A Brief Guide for Using the Telematics Thesis Class

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Acknowledgment

This is the place to thank all the people involved with your thesis / project. Examples would be your family, friends, and of course your supervisor. The acknowledgement will not have any influence on your grade; however, we think it is good style to have an acknowledgement in your thesis.

Abstract

The abstract of your thesis goes here. There may be formal requirements on it that can be found in the corresponding examination guidelines (Prüfungsordnung). If there are none, ask your supervisor. As a rule of thumb, the abstract should be concise and focused. It is not a shortened introduction to your work. We also suggest that—if an abstract is not required—only write one if it is really well done.

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List of Symbols

$\mathbb{N}, \mathbb{Z}, \mathbb{Q}, \mathbb{R}, \mathbb{C}$	Regular sets of numbers
$\mathcal{NP}, \mathcal{P}$	Complexity classes
$\mathcal{V} = \{v_0, \ldots, v_{N-1}\}$	Set of N nodes v_i belonging to a network with sink v_0
ϱ	Node density, i.e., the average number of nodes within another node's communication range
$(v_i, v_j) \in \mathcal{E}$	Set of bidirectional communication links in the network
$G = (\mathcal{V}, \mathcal{E})$	Graph representation of a wireless sensor network
$\mathcal{N}_i = \{v_j \in \mathcal{V} \mid i{\neq}j \wedge (v_i, v_j) \in \mathcal{E}\}$	The set of bidirectional communication partners of node v_i
$\mathcal{T} \subseteq \mathcal{E}, \quad \|\mathcal{T}\| = N{-}1$	Routing tree rooted in the sink
$\mathcal{T}_i$	Subtree rooted in (and including) node v_i
$\mathcal{C}_i, \quad C_i = \|\mathcal{C}_i\|$	The set and number of children of node v_i in $\mathcal{T}$
$\mathcal{F} = \{v_i \in \mathcal{V} \mid \mathcal{C}_i = \varnothing\}$	Set of leafs in $\mathcal{T}$ and the number of leafs
$\mathcal{F}_i$	Set of leafs in the subtree $\mathcal{T}_i$ of $\mathcal{T}$

LIST OF SYMBOLS

Introduction

This documents describes the usage and features of the TUHH Telematics Thesis Class for LaTeX. While the intention of this work is to explain the class and its functions to you, it is far from being complete or exhaustive. You are most welcome to contribute to this class and the attached packages by sending enhancements or feature proposals to `christian.renner@tu-harburg.de`. In case of any questions, feel also free to send an E-Mail.

1 Introduction

Structure

This chapter is intended to give you an overview about structuring your work. Note that the following instructions must be understood as a guideline. Of course, the final structure of your thesis report depends on the actual nature of the topic. For instance, the structure of pure theoretical work differs from that of implementational ones. Before starting structuring your work, discuss the actual content, chapters and sections with your supervisor.

2.1 ...

Ok, this piece of writing is incomplete ... and reserved for some future version of this guide ...

2 STRUCTURE

The TUHH Telematics Thesis Class

In order to free you from reading through all the classes and packages provided with our Thesis Template, we will summarize the main parts for you. The root document of your thesis is the file *thesis.tex*. It contains global setup and the inclusion of the different chapters, which are outsourced to individual files, i.e., each chapter is organized in a dedicated file.

3.1 Setup

Before starting your thesis report, adjust all the personal and thesis related data in the root document. We will briefly cover this matter.

3.1.1 Options

If you have at look at the very first line of the root document, you'll discover the loaded document class along with its options. The most important options are:

de German Version (cannot be combined with option `en`)

en English Version, default (cannot be combined with option `de`)

gray Use this option to make a gray-style version of the thesis report

print Use this option for your print version, i.e, switched off hyperref colors (this makes only sense for electronic versions)

declaration Use this option for inclusion of the declaration by candidate

abstract This option enables the automatic inclusion of an abstract, which is expected in the file *prelude_abstract.tex*

acknowledgment This option enables the automatic inclusion of an acknowledgment, which is expected in the file *prelude_acknowledgment.tex*

symbollist If you have a bunch of mathematical symbols, use this option in order to automatically include a list of symbols. The latter has to be provided the file *prelude_symbols.tex*

cv Use this option to include your curriculum vitae at the end of the document. The latter has to be provided the file *postlude_cv.tex*. This is required for PhD theses.

ownpub Use this option to include a list of your own publications. The latter has to be provided the file *ownpub.bib*. This is required for PhD theses. Make sure to also run `bibtex ownpub`, otherwise your own publications will not show up.

