

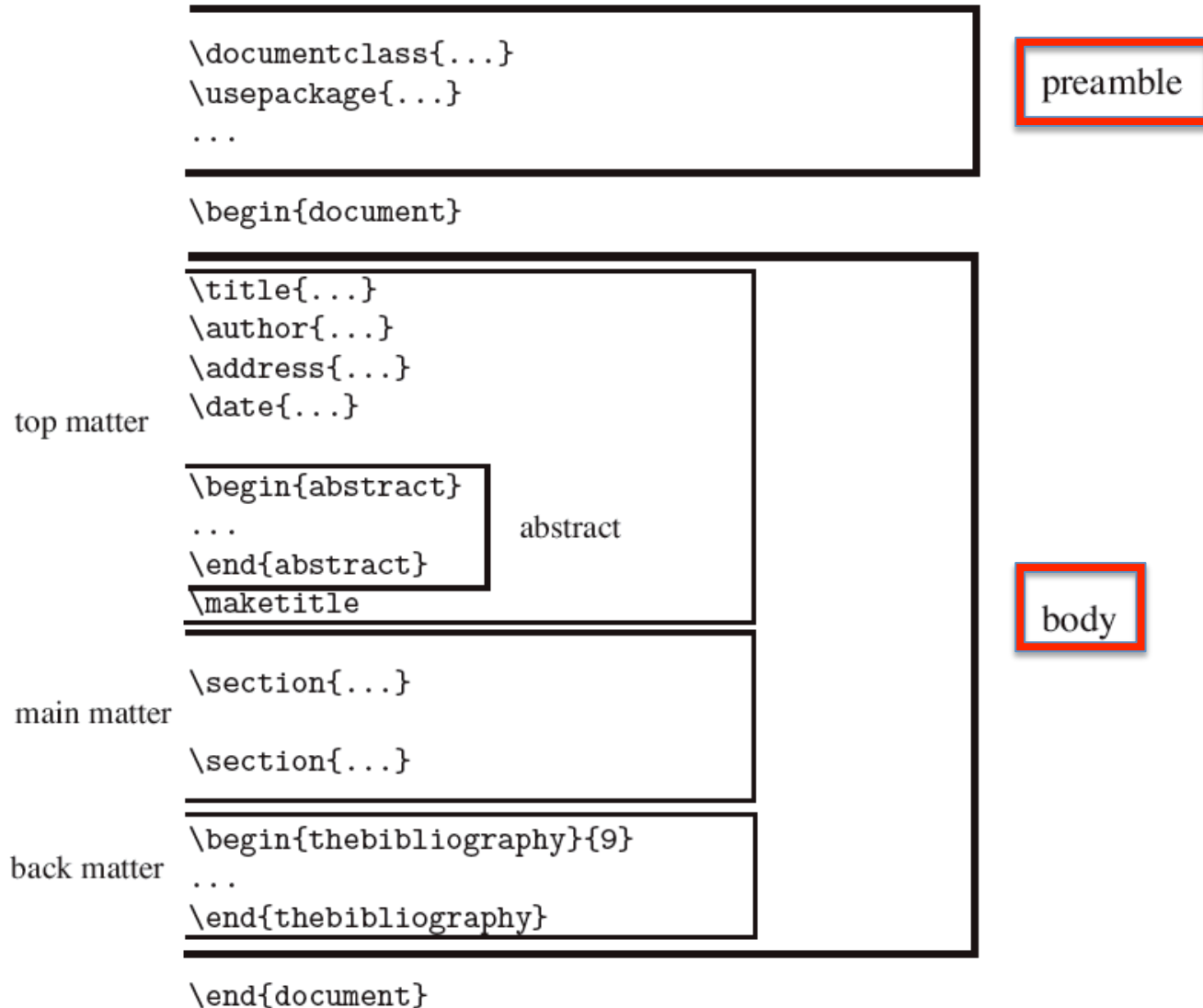
Latex 2: Document Structure



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Latex Document Structure



Preambles

- Everything before `\begin{document}`, e.g.,
- `\documentclass{amsart}` ← template
- `\usepackage{graphicx}` ← to include eps
- `\newtheorem{thm}{Theorem}` ←
proclamations, including definitions, theorems,
lemmas, corollaries, notes, and so on
 - As we see in the last homework assignment, Latex automatically format the proclamations

Top Matter

- In body and before `\maketitle`
- `\title{...}` ← document title
- `\author{...}` ← authors' names
- `\date{....}` ← publication date
- `\begin{abstract}` and
- `\end{abstract}` ← paragraphs for abstract

Top Matter Example

```
\documentclass{article}
\begin{document}
  \title{My First \LaTeX \ Report}
  \author{
    Cheng-Hsin Hsu\\
    National Tsing Hua University, Taiwan
  }
  \date{\today}
  \maketitle
  \begin{abstract}
    This is my abstract.
  \end{abstract}
\end{document}
```

Note: The article template requires abstract to be put after \maketitle

My First \LaTeX Report

Cheng-Hsin Hsu
National Tsing Hua University, Taiwan

September 2, 2015

Abstract

This is my abstract.

Main Matter

- Books or theses have chapters → sections → subsections
- Articles or reports have sections → subsections
- There are subsubsections, but I (personally) prefer not to use it
- `\section{Section Names Need to be Initial Capitalized}`
- `\subsection*{Section Names with Asterisks are Un-numbered}`

Main Matter Example

```
\documentclass{article}
\begin{document}
\section{Section Name} 1 Section Names Need to be Initial Capitalized
Write something \dot Write something ....
\subsection{First Sub} 1.1 First Subsection
More writeup. More writeup.
\subsection{Second S} 1.2 Second Subsection
Even more writeup. Even more writeup.
\section{Conclusions} 2 Conclusions
OK, we are done.
\subsection*{Acknow} Acknowledgement
We thank you for atte We thank you for attending this course.
\end{document}
```

Labels and Cross References

- Definition:
 - `\subsection{Algorithm} \label{sec:algorithm}`
- Reference:
 - We implement the proposed algorithm (see Section~`\ref{sec:algorithm}`).

