

LaTeX, automata, computability, and notation

CS154

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Outline

- What is LaTeX?
- Automata, Computability, and Complexity
- Mathematical Notation and Terminology

What is LaTeX?

- LaTeX is a markup language which can be used to specify how to typeset a document.
- It is used to prepare papers containing mathematical notation for publication.
- Most papers in theoretical computer science are written in LaTeX.

Sample Document

```
\documentclass[12pt]{article}
% create some commands of my own with people's names with accents
\newcommand{\Hastad}{H{\aa}stad}
\newcommand{\Pudlak}{Pudl{\a}k}
% define the title
\author{C. Pollett}
\title{Simple Document}
\begin{document}
% generates the title
\maketitle
\section{This is a section title}
Here is the first paragraph to be typeset by \LaTeX{}
```

Notice if I skip a line it starts a new paragraph. Backslash is used to escape special characters like the dollar sign `\$`. A backslash is also used to begin a `\LaTeX{}` command.

For instance: one could write a greek letter α . Notice we explicit left and right quotes. Double quotes are made using pairs of single quote ````. The dollar sign is used to start an inline math string. For example,

$(a_i)^{2^2}$. Simple displayed equations can be written by enclosing the equation in `\$`. For example, $\sum_{i=1}^n 2^i$.

Notice braces are used to enclose inputs to a `\LaTeX{}` command. Here's an example of using user defined commands:

```
\Hastad, \Pudlak.
```

```
\section{My second Section}
```

```
\ldots{} as Razborov~\cite{razborov95a} said.
```

```
\begin{thebibliography}{25}
```

```
\bibitem{razborov95a}
```

A.A. Razborov.

```
\newblock Lower bounds for propositional proofs and independence results in bounded arithmetic.
```

```
\newblock In {\em Proceedings of 20th International Symposium on the Mathematical Foundations of Computer Science}, page 105. Springer-Verlag, 1995.
```

```
\end{thebibliography}
```

```
\end{document}
```

How to get/compile LaTeX

- Links to obtaining LaTeX can be obtained off the class page.
- There are also various GUI front ends which can be used to create a LaTeX file. WinEdt (Windows), TeXShop (for Mac).
- From the command line one can compile a LaTeX document using a command like:
 - `latex document.tex` (produces a dvi file)
 - `pdflatex document.tex` (produces a pdf file)
- This assumes you have set up the paths to these commands.
- Once compiled you can view the file with a program like yap for dvi files or with acrobat for pdf files.

What is automata theory?

- Automata theory deals with the definitions and properties of mathematical models of computation.
- Two models we will be interested in are finite automata and context-free grammars.
- These models are of interest because the strings that can be recognized by these models can be recognized very efficiently on a real computer.
- This is useful for compilers and string matching.
- One the web language, XML, is essentially a language for specifying context free grammars.

What is computability theory?

- It is the study of what it is in principle possible to do on a computer.
- It is also the study of what it means to compute something.
- It was developed in the first half of the twentieth century by people like Godel, Turing, Church, etc.

Mathematical Notions and Terminology

- In order to begin learning about automata theory and computability we need to first fix some common notations as well as learn about various methods of proof.

Sets

- A **set** is a group of objects represented together as a unit.
 $\{7, 21, 57\}$ -- the set containing the number 7, 21, 57
 $\{\{\}, \{a\}, \text{apple}\}$ -- set containing the empty set, the set $\{a\}$, and an apple.
- We use \in and \notin to mean element of and not element of.
For example,
 $7 \in \{7, 21, 57\}, 5 \notin \{7, 21, 57\}$
- The symbol \subseteq means subset of. $A \subseteq B$ means each element of A is an element of B. For example,
 $\{7, 21\} \subseteq \{3, 7, 5, 21, 82\}$

More sets

- Some sets contain unboundedly many objects in them. These are called **infinite sets**.

Natural Numbers $\{0, 1, 2, 3, 4, 5, \dots\}$

\mathbb{N}

Integer Numbers $\{\dots, -2, -1, 0, 1, 2, \dots\}$

\mathbb{Z}

- The set which doesn't have any elements in it is called the empty set and is denoted by either $\{\}$ or \emptyset .