3.1.2 Thesis Type

Depending on the actual type of thesis, you have to use the correct parameter for the command `\setthesistype`: *bachelorthesis*, *projectwork*, *masterthesis*, *diplomathesis*, and *phdthesis*.

3.1.3 Author, Title, and Date

Next, you must specify your name, your matriculation number and course of studies, along with the title of the thesis, and the date of submission with the corresponding commands `\author`, `\matrnumber` `\course`, `\title`, and `\date`. The latter of these takes two arguments: the actual, complete date of submission and a short version for the title page with month and year only.

A PhD thesis also requires the following values: `\submitdate`, `\setBirthplace` and `\setPhDType`. The latter must be one of the values *ing*, *nat*, or *pol*.

3.1.4 Institute, Supervisor, and Examiner

You can set up one or two examiners for your thesis, depending on the examination regulations for your thesis. This is done via the commands `\examinerFirst` and `\examinerSecond`. Each of these takes two parameters: the name of the examiner and his or her affiliation, i.e., the institute and university (the latter two should be separated by `\newline`). You may also provide up to two supervisors (tutors) of your thesis. This is done via the commands `\supervisorFirst` and `\supervisorSecond`. The command requires the same two parameters as the examiner commands. However, the affiliation should make up a single line, i.e., separate institute and university by commas. Finally, you have to specify the institute explicitly using the command `\institute`. Available parameters are defined in the file *tuhhlangnames.def*. Most likely, you will need *InstTelematics*.

3.2 Building Blocks

Your report consists of a couple of building blocks, which we will discover and explain in this section.

3.2.1 Mathematical Symbols

At the moment, there is one major hint for you: If there are going to be any mathematical symbols in your report, define a command for each of them in the file *setup_math.tex*. First of all, this makes your sourcecode—and equations in particular—more readable. Secondly, symbols can be replaced or altered quickly and elegantly.

After the table of contents and before the first chapter of your report, show a table of all (mathematical) symbols used in your report with a brief explanation. An example is found in this document. Inclusion of such a list is explained in Sect. 3.1.1.

3.2.2 Chapters

Each chapter of your thesis should reside in a dedicated file. These files are linked into the thesis report via the `\input` command. We do not discuss this matter in detail, but refer to the source code of this guide.

3.2.3 Bibliography

Since you're using LaTeX, it's most suitable to employ BibTeX for your bibliography. By default, the bibliography is expected in the file *thesis.bib*. The specified style is a sincere recommendation. Information on required fields for the most important types of bibliography entries is provided in Sect. 5.5.

3.2.4 Appendix

The appendix is organized as are the chapters: in separate files. In general, there should rarely be any need for a vast appendix. We only require you to have one appendix chapter for an attached CD/DVD with all your material, source code and the final versions (PDF) of your report and talk. If there are a few things that are related to your work, but do not suit into the main part, then these may go to the appendix. However, ask your supervisor before creating an appendix.

3.2.5 Graphics and Plots

If possible, try to draw your graphics with TikZ and the plots with Gnuplot with the TikZ terminal. TikZ is flexible, neat, and capable of using just the same fonts and symbols as

used in and throughout your report. In general, create individual PDFs for each plot or graphic and insert it into your report using `\includegraphics`. Doing so will speed up the compilation process. Ask your supervisor in case of any questions.

Figures, Tables, and more

In this chapter, figures, tables, and listings as available in this template are being introduced.
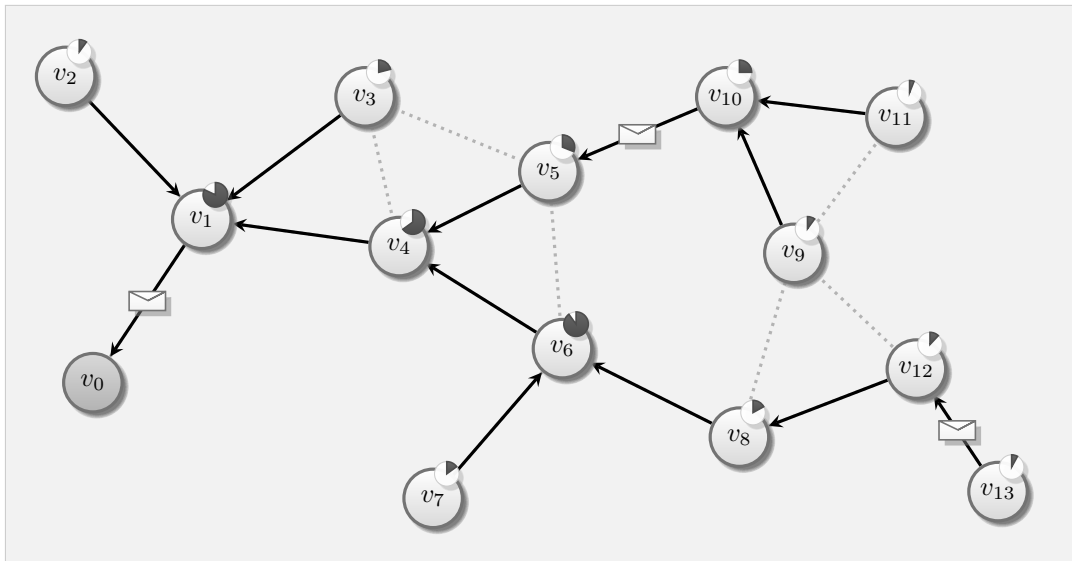
4.1 Figures

