<Title of your paper>

<Subtitle of your paper>

<Your Name[1]>

Supervisor(s): <Responsible Professor[1]>, <Supervisor[1]>

[1]EEMCS, Delft University of Technology, The Netherlands

A Thesis Submitted to EEMCS Faculty Delft University of Technology,
In Partial Fulfilment of the Requirements
For the Bachelor of Computer Science and Engineering
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Name of the student: <Your name>
Final project course: CSE3000 Research Project
Thesis committee: <Responsible Professor>, <Supervisor>, <Examiner>

Abstract

The aim of this template is to make it more clear what is expected from from your final paper. **It is by no means required to follow this exact same structure.** In fact, we encourage you to discuss with your supervising team if they expect your paper to follow some specific format. The abstract should be short and give the overall idea: what is the background, the research questions, what are your contributions, and what are the main conclusions. It should be readable as a stand-alone text (preferably no references to the paper or literature).

1 Introduction

- Introduce the topic and explain why it is important (what is the motivation to conduct your research?).
- Relate to the most relevant existing work from the literature, explain their contributions, and (critically) indicate what questions are still unanswered.
- Explain what the research questions for this work are; this usually is a subset of the unanswered questions.
- Summarize the main contributions or conclusions of this research. NB: Make sure the title of your paper matches the main research question, contribution, or conclusion.
- Briefly indicate how the rest of the paper fits together to answer your research question(s).

For a longer research paper, a section with a more elaborate discussion of the literature may follow, but for short (conference) submissions, this is often included in the introduction.

Make sure the introduction and conclusion are easily understandable by everyone with a BSc in computer science (your examiner may have a completely different expertise).

2 Methodology or Problem Description

Choose an approach that fits your research best:

2.1 Methodology

Typically in general research articles, the second section contains a description of the research methodology explaining what you – the researcher – is doing to answer the research question(s), and why you have chosen this method. For purely analytical work this is a description of the data collection process or experimental setup for testing the hypothesis with a motivation. In any case this section includes references to necessary background information. For a survey paper this includes the method of how you collected the the set of papers that are considered in your survey.

2.2 Formal Problem Description

For some types of work in computer science the methodology is standard: analyze the problem (e.g., make assumptions and derive properties), present a new algorithm and its theoretical background, proving its correctness, and evaluate unproven aspects in simulation. An explanation of the methodology is often omitted and the setup of the evaluation is part of a later section on the evaluation of the ideas[1]. In such case, you should explain relevant background concepts, theory and models in this section (with references) and relate them to your research question. Also this section then typically contains a more precise, formal description of the problem.

Do not forget to give this section another name, for example, relating to the problem which you are solving.

3 Your contribution

Typically in computer science the third section contains an exposition of the main ideas: the development of a theory, the analysis of the problem with some proofs, a new algorithm, and potentially a theoretical analysis of its properties.

Some more detailed suggestions for typical types of contributions in computer science are described below.

Experimental work

Such section will mostly contain a description of the methods or algorithms that you will be comparing. Not all methods need to be described in detail (if appropriate references are available). Nonetheless, make sure to reveal sufficient details for a reader who is not familiar with these methods so that they can (1) get a general understanding of the methods and differences between them, and (2) understand your explanation of your results and conclusions.

Improvement of an idea

Such section would require you to explain in detail how your improvement works. If your idea is based on some observation that can be proven, this is a good place to provide that proof (for instance of the correctness of your approach).

Literature survey

If your contribution is a literature survey, then the organization of these "middle" sections very much depends on the way you want to present and organize the discussed literature. First, try to cluster papers that are similar in some aspect. Then, think how these clusters are related. Finally, think of a good order to discuss these clusters. This is sometimes called a bottom-up approach to writing a paper.

In addition, you may try to think about the organization of the literature from a top-down perspective: try to "take a step back" and think about the field and its important questions, and construct a hierarchical categorization of this field.

You should make your specific contribution clear: is it a new organization of the literature? identification of open problems or challenges? new parallels or generalizations? an analysis of pros and cons of different methods?