1.3 Algorithm

2 Conclusions

We implement the proposed algorithm (see Section 1.3).

Modularized Main Matter

`\input{./introduction}` ← each line is a section
`\input{./related}`
`\input{./measurement}`
`\input{./problem}`
`\input{./evaluation}`
`\input{./testbed}`
`\input{./conclusion}`

- Reducing the collaboration overhead

Back Matter

- Bibliographic entries between `\begin{thebibliography}{9}` and `\end{thebibliography}`
 - 9 means reserving single digit space ← 1-9 entries
- `\bibitem{sF90}`
S. Foo,
`\emph{Lattice Constructions}`,
Ph.D. thesis, Univ. of Winnebago, Dec. 1990.
- In our writeup, use `Foo~\cite{sF90}` to get `Foo [3]`

Back Matter Example

```
\begin{thebibliography}{9}
```

```
\bibitem{BBEG+12}
```

F.~Bari, R.~Boutaba, R.~Esteves, M.~Podlesny, G.~Rabbani, Q.~Zhang, F.~Zhani,
and L.~Granville.

```
\newblock Data center network virtualization: A survey.
```

References

- [1] F. Bari, R. Boutaba, R. Esteves, M. Podlesny, G. Rabbani, Q. Zhang, F. Zhani, and L. Granville. Data center network virtualization: A survey. *IEEE Communications Surveys & Tutorials*, 15(2):909 – 928, 2012.
- [2] K. Chen, Y. Chang, P. Tseng, C. Huang, and C. Lei. Measuring the latency of cloud gaming systems. In *Proc. of ACM International Conference on Multimedia (MM'11)*, pages 1269–1272, Scottsdale, AZ, November 2011.

Bibtex for Bibliography

- Maintaining bibliographic entries is tedious
- Different publishers demand for different styles, e.g., numbers for IEEE and authors' names for ACM
- Bibtex and bibliography style files (**.bst**) can be used
- References are put in bibtex files (**.bib**) as records, referred by **labels**
- Bibtex binary helps us to **extract** the referred bibtex entries into reference section

Sample Bibtext Item: Journal Paper

```
@article{MEVS03,  
  year = {2003},  
  pages = {195-209},  
  title = {Scalable On-demand media streaming with packet  
loss recovery},  
  journal = {IEEE/ACM Transactions on Networking},  
  volume = {11},  
  author = {Mahanti, A. and Eager, D. and Vernon, M. and  
Sundaram-Stukel, D.},  
  number = {2},  
  month = {April}  
}
```

Sample Bibtex Item: Conference Paper

```
@inproceedings{Koblin09,  
  year = {2009},  
  booktitle = {Proc. of ACM Conference on  
Creativity and Cognition (C\&C'09)},  
  author = {A. Koblin},  
  month = {October},  
  address = {Berkeley, CA},  
  pages = {451-452},  
  title = {The Sheep Market}  
}
```

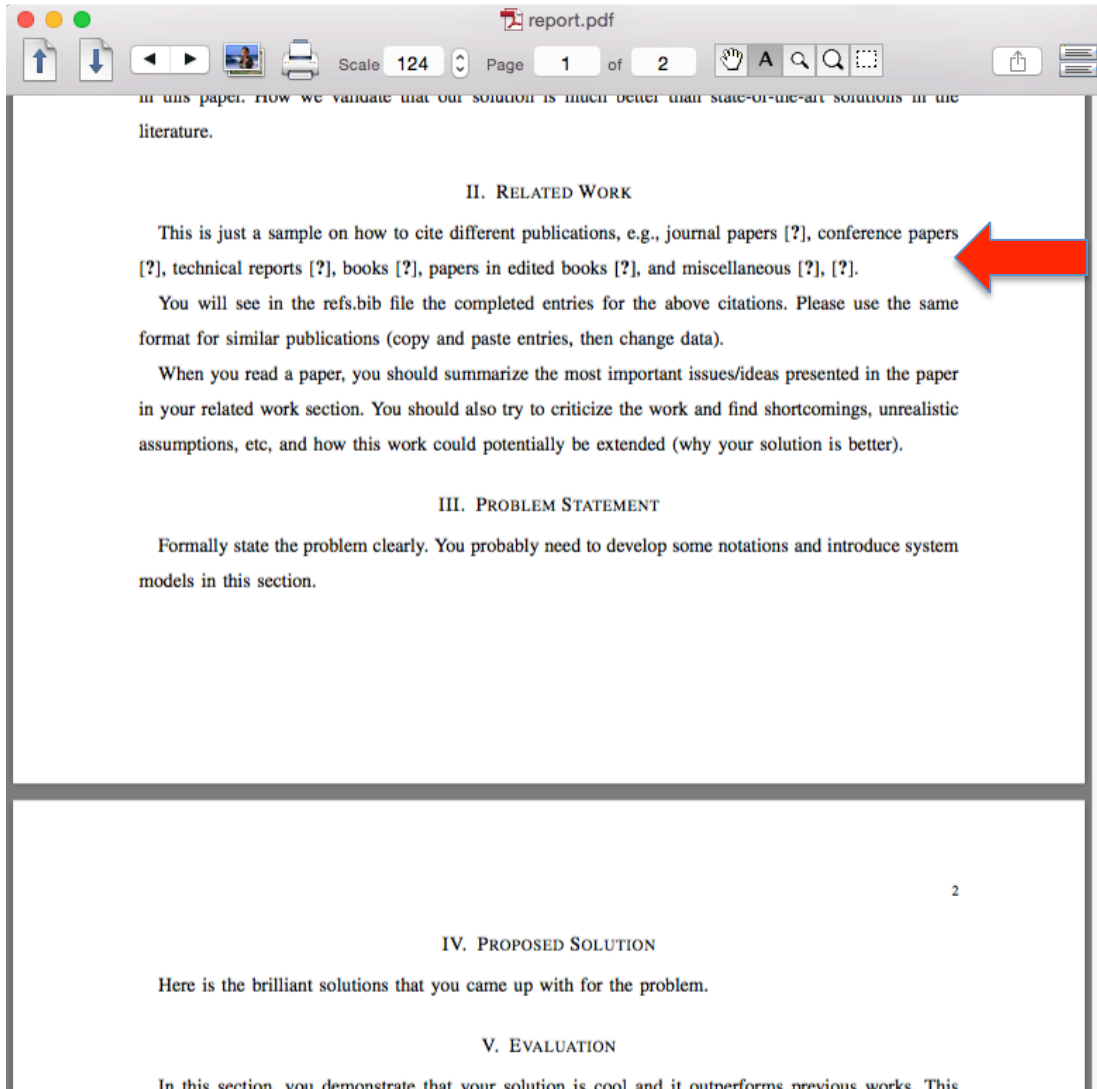
Sample Bibtex Item: Web Page

```
@misc{amt,  
  title = {Amazon Mechanical Turk},  
  key = {Amazon Mechanical Turk},  
  note = {\url{https://www.mturk.com}},  
  year = {2012},  
  month = {July}  
}
```