Figures should be frequently used throughout your thesis report, as they are a powerful instrument. Not only that one picture every two to three pages lightens up the work, a picture can even say more than a thousand words. However, note that a lonely figure is truly worthless. Make sure that you reference your figures in the text and that you explain them appropriately.

In the following, a set of useful commands for including figures into your work is introduced. Note that figures will be automatically placed by LATEX. You can rearrange figures be simply changing their position in the source code; however, you should not mess around with the figure placement options.

4.1.1 Default yet Fancy Figures

Figures may require different display properties, so that a variety of different display styles are available. The main type of figures are illustrations. For these, the `\fig` command is available. It has three parameters, which are the path to the picture, the caption, and the label. Labels of figures should have the prefix `fig:`. An example is shown in Figure 4.1. The figure must be transparent, as it will be placed within a gray frame with a tiny border.

In general, figures are displayed with a small inner spacing to the surrounding frame. As this may not be desired in some cases, there exists a version without additional spacing, `\fignospacing`.

Figure 4.1: Figure with gray background box and border spacing. In this example, you also see what happens in case of a long caption.
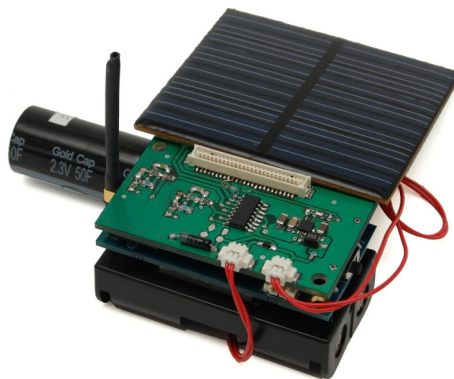

Figure 4.2: Figure without surrounding frame and without gray background

4.1.2 The Frameless Variant

If you want to display photographs or illustrations, the surrounding frame and the gray background may be disturbing. Here, the command `\fignoframe` jumps in and helps you out. The parameters are the same as described in Sect. 4.1.1. See Fig. 4.2 for a sample display.

4.1.3 Subfigures

When you start writing your evaluation and intend to display plots, having one plot per figure box is not a very handsome solution. Usually, you want to display multiple plots per figure box. This can be easily achieved using subfigures. In order to employ the neat and fancy
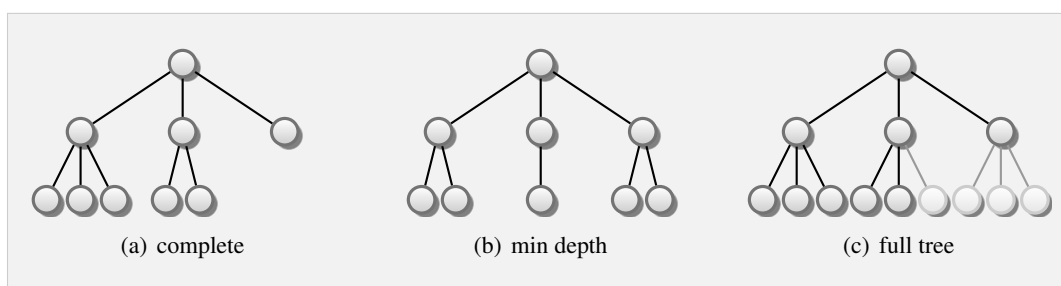
Figure 4.3: Box with gray background intended to hold subfigures

Head 1	Head 2	Head 3
sub 1	sub 2	sub 3
l1	c1	r1
l2	c2	r2
l3	c3	r3

Table 4.1: A simple table with a heading

boxing around your figures, use the `\subfigbox`. As its first parameter, it takes a series of subfigures—using the `\subfigure` command. Multiple rows are created using the `\\` command, automatic horizontal alignment is achieved via a `\hfill` between adjacent figures in the same row. A possible layout is shown in Fig. 4.3.

