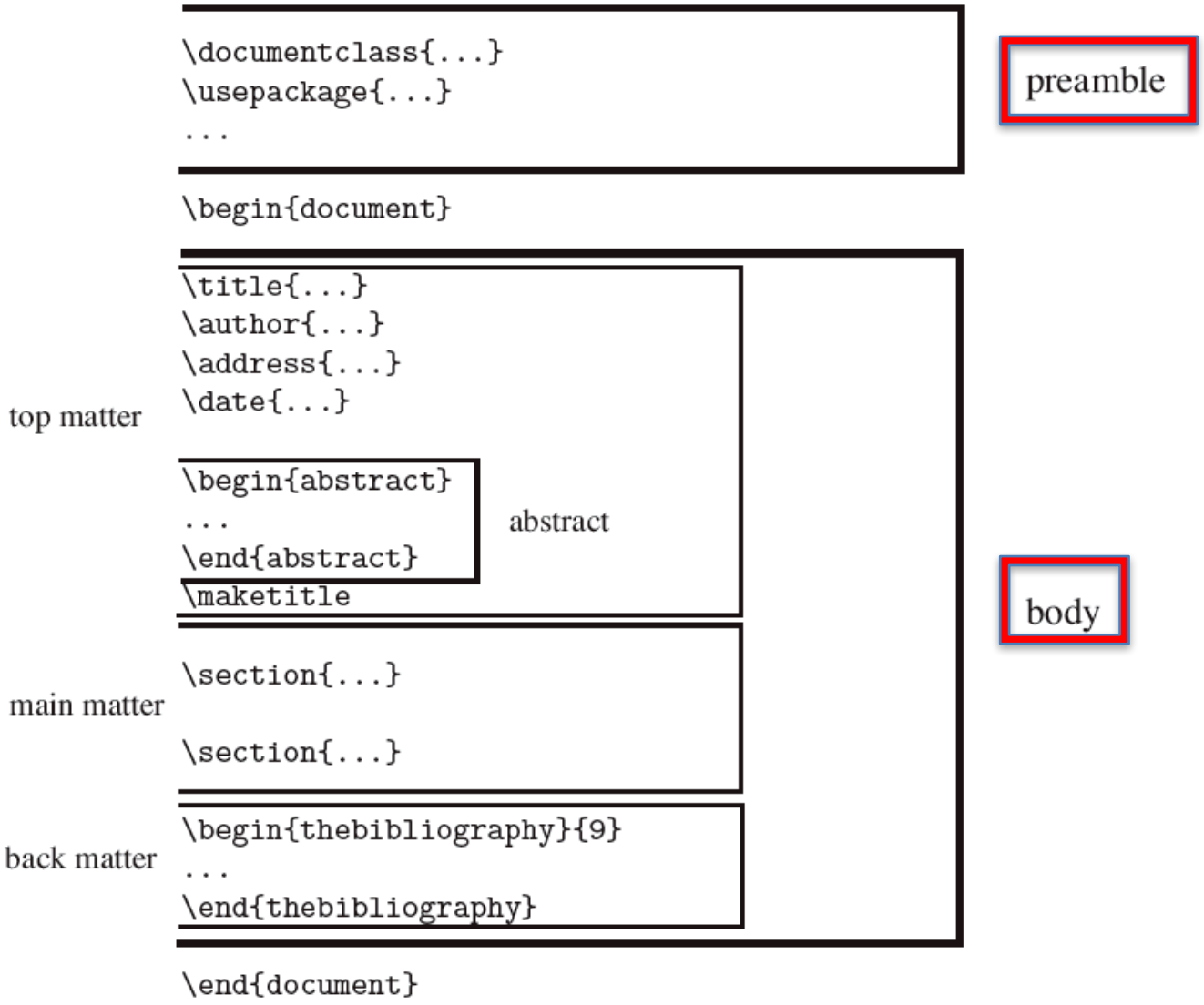
Latex 2: Document Structure and More Math

Cheng-Hsin Hsu

National Tsing Hua University

Department of Computer Science

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
  - We have used this in the last assignment

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 Nam
Write something \dot
\subsection{First Subs
More writeup.
\subsection{Second S
Even more writeup.
\section{Conclusions}
OK, we are done.
\subsection*{Acknow
We thank you for atte
\end{document}
```

1 Section Names Need to be Initial Capitalized

Write something ....

1.1 First Subsection

More writeup.

1.2 Second Subsection

Even more writeup.

2 Conclusions

OK, we are done.

Acknowledgement

We thank you for attending this course.

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}
\input{./related}
\input{./measurement}
\input{./problem}
\input{./evaluation}
\input{./testbed}
\input{./conclusion}
```

← each line is a section

- 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 your 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 Bibtex 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}
}
```

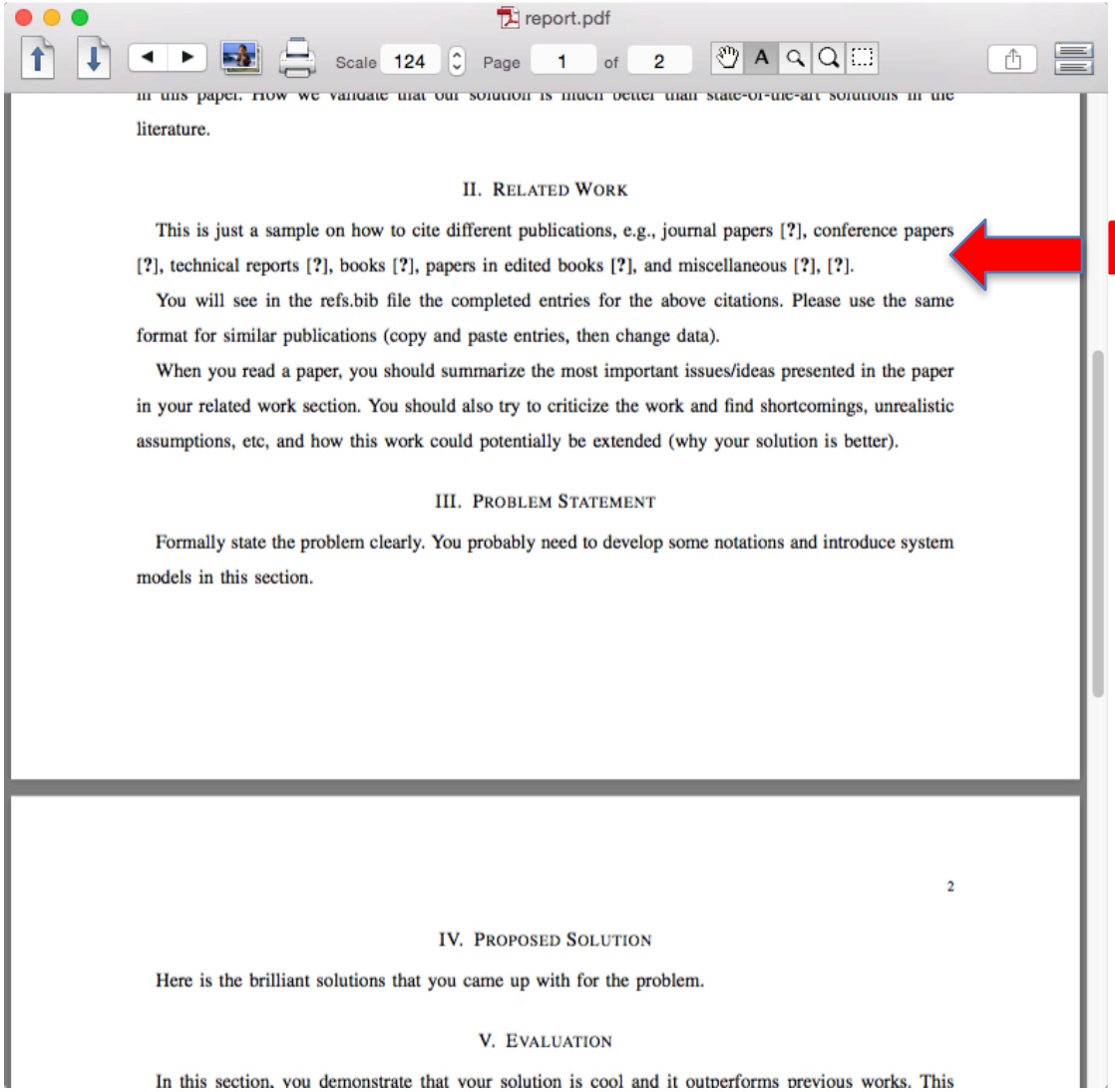
Sample Bibtex Item: Web Page

