



**PADERBORN UNIVERSITY**  
*The University for the Information Society*

BACHELOR THESIS

# **IS OIL THE FUTURE?**

LARS K.



Database and Information Systems  
Paderborn University  
Warburger Str. 100  
33098 Paderborn

Bachelor Thesis

## **Is Oil the future?**

Lars K.

<b>Course of Study:</b>	Informatik
<b>Examiner:</b>	Prof. Dr. Gregor Engels
<b>Supervisor:</b>	Dipl.-Inf. Roman Tiker, Dipl.-Inf. Laura Stern, Otto Normalverbraucher, M.Sc.
<b>Commenced:</b>	July 5, 2018
<b>Completed:</b>	January 5, 2019



## **Abstract**

... Short summary of the thesis ...



# Contents

<b>1</b>	<b>Introduction</b>	<b>19</b>
<b>2</b>	<b>Chapter Two</b>	<b>21</b>
<b>3</b>	<b>Heading on Level 0 (chapter)</b>	<b>23</b>
3.1	Heading on Level 1 (section) . . . . .	23
3.2	Lists . . . . .	24
<b>4</b>	<b>Conclusion and Outlook</b>	<b>27</b>
<b>A</b>	<b>LaTeX Hints</b>	<b>29</b>
A.1	File Encoding and Support of Umlauts . . . . .	29
A.2	Citations . . . . .	29
A.3	Formulas and Equations . . . . .	30
A.4	Sourcecode . . . . .	30
A.5	Pseudocode . . . . .	30
A.6	Figures . . . . .	32
A.7	More Illustrations . . . . .	32
A.8	Plots with pgfplots . . . . .	36
A.9	Figures with tikz . . . . .	36
A.10	UML diagrams using tikz-uml . . . . .	37
A.11	UML diagrams using PlantUML . . . . .	37
A.12	Tables . . . . .	37
A.13	Tables spanning multiple pages . . . . .	39
A.14	Abbreviations . . . . .	41
A.15	References . . . . .	41
A.16	Definitions . . . . .	42
A.17	Footnotes . . . . .	42
A.18	Verschiedenes . . . . .	42
A.19	Closing remarks . . . . .	42
	<b>Bibliography</b>	<b>43</b>





## List of Figures

A.1	Beispiel-Choreographie . . . . .	32
A.2	Beispiel-Choreographie . . . . .	33
A.3	Example to place 3 illustrations next to each other. Further, it is possible to reference each separately. . . . .	33
A.4	Beispiel-Choreographie I . . . . .	34
A.5	Beispiel-Choreographie II . . . . .	35
A.6	Plot of $\sin(x)$ directly inside the figure environment with pgfplots. . . . .	36
A.7	Coordinates $x$ and $y$ read from csv file and plotted pgfplots. . . . .	36
A.8	A regular grid generated with easily with two for loops. . . . .	37
A.9	Class diagram generated with tikz-uml. Example adapted from Nicolas Kielbasiewicz. . . . .	38



# List of Tables

A.1	Beispieltabelle . . . . .	37
A.2	Beispieltabelle für 4 Bedingungen (W-Z) mit jeweils 4 Parameters mit (M und SD). Hinweist: immer die selbe anzahl an Nachkommastellen angeben. . . . .	38
A.3	Tabelle directly generated from the values of a csf file. . . . .	39
A.4	A sample long table. . . . .	39



## List of Listings

A.1	The code is separated by two horizontal lines in the listings environment. . . . .	30
-----	--	----



# List of Algorithms

A.1	Sample algorithm . . . . .	31
A.2	Description . . . . .	32





# List of Abbreviations

**ER** error rate. 41

**FR** Fehlerrate. 41

**RDBMS** Relational Database Management System. 41



# 1 Introduction

This thesis starts with Chapter 2.



## **2 Chapter Two**



## 3 Heading on Level 0 (chapter)

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place.  $\sin^2(\alpha) + \cos^2(\beta) = 1$ . If you read this text, you will get no information  $E = mc^2$ . Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look.  $\sqrt[n]{a} \cdot \sqrt[n]{b} = \sqrt[n]{ab}$ . This text should contain all letters of the alphabet and it should be written in of the original language.  $\frac{\sqrt[n]{a}}{\sqrt[n]{b}} = \sqrt[n]{\frac{a}{b}}$ . There is no need for special content, but the length of words should match the language.  $a \sqrt[n]{b} = \sqrt[n]{a^n b}$ .