Exercise: Compile a Real Document

- Download a sample zip file:
<https://nmsl.cs.nthu.edu.tw/images/nmsl/report.tgz>
- Finder -> Downloads -> double click on report.tgz to unzip it
- In TexShop, open file, find the report.tex under the Downloads/report/ folder
- Select Latex and click on Typeset

Exercise: Compile a Real Document (cont.)



← Missing references

Exercise: Compile a Real Document

- Select Bibtex and click on Typeset
- Observe that a new file report.bbl is created in the Downloads/report/ folder, **open it**
- Select Latex and click on Typeset
 - Observe that we have Reference section now
 - But the citations in the writeup are still [?], **why?**
- Click on Typeset again, to get the final document

Exercise: Compile a Real Document (cont.)

This is just a sample on how to cite different publications, e.g., journal papers [1], conference papers [2], technical reports [3], books [4], papers in edited books [5], and miscellaneous [6], [7].

You will see in the refs.bib file the completed entries for the above citations. Please use the same format for similar publications (copy and paste entries, then change data).

When you read a paper, you should summarize the most important issues/ideas presented in the paper in your related work section. You should also try to criticize the work and find shortcomings, unrealistic assumptions, etc, and how this work could potentially be extended (why your solution is better).

III. PROBLEM STATEMENT

Formally state the problem clearly. You probably need to develop some notations and introduce system models in this section.

IV. PROPOSED SOLUTION

Here is the brilliant solutions that you came up with for the problem.

V. EVALUATION

In this section, you demonstrate that your solution is cool and it outperforms previous works. This is usually done through simulations, but real experimental results are much more convincing. Having a small prototype often significantly increase your chance to get into top conferences.

VI. CONCLUSIONS AND FUTURE WORK

What are the lessons that we should learn from this paper? What are the possible extensions of this work?

REFERENCES

[1] A. Mahanti, D. Eager, M. Vernon, and D. Sundaram-Stukel, "Scalable on-demand media streaming with packet loss recovery," *IEEE/ACM Transactions on Networking*, vol. 11, no. 2, pp. 195-209, April 2003.

Recap:

1. Latex → get cited entries
2. Bibtex → produce bbl
3. Latex → add references
4. Latex → link references

Files Under Downloads/report/

```
Bear-MBP:[13]~/Downloads/report$ ls -l
total 1112
-rw-----@ 1 bear  staff  56877 Sep 14  2008 IEEEtran.bst
-rw-----@ 1 bear  staff 201396 Sep 14  2008 IEEEtran.cls
-rw-r--r--@ 1 bear  staff  1454 Sep  6  2011 Makefile
-rw-----@ 1 bear  staff  9941 Sep 14  2008 macros.tex
-rw-r--r--@ 1 bear  staff 198877 Sep  6  2011 refs.bib
-rw-r--r--  1 bear  staff  1045 Sep  3 09:44 report.aux
-rw-r--r--  1 bear  staff  2159 Sep  3 09:41 report.bbl
-rw-r--r--  1 bear  staff  1405 Sep  3 09:41 report.blg
-rw-r--r--  1 bear  staff 15798 Sep  3 09:44 report.log
-rw-r--r--  1 bear  staff 43322 Sep  3 09:44 report.pdf
-rw-r--r--  1 bear  staff  9928 Sep  3 09:44 report.synctex.gz
-rw-----@ 1 bear  staff  3551 Sep  6  2011 report.tex
```

