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# **Fusion of Spatial Information Models with Formal Ontologies in the Medical Domain**

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Beim Fachbereich Informatik der Universität Kaiserslautern  
zur Erlangung des akademischen Grades

**Doktor der Ingenieurwissenschaften (Dr. Ing.)**

eingereichte Dissertation von

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### **Eidesstattliche Erklärung**

Hiermit erkläre ich,

1. dass ich die vorgelegte Dissertation selbst angefertigt und alle von mir benutzten Hilfsmittel in der Arbeit angegeben habe,
2. dass ich die vorgelegte Dissertation oder Teile hiervon noch nicht als Prüfungsarbeit für eine staatliche oder andere wissenschaftliche Prüfung eingereicht habe,
3. dass ich weder diese noch eine andere Abhandlung bei einem anderen Fachbereich oder einer anderen Universität als Dissertation eingereicht habe.

Kaiserslautern, den 24. Juni 2010

Manuel Möller



# Foreword

ABC xyz ...

-1em

Prof. Dr. X.Y.  
Kaiserslautern, February TODO



## **Abstract**

In `srcbook` you usually do not have an abstract. Thus, we have to format it as a chapter. The text of the abstract is contained in `outline/abstract.tex`.



## Acknowledgements

It is my pleasure to start with thanking those people and institutions that have made my research and this thesis possible.

Make sure to *comment out* the acknowledgments for the official submission to your university and activate it only for the book publications.



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# Part I.

## Background

**Summary:** Each part of the thesis can have a custom preamble which has to be set in `main.tex`.

I used a separate folder for each part: `Part1`, `Part2`...

Each chapter again is contained in a separate `.tex` file which goes to the respective part folder.

For example, Chapter 1 is located in `Part1/ch_Introduction.tex`.



## Introduction

(Concerning the allocation of research funds) It is folly to use as one's guide in the selection of fundamental science the criterion of utility. Not because (scientists) ... despise utility. But because ... useful outcomes are best identified after the making of discoveries, rather than before.

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John C. Polanyi

This chapter lists a few features of the custom `phd.cls` LaTeX class developed by various authors at German Research Center for Artificial Intelligence (**DFKI**) over the years.

### 1.1. Acronyms

To make sure that acronyms get expanded only once in your thesis, it makes sense to use the `acronym` packages. Acronyms are defined in `acronyms.tex` and can be used in the normal LaTeX source code like this:

```
\ac{dfki}
```

The first time this is used the acronym gets expanded (see above). If you use it again, only the short form is redered: **DFKI**

More documentation on this can be found in the package documentation at <http://mirror.ctan.org/macros/latex/contrib/acronym/acronym.pdf>. Make sure that you read this documentation because you cannot use the `ac` command in headings and captions!

### 1.2. Marginnotes

I used the custom command `marginnote` a lot to have the side notes identifying certain

**This is a margin-note**

definitions and keywords for paragraphs.

### 1.3. Table Format

Do yourself and others the favor and take a look on how to format tables properly. Documentation for this is included at <http://mirror.ctan.org/macros/latex/contrib/booktabs/booktabs.pdf>. Table 1.1 is an example from Manuel Möller's actual Ph.D. thesis.

number of volume data sets	50
retrieval operations per volume data set	400
search range for x, y, and z	0–200
spatial index (XTree)	on/off

Table 1.1.: Parameters of the Spatial DBMS performance evaluation

### 1.4. Source Code Listings

There are dozens of LaTeX packages out there for formatting source code. I've used listings. There is documentation for this package available at <ftp://ftp.tex.ac.uk/tex-archive/macros/latex/contrib/listings/listings.pdf>. Listing 1.1 is an example for a source code listing with line numbers. In `main.tex` we already take care of generating a list of all listings as a part of the outline.

```
has_regional_part(X,Y) :-
    true(Y,uri('fma','regional_part_of'),X).
has_regional_part(X,Y) :-
    true(Z,uri('fma','regional_part_of'),X),
    has_regional_part(Z,Y).

male_entities(X) :-
    true(X,uri('fma','member_of'),uri('fma','Set_of_male_pelvic viscera')),
    \+ true(X,uri('fma','member_of'),uri('fma','Set_of_female_pelvic viscera')).
male_entities(X) :-
    has_regional_part(uri('fma','Male_genital_system'),X).

female_entities(X) :-
    true(X,uri('fma','member_of'),uri('fma','Set_of_female_pelvic viscera')),
    \+ true(X,uri('fma','member_of'),uri('fma','Set_of_male_pelvic viscera')).
female_entities(X) :- has_regional_part(uri('fma','Female_genital_system'),X).

has_gender(X, male) :- male_entities(X).
has_gender(X, female) :- female_entities(X).
```

Listing 1.1: Prolog rules for the gender consistency check

## 1.5. Proper Curriculum Vitae

At least at the University of Kaiserslautern you have to submit a CV with you thesis. In appendix/app\_vita.tex we use the existing LaTeX package `currvita` to format the CV in a tabular way.

## 1.6. Two-Column Index

It makes sense to start putting `index` commands in your LaTeX source code right from the start we you begin with your Ph.D. thesis. The example below shows how:

```
The invention of Computed Tomography\index{Computed Tomography}
and its first application for medical diagnosis was a major
breakthrough...
```

To generate a two-column index such as at the end of this document you have to make sure that the index generator is called with the custom `indexstyle.ist` style file. To configure TexNicCenter to do this for you, you have to modify you active output profile (menu *Output* and then second last entry) according to the screenshot below.