```
@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
```

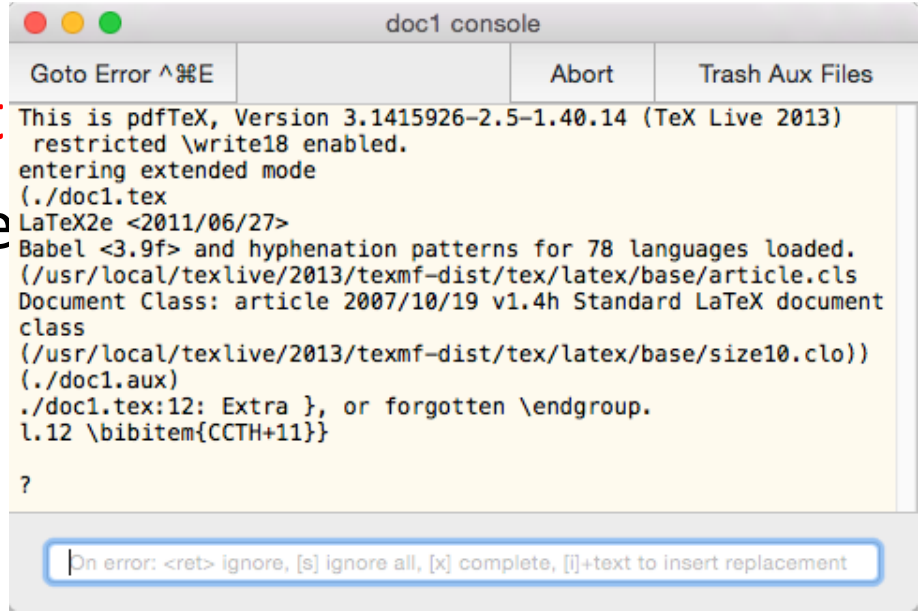
- Check out the files: report.tex, report.pdf, report.log, report.bbl
- Change report.tex a bit, recompile it
- Ask questions if any

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

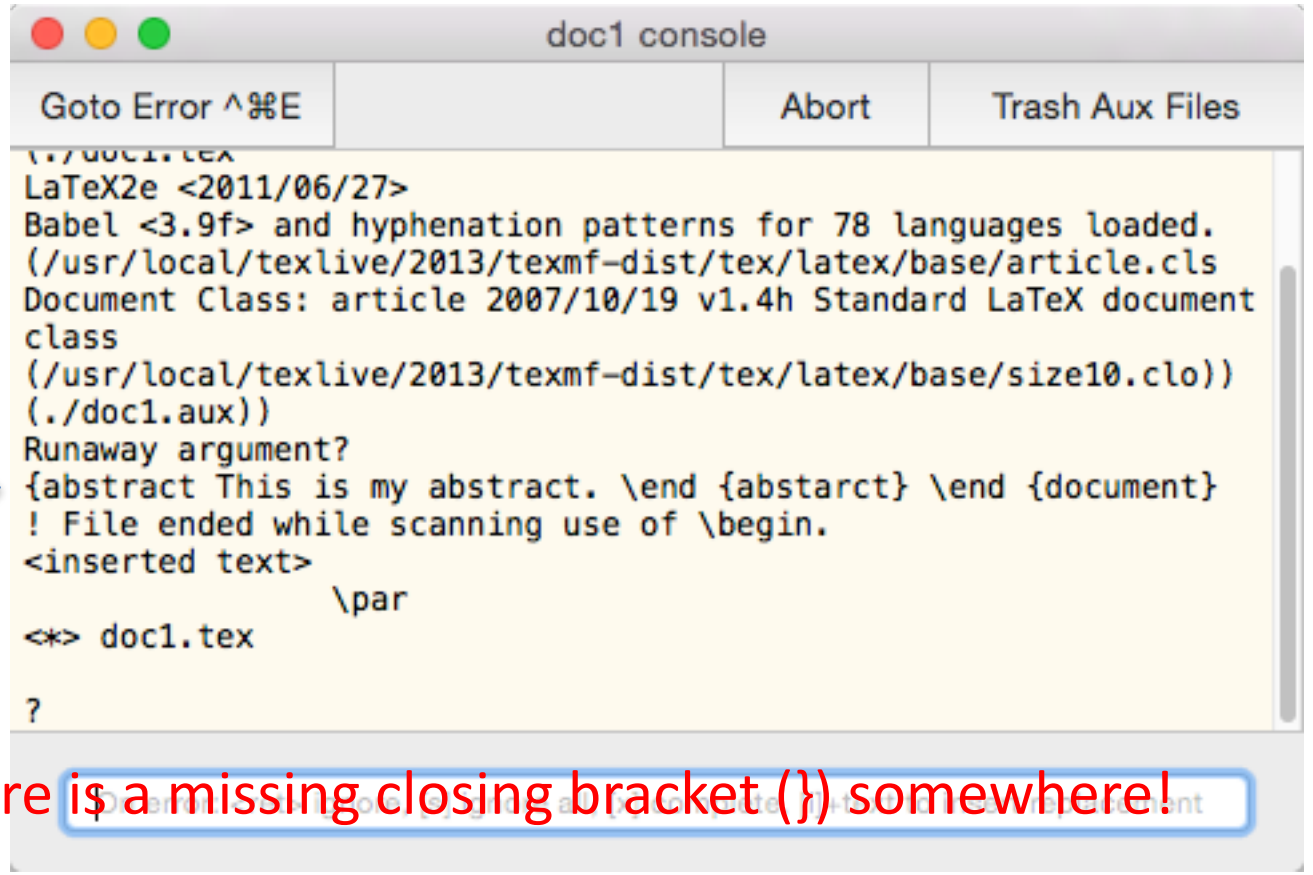
- Use spell checkers and proofread your tex files to address typos
- Once Latex complains about errors, it puts you into a ? prompt
  - Type x to abort typesett
  - Press return to continue



Troubleshooting #1

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

Runaway argument

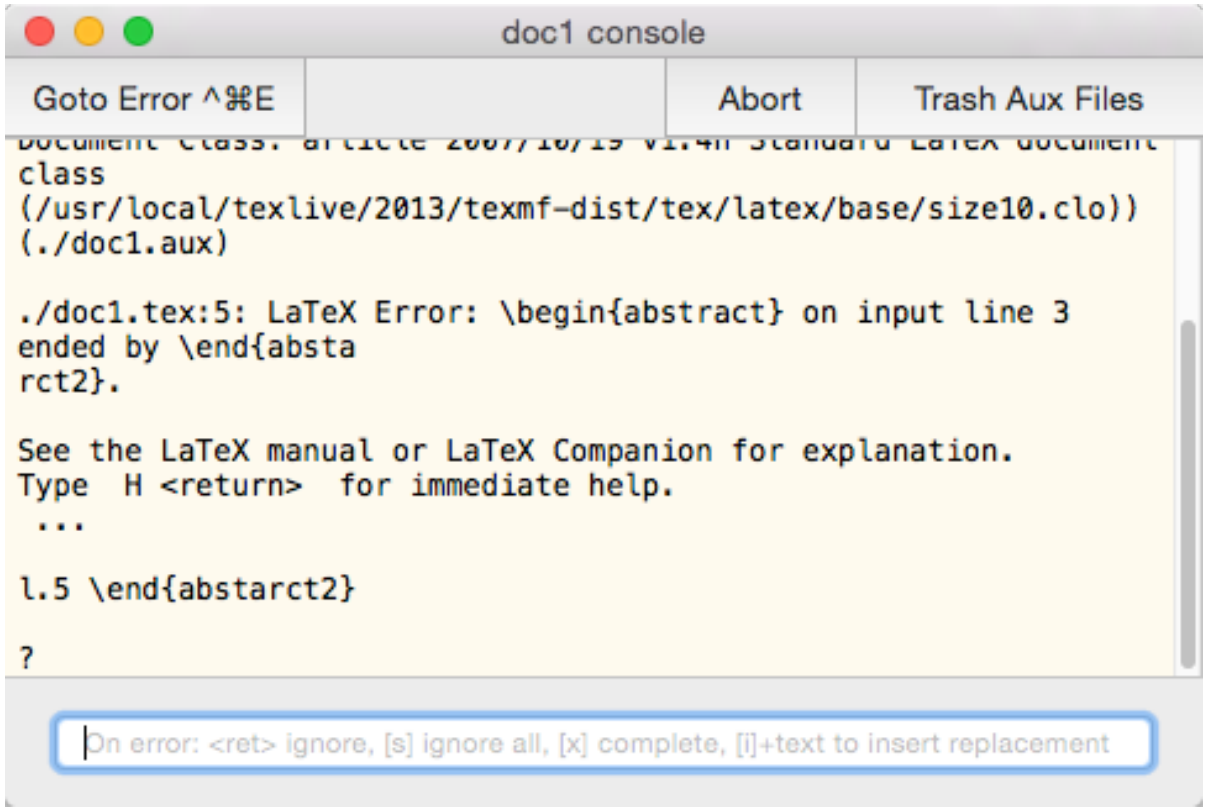


Usually means there is a missing closing bracket (}) somewhere!

Troubleshooting #2

