ACADEMIC SKILLS IN COMPUTER SCIENCE

Lecture 10: More LaTeX / Persuasive Writing

Markus Krötzsch
Knowledge-Based Systems

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Goals for today

Learning goals of this lecture:

(1) Get to know further important LaTeX commands

(2) Learn how to manage citations with BibTeX

(3) Understand how to write reports that are credible and persuasive

Tables

Tables are defined by the `tabular` environment

```
\begin{tabular}{lcrp{6cm}} % 4 col's: left, center, right, 6cm just.
 \textbf{Item} & \textbf{Category} & \textbf{Price} & \textbf{Note}\\
 Apple & fruit & 0.65 & keeps doctors away \\
 Pak Choi & veg & 1.40 & rich in potassium \\
 Mango & fruit & 4.50 & as before, line breaks
   in the source code are not important, so long rows can also
   be split across lines for readability
\end{tabular}
```

Item	Category	Price	Note
Apple	fruit	0.65	keeps doctors away
Pak Choi	veg	1.40	rich in potassium
Mango	fruit	4.50	as before, line breaks in the source code are not important, so long rows can also be split across lines for readability

Styling tables

- Fields are separated by &, lines terminated by \\
- The tabular environment receives a parameter defining columns and layouts left aligned (l), right aligned (r), centred (c), justified (p)
- Space and text between columns is defined using expressions like @{~~~} (insert three spaces; could be any text instead) between column specifiers
- Using | between column specifiers produces vertical separating lines[1]
- Separating horizontal lines can be added with \hline
- Increase or decrease space between lines by writing something like \\[0.5ex] to end a line
- Use \multicolumn to merge adjacent cells in a row
- See the `booktabs` package manual to learn how to style tables in LaTeX
- The `colortbl` package allows to add colour to tables (lines and cells)
- The `longtable` package supports tables that break across pages

[1]Vertical lines in tables are not beautiful; just omit them

Including graphics

Images can be included from many file formats as follows:

```
\usepackage{graphicx} % in preamble
...
% now include image, scaled to be 2cm wide:
\includegraphics[width=2cm]{path/to/file.png}
```

- pdflatex supports many common image formats (including jpg, png, pdf)
- A useful width can be something like `0.95\textwidth`
- Other options can be set to define the height or the scaling factor instead

Figures and tables

Figures in research reports are usually not part of the text but presented in numbered "figures" instead

```
\begin{figure}[tb]
    \includegraphics[width=1\textwidth]{architecture.pdf}
    \caption{Architecture of our system}\label{fig_arch}
\end{figure}
```

- The caption is the labelling text of the figure (guideline: short but informative)
- Figures are numbered; the label can be used to refer to it from the text
- The content can be any LaTeX, not just an image
- `table` can be used instead of `figure` (different name, similar use)

Figures and tables are placed outside of the main text by LaTeX
- Parameter `[tb]` states that LaTeX might put it at the top or bottom of pages
- The figure will appear in the document at a point after its appearance in the source
- Figures and tables will appear in the order given in the source

Document layout

LaTeX allows controlling document layout:
- The use of two columns instead of one is controlled by the document class (often with an option)
- The use of three or more columns only works with special packages and is not supported well
- The size of the margins can be controlled by several packages, e.g., `geometry`
- Line spacing is defined in the preamble (exercise)
- The contents of the header and footer can be controlled by the `fancyhdr` package

Be careful when tweaking document layout. Random changes often lead to ugly results.

Defining own macros

It is easy to define own macros in LaTeX:

```
\newcommand{\courseName}{Academic Skills in Computer Science}
...
We learned in \courseName{} that parameter-free commands eat spaces,
which can also be prevented by adding \{\} after such a command.
```

Commands can be defined in the preamble or in the main text

Commands can take parameters:

```
\newcommand{\sentence}[2]{The #1 ate the #2.}
...
\sentence{bird}{berry}
\sentence{cat}{cheese}
```

Use meaningful names for commands when working with others.

(Re)defining commands

Commands have many purposes

- Safe time typing
- Use consistent style that is defined in one place (and is easy to change)
- Encapsulate complicated typesetting & calculations

Overuse of macros can make the text hard to read

It is possible to re-define existing commands

```
\renewcommand{\emph}[1]{\textbf{#1}}
```

Do this only if the existing command should get a new meaning and never ever because you like the (shorter) name that is already in use!

