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vscode — the ultimate text editor for LaTeX

...and many other languages

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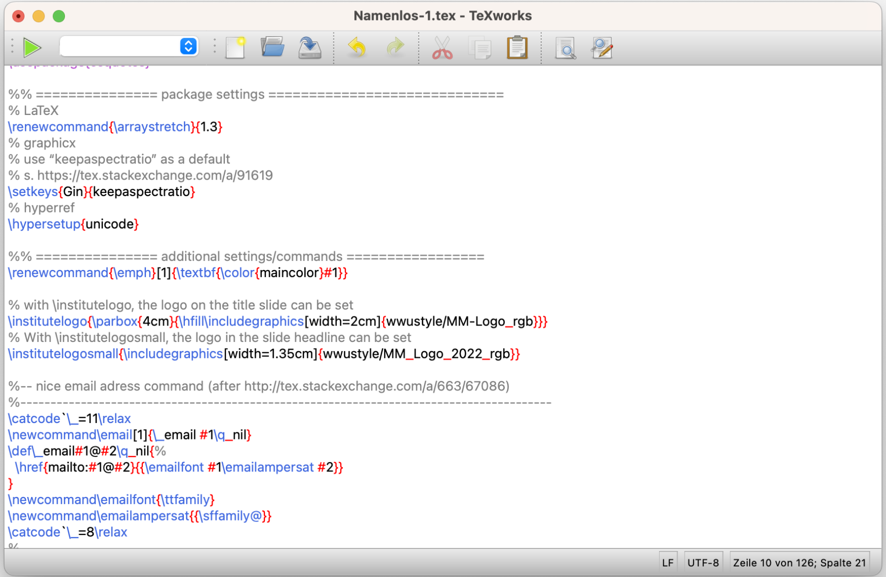
living.knowledge

MM
Mathematics Münster
Cluster of Excellence

Regularly you should ask:

Does it spark joy?



The right tool for the job

- Basic workflow: Edit `.tex` file → feed it to LaTeX
- **Any** text editor could be used for the first part and the terminal for the second one

⇒ A text editor *for* LaTeX should at least provide a button or hotkey for compilation of the `.tex` file that you are editing.

Editors designed specifically for LaTeX	General purpose text editors
TeXworks	Vim
TeXstudio	Emacs
TeXshop	Sublime Text
Texifier	**Visual Studio Code** (VSCode)

Advantages of the second category:

- can be used for source code of all sorts
- more customizable
- less of a niche product ⇒ bigger community of users, more polished UI

About VSCode

- Open source, maintained by Microsoft
- Available for all operating systems (Windows, Linux, macOS)
- uses the Electron framework (i.e. the UI is rendered by a browser engine)
- available at `https://code.visualstudio.com/`

How to learn new software and perform tasks efficiently

1. Practice!
2. Learn the hotkeys!
3. Actively challenge your habits from time to time!
   - Look for laborious mechanical tasks (e.g. looking up bib keys/labels for referencing)
   - Automate them (figure out how the autocomplete feature of your cool new text editor works)
   - Force yourself to actually use that automation

Live Demo

Some points on VSCode from the live demo

- Many languages come with some native support (HTML, CSS, Markdown)
- The “command palette” lets you find most things
- Learn to select text via the keyboard!
- Mastering multi cursors will make you feel like a wizard – and is actually useful
- The different parts of the UI can be arranged freely
- Full potential of VSCode is unlocked by extensions
- Best extension for LaTeX: LaTeX workshop
- Synctex support
- Snippets via “@”, BIT, SSE
- Autocomplete also shows user-defined commands
- For more features see `https://marketplace.visualstudio.com/items?itemName=James-Yu.latex-workshop`
- Good spellchecker for LaTeX: LTeX extension

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Remarks on mathematical typesetting

Math packages Replace the package `amsmath` with `mathtools`

Display math Do not use the TeX directive `$$...$$`, instead use LaTeX syntax `\[...\]`. Good convention for indentation: follow the standard indentation rule for environments

```
\[
    \sum_{k=0}^\infty \frac{x^k}{k!}
\]
```

Operator names to define new operators like `\exp` do not use abominations like `{\rm cosh}` instead use `\DeclareMathOperator{\cosh}{cosh}` in the preamble.