### 3.1 Heading on Level 1 (section)

Hello, here is some text without a meaning.  $d\Omega = \sin \vartheta d\vartheta d\varphi$ . This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look.  $\sin^2(\alpha) + \cos^2(\beta) = 1$ . This text should contain all letters of the alphabet and it should be written in of the original language  $E = mc^2$ . There is no need for special content, but the length of words should match the language.  $\sqrt[n]{a} \cdot \sqrt[n]{b} = \sqrt[n]{ab}$ .

#### 3.1.1 Heading on Level 2 (subsection)

Hello, here is some text without a meaning.  $\frac{\sqrt[n]{a}}{\sqrt[n]{b}} = \sqrt[n]{\frac{a}{b}}$ . This text should show what a printed text will look like at this place.  $a \sqrt[n]{b} = \sqrt[n]{a^n b}$ . If you read this text, you will get no information.  $d\Omega = \sin \vartheta d\vartheta d\varphi$ . Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.  $\sin^2(\alpha) + \cos^2(\beta) = 1$ .

#### Heading on Level 3 (subsubsection)

Hello, here is some text without a meaning  $E = mc^2$ . This text should show what a printed text will look like at this place.  $\sqrt[n]{a} \cdot \sqrt[n]{b} = \sqrt[n]{ab}$ . If you read this text, you will get no information.  $\frac{\sqrt[n]{a}}{\sqrt[n]{b}} = \sqrt[n]{\frac{a}{b}}$ . Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information

about the selected font, how the letters are written and an impression of the look.  $a\sqrt[n]{b} = \sqrt[n]{a^n b}$ . This text should contain all letters of the alphabet and it should be written in of the original language.  $d\Omega = \sin\vartheta d\vartheta d\varphi$ . There is no need for special content, but the length of words should match the language.

**Heading on Level 4 (paragraph)** Hello, here is some text without a meaning. This text should show what a printed text will look like at this place.  $\sin^2(\alpha) + \cos^2(\beta) = 1$ . If you read this text, you will get no information  $E = mc^2$ . Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look.  $\sqrt[n]{a} \cdot \sqrt[n]{b} = \sqrt[n]{ab}$ . This text should contain all letters of the alphabet and it should be written in of the original language.  $\frac{\sqrt[n]{a}}{\sqrt[n]{b}} = \sqrt[n]{\frac{a}{b}}$ . There is no need for special content, but the length of words should match the language.  $a\sqrt[n]{b} = \sqrt[n]{a^n b}$ .

## 3.2 Lists

### 3.2.1 Example for list (itemize)

- First item in a list
- Second item in a list
- Third item in a list
- Fourth item in a list
- Fifth item in a list

### Example for list (4\*itemize)

- First item in a list
  - First item in a list
    - \* First item in a list
      - First item in a list
      - Second item in a list
    - \* Second item in a list
  - Second item in a list
- Second item in a list



**3.2.2 Example for list (enumerate)**

1. First item in a list
2. Second item in a list
3. Third item in a list
4. Fourth item in a list
5. Fifth item in a list

**Example for list (4\*enumerate)**

1. First item in a list
  - a) First item in a list
    - i. First item in a list
      - A. First item in a list
      - B. Second item in a list
    - ii. Second item in a list
  - b) Second item in a list
2. Second item in a list

**3.2.3 Example for list (description)**

**First** item in a list

**Second** item in a list

**Third** item in a list

**Fourth** item in a list

**Fifth** item in a list

**Example for list (4\*description)**

**First** item in a list

**First** item in a list

**First** item in a list

**First** item in a list

**Second** item in a list

**Second** item in a list

**Second** item in a list

**Second** item in a list

## **4 Conclusion and Outlook**

### **Outlook**



# A LaTeX Hints

Probleme kann man niemals mit derselben Denkweise lösen, durch die sie entstanden sind.