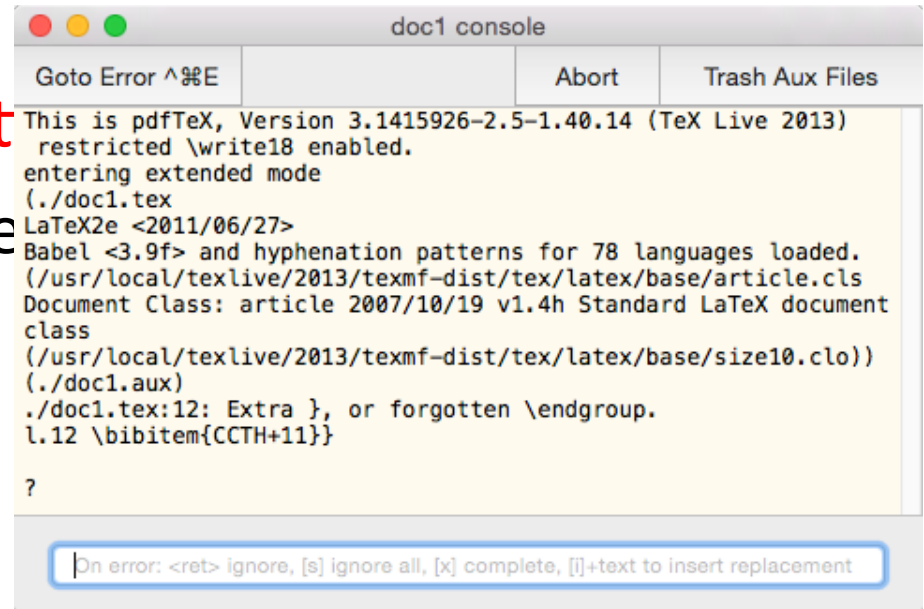
- Check out the files: report.tex, report.pdf, report.log, report.bbl
- Change report.tex a bit, recompile it
- Ask questions if any

Errors in Latex

- There are three types of errors
 - Typographical errors, such as spelling error, which will not be reported by Latex
 - Errors in mathematical formulas or in text formatting
 - Errors in instructions, like commands and environments

Handling Errors

- Use spell checkers and proofread your tex files to address typos
- Once Latex complains about errors, it puts you into a ? prompt
 - Type x to abort typesetting
 - Press return to continue



The screenshot shows a terminal window titled "doc1 console". At the top, there are three colored window control buttons (red, yellow, green) and a menu bar with "Goto Error ^%E", "Abort", and "Trash Aux Files". The main text area contains the following output from pdfTeX:

```
This is pdfTeX, Version 3.1415926-2.5-1.40.14 (TeX Live 2013)
restricted \write18 enabled.
entering extended mode
./doc1.tex
LaTeX2e <2011/06/27>
Babel <3.9f> and hyphenation patterns for 78 languages loaded.
(/usr/local/texlive/2013/texmf-dist/tex/latex/base/article.cls
Document Class: article 2007/10/19 v1.4h Standard LaTeX document
class
(/usr/local/texlive/2013/texmf-dist/tex/latex/base/size10.clo))
./doc1.aux)
./doc1.tex:12: Extra }, or forgotten \endgroup.
l.12 \bibitem{CCTH+11}}

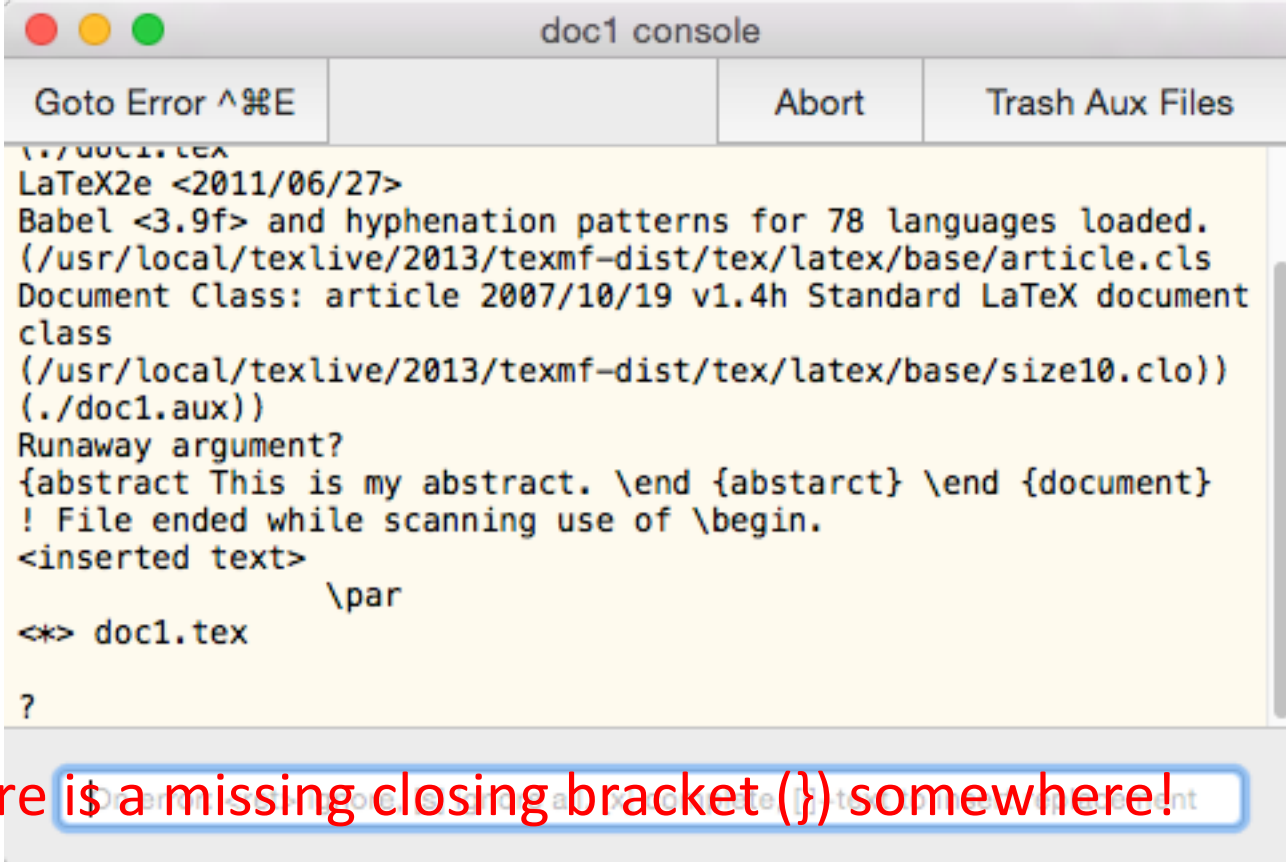
?
```

At the bottom of the window, there is a text input field with the prompt: "On error: <ret> ignore, [s] ignore all, [x] complete, [i]+text to insert replacement".

