `\frac{a}{b}` and `\binom{a}{b}` for

$$\frac{a}{b} \quad \text{and} \quad \binom{a}{b}.$$

`\frac` and `\binom` are control sequences with two parameters.

Sums and Products

Write `\sum_{n=1}^\infty \frac{1}{n} = \infty` for

$$\sum_{n=1}^{\infty} \frac{1}{n} = \infty.$$

Write `\prod_{k=1}^{n-1} k = \Gamma(n)` for

$$\prod_{k=1}^{n-1} k = \Gamma(n).$$

Limits and Big Parentheses

Write

```
\lim_{n\to\infty} \left(1+\frac{1}{n}\right)^n = e
```

for

$$\lim_{n\to\infty} \left(1+\frac{1}{n}\right)^n = e.$$

Integrals

Write
`\int_{-\infty}^\infty e^{-x^2} \,dx = \sqrt{\pi}` for

$$\int_{-\infty}^{\infty} e^{-x^2}\,dx = \sqrt{\pi}.$$

Write `\iint`, `\iiint`, `\idotsint`, and `\oint` for

$$\iint, \quad \iiint, \quad \int\cdots\int, \text{ and } \quad \oint.$$

Exercise 5

Copy the second section of `math_exercises.pdf`.

∂ `\partial` | ∇ `\nabla`

Change the displays to inline formulas. How do they look?

Changing Style in Math Mode

In math mode...

- Roman `\mathrm{rank}`: rank
- Boldface `\mathbf{Var}`: $\mathbf{Var}$
- Caligraphic `\mathcal{ABC}`: $\mathcal{ABC}$ (uppercase only)

Write `\usepackage{amssymb}` below `\documentclass` to use...

- Blackboard bold `\mathbb{NZRCH}`: $\mathbb{NZRCH}$
- Fraktur `\mathfrak{abcdEFGH}`: $\mathfrak{abcdEFGH}$

Defining Custom Commands

Use `\newcommand` to define your own commands!

- `\newcommand{\myschool}{Korea Advanced Insti...}`
- `\newcommand{\R}{\mathbb{R}}`
- `\newcommand{\vt}[1]{\vec{#1}}`:
  `\vt{x}` prints $\vec{x}$.
- `\newcommand{\setb}[2]{\{#1 \mid #2\}}`:
  `\setb{x}{|x|<1}` prints $\{x \mid |x| < 1\}$.

Defining Custom Operators

Use `\DeclareMathOperator` before `\begin{document}` to define operators:

- `\DeclareMathOperator{\rank}{\mathrm{rank}}`: $\operatorname{rank} A^T A$.
- `\DeclareMathOperator{\Var}{\mathbf{Var}}`: $\operatorname{\mathbf{Var}} X$.

Exercise 6

Create a new LaTeX file and define commands for...

1. Number sets (e.g. $\mathbb{N}$, $\mathbb{Z}$,...)
2. Operators (e.g. rank, proj,...)
3. `\inner` with two parameters so that `\inner{a}{b}` prints $\langle a, b \rangle$ (`\langle` and `\rangle` print $\langle$ and $\rangle$)
4. A two-parameter command which you think would be useful.

Test the commands so that you are sure they work.

Putting Spaces in Math Mode

A tactful use of spaces may yield better results:

- `\,`: $\Rightarrow\Leftarrow$
- `\quad`: $\Rightarrow \quad \Leftarrow$
- `\qquad`: $\Rightarrow \qquad \Leftarrow$

Writing Texts within Math

Use `\text{...}` to go into text mode.