```
\documentclass{article}
\begin{document}
\begin{abstract}
This is my abstract.
\end{abstarct2}
\end{document}
```

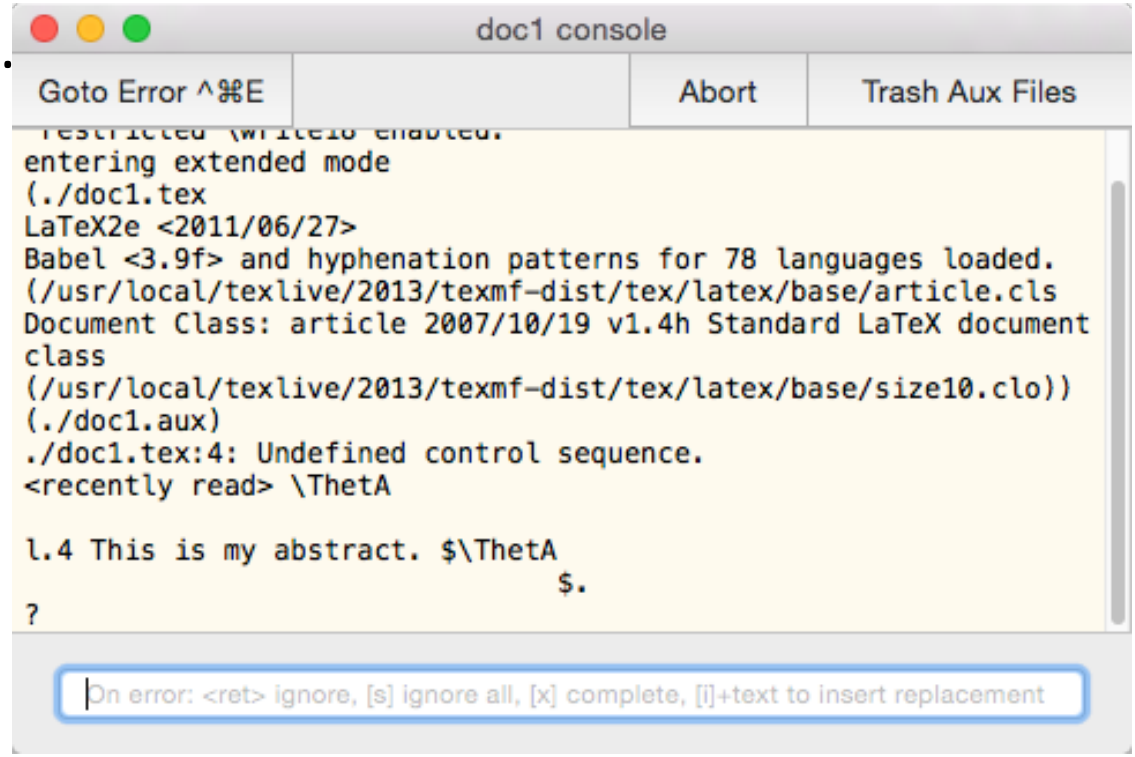
Mismatched



Troubleshooting #3

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

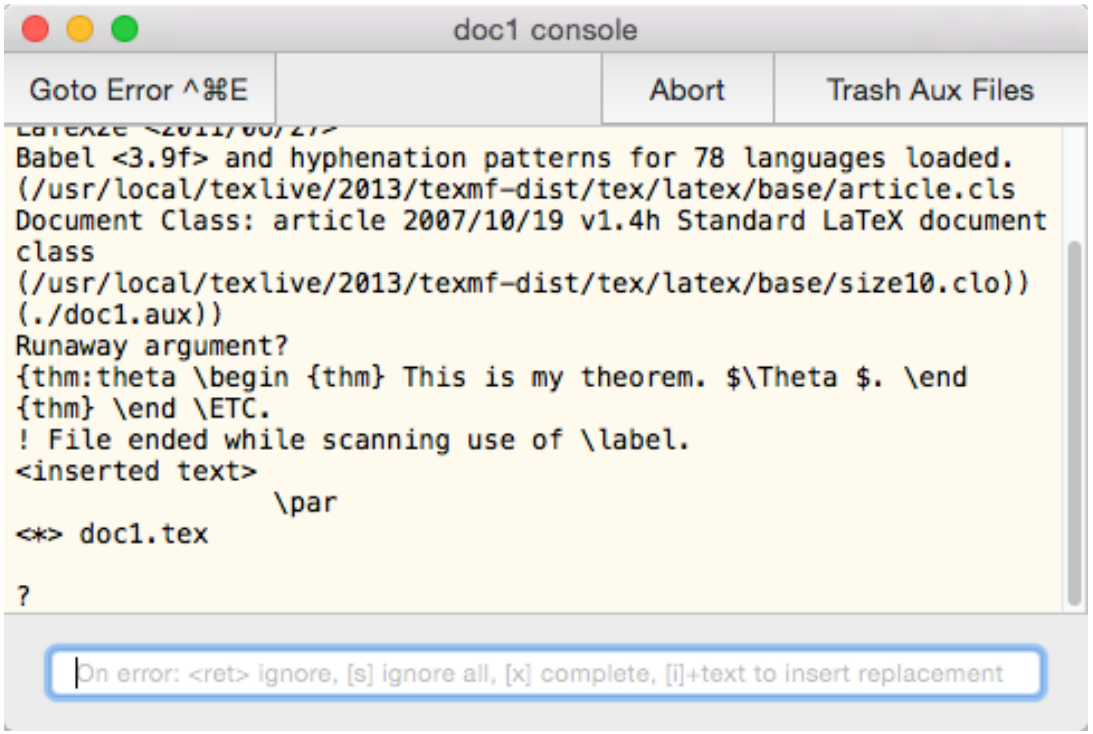
Θ != $\ThetA$



Troubleshooting #4

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

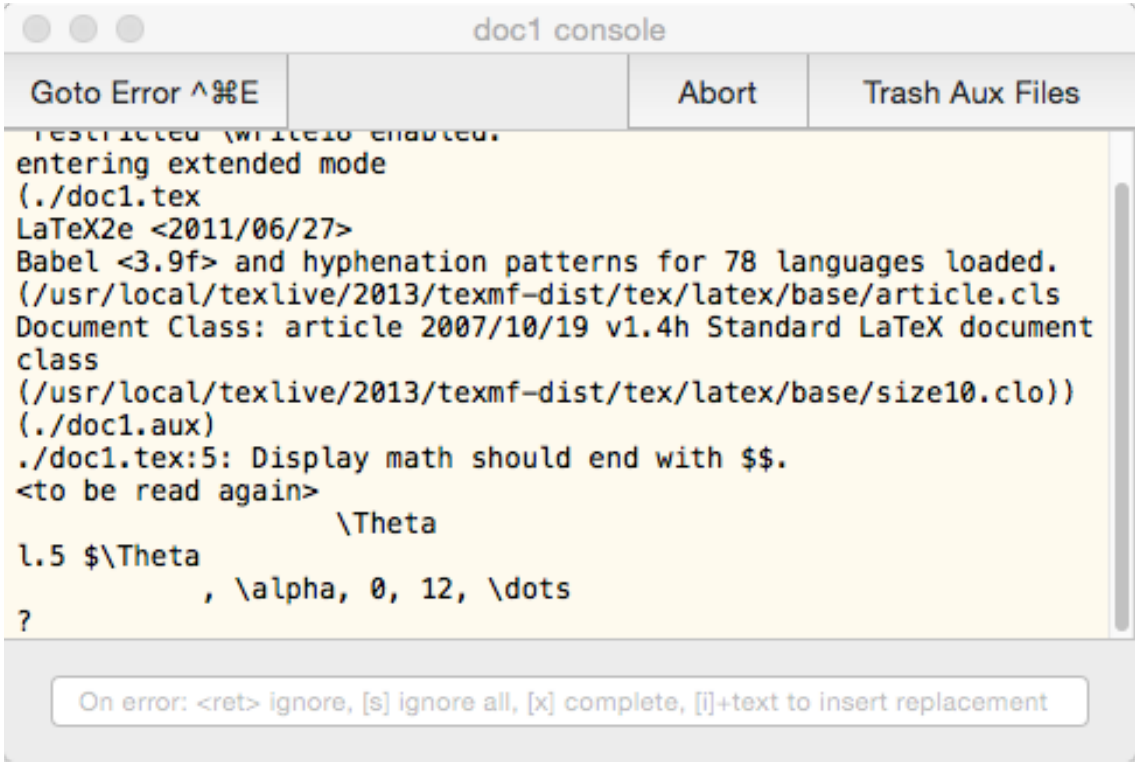
Reach the end before seeing the closing }



Troubleshooting #5

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

Not very helpful this time



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 spelling 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 $D_{i}$, $i \in I$, be complete distributive
lattices satisfying condition~\textup{(J)}.
Let $\Theta$ 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 \le
\begin{equation}\label{E:cong1}
\langle \dots, d, \dots, 0, \dots \ra
\langle \dots, c, \dots, 0, \dots \ra
\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 $d \leq c < 1_i$,*

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

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
\textnormal{...}	{\normalfont ...}	document
\emph{...}	{\em ...}	*emphasis*
\textrm{...}	{\rmfamily ...}	roman
\textsf{...}	{\sffamily ...}	sans serif
\texttt{...}	{\ttfamily ...}	`typewriter style`
\textup{...}	{\upshape ...}	upright shape
\textit{...}	{\itshape ...}	*italic shape*
\textsl{...}	{\slshape ...}	*slanted shape*
\textsc{...}	{\scshape ...}	SMALL CAPITALS
\textbf{...}	{\bfseries ...}	**bold**
\textmd{...}	{\mdseries ...}	normal weight and width

Font Size

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

Itemize, 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: $a \equiv b \pod{3}$ $$a \equiv b \pmod{3} \quad (3)$$
- Integral: $\int_{-\infty}^\infty e^{-x^2} \, dx = \sqrt{\pi}$ $$\int_{-\infty}^{\infty} e^{-x^2}\,dx = \sqrt{\pi}$$
- Equation: \begin{equation} \end{question} 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 $a b$ and ab
  - Should we write $width \times height$?
  - If not, what is the proper way to write it
- Fractions: $\frac{3+a}{4-b}$ $\frac{3+a}{4-b}$
- Superscripts/subscripts: $a^{b^c_d}$, ${a^b}^c_d$ $a^{b^c_d}$, ${a^b}^c_d$

Recap/More Math Mode (cont.)

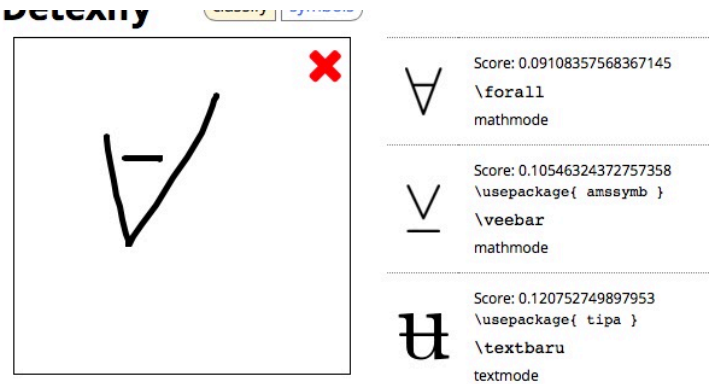
- Binomial coefficients: $\binom{\frac{n^2-1}{2}}{n+1}$ $\binom{\frac{n^2-1}{2}}{n+1}$
- Ellipse: $f(x_1, x_2, \dots, x_n)$ $f(x_1, x_2, \dots, x_n)$
- Integral: $\iint e^{-x^2y} \, dxdy $ $\iint e^{-x^2y} \, dxdy$
- Roots: $\sqrt{1+\sqrt {\frac{1}{\sqrt{3}}}}$ $\sqrt{1+\sqrt{\frac{1}{\sqrt{3}}}}$

Recap/More Math Mode (cont.)

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

$($ $\big($ $\Big($ $\bigg($ $\Bigg($

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



Exercise: Putting Everything Together

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

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

Exercise: Putting Everything Together (cont.)

