

# L<sup>A</sup>T<sub>E</sub>X Kurs: 07 Nützliche Pakete

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Wir kennen schon: babel, blindtext, geometry, graphics, biblatex, amsmath. Jetzt kommen noch neue Pakete dazu.

- Allgemein
  - hyperref `\href{http://www.der-postillion.de}{angezeigter Text}` oder `\url{ ... }`
  - paralist (kompakte Aufzählungen, mehrere Beispiele)
  - Briefe mit KOMA (<http://texdoc.net/texmf-dist/doc/latex/koma-script/scrguide.pdf>, Beispiele im Ordner 07\_Nützliche\_Pakete)
  - europecv, moderncv
  - setspace (für doppelten Zeilenabstand) `\usepackage[singlespacing]{setspace}` oder `\usepackage[onehalfspacing]{setspace}` oder `\usepackage[doublespacing]{setspace}`
  - csquotes (für internationale, auch deutsche, Anführungszeichen). Das gibt es auch als Umgebung.
  - mdframed

```
1 \documentclass[11pt,a4paper]{scrreprt}
  \usepackage[utf8]{inputenc}
3
  \usepackage{mdframed}
5 \definecolor{examplesBackground}{RGB}{220,226.5,237}
  \definecolor{examplesHeaderLine}{RGB}{122,150,191}
7 \definecolor{claimsHeaderLine}{gray}{0.97}
9
  \newmdenv[
    topline=false, bottomline=false, leftline=false, rightline=false,
11    backgroundcolor=examplesBackground,
    frametitle={\tiny\hspace{2cm}}, frametitlebackgroundcolor=
      examplesHeaderLine,
13    frametitleaboveskip=-1pt]
    {abstractSection}
15
  \begin{document}
17 \begin{abstractSection}
    Algebraic geometry heavily relies on the fact that there is a strong
      connection between ideals being algebraic objects and varieties being
      geometric ones. We will start with the basic definitions and arrive via \
      emph{Hilbert's Nullstellensatz} at the Algebra-Geometry dictionary.
      Already at this point, I would like to stress that it holds only for
      ideals in polynomial rings over algebraically closed fields. Without this
      assumption algebraic geometry is far from being intuitive and descriptive.
19
      After defining an adequate topology we decompose varieties uniquely into
      irreducible ones. Unfortunately, this does not translate into the language
      of ideals in full generality: Only radical ideals can be decomposed into
      prime ideals uniquely. For non-radical ideals we need a more sophisticated
      concept: the primary decomposition.
21 \end{abstractSection}
```