It is also possible to refer to other entries in the index. This is especially useful, if you are intending to index words which are formatted in a special way. One example is PACS, the acronym for Picture Archiving and Communication Systems, which we want to format with small caps. The LaTeX index would simply start with indexing the `textsc` which is not what we want. Instead, we can tell LaTeX that `PACS` is to be indexed and `textscPacs` to be display in the index entry. Here is how:

```
One example is \textsc{Pacs}\index{PACS@\textsc{Pacs}},
the acronym for Picture Archiving and Communication
Systems.
```

Have a look at the Index on page [20](#) to see what this looks like.

To get the latest version of the index you have to run `pdflatex` *three* times!

## 1.7. LaTeX Typesetting Improvements

To improve the typesetting of LaTeX three additional packages are used by `phd.cls`. Please refer to the respective documentation given as hyperlinks.

- `microtype`: The `microtype` package provides a LaTeX interface to the micro-typographic extensions of pdfTeX : most prominently, character protrusion and font expansion, furthermore the adjustment of interword spacing and additional kerning, as well as hyphenatable letterspacing (tracking) and the possibility to disable all or selected ligatures
- `ellipsis`: corrects whitespaces around ellipses

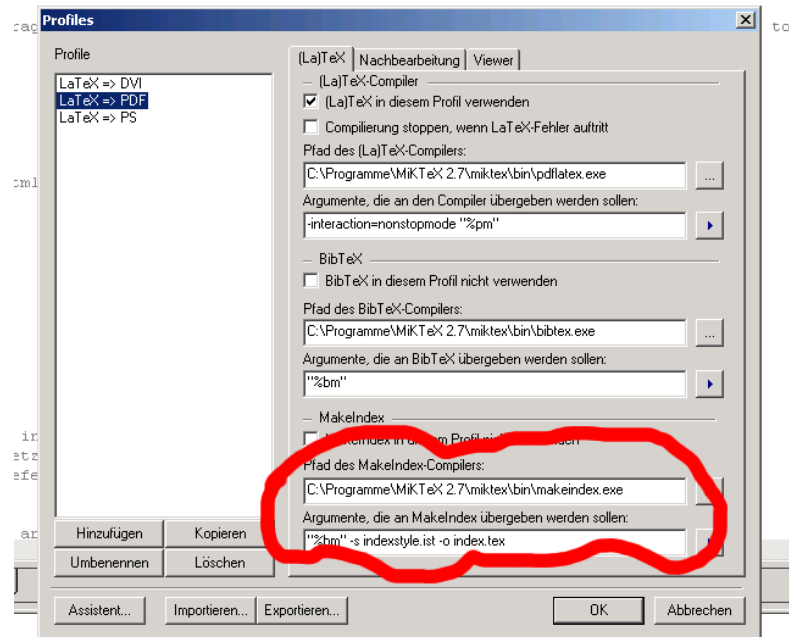


Figure 1.1.: Illustration of the inter-body-region reasoning idea

- fixltx2e: fixes some of the core competencies of LaTeX 2e

To avoid typical typeset mistakes, take 15 minutes in the beginning and take a look at the list of LaTeX taboos at <http://www.ctan.org/tex-archive/info/l2tabu/german/l2tabu.pdf> (German only). Do *NOT* use sloppy to get rid of overfull and underfull boxes because this screws up the typesetting! Instead, the phd class uses these settings:

```
\tolerance 1414
\hbadness 1414
\emergencystretch 1.5em
\hfuzz 0.3pt
\widowpenalty=10000
\vfuzz \hfuzz
\raggedbottom
```

## 1.8. Custom Chapter Headings

This document uses non-standard chapter headings. This can be configured in `phd.cls`. The current configuration looks like this:

```
\usepackage{titlesec}
```

```
\newcommand{\customtitleformat}[0]{  
\titleformat{\chapter}[display]  
{\bfseries\Large}  
{\sffamily\filleft\MakeUppercase{\chaptertitlename} \Huge\thechapter}  
{2ex}  
{\sffamily\titlerule  
\vspace{2ex}%  
\filright\Huge}  
%[\vspace{2ex}]%  
%\titlerule]  
[]  
}
```

## 1.9. BibTex references

Instead of the standard reference system we use the LaTeX package `natbib` which adds a number of extra features, among them *line wraps*. The format of the references in the text can be configured in `phd.cls`. The current configuration uses squared braces and the first authors name plus the year of the publication.



## **Part II.**

### **Related Research**



**Part III.**  
**Appendices**



# Publications by the Author

The following list gives an overview about accepted scientific publications which are authored or co-authored by the author of this thesis.

1. [Möller et al., 2008]: Möller, M.; Sintek, M.; Buitelaar, P.; Mukherjee, S.; Zhou, X. S. & Freund, J.: *Scalable Medical Image Understanding by Fusing Cross-Modal Object Recognition with Formal Domain Semantics*



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# Curriculum Vitae

## Personal

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## Education

since 2007 Ph.D. student at the German Research Center for Artificial Intelligence in Kaiserslautern, Germany under supervision of Prof. Dr. Andreas Dengel  
2001-2006 Computer Science Studies at Chemnitz University of Technology with focus on artificial intelligence, finished with a Dipl. Inform. (corresponds to M.A. Sc.), Grade *excellent*  
... ..

## Work Experience

03/2009-05/2009 visiting Ph.D. student at Siemens Corporate Research in Princeton, NJ, USA  
... ..



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# Acronyms

**DFKI** German Research Center for Artificial Intelligence.....3



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## Bibliography

Möller, M., Sintek, M., Buitelaar, P., Mukherjee, S., Zhou, X. S., and Freund, J. (2008). Scalable medical image understanding by fusing cross-modal object recognition with formal domain semantics. In Fred, A., Filipe, J., and Gamboa, H., editors, *Best papers of BIOSTEC 2008*, number 25 in CCIS, pages 390–401. Springer-Verlag Berlin Heidelberg. 13

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