---

*(Albert Einstein)*

One sentence per line. This rule is important for the usage of version control systems. A new line is generated with a blank line.

Please do *not* use double backslashes for new paragraphs. For instance, this sentence belongs to the same paragraph, whereas the last one started a new one. A long motivation for that is provided at <http://loopspace.mathforge.org/HowDidIDoThat/TeX/VCS/#section.3>.

## A.1 File Encoding and Support of Umlauts

The template offers full UTF-8 support. All recent editors should not have issues with that.

## A.2 Citations

Referenzen werden mittels `\cite[key]` gesetzt. Beispiel: [WCL+05] oder mit Autorenangabe: Weerawarana et al. [WCL+05].

Der folgende Satz demonstriert 1. die Großschreibung von Autorennamen am Satzanfang, 2. die richtige Zitation unter Verwendung von Autorennamen und der Referenz, 3. dass die Autorennamen ein Hyperlink auf das Literaturverzeichnis sind sowie 4. dass in dem Literaturverzeichnis der Namenspräfix “van der” von “Wil M. P. van der Aalst” steht. Reijers et al. [RVA16] präsentieren eine Studie über die Effektivität von Workflow-Management-Systemen.

Der folgende Satz demonstriert, dass man mittels `label` in einem Bibliographie-Eintrag den Textteil des generierten Labels überschreiben kann, aber das Jahr und die Eindeutigkeit noch von biber generiert wird. The workflow engine Apache ODE [ASF16] executes BPEL processes reliably.

Wörter am besten mittels `\qq{...}` “einschließen”, dann werden die richtigen Anführungszeichen verwendet.

Beim Erstellen der Bibtex-Datei wird empfohlen darauf zu achten, dass die DOI aufgeführt wird.

---

**Listing A.1** The code is separated by two horizontal lines in the listings environment.

---

```
1 <listing name="second sample">
2   <content>not interesting</content>
3 </listing>
```

---

### A.3 Formulas and Equations

Equations  $f(x) = x$  inside the text can be provided. A list with all available mathematical symbols is provided at <http://texdoc.net/pkg/symbols-a4>. As example the set of natural numbers is given by  $\mathbb{N}$ . For the documentation of editing mathematical formulas read the package documentation of `amsmath`<sup>1</sup>.

Following equation is not numbered because of using `\align*` as environment.

$$x = y$$

Equation A.1 is numbered and can be referenced in the text:

$$x = y \tag{A.1}$$

The template offers `\abs` to enable the bars scaling well at the absolute value:  $|X|$ .

More details about mathematical environments provides this documentation<sup>2</sup>.

### A.4 Sourcecode

Listing A.1 shows how to embed source code. With `\lstinputlisting` the source code can be loaded directly from files.

Source code is also available in the text `<listing />`.

### A.5 Pseudocode

Algorithm A.1 zeigt einen Beispielalgorithmus.

---

<sup>1</sup><http://texdoc.net/pkg/amsmath>

<sup>2</sup><http://www.ctan.org/tex-archive/help/Catalogue/entries/voss-mathmode.html>

**Algorithm A.1** Sample algorithm

---

```

procedure SAMPLE( $a, v_e$ )
  parentHandled  $\leftarrow (a = \text{process}) \vee \text{visited}(a'), (a', c, a) \in \text{HR}$ 
  //  $(a', c'a) \in \text{HR}$  denotes that  $a'$  is the parent of  $a$ 
  if parentHandled  $\wedge (\mathcal{L}_{in}(a) = \emptyset \vee \forall l \in \mathcal{L}_{in}(a) : \text{visited}(l))$  then
    visited( $a$ )  $\leftarrow$  true
    writeso( $a, v_e$ )  $\leftarrow$   $\begin{cases} \text{joinLinks}(a, v_e) & |\mathcal{L}_{in}(a)| > 0 \\ \text{writes}_o(p, v_e) & \exists p : (p, c, a) \in \text{HR} \\ (\emptyset, \emptyset, \emptyset, false) & \text{otherwise} \end{cases}$ 
    if  $a \in \mathcal{A}_{basic}$  then
      HANDLEBASICACTIVITY( $a, v_e$ )
    else if  $a \in \mathcal{A}_{flow}$  then
      HANDLEFLOW( $a, v_e$ )
    else if  $a = \text{process}$  then // Directly handle the contained activity
      HANDLEACTIVITY( $a', v_e$ ),  $(a, \perp, a') \in \text{HR}$ 
      writes•( $a$ )  $\leftarrow$  writes•( $a'$ )
    end if
    for all  $l \in \mathcal{L}_{out}(a)$  do
      HANDLELINK( $l, v_e$ )
    end for
  end if
end procedure