```
\sum_{i = 1}^{ \left[ \frac{n}{2} \right] }
    \binom{ x_{i, i + 1}^{i^{2}} }
        { \left[ \frac{i + 3}{3} \right] }
    \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

Multiline Math Displays

- Latex is pretty good at laying out inline math, but not multiline displayed math
- We help Latex to present multiline displayed math in the most appropriate way

$$
\begin{gathered}
x_1x_2 + x_3^2x_4^2 \qquad (1)\\
x_3x_4 + x_1^2x_2^2 \qquad (2)\\
x_5x_6 \qquad (3)
\end{gathered}
$$

Gather: Centered

$$
\begin{aligned}
(1)\quad & x_1x_2 + x_3^2x_4^2 + x_1x_2 + x_3^2x_4^2 + x_1x_2 + x_3^2x_4^2 + x_1x_2 + x_3^2x_4^2 + \\
& x_3x_4 + x_1^2x_2^2 + x_1x_2 + x_3^2x_4^2 + x_1x_2 + x_3^2x_4^2 + x_1x_2 + x_3^2x_4^2 + \\
& x_1x_2 + x_3^2x_4^2 + x_1x_2 + x_3^2x_4^2 + x_5x_6
\end{aligned}
$$

Multline: Flush-left, center, flush-right

Gather

- Gather groups a few one-line formulas centered
- Lines (except the last one) end with \\
- Each line can have its own \label, or \nonumber
- Blank lines are not allowed, add a % at the beginning of a line for visual separation

Gather: Example

```
\begin{gather}
x_1x_2 + x_3^2 x_4^2  + \theta ^\alpha = 0 \label{eq:con1}\\
x_3x_4 + x_1^2 x_2^2 \le  0 \nonumber \\
x_5x_6 =0
\end{gather}
```

$$x_1x_2 + x_3^2x_4^2 + \theta^\alpha = 0 \quad (1)$$

$$x_3x_4 + x_1^2x_2^2 \leq 0$$

$$x_5x_6 = 0 \quad (2)$$

Multline

- Multline breaks a very long formula into several lines ← the first line is flush left, the last line is flush right, and others are centered
- Lines (except the last one) end with \\
- All lines have a single formula number
  - Like other environments, multline* disables numbers
- Blank lines are not allowed

Multline: Example

```
\begin{multline}
x_1x_2 + x_3^2 x_4^2+ x_1x_2 + x_3^2 x_4^2+ \\
x_3x_4 + x_1^2 x_2^2 +x_1x_2 + x_3^2 x_4^2+ x_1x_2
+ x_3^2 x_4^2+ x_1x_2 + x_3^2 x_4^2+ \\
x_1x_2 + x_3^2 x_4^2+ x_1x_2 + x_3^2 x_4^2+ x_5x_6
\end{multline}
```

$$\begin{aligned}(1)\quad & x_1x_2 + x_3^2x_4^2 + x_1x_2 + x_3^2x_4^2+ \\ & x_3x_4 + x_1^2x_2^2 + x_1x_2 + x_3^2x_4^2 + x_1x_2 + x_3^2x_4^2 + x_1x_2 + x_3^2x_4^2+ \\ & x_1x_2 + x_3^2x_4^2 + x_1x_2 + x_3^2x_4^2 + x_5x_6\end{aligned}$$