Defining maps `f : X \to Y` is wrong, correct way: `f \colon X \to Y`

$f : X \to Y$ $\qquad$ $f \colon X \to Y$

Defining own commands

There are three main reasons for doing so:

1. Faster to type (in particular with autocompletion!)
2. Guarantees consistent notation ...
3. ...that can be adjusted at a central place

Use “speaking” commands

```
\newcommand{\LoopsInfinity}{\Omega^{\infty}}
```

- This makes your code more readable! (to your future you **and** others)
- With autocompletion very fast to type

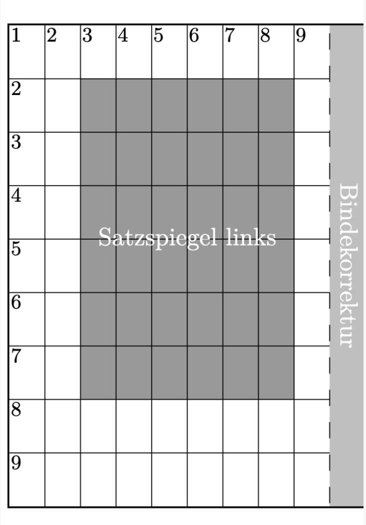
Learn how to use optional arguments

```
\NewDocumentCommand{\LoopsInfinity}{ o }{\Omega^{\infty #1}}
```

- Result: `\LoopsInfinity` $\rightsquigarrow \Omega^{\infty}$ and `\LoopsInfinity[+n]` $\rightsquigarrow \Omega^{\infty+n}$
- I suggest the package `xparse` (which was used here)

A word on typography

The art and technique of arranging type to make written language legible, readable and appealing when displayed — Wikipedia



Margins and textarea

- Choosing good margins around the textarea is best left to experts!

⇒ Do not fiddle with the `geometry` package

- I suggest using `typearea` instead (part of KOMA-script; used by the classes `scrbook` etc.)

Parindent

- Paragraphs are signalized by indenting their first line
- By `\setlength{\parindent}{0pt}` they might become hard to distinguish
- use the `parskip` package instead – if you must...

Example of LaTeX being serious about typography

(i) $\pi\colon W \to X$ is a submersion with d-dimensional fibers.
(ii) $(\pi, f)\colon W \to X \times \mathbb{R}$ is proper.

This defines a set valued sheaf $D_d(-;n) \in \mathrm{Sh}(\mathcal{X})$. Let D_d be the colimit (in $\mathrm{Sh}(\mathcal{X})$) of $D_d(-;n)$ as $n \to \infty$. Explicitly, $D_d(X)$ is the set of submanifolds $W \subseteq X \times \mathbb{R} \times \mathbb{R}^{d-1+\infty}$ satisfying (i) and (ii) above, and such that for each compact $K \subseteq X$ there exists an n with $\pi^{-1}(K) \subseteq K \times \mathbb{R} \times \mathbb{R}^{d-1+n}$.

We will prove the following theorem by constructing a natural bijection $[X, \Omega^{\infty-1}MT(d)] \cong D_d[X]$.