```

---



Figure A.1: Beispiel-Choreographie

Und wer einen Algorithmus schreiben möchte, der über mehrere Seiten geht, der kann das nur mit folgendem **üblen** Hack tun:

---

#### Algorithmus A.2 Description

---

code goes here  
test2

---

## A.6 Figures

Die Figure A.1 und A.2 sind für das Verständnis dieses Dokuments wichtig. Im Anhang zeigt Figure A.4 on page 34 erneut die komplette Choreographie.

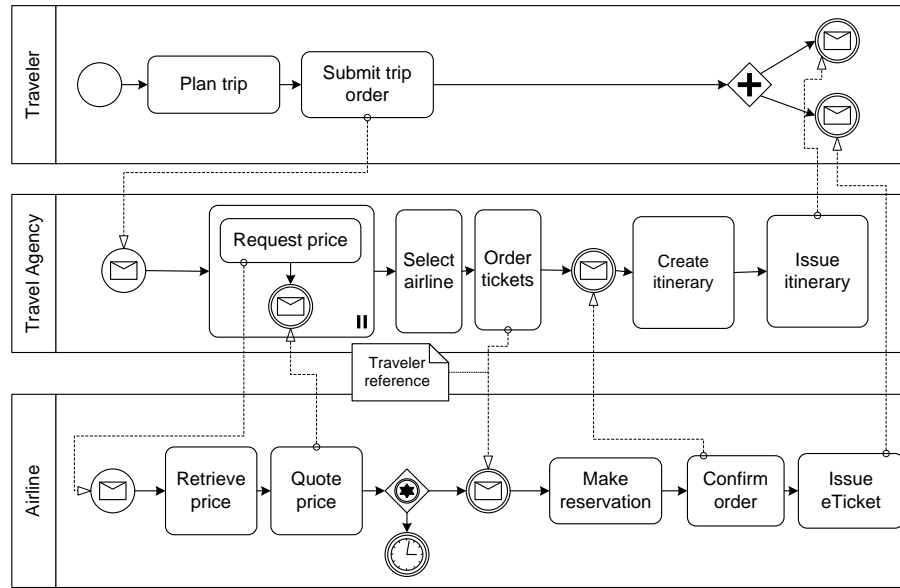
Figure A.3 shows the usage of the package subcaption. It is indeed possible to reference to sub figures: Figure A.3a.

Es ist möglich, SVGs direkt beim Kompilieren in PDF umzuwandeln. Dies ist im Quellcode zu latex-tipps.tex beschrieben, allerdings auskommentiert.

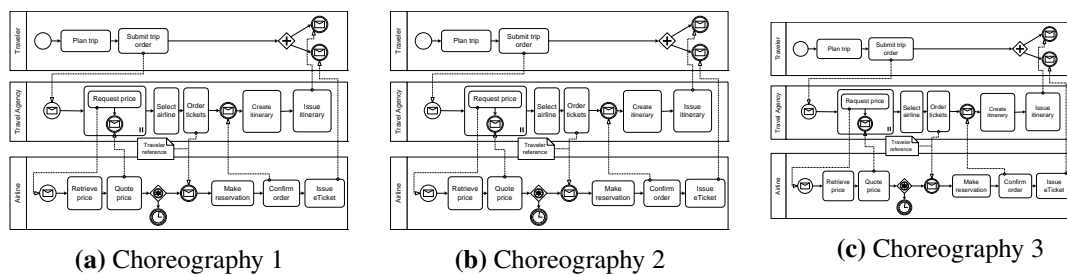
## A.7 More Illustrations

Figures A.4 and A.5 zeigen zwei Choreographien, die den Sachverhalt weiter erläutern sollen. Die zweite Abbildung ist um 90 Grad gedreht, um das Paket pdf\lscap zu demonstrieren.