Do not forget to give this section another name, for example relating to the method or the idea that you are presenting.

4 Experimental Setup and Results

As discussed earlier, in many sciences the methodology is explained in Section 2 and this section only discusses the results. However, in computer science, most often the details (for instance the simulation environment) of the evaluation

[1] There really is no single outline that works for all papers.

setup are for the first time described here. It is of critical importance that a skilled reader should be able to reproduce your setup and obtain the same results.

Then, you should report your results in an accessible manner using figures and tables (with captions that allow them to be understood without going through the whole text). You should also make observations that clearly follow from the presented results. You can also report conclusions that follow logically from the previous material – sometimes the conclusions are in fact hypotheses which in turn may give rise to new experiments to be validated in this or future works.

Again, you may want to give this section another name.

5 Responsible Research

Here you should critically reflect on the ethical aspects of your research and discuss the reproducibility of your methods. Note that although in many published works there is no such a section (it may be part of some meta-information collected by the journal, or part of the discussion section), we require you to think and report about this in your final paper.

6 Discussion

In this section results are compared to those of previous work and placed in a broader context. You also provide a reflection on what has been concluded and how this was done. Finally, you attempt to give a possible explanation of results.

Again, you may opt to give this section another name, or even combine it with the preceding or following section.

7 Conclusions and Future Work

There are multiple goals which should be satisfied in this section. Briefly summarize the main research question(s) and provide your conclusions, the answers to the research question(s). Highlight interesting elements, contributions. Discuss open issues, possible improvements, and new questions that arise from this work; formulate recommendations for further research (for instance suggest new lines of research).

This section should stand on its own: it should be readable without having read the earlier sections and be understandable for anyone with a BSc degree in Computer Science.

A Some further guidelines for your paper

- Make sure to read the manual for CSE3000 Research Project at least once (note for example the instructions on the maximum length – less can be more!).

A.1 Reference use

- use a system for automatically generating the bibliographic information from your database (a reference manager): BibTex, Zotero, EndNote, Papers, . . . ;
- all ideas, fragments, figures, and data quoted from other work must be appropriately referenced;
- literal quotations must be placed inside quotation marks and include the exact page numbers;
- paraphrases cannot be too close to the original wording;
- every reference in the text (such as this one [1]) corresponds to an item in the bibliography and vice versa.

A.2 Structure

- paragraphs are well-constructed;
- each paragraph discusses one topic;
- they start with clear topic sentences;
- they are organized into a clear structure;
- there is a clear line of argumentation following from research question to the conclusions;
- existing scientific literature is reviewed critically.

A.3 Style

- you should use proper English: your paper should be grammatically correct, without spelling errors and lexical mistakes (make sure to run a grammar and spell checker before submission);
- you should write objectively;
- you should attempt to write in an engaging manner: for instance, make sure to vary the length of the sentences, mix active and passive voice;
- your sentences should not be unnecessarily complicated (e.g. not too long), they should refrain from ambiguity.

A.4 Tables and figures

- they should have a number and a caption;
- they should be referred to at least once in the text;
- if copied, they must contain a reference to the source;
- they should be interpretable on their own (by means of labeled axes, descriptive legend, etc.);

B Gathering relevant literature

A rule of thumb for dealing with the literature: scan about 10–20 papers: read the titles, abstracts, parts of introduction and conclusions, and categorize their contributions. Some of these should be studied more closely: read around 5 conference papers or equivalent completely (you should be able to summarize their contribution in your own words); study around 2 of them in-depth (you should be able to explain them in detail and criticize contributions). This process may result in 5–20 references, possibly even more if the project is a literature study. In case you need to gather a large number of references we suggest that you read online about two useful techniques: *pearl growing* and *snowballing*.

References

[1] Bob Coecke. Kindergarten quantum mechanics: Lecture notes. In *AIP Conference Proceedings*, volume 810, pages 81–98. American Institute of Physics, 2006.