Theorem 3.4. *There is a weak homotopy equivalence*

$$|D_d| \xrightarrow{\simeq} \Omega^{\infty-1}MT(d).$$

Given $W \subseteq X \times \mathbb{R} \times \mathbb{R}^{d-1+n}$ with n-dimensional normal bundle $N \to W$, there is a vector bundle map

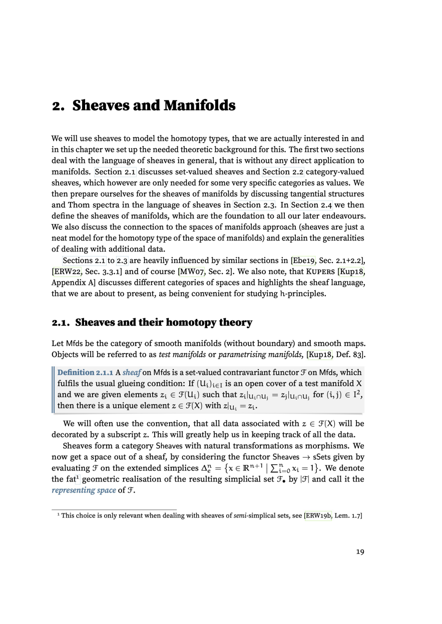
$$\begin{CD} N @>{\hat{\gamma}}>> U_{d,n}^{\perp} \\ @VVV @VVV \\ W @>>{\gamma}> G(d,n). \end{CD} \tag{3.7}$$

How to make your document stand out (at least visually...)

Use a font which is not Computer Modern.

- Fonts for text and math have to match to some extend!
- `https://tug.org/FontCatalogue/`
- Part of TEXlive and recommendable:
  - (X)Charter
  - EB Garamond
  - New PX
  - Linux Libertine
  - Adobe Source Serif
  - IBM Plex

  Read the documentation of the associated packages!
- In particular play around with weights!


2. Sheaves and Manifolds

We will use sheaves to model the homotopy types, that we are actually interested in and in this chapter we set up the needed theoretic background for this. The first two sections deal with the language of sheaves in general, that is without any direct application to manifolds. Section 2.1 discusses set-valued sheaves and Section 2.2 category-valued sheaves, which however are only needed for some very specific categories as values. We then prepare ourselves for the sheaves of manifolds by discussing tangential structures and Thom spectra in the language of sheaves in Section 2.3. In Section 2.4 we then define the sheaves of manifolds, which are the foundation to all our later endeavours. We also discuss the connection to the spaces of manifolds approach (sheaves are just a neat model for the homotopy type of the space of manifolds) and explain the generalities of dealing with additional data.

Sections 2.1 to 2.3 are heavily influenced by similar sections in [Ebe19, Sec. 2.1+2.2], [ERW22, Sec. 3.3.1] and of course [MW07, Sec. 2]. We also note, that Kupers [Kup18, Appendix A] discusses different categories of spaces and highlights the sheaf language, that we are about to present, as being convenient for studying h-principles.

2.1. Sheaves and their homotopy theory

Let Mfds be the category of smooth manifolds (without boundary) and smooth maps. Objects will be referred to as *test manifolds* or *parametrising manifolds*, [Kup18, Def. 83].

Definition 2.1.1 A *sheaf* on Mfds is a set-valued contravariant functor $\mathcal{F}$ on Mfds, which fulfils the usual glueing condition: If $(U_i)_{i\in I}$ is an open cover of a test manifold X and we are given elements $z_i \in \mathcal{F}(U_i)$ such that $z_i|_{U_i\cap U_j} = z_j|_{U_i\cap U_j}$ for $(i,j) \in I^2$, then there is a unique element $z \in \mathcal{F}(X)$ with $z|_{U_i} = z_i$.

We will often use the convention, that all data associated with $z \in \mathcal{F}(X)$ will be decorated by a subscript z. This will greatly help us in keeping track of all the data.

Sheaves form a category Sheaves with natural transformations as morphisms. We now get a space out of a sheaf, by considering the functor Sheaves $\to$ sSets given by evaluating $\mathcal{F}$ on the extended simplices $\Delta^n_e = \{x \in \mathbb{R}^{n+1} \mid \sum_{i=0}^n x_i = 1\}$. We denote the fat[1] geometric realisation of the resulting simplicial set $\mathcal{F}_\bullet$ by $|\mathcal{F}|$ and call it the *representing space* of $\mathcal{F}$.