**Figure A.2:** Die Beispiel-Choreographie. Nun etwas kleiner, damit \textwidth demonstriert wird. Und auch die Verwendung von alternativen Bildunterschriften für das Verzeichnis der Abbildungen. Letzteres ist allerdings nur Bedingt zu empfehlen, denn wer liest schon so viel Text unter einem Bild? Oder ist es einfach nur Stilsache?



**Figure A.3:** Example to place 3 illustrations next to each other. Further, it is possible to reference each separately.



**Figure A.4:** Beispiel-Choreographie I



Figure A.5: Beispiel-Choreographie II

## A.8 Plots with pgfplots

The package `pgfplots` provides plotting of functions directly in  $\text{\LaTeX}$  like with `matlab` or `gnuplot`.



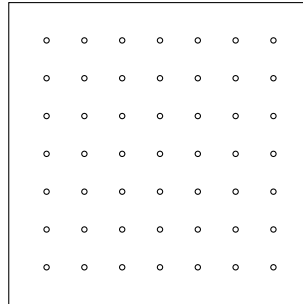
**Figure A.6:** Plot of  $\sin(x)$  directly inside the figure environment with `pgfplots`.



**Figure A.7:** Coordinates  $x$  and  $y$  read from csv file and plotted `pgfplots`.

## A.9 Figures with tikz

The `tikz` is a package for creating graphics programmatically. With this package grids or other regular structures can be easily generated.



**Figure A.8:** A regular grid generated easily with two for loops.

zusammengefasst		Titel
Tabelle	wie	in
<a href="#">tabsatz.pdf</a>	empfohlen	gesetzt
Beispiel	ein schönes Beispiel für die Verwendung von “multirow”	

**Table A.1:** Beispieltabelle – siehe <http://www.ctan.org/tex-archive/info/german/tabsatz/>

## A.10 UML diagrams using tikz-uml

Figure A.9 presents a class diagram typeset using tikz-uml.