- `\{x \mid x\text{ is even}\}`:

$$\{x \mid x \text{ is even}\}$$

- `f_i \text{ is monotonic,}\quad i=1,\dots,n`:

$$f_i \text{ is monotonic,} \quad i = 1, \dots, n$$

The cases Environment

```
x_{n+1} = \begin{cases}
x_n/2 & \text{if $x_n$ is even},\\
3x_n+1 & \text{if $x_n$ is odd}.
\end{cases}
```

$$x_{n+1} = \begin{cases} x_n/2 & \text{if } x_n \text{ is even}, \\ 3x_n + 1 & \text{if } x_n \text{ is odd}. \end{cases}$$

The `split` Environment

```
\begin{split}
a &=b+c-d \\
  &\quad +e-f \\
  &=g+h \\
  &=i
\end{split}
```

$$\begin{aligned} a &= b + c - d \\ &\quad + e - f \\ &= g + h \\ &= i \end{aligned}$$

Matrix Environments

```
\begin{pmatrix}
a & b & c \\
d & e & f
\end{pmatrix}
```

prints $\begin{pmatrix} a & b & c \\ d & e & f \end{pmatrix}$. Using `bmatrix` and `vmatrix` instead yield

$$\begin{bmatrix} a & b & c \\ d & e & f \end{bmatrix} \text{ and } \begin{vmatrix} a & b & c \\ d & e & f \end{vmatrix}.$$

Exercise 7

Copy the third section of `math_exercises.pdf`.

$\cdots$ `\cdots`	$\vdots$ `\vdots`	$\ddots$ `\ddots`

Outline

Centering and Flushing

- `\begin{center} abc \\ def \end{center}`:

  abc
  def

- `\begin{flushright} abc \\ def \end{center}`:

  abc
  def

Itemize and Enumerate

```
\begin{itemize}
\item First item
\item Second item
\item Third item
\end{itemize}
```

- First item
- Second item
- Third item

```
\begin{enumerate}
\item First item
\item Second item
\item Third item
\end{enumerate}
```

1. First item
2. Second item
3. Third item

Numbered Formulas

Use `\begin{equation}...\end{equation}` instead of `\[...\]` to show equation numbers.

$$\frac{1}{n}\sum_{i\in J_n}\sum_{j=1}^{n}\mathbf{E}\,|w_{ij}|^2 \to 0 \qquad \text{for any } J_n \subset \{1,\dots,n\} \text{ with } |J_n|/n \to 0. \tag{1.5}$$

Insert `\numberwithin{equation}{section}` before `\begin{document}` to have equation numbering tied to section numbering.

Theorem-like Environments

The following defines an environment `theorem`

```
\theoremstyle{plain}
\newtheorem{theorem}{Theorem}
```

that allows us to write theorems like this:

Theorem 1. *If $X_1, X_2, \ldots$ are independent and identically distributed random variables with finite mean, then*

$$\frac{X_1 + \cdots + X_n}{n} \to \mathbf{E}X_1 \quad \textit{in probability.}$$

Theorem-like Environments

We can name the theorem in the following way.

```
\begin{theorem}[weak law of large numbers]
If $X_1,X_2,\dots$ are independent...
\end{theorem}
```

Theorem 1 (weak law of large numbers). *If $X_1, X_2, \ldots$ are independent and identically distributed random variables with finite mean, then*

$$\frac{X_1 + \cdots + X_n}{n} \to \mathbf{E}X_1 \quad \textit{in probability.}$$

An Example of Custom Theorem-like Environments

```
\theoremstyle{plain}
\newtheorem{theorem}{Theorem}[section]
\newtheorem{proposition}[theorem]{Proposition}
\newtheorem{lemma}[theorem]{Lemma}
\newtheorem{corollary}[theorem]{Corollary}

\theoremstyle{definition}
\newtheorem{definition}[theorem]{Definition}
\newtheorem{example}[theorem]{Example}

\theoremstyle{remark}
\newtheorem{remark}[theorem]{Remark}
\newtheorem*{claim}{Claim}
```

The Built-in `proof` Environment

```
\begin{proof}
Notice that there are no natural numbers $x$, $y$,
and $z$ such that \[ x^3 + y^3 = z^3. \]
From this the result immediately follows.
\end{proof}
```

Proof. Notice that there are no natural numbers x, y, and z such that

$$x^3 + y^3 = z^3.$$

From this the result immediately follows. □

The Built-in `proof` Environment

```
\begin{proof}[Proof of the main theorem]
Notice that there are no natural numbers $x$, $y$,
and $z$ such that \[ x^3 + y^3 = z^3. \]
From this the result immediately follows.
\end{proof}
```

Proof of the main theorem. Notice that there are no natural numbers x, y, and z such that

$$x^3 + y^3 = z^3.$$

From this the result immediately follows. □

For more information on Theorem-like environments, see `manuals/amsthdoc.pdf`.