[1] This choice is only relevant when dealing with sheaves of *semi*-simplical sets, see [ERW19b, Lem. 1.7]

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Unicode and LuaLaTeX

- Unicode is "the most elegant hack" (Youtube)
- There is no reason not to use Unicode/UTF-8!
- It's the year 2023, you don't have to write `\"a` anymore, input characters like ä,ø,ñ,č,ù,æ,Œ,Å directly instead.
- A good font should at least support every character derived from Latin

PDFLaTeX vs. LuaLaTeX

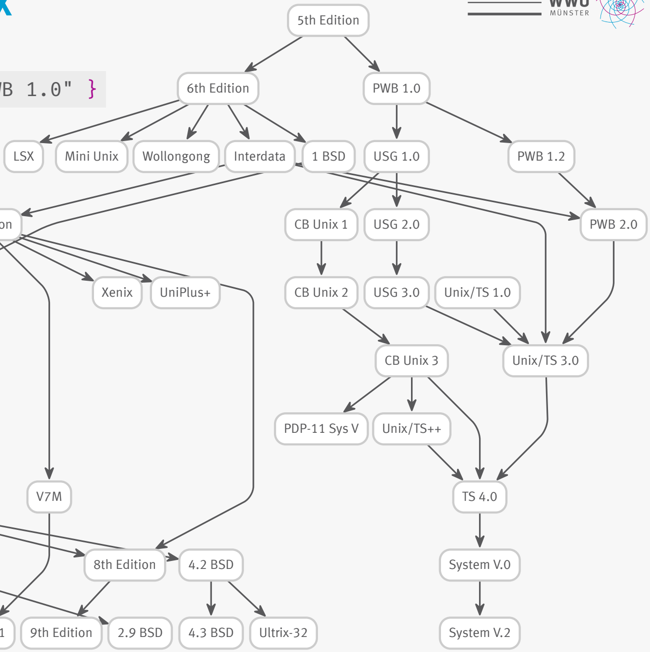
- PDFLaTeX is the standard compiler
- I predict, that LuaLaTeX will take over in the future
- Advantages:
  - TeX intertwined with a modern programming language (Lua)
  - native UTF-8 support (no `inputencoding`)
  - supported by `fontspec` package ⇝ use arbitrary fonts! (like the official WWU font)
  - access to LuaLaTeX-exclusive packages

BTW: Template used for these slides will(?) be available here:
`https://zivgitlab.uni-muenster.de/muenster-mathematics/latex-beamer-template`

This is only possible with LuaLaTeX

Draw a graph using only the notation

```
"5th Edition" -> { "6th Edition", "PWB 1.0" }
```



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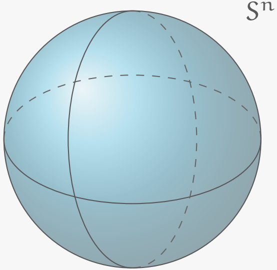
Sample “MMstyle” slide with math

Let (M, g) be a Riemannian manifold.

- Central notion in differential geometry: Riemannian curvature tensor associated to g.
- Tensor contraction turns this into **scalar curvature** $\rightsquigarrow$ smooth function $\mathrm{scal}_g : M \to \mathbb{R}$



$$\mathrm{scal} \equiv \frac{n(n-1)}{r^2}$$

Existence question

Given a smooth manifold M, does M admit a metric with $\mathrm{scal}_g > 0$?

- Admitting a **p**ositive **s**calar **c**urvature metric has topological implications
- Only orientable surface admitting psc is S^2
- In fact, there are many (topological) obstructions to admitting psc, e.g. the $\widehat{A}$-genus

Dimension 2: Gauß–Bonnet

$$0 < \int_M \mathrm{scal}_g \, d\omega = 4\pi \cdot \chi(M)$$

Ask me anything