Splitting projects in several files

LaTeX allows splitting content across files for better clarity and easier collaboration

```
\input{macros} % include all content of file ./macros.tex here
```

- Paths are relative to directory of main tex file
- LaTeX's \usepackage and \documentclass essentially also pull in LaTeX from other files (with subtle differences)

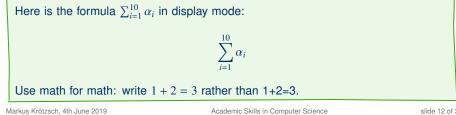Another one is \include; you won't need it.

Math

Math

Mathematical formulae are an important feature of LaTeX

Math can be typeset in two ways:

- Inline math is written in $...$
- Display math is written in \[...\]

```
Here is the formula $\sum_{i=1}^{10} \alpha_i$ in display mode:
\[\sum_{i=1}^{10} \alpha_i\]
Use math for math: write $1+2=3$ rather than 1+2=3.
```

produces:

Here is the formula $\sum_{i=1}^{10} \alpha_i$ in display mode:

$$\sum_{i=1}^{10} \alpha_i$$

Use math for math: write $1 + 2 = 3$ rather than 1+2=3.

Important math features

Some important math features include:

- Subscripts are produced by `_{...}` where { and } can be omitted if only one character is in subscript
- Superscripts work like subscripts using ^ instead of _
  Sup- and superscripts can be nested, but this should be avoided if possible.
- Greek letters are produced by eponymous commands, e.g., `\alpha` or `\Omega` (case matters!); some letters have two forms, e.g., `\epsilon` ϵ vs. `\varepsilon` ε
- Regular text is produced with `\text{...}`; font commands like `\textsf{...}` also work; the commands `\mathit{...}`, `\mathbf{...}`, `\mathrm{...}` are preferable for written identifiers (i.e., "words" that are not part of regular text)
  Without `\text` or similar commands, words written in math are spaced wrongly!
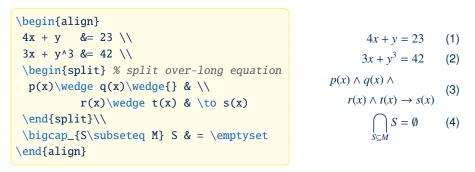- Space commands: `\,` `\;` `\quad` `\qquad` and `\!` (= negative `\,` space)
- Parenthesis size: manually set with `\big (` $($, `\Big (` $\big($, `\bigb (` $\Big($, `\Bigb (` $\bigg($
  or automatically determined using `\left( ... \right)`

Important math commands

Many math commands are provided by AMS packages:

```
\usepackage{amsmath,amssymb} % additional commands, including \text
\usepackage{amsthm} % commands for making numbered theorems etc.
```

Further common commands:

- Sets: `\cap` $\cap$, `\cup` $\cup$, `\setminus` $\setminus$, `\in` $\in$, `\subseteq` $\subseteq$, `\subset` $\subset$, `\supset` $\supset$, ...
- Set builder: `\{ x \mid x < 100\}` $\{x \mid x < 100\}$ (use `\mid` for proper spacing!)
- Functions: `f:\mathbb{N}\to\mathbb{N}: n\mapsto n+1` $f : \mathbb{N} \to \mathbb{N} : n \mapsto n+1$
- Logic: `\wedge` $\wedge$, `\vee` $\vee$, `\neg` $\neg$, `\to` $\to$, `\forall` $\forall$, `\exists` $\exists$
- Equalities and inequalities: `=` $=$, `\approx` $\approx$, `\neq` $\neq$, `<` $<$, `\leq` $\leq$, `>` $>$, `\geq` $\geq$, ...
- Fractions, stacking, braces: `\frac{x+1}{x}` $\frac{x+1}{x}$, `\underbrace{a+b}_{x}` $\underbrace{a+b}_{x}$

  `x \stackrel{\alpha}{\to} y` $x \stackrel{\alpha}{\to} y$

Many more commands are given in the Comprehensive LaTeX Symbol List (link)