Align

- Align create multiple aligned columns
- The first & marks the alignment point of the first column
- The second & is a column separator
- The third & marks marks the alignment point of the second column
- For *n* aligned columns, there are *2n-1* &'s

```
\begin{align}\label{E:mm3}
   f(x) &= x + yz          & g(x) &= x + y + z\\
   h(x) &= xy + xz + yz    & k(x) &= (x + y)(x + z)(y + z)
    \notag
\end{align}
```

Align: Example

first column

second column

```
f(x) &= x + yz          & g(x) &= x + y + z\\
h(x) &= xy + xz + yz    & k(x) &= (x + y)(x + z)(y + z)
```

alignment points of first column

alignment points of second column

start of second column

(6)

$$\begin{aligned} f(x) &= x + yz & g(x) &= x + y + z \\ h(x) &= xy + xz + yz & k(x) &= (x + y)(x + z)(y + z) \end{aligned}$$

first column

second column

intercolumn space

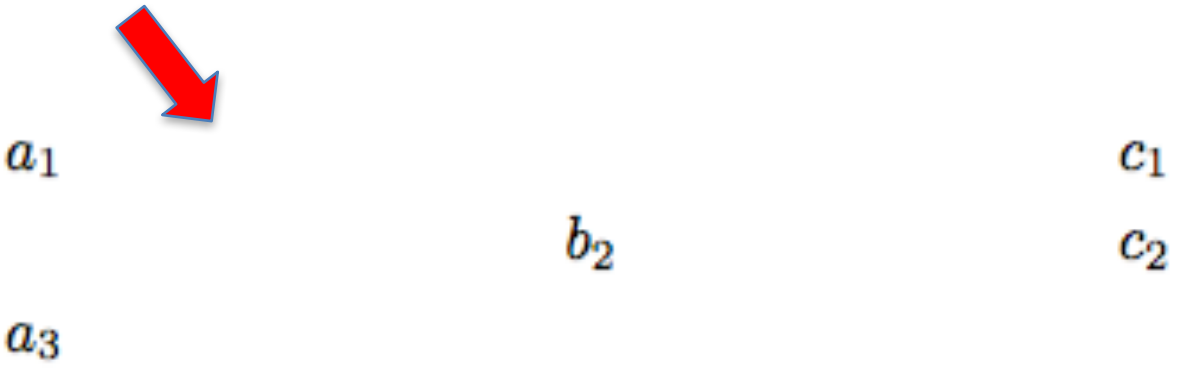
alignment points of first column

alignment points of second column

Align: More Example

```
\begin{align*}
& a_1 & &       & & c_1 \\
&       & & b_2 & & c_2 \\
& a_3 & &       & &
\end{align*}
```

Gaps are possible!



There are several variations of align with slightly different features ← see our textbook for details

Matrix

```
\begin{equation*}
\left[
\begin{matrix}
a + b + c & uv & x - y & 27\\
a + b & u + v & z & 1340
\end{matrix}
\right]
\end{equation*}
```

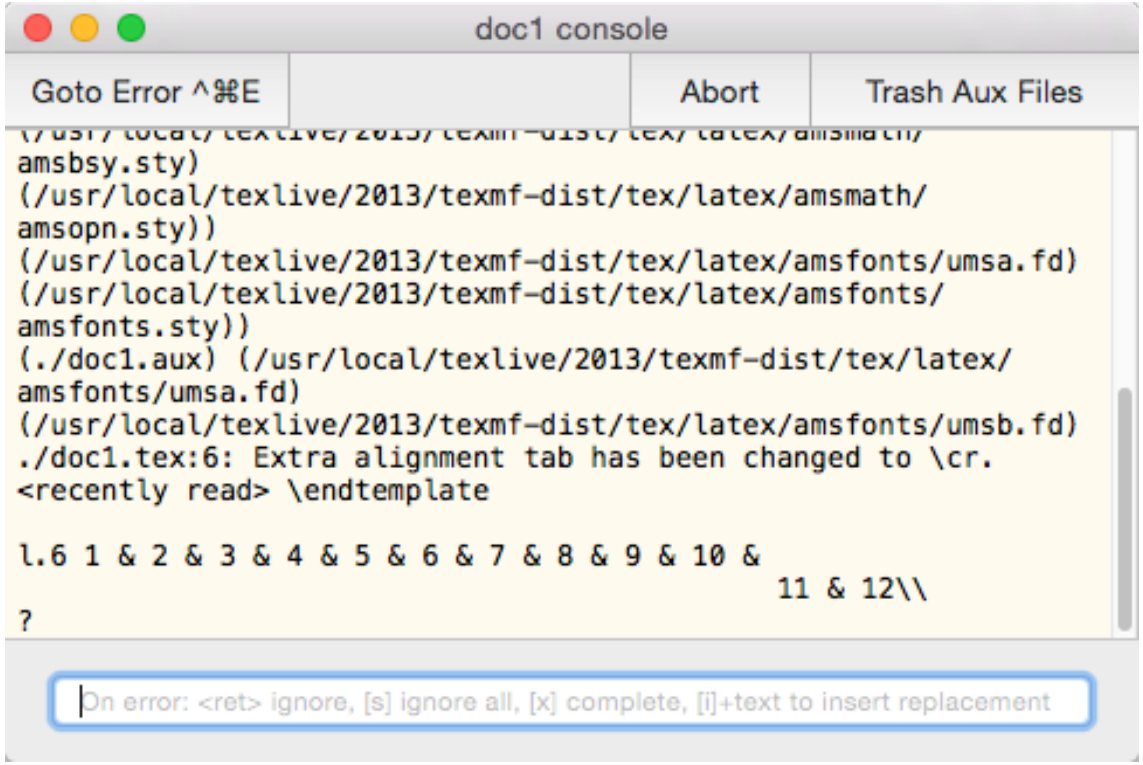
Remember to include amsmath package

$$\left[\begin{matrix} a+b+c & uv & x-y & 27 \\ a+b & u+v & z & 1340 \end{matrix}\right]$$

More Matrix

```
$\begin{matrix}
1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 & 10 & 11 & 12\\
1 & 2 & 3 & \hdotsfor{7} & 11 & 12
\end{matrix}$
```

Why?



More Matrix (cont.)

- This is because the matrix environment by default support up to 10 centered columns
- Solution: add more columns

```
$\left[
\setcounter{MaxMatrixCols}{12}
\begin{matrix}
1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 & 10 & 11 & 12\\
1 & 2 & 3 & \hdotsfor{7} & 11 & 12
\end{matrix} \right]$
```

$$\begin{bmatrix} 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 & 10 & 11 & 12 \\ 1 & 2 & 3 & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & 11 & 12 \end{bmatrix}$$

Exercise: Matrix Variants

$$\begin{matrix} a+b+c & uv \\ a+b & c+d \end{matrix} \qquad \begin{pmatrix} a+b+c & uv \\ a+b & c+d \end{pmatrix} \qquad \begin{bmatrix} a+b+c & uv \\ a+b & c+d \end{bmatrix}$$

$$\begin{vmatrix} a+b+c & uv \\ a+b & c+d \end{vmatrix} \qquad \begin{Vmatrix} a+b+c & uv \\ a+b & c+d \end{Vmatrix} \qquad \begin{Bmatrix} a+b+c & uv \\ a+b & c+d \end{Bmatrix}$$

Array

- Similar to matrix, but is more flexible

```
\begin{equation*}
\left(
\begin{array}{lccr}
a + b + c & uv & x - y & 27\\
a + b & u + v & z & 134
\end{array}
\right)
\end{equation*}
```

$$\left(\begin{array}{lccr} a + b + c & uv & x - y & 27 \\ a + b & u + v & z & 134 \end{array} \right)$$