Troubleshooting #1

```
\documentclass{article}
\begin{document}
\begin{abstract}
This is my abstract.
\end{abstarct}
\end{document}
```

**Runaway
argument** →



The screenshot shows a terminal window titled "doc1 console" with a menu bar containing "Goto Error ^⌘E", "Abort", and "Trash Aux Files". The terminal output shows the LaTeX compilation process for "doc1.tex". It reports the LaTeX version as 2011/06/27, the Babel version as 3.9f, and the document class as "article 2007/10/19 v1.4h Standard LaTeX document class". The error message is: "Runaway argument? {abstract This is my abstract. \end {abstarct} \end {document} ! File ended while scanning use of \begin." Below the error, the terminal shows the source code being scanned: "<inserted text>" followed by "\par" and "<*> doc1.tex". A blue box highlights the error message in the terminal.

Usually means there is a missing closing bracket (}) somewhere!

Troubleshooting #2

```
\documentclass{article}
```

```
\begin{document}
```

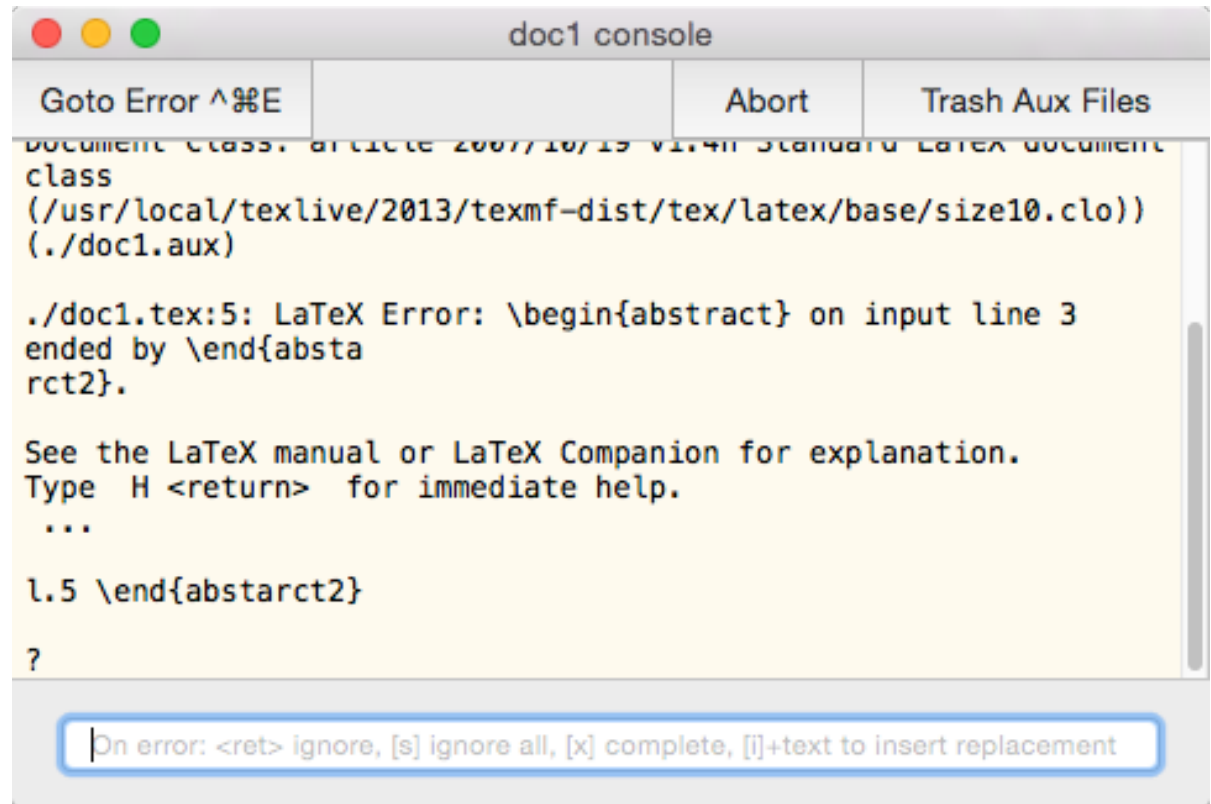
```
\begin{abstract}
```

```
This is my abstract.
```

```
\end{abstarct2}
```

```
\end{document}
```

Mismatched



```
doc1 console
Goto Error ^%E Abort Trash Aux Files
document class: article 2007/10/19 v1.4n Standard LaTeX document
class
(/usr/local/texlive/2013/texmf-dist/tex/latex/base/size10.clo)
(./doc1.aux)

./doc1.tex:5: LaTeX Error: \begin{abstract} on input line 3
ended by \end{abstarct2}.

See the LaTeX manual or LaTeX Companion for explanation.
Type H <return> for immediate help.
...

1.5 \end{abstarct2}
?

|On error: <ret> ignore, [s] ignore all, [x] complete, [i]+text to insert replacement
```