Aligning and enumerating equations

AMS provides environments to enumerate equations

```
\begin{align}
4x + y   &= 23 \\
3x + y^3 &= 42 \\
\begin{split} % split over-long equation
 p(x)\wedge q(x)\wedge{} & \\
       r(x)\wedge t(x) & \to s(x)
\end{split}\\
\bigcap_{S\subseteq M} S & = \emptyset
\end{align}
```

$$4x + y = 23 \tag{1}$$
$$3x + y^3 = 42 \tag{2}$$
$$\begin{aligned} p(x) \wedge q(x) \wedge \\ r(x) \wedge t(x) \to s(x) \end{aligned} \tag{3}$$
$$\bigcap_{S \subseteq M} S = \emptyset \tag{4}$$

- Labels can be used on equations (use `\eqref` for ref's in parenthesis)
- Numbers are switched off using `align*` instead; or for individual equations with `\nonumber`

Bibliography management

Bibliographies in LaTeX

LaTeX uses the tool BibTeX for managing bibliographic references

Basic workflow:

- A .bib file is used to store literature references, each with an ID
- The bibliography is loaded from a .tex file
- The `\cite` command is used in LaTeX to cite references
- After LaTeX was ran to make a pdf, the program `bibtex` is run to prepare the necessary references; then LaTeX is ran again (twice) to get all references included in the right way

Making bib files

Bibliography files are organised in blocks, with different fields depending on reference type:

```
@book{EXSample2019,
    author    = {Edgar X. Sample},
    title     = {The Example Book},
    publisher = {TU Dresden},
    year      = {2019}
}

@inproceedings{UthorWan2019,
    author    = {Ana Uthor and So Me Wan},
    title     = {How Conference Papers are Cited},
    editor    = {Markus Kr{\"{o}}tzsch},
    booktitle = {Proc. of the 1st Conf. on BibTeX Examples (BibEx 2019)},
    year      = {2019},
    pages     = {23--42},
    series    = {Examples in Computer Science},
    volume    = {115},
    publisher = {TU Dresden}
}
```

Making bib files (2)

```
@article{JourCaps:2019,
   author  = {Nell Jour},
   title   = {Forcing Capitalisation with {DOUBLE BRACES}: {A} Journal Paper},
   journal = {Journal on LaTeX Quirks},
   volume  = {42},
   pages   = {1--3},
   year    = {2019}
}
@misc{example.org,
   author = {Fourin Stance},
   title  = {{Example website: one way of citing}},
   year   = {2019},
   note   = {\url{http://example.org}, accessed June 2019},
}
@manual{inftud,
   key          = {TUDINF},
   title        = {{Startpage Faculty of Computer Science}},
   organization = {TU Dresden},
   note         = {\url{https://tu-dresden.de/ing/informatik}, accessed 06/19}
}
```

Making bib files (3)

- Standard publication types can often be used (book, article, inproceedings)
- Some citable things have no own type: the available types should be used creatively to achieve the desired output format

  Example: W3C standards are published on web sites but have editors. The book type works well for this.

- Strings used as values can use LaTeX commands
- Always specify full names of authors (the style defines if they should be abbreviated or not)

Using bib in LaTeX

To use BibTeX references, the LaTeX document is modified as follows:

```
Citations are used via their keys \cite{EXSample2019}.

Never use multiple cite commands to cite several
references in one place \cite{UthorWan2019,inftud}.
...

% At the place where the literature list should appear:
\bibliographystyle{plain} % selects citation style
\bibliography{references} % loads file references.bib
```

There are many bibliography styles to choose from

- Common LaTeX options include plain [42] and apalike [Sample, 2019]
- Many publishers provide their own styles that should be used

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Persuasive writing

Form and Content

Compelling research has three components:

1. A strong contribution (original, significant, relevant, correct)
2. A professional appearance (flawless writing and formatting)
3. A convincing narrative (a story that conveys the qualities of the contribution)

If just one of these is missing, the work will be rated poorly!

**What is a "convincing narrative" depends on the context,
but some guides can be given:**

- Keep the right balance of drama and facts
- Avoid claims that ask for being attacked

The role of the introduction

Most parts of a research report are absolutely factual and objective, but there is an important exception where some drama is allowed.