Outline

Cross Reference

Set labels for sections, theorems, formula, . . . :

- `\section{The proof of $P=NP$} \label{sec:p=np}..`
- `\begin{theorem} \label{thm:fermat}...`
- `\begin{equation} \label{eq:clt}...`

Then refer them using `\ref`:

```
In Section \ref{sec:p=np}, we prove Theorem
\ref{thm:fermat} using \eqref{eq:clt}.
```

In Section 4, we prove Theorem 2 using (3).

Hyperlinks

- Just by importing `hyperref` package we can turn all references into hyperlinks:

```
\usepackage{hyperref}
```

- The package `hyperref` allows us to create hyperlinks to URLs:

```
\href{https://wych.in}{My homepage}
```

Exercise 8

Copy the fourth section of `math_exercises.pdf`.
Let all numberings be auto-generated.
Put `\tableofcontents` right below `\maketitle`, and compile twice. What happens?

Bibliography

```
\begin{thebibliography}{2}

\bibitem{Ash70} Ash, R. B. (1970).
\textit{Basic Probability Theory.}
New York--London--Sydney: John Wiley \& Sons, Inc.

\bibitem{Dur19} Durrett, R. (2019)...

\end{thebibliography}
```

References

[1] Ash, R. B. (1970). *Basic Probability Theory.* New York–London–Sydney: John Wiley & Sons, Inc.

[2] Durrett, R. (2019). *Probability: Theory and Examples,* 5th ed. Cambridge Series in Statistical and Probabilistic Mathematics, 49. Cambridge: Cambridge University Press.

Citing References

```
...\cite{Ash70}...
...\cite[Theorem 4.8.9]{Dur19}
```

If X_1 only takes ± 1 as values, a classical approach [1] involving difference equations yields (1). More generally, if X_1 is bounded and $\mathbf{P}(X_1 < 0) > 0$, then we can use the fact that $(e^{rS_n})_{n \in \mathbf{N}}$ is a martingale for some $r < 0$ to obtain (1); see [2, Theorem 4.8.9]. However, these methods do not easily generalize to arbitrary X_1 with finite mean.

`\cite{Ash70,Dur19}` would print [1,2].

BibTeX

Some people discourage using BibTeX, but the convenience often outweighs the discouragement.

```
\bibliographystyle{STYLE}
\bibliography{FILE_NAME}
```

- Possible `STYLE`s: `plain`, `alpha`, `abbrv`,....
- Copy and paste BibTeX entries from the internet to save time.

Exercise 9

Cite two papers or books of your choice using BibTeX.

Outline

Manuals

Most of what you need could be found in

- *The Not So Short Introduction to LaTeX2ε* (`lshort.pdf`)
- *User's Guide for the* `amsmath` *Package* (`amsldoc.pdf`)
- *LaTeX: A Document Preparation System* by Leslie Lamport

If you *really* want to understand the inner workings of TeX, see

- *The TeXbook* by Donald Knuth.

The files are in the `manuals` folder.
Don't forget that Google and Stack Exchange are your friends!

How to Find the Commands for Symbols

- See 3.10 of `manuals/lshort.pdf`.
- See `manuals/symbols-a4.pdf` for a comprehensive (338 pages) list of symbols.
- Or use Detexify (http://detexify.kirelabs.org/classify.html)!

