documentation and usage example

FELthesis – LaTeX templates for thesis on CTU FEL

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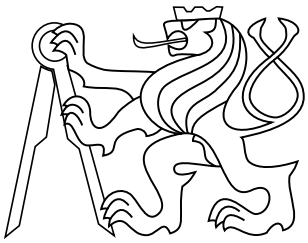

December 2012

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Acknowledgement

Let me thank to the Center for Machine Perception whose mutial cooperation, needs, and support enabled me to learn how to prepare such TEX templates.

Declaration

I declare that I worked out the presented thesis independently and I quoted all used sources of information in accord with Methodical instructions about ethical principles for writing academic thesis.

Abstract

Tento dokument ukazuje a testuje použití oficiálně doporučené LaTeXové šablony FEL-thesis pro sazbu bakalářské, diplomové a disertační práce na Elektrotechnické fakultě ČVUT. Šablona definuje všechny povinné strukturní elementy zmíněných závěrečných prací a formátuje jejich obsah tak, aby splňovala na škole daná formální pravidla.

Klíčová slova

styl dokumentu; šablona; bakalářská, diplomová, disertační závěrečná práce; LaTeX

Abstract

This document shows and tests an usage of the LaTeX officially recommended design style FELthesis for bachelor (Bsc.), master (Ing.), or doctoral (Ph.D.) thesis at the Faculty of Electrical Engineering of the Czech Technical University in Prague. The template defines all thesis mandatory structural elements and typesets their content to fulfil the university formal rules.

Keywords

document design template; bachelor, master, ph.d. thesis; LaTeX

Contents

Abbreviations

As an example of an abbreviation description serve some terms from TeX world. This introductory paragraph is optional and can stay empty.

TEX	Typesetting program and macro language by Donald Knuth.
METAFONT	Program and macro language for font creation by Donald Knuth.
METAPOST	Vector drawing program based on METAFONT with Encapsulated PostScript output by John Hobby.
plain TEX	Original TEX format (macro extension) by Donald Knuth. User customization is done by programing in TEX macro language.
LATEX	Most known and used TEX format originally by Leslie Lamport. There is a huge number of packages that extends standard functionality or bypass programing in TEX. User customization is primarily done by loading predefined class or package and rewriting their definitions.
ConTEXt	Complex typesetting and vector drawing system based on TEX, METAPOST and Lua script language by Hans Hagen. Customization is done by key-value parametrization with conjunction to TEX, METAPOST and Lua programing.

Symbols

The abbreviation environment starts a new page. If we want to avoid page break like in this second short list use starred version `\startAbbreviations*`. Indentation might be adjusted by the command `\setlength{\AbbrvIndent}{5em}` to be appropriate to the symbols width.

π	Final version number of TEX.
e	Final version number of METAFONT.
2ε	Version of today's LATEX valid since 1994. It was intended as a temporary intermediate version between original Leslie Lamports's last version LATEX 2.09 and LATEX3 that is developed as its successor.

1. Introduction

This document briefly describes LaTeX class FELthesis. It is an officially recommended LaTeX style and structure template to prepare bachelor's, master's, or ph.d. thesis. It also serves as an example of the class usage and it gives some typesetting advice for thesis authors.

FELthesis defines all needed thesis structure elements and it designs its style. It saves students' and their advisors' time enabling them to focus on the thesis content. The main goals of the package are as follows:

- setup page, text, and border size;
- setup fonts and their sizes;
- setup titlepage;
- setup front elements like acknowledgement, declaration, abstracts, keyword lists, table of contents and list of abbreviations/symbols;
- setup running heads and foots;
- setup headings and captions;
- make easier using a bibliography.

Since the thesis which utilizes FELthesis class is still a LaTeX document at least some LaTeX knowlewdge is needed. This user manual covers only additional specialities for thesis but does not include a description of the LaTeX structural language or TeX macrolanguage basis. That is why it can not replace LaTeX textbooks among them we recommend: *LaTeX pro začátečníky* [1], *The not so short introduction to LaTeX 2ε* [2], *Guide to LaTeX* [3], *The LaTeX Companion* [4], *The LaTeX Graphics Companion* [5]. For description of the TeX macrolanguage see following books: *The TeXbook* [6], *TeXbook naruby* [7].