4.2 Tables

Unfortunately, tables can be a pain in LaTeX and have a clear tendency to look ugly. For this reason, we built the package *tuhhtable*. A brief discussion of frequently used table pattern follow in dedicated subsections.

4.2.1 Simple Tables with Headings

When creating tables, a couple of rules should be obeyed. Firstly, vertical lines are rarely helpful in tables. In contrast, they make a table harder to read in most cases, when people read from left to right. So try not to use them. To further support readability—while also hinting at eye candy—shaded rows are employed. To mark the end of a table and to separate the table body from the header, horizontal lines can be used. A recommended table layout is depicted in Table 4.1. Have a look at the source code of this document to understand how things work.

	Product 1	Product 2	Product 3
has feature	✓	✓	–
usability	⊕	⊕⊕	⊖
price	n.a.	◯	⊖⊖

Table 4.2: Special symbols for use in tables

4.2.2 Special Table Elements

In case your are carrying out comparisons of, lets say, different algorithms, you might want to judge the quality of certain properties by symbols, such as '+', '-', or the like. Unfortunately, these symbols are not very fancy, so that we have defined a set of more eye-catchings ones. They are displayed in Table 4.2. Again, have a look at the source code of this document to understand how they can be used.

4.2.3 Advanced Tables

Sometimes, a simple table layout as presented in the previous section is not sufficient. An example is shown in Table 4.3. Hence, additional commands are available.

4.3 Enumerations & Co.

Feel free to use enumerations, itemizations, and the like to suit your needs. We have adjusted the itemization to match our slides class plus our color scheme. We thus discourage you from changing items or colors.

4.4 Listings

For placing and typesetting listings, we encourage the use of the *listings* package available for LATEX. Please have a look into the corresponding package manual. The facilitate the usage of this package, we have already set it up to follow the same look as the rest of our visual stuff. This includes the gray background, the frame, and appropriate colors. The package is automatically loaded by the template class and defines *C++* as the default programming language—you are completely free to adjust the language, of course. A sample listing is displayed in Lst. 4.1. Note that all listings should have labels with the prefix `lst:` and should be referenced in the text. Besides complete listings, we have defined the command `\cmd`, which display its first parameter text in monospace font.

```
#include <iostream>
#include <vector>
```

	Type I	Type II	Type III	Type IV	Type V
Network Size					
Small					
Medium					
Large					
Density					
Low					
Medium					
High					
Initial Fill Level					
Low					
High					
Variation of Initial Fill Levels					
Low					
High					
Collisions and Packet Loss					
Collisions / Yield					
Packet Loss					

Table 4.3: Characteristics of the TDMA schedules: Decision Guidance [?]

```cpp
#include <inttypes.h>

using namespace std;

/* 2-D positions */
typedef struct pos_s {
        int16_t   x, y;
} pos_t;

int main(void)
{
        uint16_t        numData;
        vector<pos_t>   v;
        pos_t           tmp;

        /* read numData 2-D points */
        cin >> numData;
        for (unsigned i = 0; i < numData; i++) {
                cin >> tmp.x >> tmp.y;
                v.push_back(tmp);
        }
        cout << "read " << numData << " points" << endl;

        /* process data */
        process(v);

        return 0;
}
```

Listing 4.1: A simple C++ program for reading in positions

Style Guide

Finally, we want to give some advices and recommendations on styling. This does not relate to writing skills, which is gracefully embraced by the *Chicago Writer's Manual*.

5.1 Fonts

Font setup etc. has been done for you by means of this very template. We hence expect you to follow the given style; meaning that we discourage you from changing font sizes, faces, families, colors, as well as line and paragraph spacing or any spacing in general.

5.2 Citing and Referencing

Citing other sources and referencing parts of your work is quite easy using the commands `\cite` and `\ref`. Yet, let us mention some aspects. Firstly, when citing, you should make clear, somehow, which part is from the cited work and which is not. Secondly, you most likely want to place a tilde ($\sim$) between the word just in front of the `\cite` or `\ref` commands to avoid ugly looking line breaks. Thirdly, note that citations and references are proper parts of a sentence: Do not simply put them at the end of a sentence; use them as nouns!

More importantly, obey the following rules. Always capitalize when referencing, e.g., say Fig. 17 instead of fig. 17. You can abbreviate Figure with Fig., Section with Sect., and Listing with Lst. When referencing equations, simply place the number in parentheses—e.g., say (3.2) instead of Eq. 3.2—that's all. While you can certainly do this by hand, we encourage you to use the *cleveref* package, which already does this for you. By using `\cref` or `\Cref` (at the beginning of a sentence) as a replacement for `\ref`, the type of reference is automatically added. Please check the manual of the package for further details.