Exercise 10. Find the commands for the following symbols:

$$\varphi,\ \ni,\ \bigotimes,\ \Leftrightarrow,\ \aleph,\ \models,\ \therefore,\ \angle.$$

More Ways to Display Formulas

See the Section 3 of `manuals/amsldoc.pdf`.

```
\begin{multline}
a+b+c+d+e+f\\
+i+j+k+l+m+n
\end{multline}
```

$$a+b+c+d+e+f \\ +i+j+k+l+m+n \tag{3}$$

```
\begin{gather}
a_1=b_1+c_1\\
a_2=b_2+c_2-d_2+e_2
\end{gather}
```

$$a_1 = b_1 + c_1 \tag{4}$$
$$a_2 = b_2 + c_2 - d_2 + e_2 \tag{5}$$

```
\begin{align}
a_1& =b_1+c_1\\
a_2& =b_2+c_2-d_2+e_2
\end{align}
```

$$a_1 &= b_1 + c_1 \tag{6}$$
$$a_2 &= b_2 + c_2 - d_2 + e_2 \tag{7}$$

```
\begin{align}
a_{11}& =b_{11}&
  a_{12}& =b_{12}\\
a_{21}& =b_{21}&
  a_{22}& =b_{22}+c_{22}
\end{align}
```

$$a_{11} &= b_{11} & a_{12} &= b_{12} \tag{8}$$
$$a_{21} &= b_{21} & a_{22} &= b_{22} + c_{22} \tag{9}$$

How to Insert Figures

Load the `graphicx` package and write

```
\begin{figure}[h]
\includegraphics[width=.8\textwidth]{figure.eps}
\caption{Illustration of...}
\label{fig}
\end{figure}
```

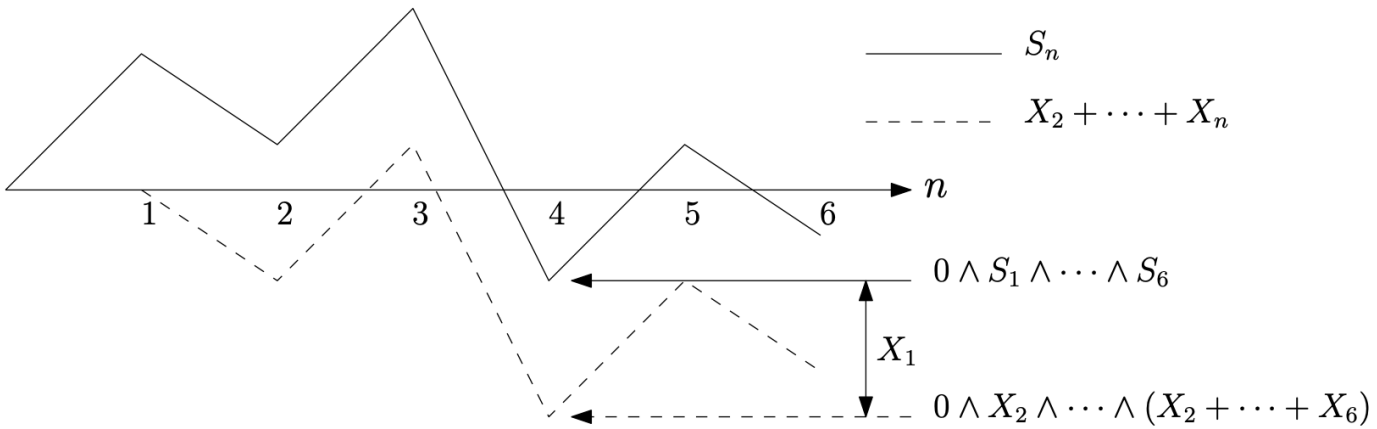


FIGURE 1. Illustration of (2) when $S_1 \wedge \cdots \wedge S_n \leq 0$.

How to Insert Tables

```
\begin{table}
\begin{tabular}{lrr}
Group & Albums & EPs \\
\hline
Blackpink & 1 & 2 \\
fromis\_9 & 0 & 3 \\
Oh My Girl & 1 & 8 \\
WJSN & 1 & 9 \\
\end{tabular}
\caption{Discography...}
\end{table}
```

Group	Albums	EPs
Blackpink	1	2
fromis_9	0	3
Oh My Girl	1	8
WJSN	1	9

TABLE 1. Discography of Korean Girl Groups

More on Images and Tables

- More on inserting images: click here.
- More on Tables: click here.