Troubleshooting #3

```
\documentclass{article}
```

```
\begin{document}
```

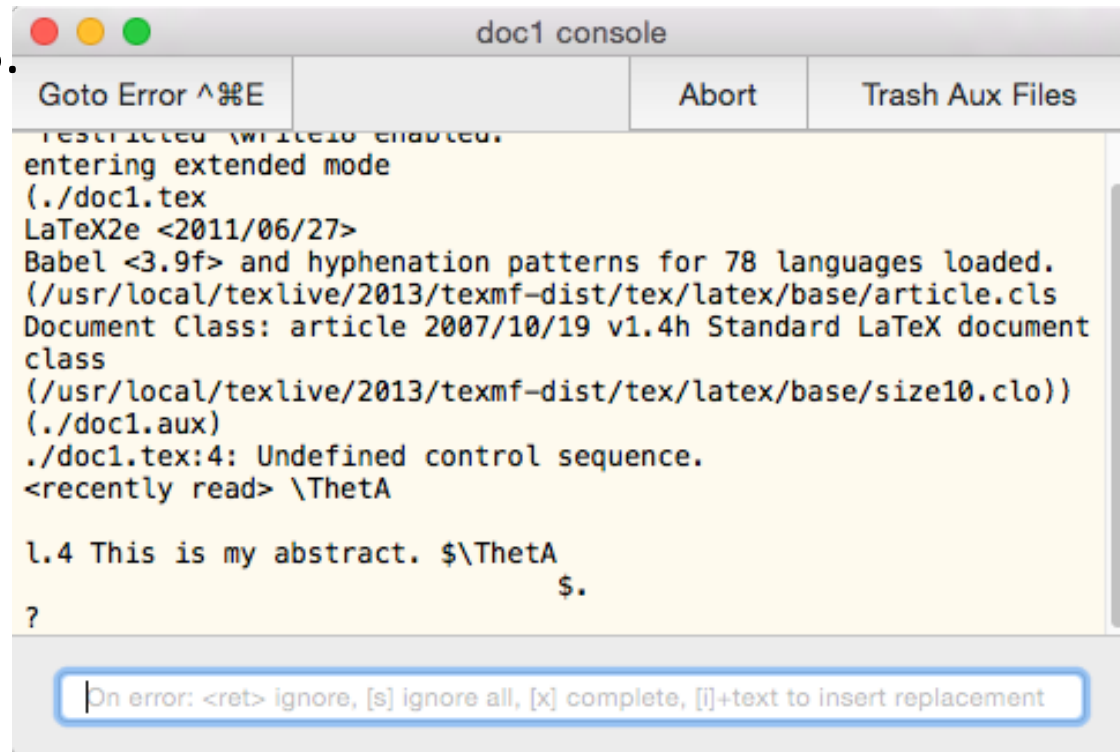
```
\begin{abstract}
```

```
This is my abstract. $\Theta$.
```

```
\end{abstract}
```

```
\end{document}
```

Θ \neq Θ



```
doc1 console
Goto Error ^%E Abort Trash Aux Files
restricted \write10 enabled.
entering extended mode
./doc1.tex
LaTeX2e <2011/06/27>
Babel <3.9f> and hyphenation patterns for 78 languages loaded.
(/usr/local/texlive/2013/texmf-dist/tex/latex/base/article.cls
Document Class: article 2007/10/19 v1.4h Standard LaTeX document
class
(/usr/local/texlive/2013/texmf-dist/tex/latex/base/size10.clo))
./doc1.aux)
./doc1.tex:4: Undefined control sequence.
<recently read> \Theta

1.4 This is my abstract. $\Theta
$.
?
```

On error: <ret> ignore, [s] ignore all, [x] complete, [i]+text to insert replacement

Troubleshooting #4

```
\documentclass{article}
\newtheorem{thm}{Theorem}
\begin{document} \label{thm:theta}
\begin{thm}
This is my theorem.
\end{thm}
\end{document}
```