The Introduction

- Sets the expectations of the reader (reviewer, examiner, . . .)
- Needs to motivate the research subject and the approach taken
- Gives an overview of the main claims and techniques
- Arouses interest to continue reading

⤳ a pleasantly written, captivating story

The Rest of the Paper (everything besides the outlook in the Conclusions)

- Delivers on each of the claims
- Provides evidence that establishes the correctness of the results
- Explains in detail approaches and methods
- Discusses the outcomes objectively

⤳ a terse, factual, impeccable argumentation

The role of the introduction (2)

The Introduction

- Establishes relevance (why is this interesting? what is it good for?)
- Partly establishes novelty (why was it open?) and significance (why was it hard?)
- Will bias the reader regarding correctness (plausible? professional? well-informed?)

The Rest of the Paper

- Given further details
- Establishes correctness

Corollary: The reader's opinion is largely formed after the introduction! The rest can hardly do anything to improve it – problems in the middle part can make it significantly worse, but rarely better.

This applies to introduction section of papers and to introductory chapters of theses.

A good introduction

The introduction has a completely different style from the rest of the paper!

- Some exaggeration is acceptable (emotionally, not factually!)
- Some drama is acceptable (tension, conflict, surprise)
- Some imprecision is acceptable (to sharpen the message; without saying wrong things)

Nevertheless, the introduction also introduces you as a serious scholar

- Claims need to be plausible and backed by citations
- Technical vocabulary must be used and used correctly
- Language and layout should be perfect

Structure of an introduction

The introduction is the entrance to your work

- "Outside": General views and common knowledge in a research field
- "Inside": A (very) specific problem and proposed solution (hypothesis)

⤳ The transition can take a few steps

High-level structure of an introduction:

- Zoom in to the specific problem
  Motivate the specific subject area and the research question
- Say what you do in this paper
  This may lead up to an explicit list of claimed main contributions
- Give an outline of the report
  For short reports sometimes dropped or merged with previous part

Drama

Georg Gottlob suggests the following fairy-tale structure to introductions:

The Beautiful Prince(ss):

- Describe the potential benefits of your work (for practice or for research)
- Give a strongly positive, optimistic perspective on what might be

The Dragon:

- Explain why these benefits are out of reach due to an unsolved problem
- Highlight the huge difficulties that this creates today

The Magic Sword:

- Reveal how you are going to slay the dragon to free the prince(ss)
- Explain what new idea allows you to achieve what was not achieved so far

Each of these can use *some* drama and exaggeration, but with measure!

Fact vs. fiction

> The liberties you take in the introduction, you have to earn rigorously in the remainder of the text. Claims have to be repaid in hard facts.

Common mistakes in the introduction:

- Setting wrong expectations (leading to disappointment)
- Making claims one can never show (experienced readers will spot this immediately)

  Guideline: Most readers will forgive a lack of external motivation more readily than an overblown claim that tries to fake it. Not every paper needs to change the world.

- Motivating another research project than the one that was actually done
- Misrepresenting existing works (authors and their colleagues are allergic to this)
- Boring the reader with commonalities and waffle (cut the deadwood)
- Assuming too much background knowledge from the reader
- Displaying sloppiness of any kind (diminishing trust in your work)

The "rest" of the paper

Introduction well done? Reader motivated and full of expectations? – Payback time!

The middle part is very different from the introduction:

- Use terse, factual language
- Prefer clarity over stylistic concerns
- Stay focussed – you can return to the bigger picture in the Conclusions
- Clearly separate intuitive explanations from formal details and educated guesses from hard results
- No surprises, no drama

Note: One can write rock-hard papers that leave all the motivation to the introduction, while making the middle part an impenetrable fortress of rigour, which eliminates all points of attack by saying only what is needed. This might be a viable tactic to get through review, but will not lead to the most useful (or widely cited) papers. Some "soft" content is still allowed even after the introduction.

Summary

LaTeX can be used to typeset tables and figures

Custom commands and includes simplify work on LaTeX projects

LaTeX excels at typesetting mathematical expressions

BibTeX is used to manage citations in LaTeX

The introduction of a paper must tell its story; the remainder must back it up convincingly

What's next?

- Oral presentations
- Presenting experimental results
- Good academic conduct