## A.11 UML diagrams using PlantUML

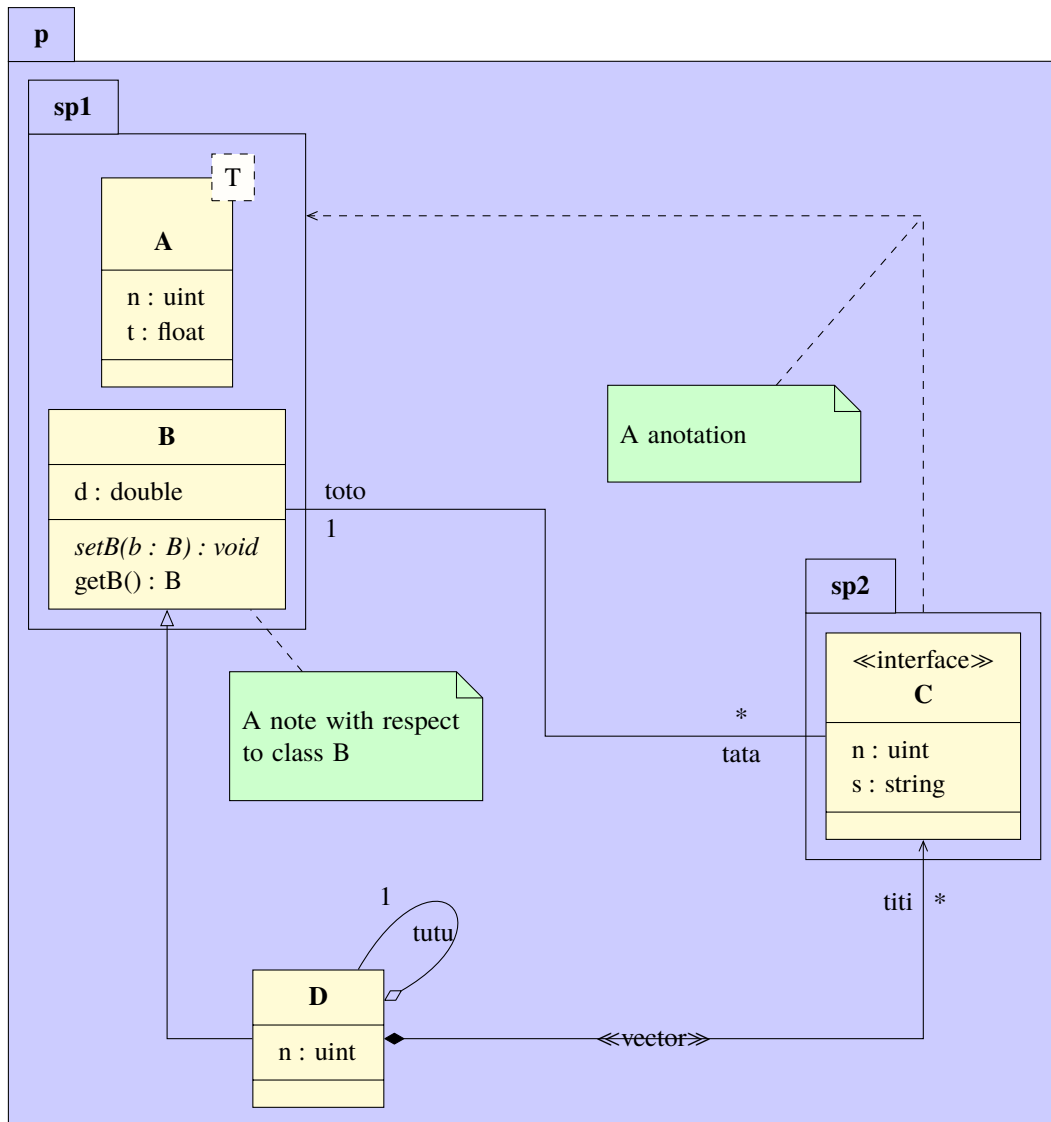
In case Lua<sup>A</sup>T<sub>E</sub>X is used and PlantUML is installed, UML diagrams can be defined using PlantUML.

## A.12 Tables

Table A.1 zeigt Ergebnisse und die Table A.1 zeigt wie numerische Daten in einer Tabelle repräsentiert werden können.

### A.12.1 Tabellen mit pgfplots

With the pgfplotstable package tables can be directly generated from a csv file.



**Figure A.9:** Class diagram generated with tikz-uml. Example adapted from Nicolas Kielbasiewicz.

Bedingungen	Parameter 1		Parameter 2		Parameter 3		Parameter 4	
	M	SD	M	SD	M	SD	M	SD
W	1.1	5.55	6.66	.01				
X	22.22	0.0	77.5	.1				
Y	333.3	.1	11.11	.05				
Z	4444.44	77.77	14.06	.3				

**Table A.2:** Beispieltabelle für 4 Bedingungen (W-Z) mit jeweils 4 Parameters mit (M und SD).  
Hinweist: immer die selbe anzahl an Nachkommastellen angeben.

	b	c	d
1	4	5	1
2	3	1	5
3	5	6	1
4	1	4	9
5	3	4	7

**Table A.3:** Tabelle directly generated from the values of a csf file.

### A.13 Tables spanning multiple pages

**Table A.4:** A sample long table.

[illegible]

Table A.4 – continued from previous page

[illegible]



Table A.4 – continued from previous page

First column	Second column	Third column
A	BC	D
A	BC	D
A	BC	D
A	BC	D
A	BC	D
A	BC	D
A	BC	D
A	BC	D
A	BC	D
A	BC	D
A	BC	D
A	BC	D
A	BC	D

## A.14 Abbreviations

Beim ersten Durchlauf betrug die Fehlerrate (FR) 5. Beim zweiten Durchlauf war die FR 3. Die Pluralform sieht man hier: error rates (ERs). Um zu demonstrieren, wie das Abkürzungsverzeichnis bei längeren Beschreibungstexten aussieht, muss hier noch Relational Database Management Systems (RDBMS) erwähnt werden.