1.1. First usage

1.1.1. Minimal document

The minimal FELthesis document looks as follows:

```
\documentclass[bcl,draft]{felthesis}% bcl/msc/phd czech/slovak

\usepackage[utf8x]{inputenc}

\startThesisInfo
  \Title{thesis title}
  \Author{author name}
  \Date{November 2012}
  \Department{Katedra kybernetiky}
  \Advisor{advisor: name}
  \KeywordsCz{Prvni klicove slovo; druhe; treti; \dots}
  \KeywordsEn{First keyword; second; third; \dots}
\stopThesisInfo
```

```
\addbibresource{\jobname.bib} % bibliography file

\begin{document}

\MakeTitle

\startFrontMatter
  \startAcknowledgement ... \stopAcknowledgement
  \startDeclaration ... \stopDeclaration
  \startAbstractCz ... \stopAbstractCz
  \startAbstractEn ... \stopAbstractEn
  \TableOfContents
\stopFrontMatter

\startBodyMatter
  \chapter{...}
  \section{...}
  \subsection{...}

  \startAppendices
    \chapter{...}
  \stopAppendices
\stopBodyMatter

\startBackMatter
  \PrintBibliography
\stopBackMatter

\end{document}
```

As writing the thesis in a single file makes its editing very difficult it is useful to split it into several files that mimics the document structure:

```
... % preamble is omitted
\begin{document}

\MakeTitle

\startFrontMatter
  \input{acknowledgement}
  \input{declaration}
  \input{abstract}
  \TableOfContents
  \input{abbreviations}
\stopFrontMatter

\startBodyMatter
  %\includeonly{ch01}
  \include{ch01}
  \include{ch02}
```

```
  ...

  \startAppendices
    \include{app01}
  \stopAppendices
\stopBodyMatter

\startBackMatter
  \PrintBibliography
\stopBackMatter

\end{document}
```

1.1.2. Class options

The class FELthesis can be customized by following `\documentclass[...]{felthesis}` options:

bcl | msc | phd Thesis type: bachelor, master, or ph.d. respectively. For now it does not influense thesis structure or design, just the text of the thesis's subject. [default: bcl]

english | czech | slovak Main thesis language. Set labels and hyphenation patterns. [english]

draft Print proof mark on every page footer with date information for versioning of draft (not final) version. Remove this option for the final thesis versions. []

1.1.3. Compilation

1. Install TeX distribution (TeXLive recommended).
2. Unzip file felthesis.zip into some directory (e.g. thesis).
3. Run 'latex felthesis.ins'.
4. Make your copy of the file template.tex (e.g. 'your-surname-msc.tex').
5. Test compilation
   ```
   pdflatex your-surname-msc.tex
   biber your-surname-msc
   pdflatex your-surname-msc.tex
   pdflatex your-surname-msc.tex
   ```
6. If it runs without errors and `your-surname-msc.pdf` is generated than your TeX distribution contains all needed packages (see 1.2.1) and you are ready to use the template.

See that we run `(pdf)latex` format. Do not use `(pdf)cslatex` for thesis in Czech or Slovak. CsLaTeX is obsolete and not maintained. With combination of standard `pdflatex` format, `babel` package, UTF-8 encoding, and Latin Modern fonts [8] we obtain the best LaTeX standard environment for typesetting Czech or Slovak languages.

1.2. LaTeX distribution

Among several free or commertial TeX distributions we recommend to use the TeXLive 2012 [9] or newer. It is huge but fresh, complete and well maintained distribution. You will not miss any package or tool there. TeXLive works on all main platforms (Unix, windows, Mac) so you can share the same TeX environment on several working places.

1.2.1. Packages

FELthesis class loads the following LaTeX packages which must be present at your system:

- babel,
- lmodern, cmap,
- ifpdf,
- xcolor, graphicx,
- hyperrref, url,
- amsmath, amssymb,
- chngcntr, subfigure,
- biblatex,
- makeidx,
- pdfpages.

1.3. Encodings

For avoiding character confusions FELthesis supports UTF-8 encoding for all input source files including bibliography. We recommend to stay with it. Most of today's text editors and LaTeX writing environments are capable to save files in UTF-8, e.g. TeXworks [10], TeXnicCenter [11], or XEmacs [12].