Positions of Floating Objects

- `\begin{figure}[...]` can be filled with `h`, `t`, `b`, and `p`; e.g. `[htp]`: h: Here, t: Top, b: Bottom, p: Page of floats.
- The option defaults to `[tbp]`.
- Putting `!` as in `[h!]` directs LaTeX try *harder* to place the figure at the earliest possible place.
- For more details, see Section C.9 of Lamport's book.
- It is difficult to achieve complete control over the location of a figure.

Try Not to Control the Appearance!

- The exact location of a figure or a table is only important at the very last stage of publication.
- Narrowing the margin might harm readability.
- Adjust the appearance only when you know what you're doing.

How to Draw Figures

- Try Ipe! (Developed by Prof. Otfried Cheong)
- For commutative diagrams, try the `xymatrix` package.
- To draw by coding, learn TikZ. See `manuals/minimaltikz.pdf`.
- Learning Adobe Illustrator might be the best choice.

Multiple Columns

Use the `multicol` package. Click here for an introduction.

1 Introduction

Switching between two-column and one-column layout is possible in LaTeX, but every use of `\twocolumn` or `\onecolumn` starts a new page. Moreover, the last page of two-column output isn't balanced and this often results in an empty, or nearly empty, right column. When I started to write macros for doc.sty (see "The doc–Option", *TUGboat* volume 10 #2, pp. 245–273) I thought that it would be nice to place the index on the same page as the bibliography. And balancing the last page would not only look better, it also would save space; provided of course that it is also possible to start the next article on the same page. Rewriting the index environment was comparatively easy, but the next goal, designing an environment which takes care of footnotes, floats, etc., was a harder task. It took me a whole weekend[1] to get together the few lines of code below and there is still a good chance that I missed something after all.

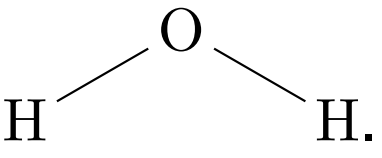
Try it and, hopefully, enjoy it; and *please* direct bug reports and suggestions back to Mainz.

Writing Hangul

Just load the `kotex` package, and you're good to go.

- Q에 유사 등각 변환을 취하면 점근 프로파일이 0인 유한시간 폭발 해를 얻는다.
- ㅋ
- 뷁
- BB크림 파파파 립스틱을 맘맘마

Other Packages

- Use the `chemfig` package to draw molecules: 

See `manuals/chemfig-en.pdf`.
- Use the `tipa` package to write in the international phonetic alphabet (IPA): [xɯŋʤɮʌŋ].
- You can find many more on the internet, and TEXLive contains most of them.

Outline

Delimiter Sizes

You can manually adjust the sizes of delimiters:

```
\bigl( \bigm| \bigr)
```
$\bigl(\bigm| \bigr)$

```
\Bigl( \Bigm| \Bigr)
```
$\Bigl(\Bigm| \Bigr)$

```
\biggl( \biggm| \biggr)
```
$\biggl(\biggm| \biggr)$

```
\Biggl( \Biggm| \Biggr)
```
$\Biggl(\Biggm| \Biggr)$

Commas and Sets

- Write `$a$, $b$, and $c$` instead of `$a, b,$ and $c$`.
  - a, b, and c (Better spacing)
  - $a, b,$ and c
- Write `i.i.d.\␣` instead of `i.i.d.␣`.
  - $X_1, X_2, \ldots$ are i.i.d. random variables. (Better spacing)
  - $X_1, X_2, \ldots$ are i.i.d. random variables.
- Insert a thin space next to the braces in a set builder notation.
  - `\{\,x\mid x\not\in x\,\}`: $\{\,x \mid x \notin x\,\}$
  - `\bigl\{\,x\bigm|x=\{x\}\,\bigr\}`: $\bigl\{\,x \bigm| x = \{x\}\,\bigr\}$

Types of Atoms

A math formula $x + y = \max\{x, y\} + \min\{x, y\}$ consists of the atoms of the following types.