23 \end{document}

mdframed.tex

- Mathe

– amsthm

```

1 \documentclass[11pt,a4paper]{scrreprt}
\usepackage[utf8]{inputenc}
3 \usepackage{amsmath,amsfonts,amssymb,amsthm}

5 \usepackage[backend=biber,style=alphabetic]{biblatex}

7 \newtheorem{defn}{Definition}
\newtheorem{thm}[defn]{Theorem}
9 \newtheorem{lem}[defn]{Lemma}
\newtheorem{prop}[defn]{Proposition}
11 \newtheorem{cor}[defn]{Corollary}
\newtheorem{ex}[defn]{Example}

13
\newcommand{\R}{\mathbb{R}}
15 \newcommand{\C}{\mathbb{C}}
\newcommand{\N}{\mathbb{N}}
17 \newcommand{\Q}{\mathbb{Q}}
\newcommand{\Zn}{\mathbb{Z}^n_{\geq 0}}
19 \newcommand{\V}{\mathbf{V}}
\newcommand{\I}{\mathbf{I}}
21 \newcommand{\mvar}[2]{\#1_{\#2}, \ldots, \#1_{\#2}}
\newcommand{\kxn}{k[\mvar{x}{n}]}
23 \newcommand{\fs}{\mvar{f}{s}}
%\newcommand{\mc}[1]{\boldsymbol{1}^{(\#1)}}
25 \newcommand{\mc}[1]{\vphantom{\bar{\boldsymbol{1}}}\boldsymbol{1}^{\mkern-2mu(\#1)}}
\newcommand{\mcb}[1]{\bar{\boldsymbol{1}}^{(\#1)}}
27 \newcommand{\ya}{\mc{1}\mcb{4}\mc{5}}
\newcommand{\yb}{\mc{2}\mcb{3}\mc{5}}
29 \newcommand{\yc}{\mc{2}\mcb{4}\mc{6}}
\newcommand{\yd}{\mc{1}\mc{2}\mcb{6}}
31 \newcommand{\ye}{\mcb{3}\mc{4}\mc{6}}
\newcommand{\yf}{\mcb{5}\mc{6}}
33 \newcommand{\yfs}{\mcb{5}\mc{6}\mc{6}}

35 \setlength{\parindent}{0mm}

37 \begin{document}
\begin{defn}
39 Let  $R$  be a ring. Then  $R[X]$  is the set of all finite sequences
\begin{align*}
41 R^{(\N_0)} :=
& \left\{ \left\{ a_i \right\}_{i \in \N_0} \mid ; : \mid a_i \in R, a_i = 0 \text{ for almost all } i \right\}
43 \end{align*}
We define an addition component-by-component  $(a_i)_{i \in \N_0} + (b_i)_{i \in \N_0} := (a_i + b_i)_{i \in \N_0}$  and a multiplication by the
convolution of both sequences  $(a_i)_{i \in \N_0} \cdot (b_i)_{i \in \N_0} := (\sum_{i=0}^k a_i b_{k-i})_{k \in \N_0}$ .

45 The resulting ring is denoted by  $R[X]$  and called polynomial ring over  $R$ . Let us define  $x := (0, 1, 0, 0, \ldots)$ . Then
47 \begin{align*}
& (\underbrace{0, \ldots, 0}_{k \text{ zeros}}, 1, 0, \ldots) \equiv x^k = \underbrace{x \cdot \ldots \cdot x}_{k \text{ times}}
49 \end{align*}
and all Elements  $f \in R^{(\N_0)}$  can be written as

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51 \begin{align*}
f = a_0 + a_1 x + a_2 x^2 + \cdots + a_n x^n.
53 \end{align*}
\end{defn}

55 \begin{defn}
57 Let  $R$  be a ring. The \emph{polynomial ring in  $n$  variables over  $R$ } is
defined recursively:
\begin{align*}
59 R[\mathbf{x}_n] &:= R[\mathbf{x}_{n-1}] [\mathbf{x}_n].
\end{align*}
61 The elements of  $R[\mathbf{x}_n]$  can be written as
\begin{align*}
63 \sum_{k=0}^{\infty} a_k \mathbf{x}^{\mathbf{k}}
\end{align*}
65 \end{defn}

67 In the sequel, we will only consider polynomial rings over fields, e.g.  $\mathbb{R}$ 
or  $\mathbb{C}$ . To avoid endless repetitions let  $k$  be a field from now on. We
move on to the basic algebraic object of this work.

69 \begin{defn}
A subset  $I \subseteq k[\mathbf{x}_n]$  is an \emph{ideal} if:
71 \begin{enumerate}
\item  $0 \in I$ .
73 \item  $f, g \in I \implies f+g \in I$ .
\item  $f \in I$  and  $h \in k[\mathbf{x}_n] \implies hf \in I$ .
75 \end{enumerate}
\end{defn}

77

79 \begin{lem}
If  $f \in k[\mathbf{x}_n]$ , then
81 \begin{align*}
\langle f \rangle := \left\{ \sum_{i=1}^s h_i f_i \mid h_i \in k[\mathbf{x}_n] \right\}
83 \end{align*}
is an ideal of  $k[\mathbf{x}_n]$  and is called the \emph{ideal generated by the  $f_i$ s}
85 \end{lem}

87 This fact leads to the first interesting observation. When manipulating
systems of linear equations one is allowed to multiply any equation by a
polynomial and to add two equations. These rules correspond to the
definition of an ideal. Therefore we can think of the ideal  $\langle f_1, \dots, f_s \rangle$  as the set of all consequences of the equations  $f_1=f_2=\dots=f_s=0$  in the sense that if all generating polynomials are set to
zero then all elements of the ideal will be zero as well.

89 We now come to special ideals which will play an important role in the
context of varieties.

91 \begin{defn}
An ideal  $I$  is \emph{radical} if the following implication holds:
93 \begin{align*}
f^m \in I \implies f \in I
95 \end{align*}
\end{defn}

97 Given an arbitrary ideal it is always possible to produce a radical ideal.

99 \begin{defn}
Let  $I \subseteq k[\mathbf{x}_n]$  be an ideal. The \emph{radical} of  $I$  is
101 \begin{align*}
\sqrt{I} := \left\{ f \mid f^m \in I \text{ for some integer } m \geq 1 \right\}
103 \end{align*}

```

```

\end{defn}
105
\begin{lem}
107 \label{lemradideals}
 $\sqrt{I}$  is a radical ideal and  $I \subset \sqrt{I}$ .
109 \end{lem}
\begin{proof}
111 This is easy to see.
\end{proof}
113 To see that equality is not guaranteed consider  $I = \langle x^2 \rangle \subset \mathbb{C}[x]$ . Then  $\sqrt{I} = \langle x \rangle \neq \langle x^2 \rangle$ .

115 We move on to another important property an ideal can have.
\begin{defn}
117 An ideal  $I \subset R$  is \emph{prime} if the following implication is
      true:
      \begin{align*}
119 f, g \in R \text{ and } fg \in I &\quad \Rightarrow \quad f \in I \text{ or } g \in I.
      \end{align*}
\end{defn}
121 \end{document}

```

amsthm.tex

- esvect (schöne Vektoren)
- nicefrac (schöne Brüche)
- Informatik
  - listings (Beispiel vorbereitet)
- Physik
  - feyn (Beispiel vorbereitet) oder alternativ feynmp (<http://www.ctan.org/tex-archive/macros/latex/contrib/feynmf/>, schwieriger zu installieren, einfacher zu bedienen)
  - siunitx (praktisch fürs Praktikum)
- Sonstiges
  - tikz
  - beamer (streng genommen kein Paket sondern eine Dokumentenklasse)

Aufgabe: Probiere folgende Pakete aus:

- setspace (Standard für Bachelorarbeiten etc. ist onehalfspacing),
- csquotes
- amsthm
- nicefrac