2. Thesis structural elements

The whole thesis is structured into three parts: front, body, and back. First part covers introductory pages and they are separately numbered by roman numbers. The body and back parts – which include the core of the student work – are numbered by arabic numbers so that the work axtend is simply distinguished. We discuss each part in the following sections.

2.1. Front elements

Front elements start at title page with roman number 3 and they extend till the first thesis chapter.

2.1.1. Title page and general thesis information

The title page (do not confuse with the cover page) is generated automatically from general information inserted in the document preamble between `\startThesisInfo ... \stopThesisInfo`. Tab. 1 shows the complete list of thesis info elements. They are not used only for the document titlepage but also for PDF properties and the user can typeset them by e.g. `\theTitle` throughout the document.

command		description
`\Title`	*	document title
`\Author`	*	author's name(s)
`\AuthorEmail`		author's email
`\Thesis`	–	thesis type (bachelor, master or ph.d.); add automatically
`\ThesisUrl`		public URL of thesis PDF
`\Date`	*	(month and) year
`\Advisor`	*	advisor's name usually with label *Advisor:*
`\School`		school name (predefined CTU)
`\Faculty`		faculty name (predefined FEL)
`\Department`		department
`\KeywordsCz`	*	keywords in Czech (semicolon separated)
`\KeywordsEn`	*	keywords in English (semicolon separated)
`\AssignmentPage`		PDF file of the thesis assignment for an inclusion

Table 1. List of document information commands (marked by * if mandatory).

2.1.2. Acknowledgement

If you want to say a word of thanks to some people or to some support include it between `\startAcknowledgement ... \stopAcknowledgement`. The template contains a separate file for it called `acknowledgement.tex` for inclusion into the main file. The acknowledgement is placed on the top of the page together with a declaration.

2.1.3. Declaration

For a declaration of independent work there is an environment `\startDeclaration ... \stopDeclaration`. The template contains a file `declaration.tex` with predefined text of the declaration.

2.1.4. Abstracts

The thesis must contain both Czech/Slovak and English abstract versions. For them FELthesis defines `\startAbstractCz ... \stopAbstractCz`, `\startAbstractSk ... \stopAbstractSk`, and `\startAbstractEn ... \stopAbstractEn` environments and generates a file `abstract.tex` for them.

The lists of keywords are placed automatically below the abstracts from `\KeywordsCz` and `\KeywordsEn` entries of the general information section (see Tab. 1).

2.1.5. Table of contents

The table of contents is generated by macro `\TableOfContents`.

2.1.6. List of abbreviations/symbols

List of abbreviations or symbols is enclosed in `\startAbbreviations[...]{...} ... \stopAbbreviations` with `\items` for each abbreviation. The environment has one mandatory parameter for introductory paragraph and one optional for nonstandard title. Again, the template contains a separate file for this list. See abbreviation and symbol lists in this document for en example of two lists at page vii.

2.2. Body elements

We will not mention all body elements here. See LaTeX documentation instead. Let us speak about the ones which are changed by FELthesis or we have some special related advice about.

2.2.1. Math

FELthesis loads packages `amsmath` and `amssymb` for nicer mathematic equations. Use `equation` or `multiline` environments as shown in [13] instead of `array`.

$$1 + 1 = ? \tag{1}$$

2.2.2. Tables and figures

Tables and figures are block elements that can not be simply broken into parts when there is not enough room to place them on the page. To treat this we take them out from the continuous text and move them as a whole somewhere where there is more place on the page. That is why they are called floating elements.

Every table and figure should be accompanied by a caption with a number. This number connects the floating element with the relevant place in the text, see Fig. 1. To simplify reading there is a general rule to place floating elements. They should lay on *the same facing pages* as their reference point. It prevents the reader to turn the page.