Use Array to Create Tables

```
\begin{equation*}
\begin{array}{r|rrr}
& a & b & c \\
\hline
1 & 1 & 1 & 1 \\
2 & 1 & -1 & -1 \\
2 & 2 & 1 & 0
\end{array}
\end{equation*}
```

	a	b	c
1	1	1	1
2	1	-1	-1
2	2	1	0

(Real) Tables

```
\begin{table}
\caption{Flying Disc Distance (m)}\label{tab:disc}
\begin{tabular}{ | l | r | r | r | }
\hline
        & 1 & 2 & 3 \\ \hline
Peter & 2.45 & 34.12 & 1.00\\ \hline
John  & 0.00 & 12.89 & 3.71\\ \hline
David & 2.00 & 1.85 & 0.71\\ \hline
\end{tabular}
\end{table}
```

TABLE 1. Flying Disc Distance (m)

	1	2	3
Peter	2.45	34.12	1.00
John	0.00	12.89	3.71
David	2.00	1.85	0.71

Table and Tabular

- Table and caption give floating tables
- The rules of tabular environment
  - \begin{tabular} requires an argument specifying the alignment: l, c, and r
  - Column separator is &, newline is \\
  - \hline gives a horizontal line
  - \begin{table} takes an option of vertical alignment: b or t
- Example: \begin{table}[b]

Table with Specific Column Width

```
\begin{tabular}{ | p{1in} | r | r | r | }\hline
Name & 1 & 2 & 3 \\ \hline
Peter & 2.45 & 34.12 & 1.00\\ \hline
John & 0.00 & 12.89 & 3.71\\ \hline
David & 2.00 & 1.85 & 0.71\\ \hline
\end{tabular}
```

Name	1	2	3
Peter	2.45	34.12	1.00
John	0.00	12.89	3.71
David	2.00	1.85	0.71

More Table Refinements

- \cline{1-3}: draw a line between columns 1 and 3 ← if we don't want \\hline
- \multicolumn{3}{c}{Text}: Merge three column into a cell
- There is also a \multirow command

Example: Multicolumn

```
\begin{tabular}{ | l | r | r | r | } \hline
Name & 1 & 2 & 3\\ \hline
Peter & 2.45 & 34.12 & 1.00\\ \hline
John & \multicolumn{3}{c |}{\emph{absent}}\\
\hline
David & 2.00 & 1.85 & 0.71\\ \hline
\end{tabular}
```

Name	1	2	3
Peter	2.45	34.12	1.00
John	*absent*		
David	2.00	1.85	0.71

PostScript

- PostScript (PS) is the predecessor of the well-known PDF
- PDF aimed for paper-less offices
  - But was later extended for printing
- PostScript is a language widely used by modern printers
  - There are software interpreters ← ghostscript and gsview on Windows and Linux; gs on all platforms
- Encapsulated PS (EPS) is a subset of PS that can be included in other PS/PDF files, as figures

EPS Example

- vim ~/Desktop/test.eps
- Add the content:

```
100 0 translate
1 0 0 setrgbcolor
gsave
19 {0 0 moveto 100 0 lineto 10 rotate} repeat
stroke
grestore
0 0 1 setrgbcolor
/Times-Roman 40 selectfont
-80 5 moveto (Computing) show
```

Source: http://www.tcm.phy.cam.ac.uk/~mjr/eps.pdf

EPS Example (cont.)

- Open it using open (or gs) ~/Desktop/test.eps

- We will mostly plot eps files using matlab
- For illustrative figures, use visio (Windows), omnigraffle (Mac), or xfig and inkscape (all platforms) ← out of scope

Include a Figure in Latex

- Download a few eps files to your ~/Desktop for exercises
  - http://people.sc.fsu.edu/~jburkardt/data/eps/mathematica.eps
  - http://people.sc.fsu.edu/~jburkardt/data/eps/heawood.eps

```
\usepackage{graphicx}
…
\begin{figure}
\centering\includegraphics{mathematica}
\caption{Our first figure.}\label{fig:test}
\end{figure}
```

Include a Figure in Latex (cont.)

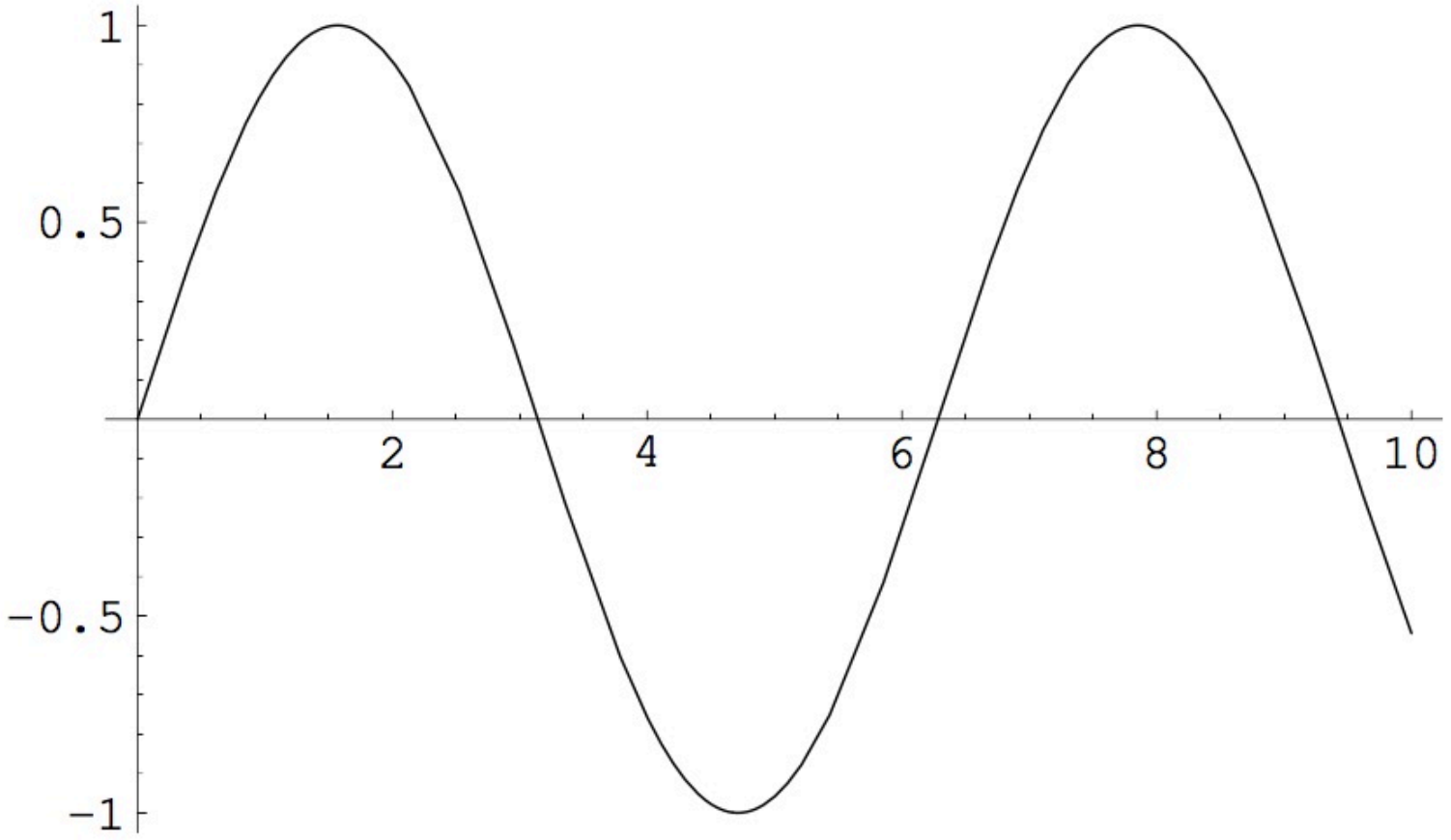
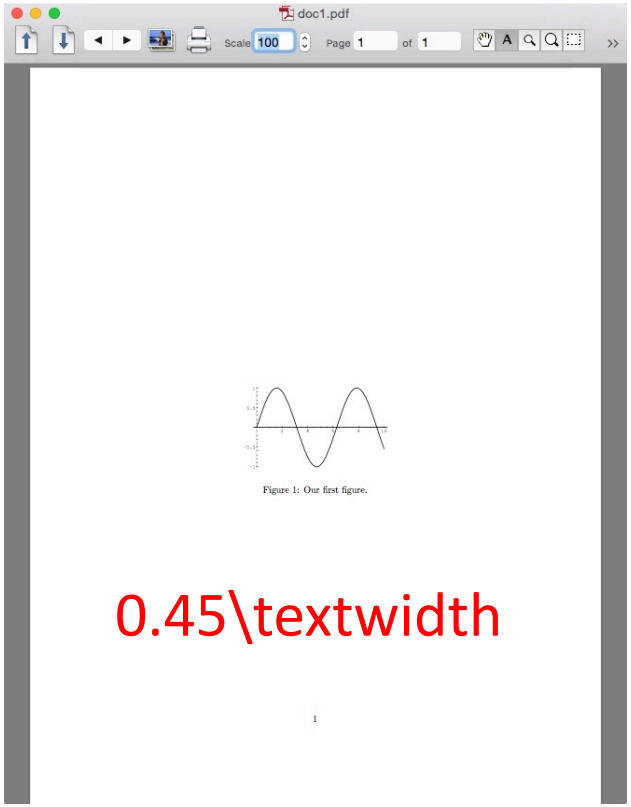
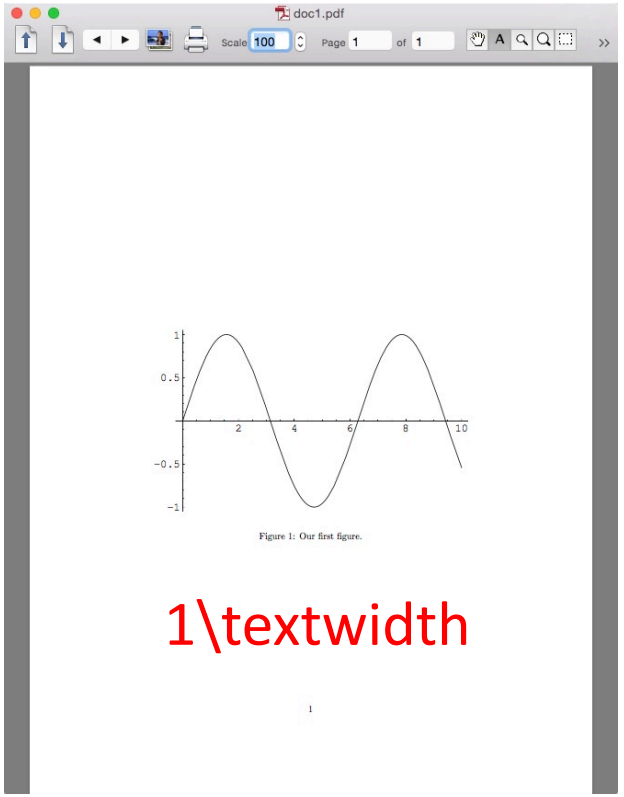