Mit `\gls{...}` können Abkürzungen eingebaut werden, beim ersten Aufrufen wird die lange Form eingesetzt. Beim wiederholten Verwenden von `\gls{...}` wird automatisch die kurz Form angezeigt. Außerdem wird die Abkürzung automatisch in die Abkürzungsliste eingefügt. Mit `\glspl{...}` wird die Pluralform verwendet. Möchte man, dass bei der ersten Verwendung direkt die Kurzform erscheint, so kann man mit `\glsunset{...}` eine Abkürzung als bereits verwendet markieren. Das Gegenteil erreicht man mit `\glsreset{...}`.

Definiert werden Abkürzungen in der Datei *content*  
*ausarbeitung.tex* mithilfe von `\newacronym{...}{...}{...}`.

Mehr Infos unter: <http://tug.ctan.org/macros/latex/contrib/glossaries/glossariesbegin.pdf>

## A.15 References

Für weit entfernte Abschnitte ist “`varioref`” zu empfehlen: “Siehe Appendix A.3 on page 30”. Das Kommando `\vref` funktioniert ähnlich wie `\cref` mit dem Unterschied, dass zusätzlich ein Verweis auf die Seite hinzugefügt wird. `vref`: “Appendix A.1 on page 29”, `cref`: “Appendix A.1”, `ref`: “A.1”.

Falls “`varioref`” Schwierigkeiten macht, dann kann man stattdessen “`cref`” verwenden. Dies erzeugt auch das Wort “Abschnitt” automatisch: Appendix A.3. Das geht auch für Abbildungen usw. Im Englischen bitte `\Cref{...}` (mit großen “C” am Anfang) verwenden.

## A.16 Definitions

### Definition A.16.1 (Title)

*Definition Text*

Definition A.16.1 zeigt ...

## A.17 Footnotes

Footnotes are provided by the command `\footnote{...}`<sup>3</sup>. Citing footnotes is possible by providing a label `\footnote{\label{...}}...` and cite the footnote with `\cref{...}` in the text<sup>3</sup>.

## A.18 Verschiedenes

- I. Man kann auch die Nummerierung dank `paralist` kompakt halten
- II. und auf eine andere Nummerierung umstellen

The words “workflow” and “dwarflike” can be copied from the PDF and pasted to a text file.

In case `LuaATEX` is used as compiler, there is no ligature at “fl” in the word “dwarflike” (in contrast to “fl” at “workflow”). In other words: “dwarflike” and “dwarflike” look the same in the PDF. In case they do not, there is an issue with `LuaATEX` and the `selnolig` package.

## A.19 Closing remarks

Please feel free to provide enhancements for this template and create a new ticket on github (<https://github.com/latextemplates/uni-stuttgart-computer-science-template/issues>).

---

<sup>3</sup>Example footnote.

## Bibliography

- [ASF16] The Apache Software Foundation. *Apache ODE™ – The Orchestration Director Engine*. 2016. URL: <http://ode.apache.org> (cit. on p. 29).
- [RVA16] H. Reijers, I. Vanderfeesten, W. van der Aalst. “The effectiveness of workflow management systems: A longitudinal study”. In: *International Journal of Information Management* 36.1 (Feb. 2016), pp. 126–141. DOI: [10.1016/j.ijinfomgt.2015.08.003](https://doi.org/10.1016/j.ijinfomgt.2015.08.003) (cit. on p. 29).
- [WCL+05] S. Weerawarana, F. Curbera, F. Leymann, T. Storey, D. F. Ferguson. *Web Services Platform Architecture : SOAP, WSDL, WS-Policy, WS-Addressing, WS-BPEL, WS-Reliable Messaging, and More*. Prentice Hall PTR, 2005. ISBN: 0131488740. DOI: [10.1.1/jpb001](https://doi.org/10.1.1/jpb001) (cit. on p. 29).

All links were last followed on March 17, 2018.



### **Declaration**

I hereby declare that the work presented in this thesis is entirely my own and that I did not use any other sources and references than the listed ones. I have marked all direct or indirect statements from other sources contained therein as quotations. Neither this work nor significant parts of it were part of another examination procedure. I have not published this work in whole or in part before. The electronic copy is consistent with all submitted copies.

---

place, date, signature