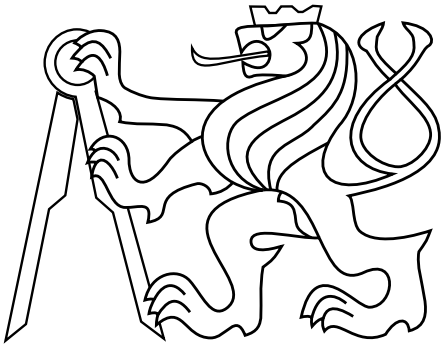
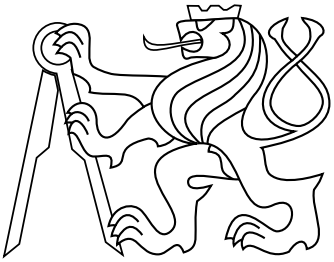
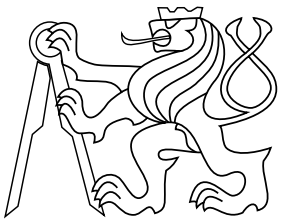


Figure 1. The best way to set the size of graphics is to setup it relatively to the text line width, e.g. `width=.4\linewidth`. Because of its frequent usage the FELthesis introduces an abbreviation `\LW` for `\linewidth`.



a) Big lion.



b) Smaller lion. This subcaption contains enough text to span several lines.

Figure 2. Example of subfigure usage.

The reference number is generated automatically. The only thing we must do is to mark the referencing element by `\label{my-label}` and use it in the `\ref{my-label}`. Be careful to place the `\label` *after* the `\caption{...}` otherwise the number will not be correct.

We couple reference number with an element type name or its abbreviation like Figure 87 or Tab. 23. We should avoid breaking this pair into two lines so we use unbreakable space inbetween, e.g. `Figure~\ref{fig:lev}`. To simplify reference writing the FELthesis introduces two macros: `\Fref{fig:lev}` and `\Tref{tab:students}`. They typeset both the element type abbreviation and the number and they also forse uniformity of the typographic style across the whole document. As an example of usage, see Tab. 2.

number of	2007	2008	2009	2010	2011
students Bc. and Mgr.	6313	5913	5951	5188	4737
graduate Bc. and Mgr.	1195	1489	1379	1160	1260
students Ph.D.	457	468	366	395	434
graduate Ph.D.	65	60	55	54	51

Table 2. Number of students and graduates in CTU FEL. See that proper inter-column space and data align express table structure sufficiently. Using redundant cell borders or plenty of horizontal or vertical lines is not a sign of a nice style. Data source: [14].

Some more tips:

- It is useful to place external graphical files to some subdirectory. We must let know to LaTeX where they are. The search path is set by `\graphicspath{}`. See

the template preamble for an example.
- For tables that do not fit into a single page `\usepackage{longtable}` [15]. It can insert column header/footer on every start/end of a splitting table part.
- The manual [16] shows plenty of examples how to incorporate graphics into LaTeX document (e.g. more graphics in a single figure, subcaptions, full page figure, caption beside the figure, rotation, ...).

2.2.3. Appendices

Appendices are normal chapters and (sub)sections included into `\startAppendices` and `\stopAppendices`. These pairing structural elements ensure numbering chapters by letters A., B., C., ...

2.3. Back elements

2.3.1. Bibliography

Every piece of information that is not our should be cited. In LaTeX world the referred publications are stored in the `.bib` file, in our text they are referred by command `\cite{label}`, and originally compiled by program called BibTeX [17, 18].

Our document is written in UTF-8 encoding that is why we prefer the bibtex file will also in UTF-8. Unfortunately, nearly 30 years old BibTeX still accepts only 7-bit encoding. To avoid writing references like

```
@MISC{ CVUT_FEL:smernice,
  author= {{\v C}VUT FEL},
  title = {Sm{\v e}rnice d{\v e}kana pro magistersk{\'e} st{\'a}tn{\'\i}
           z{\'a}v{\v e}re{\v c}n{\'e} zkou{\v s}ky na {{\v C}VUT FEL}},
}
```

we have to look for another bibliography aware program. There exists CsBibTeX (outside of the standard LaTeX distributions [19]) which understands ISO-8859-2 or CP1252 and enables Czech sorting rules. But it does not accept input in UTF-8. Another 8-bit extension is called BibTeX8 [20] but also there is no UTF-8 capatibility here.