Figure 1: Our first figure.

Control Size (Width)

- \includegraphics[width=0.45\textwidth]{mathematica}



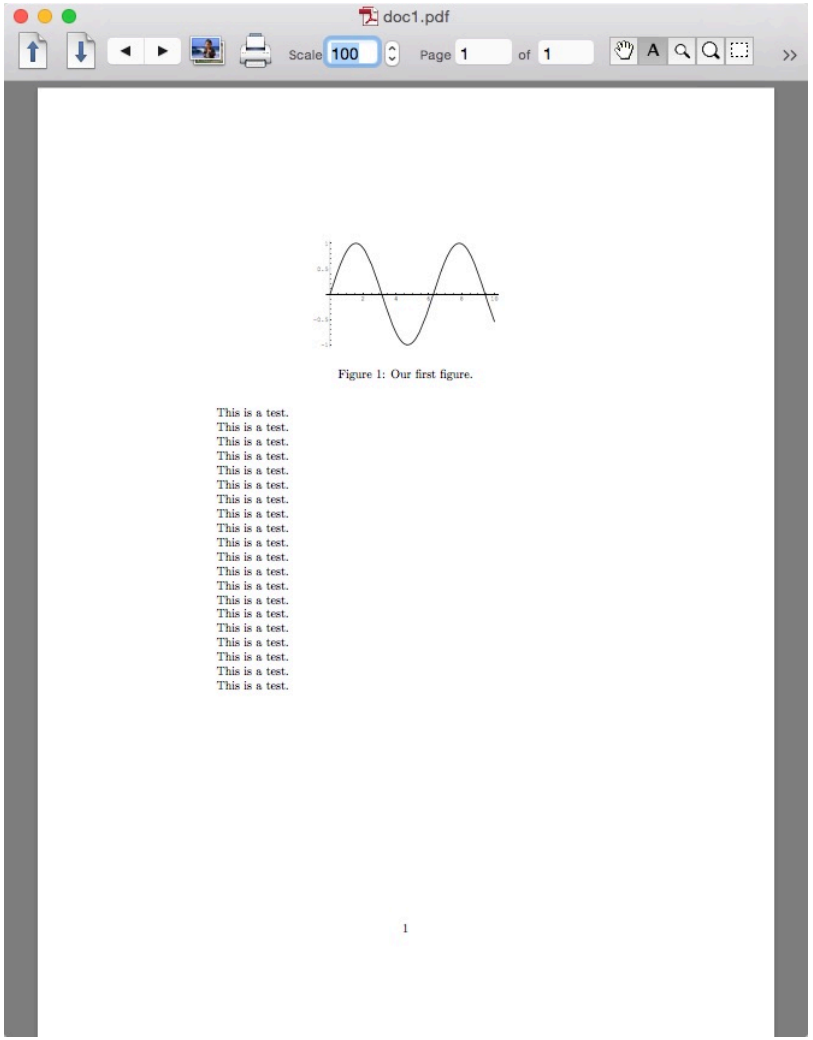


Float Control

- We can suggest latex to place figures at different position
  - b: the bottom of the page
  - h: here
  - t: the top of the page
  - p: a separate page
- Example: \begin{figure}[tbh]
- The same options work for tables as well

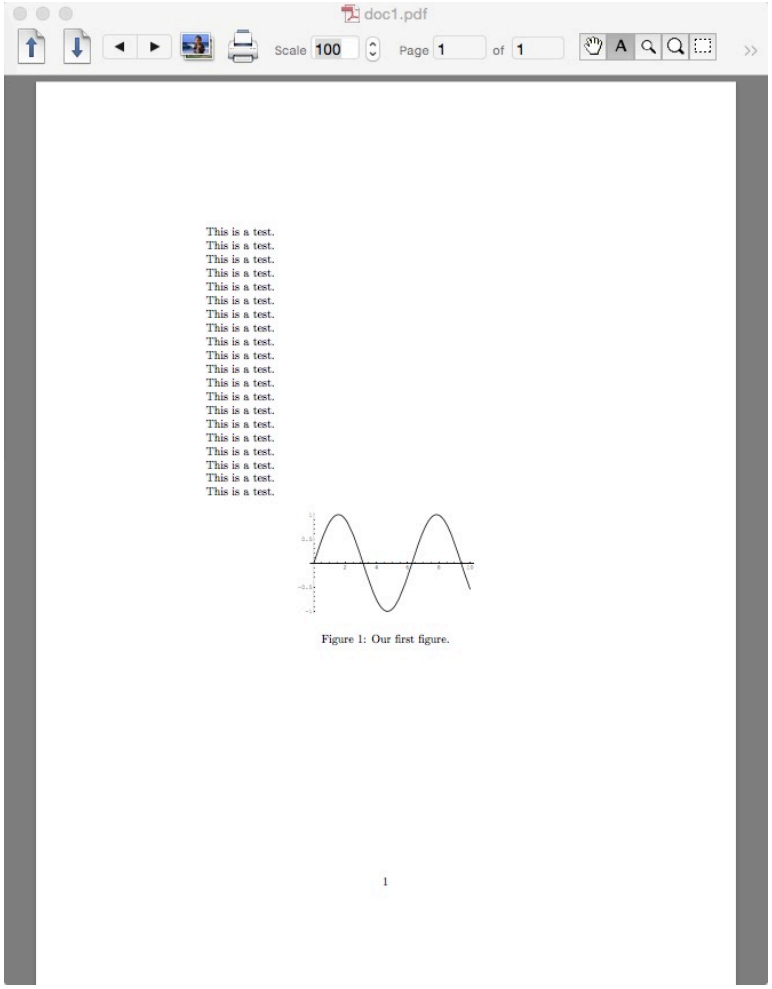
Example: Float Figure

- \begin{figure}[t]



Example: Float Figure (cont.)

