

Eine interaktive Einführung in \LaTeX

Part 1: Grundlagen

(basierend auf den Folien von Dr. John D. Lees-Miller)

Stefan Müller

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Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

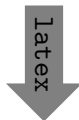
Warum L^AT_EX?

- ▶ Es erstellt wunderschöne Dokumente
 - ▶ Insbesondere mathematische Formeln
- ▶ Erstellt von Wissenschaftlern für Wissenschaftler
 - ▶ Eine große und aktive Community
- ▶ Es ist leistungsfähig – und Du kannst es erweitern
 - ▶ Packages für Papers, Presentations, Poster, Lebensläufe, . . .

Wie funktioniert es?

- ▶ Schreibe das Dokument in plain text mit **Befehlen**, die die dertn Struktur und Bedeutung definieren.
- ▶ Das latex Programm verarbeitet den Text und die Befehle und erstellt wundervoll formatierte Dokumente.

`\LaTeX` ist ein wirklich `\emph{hilfreiches}` Programm.



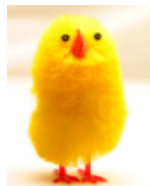
\LaTeX ist ein wirklich *hilfreiches* Programm.

Weitere Beispiele für Befehle und deren Ergebnis...

```
\begin{itemize}  
\item Tee  
\item Milch  
\item Kekse  
\end{itemize}
```

- ▶ Tee
- ▶ Milch
- ▶ Kekse

```
\begin{figure}  
\includegraphics{kuecken}  
\end{figure}
```



```
\begin{equation}  
\alpha + \beta + 1  
\end{equation}
```

$$\alpha + \beta + 1 \quad (1)$$

Bild basierend auf http://www.andy-roberts.net/writing/latex/importing_images.

Anpassung der Grundhaltung

- ▶ Nutze die Befehle, um zu beschreiben „was ist“, nicht „wie es aussieht“.
- ▶ Fokussiere Dich auf den Inhalt.
- ▶ Lass \LaTeX den Rest machen.

Erste Schritte

- ▶ Ein Minimalbeispiel:

```
\documentclass{article}
\begin{document}
Hallo Welt % hier kommt Dein Inhalt hin...
\end{document}
```

- ▶ Befehle starten mit einem *Backslash* `\`.
- ▶ Jedes Dokument beginnt mit einem `\documentclass`-Befehl.
- ▶ Ein *Argument* in geschweiften Klammern `{ }` zeigt \LaTeX , welche Art von Dokument es erstellen soll: einen `article`.
- ▶ Ein Prozentzeichen `%` startet einen *Kommentar* — \LaTeX ignoriert den Rest der Zeile.

Erste Schritte mit **Overleaf**

- ▶ Overleaf ist eine Website zur Erstellung von Dokumenten in \LaTeX .
- ▶ Es kompiliert Dein \LaTeX automatisch und zeigt Dir das Resultat.

Klicke hier, um ein Beispiel-Dokument in **Overleaf** zu öffnen

Google Chrome oder eine neuere Version von Firefox garantieren die besten Ergebnisse.

- ▶ Während wir durch die Folien gehen, probiere die Beispiele in Overleaf aus.
- ▶ **Wirklich, Du solltest die Befehle selber durchführen!**

Textsatz

- ▶ Tippe Deinen Text zwische `\begin{document}` und `\end{document}`.
- ▶ Meistens kannst Du den Text ganz normal eingeben.

En Wort wird durch ein oder mehrere Leerzeichen getrennt.

Ein Absatz wird durch eine oder mehrere leere Zeilen vom letzten Absatz getrennt.

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- ▶ Abstände in der Quelldatei werden im gesetzten Dokument entfernt.

`\LaTeX{}` ist wirklich extrem hilfreich.

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Textsatz: Einschränkungen

- Einige gebräuchliche Zeichen eine besondere Bedeutung in in \LaTeX :

%	Prozent
#	Raute
&	„Und-Zeichen“
\$	Dollar

- Wenn Du diese Zeichen benutzt, erscheint eine Fehlermeldung.
Wenn Du das tatsächliche Symbol nutzen willst, musst Du einen *Gegenschrägstrich* (Backslash) vor das Zeichen setzen.