In FELthesis we finally choose very general bibliography tool Biber [21] in conjunction with LaTeX package `biblatex` [22]. Except for UTF-8 input it naturally understands today's very common on-line (web) references, is is compatible with old BibTeX files, it knows national sorting rules, and it is highly configurable.

Specification for FELthesis (see App. A) says that bibliography marks should be numbered in referenced order. So the `biblatex` package is loaded and configured accordingly. The only things the thesis writer must do is:

1. write his/her bib file,
2. cite the bibliography entries, and
3. run Biber by the command:

```
biber tex_file_without_extension
```

2.3.2. Index

It is not common that thesis contains index (e.g. list of terms or names) because the document is not large, number of index entries is low, and that is why the navigation

is simple. Only in some special theses it makes sence to include the index. FELthesis enables to prepare the index using macro `\index{...}` in your text and uncommenting `\PrintIndex` in the template. Sorting must be done by external program like MakeIndex [23, 24], CsIndex [25], or the most modern Xindy [26].

3. Design

Since this template intent is to serve for a wide variety of technical students we chose a conservative design with a stress on the structure.

3.1. Return to classical book design

We support new offical conditions for thesis preparation on CTU [27]. They mimic the fact that the technology of high quality typesetting and printing is now generally available for students. It anables to bring back the classical book design which has developed during centuries according to human ergonomy needs. That is why we do not follow the typewriter restrictions any more.

Let us list these classical book design principles:

Duplex printing: Text on both even and odd pages has several advantages. The reader can view bigger amount of text, figures, and tables together; it reduces flipping pages; it saves paper, expenses, and library storage.

Interline space 'single': Well designed font has its optimal interline space. Increasing this space makes reading more tiring. Even for proof reading there is no need for 'double' interlines when using proofing marks and big binding margin.

Suppress underline emphasizing: Underling breaks letter baselines. It again makes reading more difficult. Use `\emph{...}` (*italics*) or `\Emph{...}` (**bold sans**) instead.

3.2. Fonts

For the class we chose a Latin Modern [8] font family. Its classicist 'didon' origin suits well to the technical content. We see the following technical advantages of the font:

- Good legibility.
- Richness of the family (italic, bold, mono, math).
- Excelent math design.
- Good design of Czech/Slovak accents and other national specifics.
- OTF format for simple Unicode and non-TEX (MS Word) usage.
- Free usage licence.

The size of base text is 11 pt.

3.3. Geometry

Theses are typically bind together with wide and cheep bindings. That is why the inner border is setup to 37 mm. The rest dimensions are adjusted to the A4 paper size and the font size.

Appendix A.

Specification/Specifikace

Tento dokument specifikuje šablony pro LaTeX a MS Word, které jsou doporučeny pro psaní bakalářských, diplomových nebo disertačních prácí na ČVUT FEL. Specifikace se opírá o dokumenty [27, 28, 29].

Šablony mají splňovat následující požadavky:

- Písmo Latin Modern (v LaTeX instalacích je standardně obsaženo, pro MS Word bude OTF verze s podporou matematiky přiložená k šabloně). Velikost základního písma 11 bodů.
- Implicitní kódování šablon UTF-8.
- Formátování na papír A4, vnitřní okraj 30 mm pro pevnou vazbu, délka řádky přizpůsobena velikosti písma.
- Implicitně se předpokládá oboustranná sazba.
- Strukturní elementy: titulní list, poděkování, prohlášení, abstrakt + klíčová slova (cz/en), obsah, seznam symbolů/zkratek, přílohy, bibliografie, tabulky a obrázky s popisky.
- Číslování stránek od 1. strany textu (úvodu); úvodní stránky číslovány římsky. Důvodem je snadno rozpoznatelný rozsah práce.
- V záhlaví stránky číslo a název hlavní kapitoly. V patičce u vnějšího okraje číslo stránky.
- Součástí šablony bude styl pro bibliografie s číselnými odkazy; v seznamu literatury řazení dle pořadí citování.
- Šablona umožní následující varianty výsledného dokumentu:
  - bakalářská/diplomová/disertační práce (předpokládá se stejná základní struktura, jen změna podtitulků),
  - anglický nebo český jazyk textu (vzory dělení, nadpisy, číslování kapitol),
  - pracovní verze (draft) s textem „Draft + datum" v patičce.

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