Reach the end
before seeing
the closing }

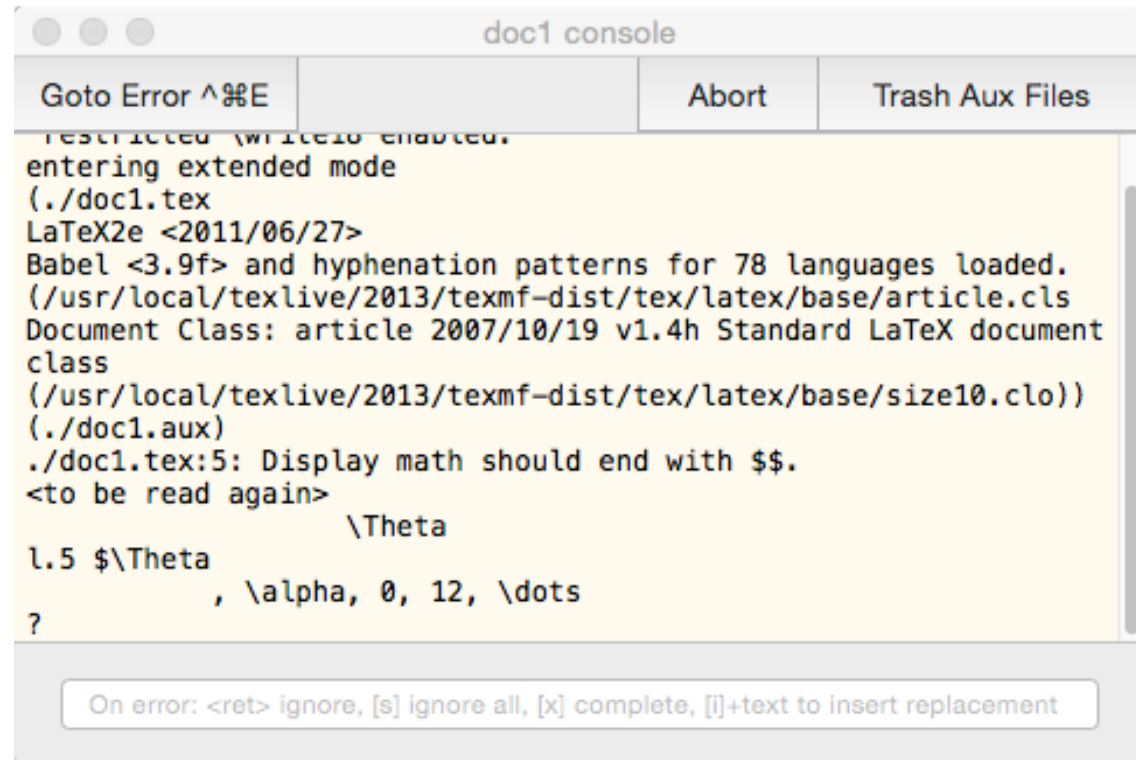


The screenshot shows a terminal window titled "doc1 console" with a menu bar containing "Goto Error ^%E", "Abort", and "Trash Aux Files". The terminal output displays the LaTeX compilation process, including the loading of Babel and the LaTeX base classes. The error message is: "Runaway argument? {thm:theta \begin {thm} This is my theorem. \$\Theta\$. \end {thm} \end \ETC. ! File ended while scanning use of \label. <inserted text> \par <*> doc1.tex ?". At the bottom, there is a prompt: "On error: <ret> ignore, [s] ignore all, [x] complete, [i]+text to insert replacement".

Troubleshooting #5

```
\documentclass{article}
\newtheorem{thm}{Theorem}
\begin{document}
\[
\$\Theta, \alpha, 0, 12, \dots
\]
\end{document}
```

Not very
helpful this
time 



The screenshot shows a terminal window titled "doc1 console". It contains the following text:

```
Goto Error ^%E Abort Trash Aux Files
restricted \write enabled.
entering extended mode
./doc1.tex
LaTeX2e <2011/06/27>
Babel <3.9f> and hyphenation patterns for 78 languages loaded.
(/usr/local/texlive/2013/texmf-dist/tex/latex/base/article.cls
Document Class: article 2007/10/19 v1.4h Standard LaTeX document
class
(/usr/local/texlive/2013/texmf-dist/tex/latex/base/size10.clo))
./doc1.aux
./doc1.tex:5: Display math should end with $$
<to be read again>
\Theta
l.5 $\Theta
, \alpha, 0, 12, \dots
?
```

At the bottom of the window, there is a status bar with the text: "On error: <ret> ignore, [s] ignore all, [x] complete, [i]+text to insert replacement".

Tips for Troubleshooting

- Always start from the **first** error/warning
 - Follow-up errors/warnings could be side effects of the first error/warning
- Read the messages carefully, but be aware that Latex often gets confused itself
- **Isolate** the problem using `%` or `\begin{comment}`
`\end{comment}` to speed up your troubleshooting
- Frequently re-typeset while writing ← so that you know where a new error/warning come from

Tips for Getting an Error in Commands

- Check the spell of commands, including upper- and lower-case
- Check required arguments in braces
- Optional arguments should be in brackets, not braces or parentheses
- Commands need to be properly terminated
- Packages providing the commands should be loaded (using `\usepackage`)

Recap: Logical and Visual Design

- Latex philosophy: focus on **logical design** (content), instead of **visual design** (layout)

```
\begin{theorem}\label{T:P*}
Let  $D_{\{i\}}$ ,  $\mathcal{S}_i \in I$ , be complete distributive
lattices satisfying condition  $\sim \text{up}\{J\}$ .
Let  $\Theta$  be a complete congruence relation on
 $\Pi^* ( D_{\{i\}} \mid i \in I )$ .
```

If there exist $\mathcal{S}_i \in I$ and $d \in D_{\{i\}}$ with
 $d < 1_{\{i\}}$ such that, for all $d \in I$

```
\begin{equation}\label{E:cong1}
\langle \dots, d, \dots, 0, \dots \rangle_{\mathcal{S}_i}
\langle \dots, c, \dots, 0, \dots \rangle_{\mathcal{S}_i}
\text{pod}\{\Theta\},
\end{equation}
```

then $\Theta = \iota$.
`\end{theorem}`

Structures:
theorem and
equation

When it comes to the
visual design, there are
literally thousands of choices

Do we really want this?

Recap: Logical and Visual Design (cont.)

Theorem 1. *Let $D_i, i \in I$, be complete distributive lattices satisfying condition (J). Let Θ be a complete congruence relation on $\Pi^*(D_i \mid i \in I)$. If there exist $i \in I$ and $d \in D_i$ with $d < 1_i$ such that, for all $d \leq c < 1_i$,*

$$(1) \quad \langle \dots, d, \dots, 0, \dots \rangle \equiv \langle \dots, c, \dots, 0, \dots \rangle \quad (\Theta),$$

then $\Theta = \iota$.