- \begin{figure}[th]

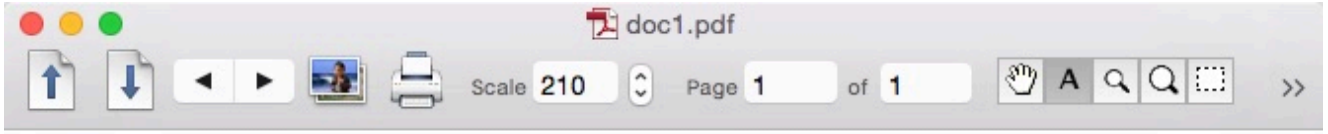


How to Arrange Multiple Figures

- Subfigure: \usepackage{subfigure}

```
\begin{figure*}[th]
\centering{
\hfill
   \subfigure[]{ \label{fig:sub1}
      \includegraphics[width=.45\textwidth]{mathematica}
   }
\hfill
   \subfigure[]{ \label{fig:sub2}
      \includegraphics[width=.25\textwidth]{heawood}
   }
\hfill
}
\caption{Sample figures: (a) subfigure 1 and (b) subfigure 2.}
\end{figure*}
```

How to Arrange Multiple Figures (cont.)



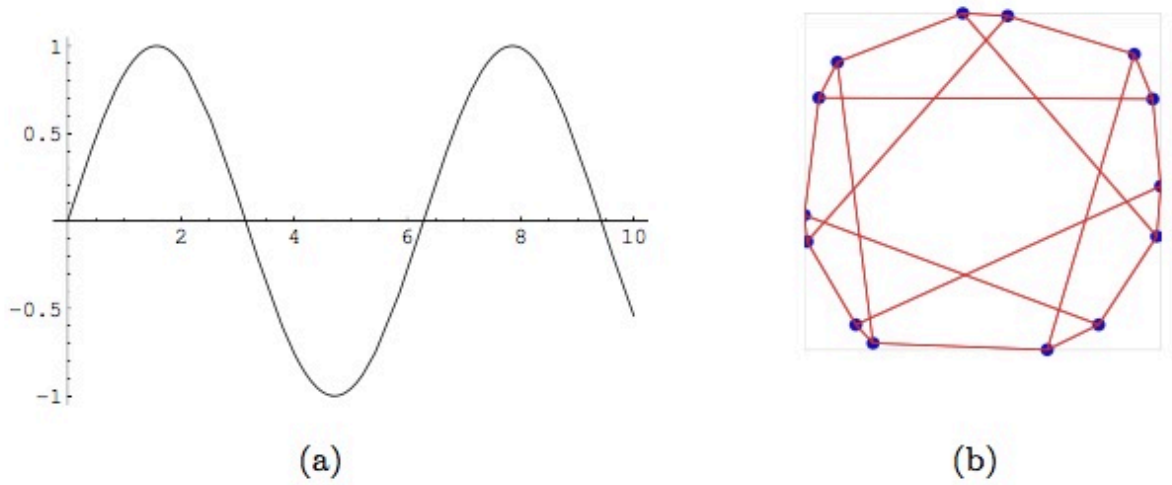
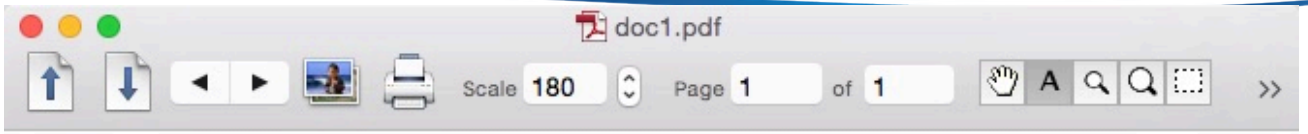


Figure 1: Sample figures: (a) subfigure 1 and (b) subfigure 2.

Alternate Way to Arrange Figures

```
\begin{figure*}[th]
\centering{
\hfill
  \begin{minipage}[t]{2.9in}
   \begin{center}
      \includegraphics[width=\textwidth]{mathematica}
      \caption{The first figure.}
       \label{fig:sub1}
  \end{center}
 \end{minipage}
\hfill
  \begin{minipage}[t]{1.8in}
   \begin{center}
       \includegraphics[width=\textwidth]{heawood}
      \caption{The second figure.}
       \label{fig:sub2}
  \end{center}
 \end{minipage}
\hfill
}
\end{figure*}
```

Alternate Way to Arrange Figures (cont.)



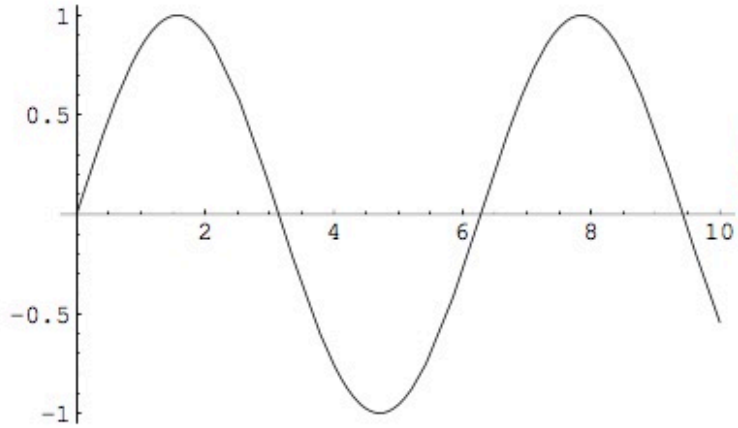


Figure 1: The first figure.

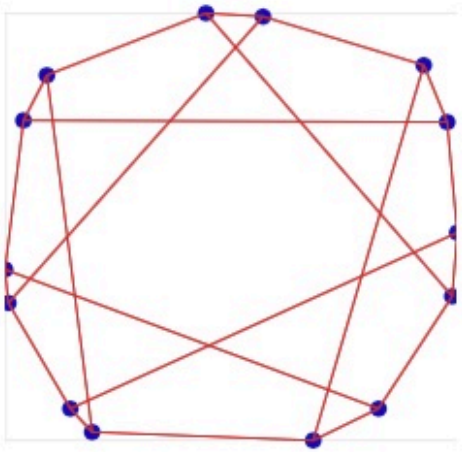
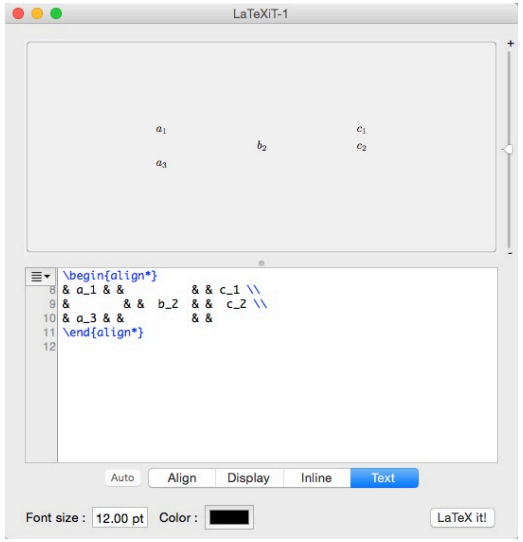


Figure 2: The second figure.

How Did I Add Equations into Slides?

- It is well-known that almost all Microsoft tools do not handle eps files in a nice way
  - Doesn't look good
- LatexIt is a tool to create high quality png/jpg for Microsoft Office
  - Come with MacTex
- Just drag and drop into your slides



Summary

- We discussed what are ps/eps
- We exercised how to add tables and figures in latex
- We went over two ways to arrange figures: subfigures and minipage
- 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.