$\backslash \$ \backslash \% \backslash \& \backslash \# !$

$\$ \% \& \# !$

Handling Errors

- ▶ \LaTeX can get confused when it is trying to compile your document. If it does, it stops with an error, which you must fix before it will produce any output.
- ▶ For example, if you misspell `\emph` as `\meph`, \LaTeX will stop with an “undefined control sequence” error, because “meph” is not one of the commands it knows.

Advice on Errors

1. Don't panic! Errors happen.
2. Fix them as soon as they arise — if what you just typed caused an error, you can start your debugging there.
3. If there are multiple errors, start with the first one — the cause may even be above it.

Typesetting Exercise 1

Typeset this in L^AT_EX: ¹

In March 2006, Congress raised that ceiling an additional \$0.79 trillion to \$8.97 trillion, which is approximately 68% of GDP. As of October 4, 2008, the “Emergency Economic Stabilization Act of 2008” raised the current debt ceiling to \$11.3 trillion.

Click to open this exercise in **Overleaf**

- ▶ Hint: watch out for characters with special meanings!
- ▶ Once you’ve tried, [click here to see my solution](#).

¹http://en.wikipedia.org/wiki/Economy_of_the_United_States

Typesetting Mathematics: Dollar Signs

- Why are dollar signs $\$$ special? We use them to mark mathematics in text.

% not so good:

Let a and b be distinct positive integers, and let $c = a - b + 1$.

% much better:

Let a and b be distinct positive integers, and let $c = a - b + 1$.

Let a and b be distinct positive integers, and let $c = a - b + 1$.

Let a and b be distinct positive integers, and let $c = a - b + 1$.

- Always use dollar signs in pairs — one to begin the mathematics, and one to end it.
- \LaTeX handles spacing automatically; it ignores your spaces.

Let $y = mx + b$ be \ldots

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Let $y = mx + b$ be \ldots

Typesetting Mathematics: Notation

- Use caret `^` for superscripts and underscore `_` for subscripts.

```
$y = c_2 x^2 + c_1 x + c_0$
```

$$y = c_2 x^2 + c_1 x + c_0$$

- Use curly braces `{}` `}` to group superscripts and subscripts.

```
$F_n = F_{n-1} + F_{n-2}$ % oops!
```

$$F_n = F_n - 1 + F_n - 2$$

```
$F_n = F_{n-1} + F_{n-2}$ % ok!
```

$$F_n = F_{n-1} + F_{n-2}$$

- There are commands for Greek letters and common notation.

```
$\mu = A e^{Q/RT}$
```

$$\mu = A e^{Q/RT}$$

```
$\Omega = \sum_{k=1}^n \omega_k$
```

$$\Omega = \sum_{k=1}^n \omega_k$$

Typesetting Mathematics: Displayed Equations

- If it's big and scary, *display* it on its own line using `\begin{equation}` and `\end{equation}`.

The roots of a quadratic equation
are given by
`\begin{equation}`
`x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}`
`\end{equation}`
where `a`, `b` and `c` are `\ldots`

The roots of a quadratic
equation are given by

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \quad (2)$$

where a , b and c are ...

Caution: \LaTeX mostly ignores your spaces in mathematics, but it can't handle blank lines in equations — don't put blank lines in your mathematics.

Interlude: Environments

- ▶ `equation` is an *environment* — a context.
- ▶ A command can produce different output in different contexts.

We can write

```
$ \Omega = \sum_{k=1}^n \omega_k $
```

in text, or we can write

```
\begin{equation}
```

```
\Omega = \sum_{k=1}^n \omega_k
```

```
\end{equation}
```

to display it.

We can write $\Omega = \sum_{k=1}^n \omega_k$
in text, or we can write

$$\Omega = \sum_{k=1}^n \omega_k \quad (3)$$

to display it.

- ▶ Note how the Σ is bigger in the `equation` environment, and how the subscripts and superscripts change position, even though we used the same commands.

In fact, we could have written `$...$` as `\begin{math}...\end{math}`.