- Ord (ordinary): x and y.
- Op (large operator): $\max$ and $\min$.
- Bin (binary operation): $+$.
- Rel (relation): $=$.
- Open (opening): $\{$.
- Close (closing): $\}$.
- Punct (punctuation): ,.

Spacing Rules

		Right atom							
		Ord	Op	Bin	Rel	Open	Close	Punct	Inner
Left atom	Ord	0	1	(2)	(3)	0	0	0	(1)
	Op	1	1	*	(3)	0	0	0	(1)
	Bin	(2)	(2)	*	*	(2)	*	*	(2)
	Rel	(3)	(3)	*	0	(3)	0	0	(3)
	Open	0	0	*	0	0	0	0	0
	Close	0	1	(2)	(3)	0	0	0	(1)
	Punct	(1)	(1)	*	(1)	(1)	(1)	(1)	(1)
	Inner	(1)	1	(2)	(3)	(1)	0	(1)	(1)

- Here 0, 1, 2, and 3 stand for no space, thin space (`\,`), medium space (`\>`), and thick space (`\;`).
- Use the table to determine what spacing has been inserted in $x + y = \max\{x, y\} + \min\{x, y\}$.

Spacing Rules in Action

- The symbol : is a relation. Use `\colon` for a punctuation mark.
  - $f : A \to B$ (relation :)
  - $f\colon A \to B$ (punctuation `\colon`)
- The symbols | is ordinary.
  - `|-x|=|+x|` yields a wrong spacing $|-x| = |+x|$.
  - Use `\left|` and `\right|` instead to obtain $\left|-x\right| = \left|+x\right|$.
  - TEX knows that symbols such as $\lfloor$ and $[$ are openings.
- The commands `\bigl`, `\bigm`, and `\bigr` generate openings, relations, and closings.

Outline

Templates

I included three minimalistic templates:

- Homework (`templates/hw.pdf`)
- Quiz (`templates/quiz.pdf`)
- CV (`templates/cv.pdf`)

You can find a plethora of sophisticated templates at Overleaf (https://www.overleaf.com/latex/templates).

Samples

I included two samples you can learn from:

- TikZ examples (`samples/tikz.tex`)
- LaTeX challenges with answers (`samples/challenges`)

Editors with More Features

- TEXstudio and WinEdt are popular choices.
- Try VSCode: a lecture by Prof. Jang Soo Kim (Click here!)
- Or Lyx:

$$
\begin{aligned}
&\| \mathbf{1}_{y\sim 1} A_\theta[\psi_1,\psi_2]\psi_3 \|_{L^2} + \| \tfrac{1}{y}\big(\textstyle\int_0^y \Re(\overline{\psi_1}\,\psi_2) y' dy' \big)(\partial_y - \tfrac{1}{y})\partial_y \psi_3 \|_{L^2} \\
&\lesssim \begin{cases} \| \psi_1 \psi_2 \|_{L^1} \| \tfrac{1}{y}(\partial_y - \tfrac{1}{y})\partial_y \epsilon \|_{L^2} \lesssim (b^{1-} + \|\epsilon\|_{L^2} + \|\epsilon\|_{L^2}^2)\|\epsilon\|_{\dot{\mathcal{H}}^3_0} & \text{if } \psi_3 = \epsilon, \\ \| \langle y \rangle^{-3+} \psi_1 \psi_2 \|_{L^\infty} \lesssim (b + \|\epsilon\|_{L^\infty})\|\epsilon\|_{\dot{\mathcal{H}}^3_0} & \text{if } \psi_3 \in \{P, Q\}, \\ b \| \langle y \rangle^{-1} \psi_1 \psi_2 \|_{L^\infty} \lesssim b \|\epsilon\|_{\dot{\mathcal{H}}^3_0} & \text{if } \psi_3 = P - Q, \end{cases} \\
&\lesssim (o_{b^* \to 0}(1) + \|\epsilon\|_{\dot{\mathcal{H}}^3_0})\|\epsilon\|_{\dot{\mathcal{H}}^3_0}.
\end{aligned}
$$

Other Lectures

Check out Will Kwon's lecture on LaTeX at his YouTube channel: Click here!