For your own sake, use a pattern for labels. We recommend to use prefixes for each type of label: chapters (`cha:`), sections (`sec:`), subsections and below (`sub:`), figures (`fig:`), tables (`tbl:`), listings (`lst:`), and equations (`eqn:`).

5.3 Physical Units

If you plan on using physical units, particularly SI-units, in your report, we encourage you to use the *siunitx* package for LaTeX. In all cases, separate numbers from their units with a small space, i.e., with a `\,`. Well, there is an exception: No space for %!

5.4 Mathematical Stuff

When using mathematical functions or sub-/superscripts that are text and not variables, please typeset these appropriately: In the case of functions, use the command version, e.g., `\log` (prints log) instead of plainly `log` (which prints log). For subscripts or the like, use the command `\textnormal`. Compare T_{sleep} with T_{sleep}. The reasons for this is twofold. Firstly, the produced italic text looks ugly, and secondly, italics are used for variables (only).

The usage of the environment `equation` is disouraged and may cause display errors. In the future, please use the `align` environment for equations:

$$|x| = \begin{cases} x & \text{if } x > 0, \\ -x & \text{if } x \leq 0. \end{cases}$$

```
\begin{align*}
   |x|=
   \begin{cases}
       x   & \text{if $x > 0 $,} \\
       -x    & \text{if $x \leq 0$.}
   \end{cases}
\end{align*}
```

5.5 Bibliography

When it comes to writing your bibfile, i.e., your bibliography, please follow the next few advices. Firstly, be consistent (if possible): Regarding authors' names, either abbreviate first names always or write them out always! For US addresses, write down the name of the city, the two-character abbreviation for the state plus the term USA! For all other countries, the name of the city and the country are sufficient. Capitalize titles correctly (there are multiple rules on this, please pick one and stick to it)! If possible, write down the full name of a conference and repeat its abbreviation with the year in parentheses afterwards. We give a few examples in the following listings.

Beside this, please have a look at the required fields for the main types of citations:

Journal Articles Use the type `@article` and include the fields `author`, `title`, `journal`, `volume`, `number`, `year`, `publisher`, and `address`.

Conference Papers Use the type `@inproceedings` and provide the fields `author`, `title`, `booktitle`, `month`, `year`, and `address`.

Technical Reports Use the type `@techreport` and provide the fields `author`, `title`, `month`, `year`, and `institution`.

Websites Use the type `@misc` and provide the fields `author`, `title`, `year`, `note` and `howpublished`. The last two fields hold a note on your last visiting date of the site and its web address.

We have put together a couple of examples for you in Lst. 5.1.

```
@article{ ECPS:2002:ConnectingThePhysicalWorld,
   author      = "D. Estrin and D. Culler and K. Pister and G. Sukhatme",
   title       = "{Connecting the Physical World with Pervasive Networks}",
   journal     = "IEEE Pervasive Computing",
   volume      = "1",
   number      = "1",
   year        = "2002",
   publisher   = "IEEE Educational Activities Department",
   address     = "Piscataway, NJ, USA"
}


@inproceedings{ KPC:2006:StructuralMonitoring,
   author      = "S. Kim and S. Pakzad and D. Culler and J. Demmel and G. ↙
      Fenves and S. Glaser and M. Turon",
   title       = "{Wireless Sensor Networks for Structural Health Monitoring}",
   booktitle   = "Proceedings of the 4th International Conference on Embedded ↙
      Networked Sensor Systems (SenSys~'06)",
   month       = oct,
   year        = "2006",
   address     = "Boulder, CO, USA"
}


@techreport{ EV:2005:TDMAScheduling,
   author      = "S. Coleri Ergen and P. Varaiya",
   title       = "{TDMA Scheduling Algorithms for Sensor Networks}",
   year        = "2005",
   month       = jul,
   institution = "Department of Electrical Engineering and Computer Science, ↙
      University of California, Berkeley, CA, USA"
}


@misc{ TI5:WIKI,
   author      = "S. Untersch{\"u}tz",
```

```
   title        = "{Network Simulator (NS-2), Institute of Telematics, Hamburg ↙
       University of Technology, Germany}",
   howpublished = "http://wiki.ti5.tu-harburg.de/wsn/ns2/intro",
   year         = 2008,
   note         = "Last visited: 05/06/2008"
}
```

Listing 5.1: BibTeX examples

Content of the DVD

In this chapter, you should explain the content of your DVD.