- Probably not a good idea.
- A book, say, may have hundreds of theorems
- What if we switch from one-column to two column formats? ← **documentclass**

Spacing in Texts

- Two+ spaces in text are the same as one
- A tab or end-of-line (new line) character is the same as a space
- A blank line, that is two end-of-line characters indicate a new paragraph; `\par` command also does the same
- Spaces at the beginning of a line are ignored

Popular Font Families

Command with Argument	Command Declaration	Switches to the font family
<code>\textnormal{...}</code>	<code>{\normalfont ...}</code>	document
<code>\emph{...}</code>	<code>{\em ...}</code>	<i>emphasis</i>
<code>\textrm{...}</code>	<code>{\rmfamily ...}</code>	roman
<code>\textsf{...}</code>	<code>{\sffamily ...}</code>	sans serif
<code>\texttt{...}</code>	<code>{\ttfamily ...}</code>	typewriter style
<code>\textup{...}</code>	<code>{\upshape ...}</code>	upright shape
<code>\textit{...}</code>	<code>{\itshape ...}</code>	<i>italic shape</i>
<code>\textsl{...}</code>	<code>{\slshape ...}</code>	<i>slanted shape</i>
<code>\textsc{...}</code>	<code>{\scshape ...}</code>	SMALL CAPITALS
<code>\textbf{...}</code>	<code>{\bfseries ...}</code>	bold
<code>\textmd{...}</code>	<code>{\mdseries ...}</code>	normal weight and width

Font Size

Command	Sample text
<code>\Tiny</code>	sample text
<code>\tiny</code>	sample text
<code>\SMALL</code> or <code>\scriptsize</code>	sample text
<code>\Small</code> or <code>\footnotesize</code>	sample text
<code>\small</code>	sample text
<code>\normalsize</code>	sample text
<code>\large</code>	sample text
<code>\Large</code>	sample text
<code>\LARGE</code>	sample text
<code>\huge</code>	sample text
<code>\Huge</code>	sample text

Lists, Enumerates, and Descriptions

- An `\item` command must follow `\begin{enumerate}`, `\begin{itemize}`, or `\begin{description}`
- Multi-level lists are possible

```
\begin{description}  
\item [One] 1  
\item [Two] 2  
\item [Three] 3  
\end{description}
```

```
(1) One 1  
(2) Two 2  
(3) Three 3
```

```
• One 1  
• Two 2  
• Three 3
```

```
One: 1  
Two: 2  
Three: 3
```

```
One: 1  
Two: 2  
Three: 3  
• 3.1  
• 3.2  
• 3.3
```

Recap/More Math Mode

- Congruence: $a \equiv b \pmod{3}$ (3)
- Integral: $\int_{-\infty}^{\infty} e^{-x^2} dx = \sqrt{\pi}$
- Equation: `\begin{equation} \end{equation}` gives us **displayed formulas**:

$$\int_{-\infty}^{\infty} e^{-x^2} dx = \sqrt{\pi} \quad (1)$$

Recap/More Math Mode (cont.)

- Arithmetic operations: $a+b$, $a-b$, $-a$, a/b , ab ← try it and discuss what is the difference between $a \times b$ and ab
 - Should we write $\text{width } \times \text{height}$?
 - If not, what is the proper way to write it
- Fractions: $\frac{3+a}{4-b}$
- Superscripts/subscripts: $a^{b^c_d}$, $\{a^b\}^c_d$
 $a^{b^c}_d$, a^b_c

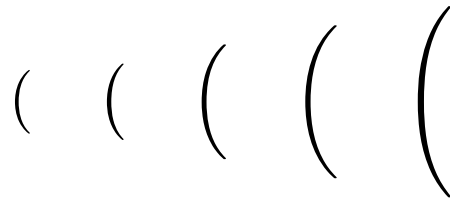
Recap/More Math Mode (cont.)

- Binomial coefficients: $\binom{n^2-1}{2}{n+1}$
- Ellipse: $f(x_1, x_2, \dots, x_n)$
- Integral: $\iint e^{-x^2y} \, dx dy$
- Roots: $\sqrt{1 + \sqrt{\frac{1}{\sqrt{3}}}}$

$$\sqrt{1 + \sqrt{\frac{1}{\sqrt{3}}}}$$

Recap/More Math Mode (cont.)

- Size of parenthesis, braces, and brackets:
(\quad \big(\quad \Big(\quad \bigg(\quad \Bigg(



- Last, <http://detexify.kirelabs.org/classify.html> is your friend

	Score: 0.09108357568367145 <code>\forall</code> mathmode
	Score: 0.10546324372757358 <code>\usepackage{ amssymb }</code> <code>\veebar</code> mathmode
	Score: 0.120752749897953 <code>\usepackage{ tipa }</code> <code>\textbaru</code> textmode

Exercise: Putting Everything Together

- Type the following formula in Latex
 - Hint: Build it step-by-step

$$\sum_{i=1}^{\lfloor \frac{n}{2} \rfloor} \binom{x_{i,i+1}^{i^2}}{\lfloor \frac{i+3}{3} \rfloor} \frac{\sqrt{\mu(i)^{\frac{3}{2}} (i^2 - 1)}}{\sqrt[3]{\rho(i) - 2} + \sqrt[3]{\rho(i) - 1}}$$

Exercise: Putting Everything Together (cont.)

$$\sum_{i=1}^{\left\lfloor \frac{n}{2} \right\rfloor} \binom{x_{i, i+1}^{i^2}}{\left\lfloor \frac{i+3}{3} \right\rfloor} \frac{\sqrt{\mu(i)^{\frac{3}{2}} (i^2 - 1)}}{\sqrt[3]{\rho(i)-2} + \sqrt[3]{\rho(i) - 1}}$$

Summary

- We discussed the structure of Latex documents
- We put up the first complete report
- We tried more tricks in text and math modes
- References:
 - <http://www.latex-project.org> ← Official Web and resources
 - <http://link.springer.com/book/10.1007%2F978-0-387-68852-7> ← Our textbook

Latex #2 Homework (L2)

1. (3%) Resumes are documents for individuals to present their education/work histories. Typical resumes are 1-2 page long, while academic ones, often called Curricula Vitae, are longer. Use the templates at <http://www.latextemplates.com/cat/curricula-vitae> to create your resume. Notice that some templates may require specific Latex distributions to compile.