Interlude: Environments

- ▶ The `\begin` and `\end` commands are used to create many different environments.
- ▶ The `itemize` and `enumerate` environments generate lists.

```
\begin{itemize} % for bullet points  
\item Biscuits  
\item Tea  
\end{itemize}
```

- ▶ Biscuits
- ▶ Tea

```
\begin{enumerate} % for numbers  
\item Biscuits  
\item Tea  
\end{enumerate}
```

1. Biscuits
2. Tea

Interlude: Packages

- ▶ All of the commands and environments we've used so far are built into L^AT_EX.
- ▶ *Packages* are libraries of extra commands and environments. There are thousands of freely available packages.
- ▶ We have to load each of the packages we want to use with a `\usepackage` command in the *preamble*.
- ▶ Example: `amsmath` from the American Mathematical Society.

```
\documentclass{article}
\usepackage{amsmath} % preamble
\begin{document}
% now we can use commands from amsmath here...
\end{document}
```

Typesetting Mathematics: Examples with `amsmath`

- Use `equation*` (“equation-star”) for unnumbered equations.

```
\begin{equation*}
  \Omega = \sum_{k=1}^n \omega_k
\end{equation*}
```

$$\Omega = \sum_{k=1}^n \omega_k$$

- \LaTeX treats adjacent letters as variables multiplied together, which is not always what you want. `amsmath` defines commands for many common mathematical operators.

```
\begin{equation*} % bad!
  min_{x,y} (1-x)^2 + 100(y-x^2)^2
\end{equation*}
\begin{equation*} % good!
  \min_{x,y} \{(1-x)^2 + 100(y-x^2)^2\}
\end{equation*}
```

$$min_{x,y} (1-x)^2 + 100(y-x^2)^2$$

$$\min_{x,y} (1-x)^2 + 100(y-x^2)^2$$

- You can use `\operatorname` for others.

```
\begin{equation*}
  \beta_i =
  \frac{\operatorname{Cov}(R_i, R_m)}
        {\operatorname{Var}(R_m)}
\end{equation*}
```

$$\beta_i = \frac{\operatorname{Cov}(R_i, R_m)}{\operatorname{Var}(R_m)}$$

Typesetting Mathematics: Examples with `amsmath`

- Align a sequence of equations at the equals sign

$$\begin{aligned}(x + 1)^3 &= (x + 1)(x + 1)(x + 1) \\ &= (x + 1)(x^2 + 2x + 1) \\ &= x^3 + 3x^2 + 3x + 1\end{aligned}$$

with the `align*` environment.

```
\begin{align*}
(x+1)^3 &= (x+1)(x+1)(x+1) \\
        &= (x+1)(x^2 + 2x + 1) \\
        &= x^3 + 3x^2 + 3x + 1
\end{align*}
```

- An ampersand `&` separates the left column (before the `=`) from the right column (after the `=`).
- A double backslash `\``\` starts a new line.

Typesetting Exercise 2

Typeset this in \LaTeX :

Let X_1, X_2, \dots, X_n be a sequence of independent and identically distributed random variables with $E[X_i] = \mu$ and $\text{Var}[X_i] = \sigma^2 < \infty$, and let

$$S_n = \frac{1}{n} \sum_i^n X_i$$

denote their mean. Then as n approaches infinity, the random variables $\sqrt{n}(S_n - \mu)$ converge in distribution to a normal $N(0, \sigma^2)$.

Click to open this exercise in **Overleaf**

- ▶ Hint: the command for ∞ is `\infty`.
- ▶ Once you've tried, [click here to see my solution](#).

End of Part 1

- ▶ Congrats! You've already learned how to ...
 - ▶ Typeset text in \LaTeX .
 - ▶ Use lots of different commands.
 - ▶ Handle errors when they arise.
 - ▶ Typeset some beautiful mathematics.
 - ▶ Use several different environments.
 - ▶ Load packages.
- ▶ That's amazing!
- ▶ In Part 2, we'll see how to use \LaTeX to write structured documents with sections, cross references, figures, tables and bibliographies. See you then!