RUHR UNIVERSITÄT BOCHUM RUB

Artificial Intelligence and Formal Methods

August 1, 2024

Title of the Project

Name and email address of student 1	Lisa Musterfrau, lisa.musterfrau@rub.de
Completed courses relevant for thesis work, student 1:	*list here all the relevant courses with course code and name of the course*
Name and email address of student 2	Max Mustermann, max.mustermann@rub.de
Completed courses relevant for thesis work, student 2:	*list here all the relevant courses with course code and name of the course*

Type of thesis (Bachelor/Master)	Bachelor/Master Thesis
Company supervisor (if applicable)	Name of supervisor, name of company

Introduction

The introduction provides a concise overview of the thesis, also aiming to highlight its significance. A good introduction will cover the following points.

- **Context.** Describe the context of your thesis project in one or two paragraphs. This establishes the foundation of the problem addressed. The context describes the larger area your project concerns, and it embeds the following problem description, so that one knows in what area and under what circumstances the problem exists. Already use references here to highlight important general literature. Describe the context in a way that motivates working on this area.
- **Problem.** Clearly define the problem, why it is important, and what is its foundation. It should be clearly stated why it is crucial to address the challenge and what new knowledge can be gained from it. Also, how can the new knowledge be applied? Mention an example.
- **Goals and novelty.** Now describe what the goal of your thesis project is. Especially explain its novelty, perhaps also the novelty of your approach or solution. It is important that the goal is significant and that it is not about the research method itself. For instance, a goal is never a study, but to determine some specific knowledge or to design or realize a solution to a research problem.
- **Methodology.** Briefly describe your methodology, without going into too much detail. The reader should understand the approach of how you address the problem. What results do you expect, and what is your contribution? It should be clearly stated who is expected to benefit from the results of the thesis project.
- **Expected results and contribution.** Very briefly, describe the expected results and concrete contributions. The latter can be, for instance, a tool, a dataset, empirical data, or a new method. Very briefly, also define and delimit the specific research area and explain how your research relates to it. How is your research related to previous research?

In summary, the introduction should briefly describe the whole thesis, serving as a roadmap for the whole project. The following sections describe the most important points in more detail.

Background, Motivation and Related Work

Conduct a reasonably short literature review to describe the background and context of your research topic in more detail. Cite one or two relevant and high-quality references to demonstrate via the literature that the proposed thesis project does indeed involve scientific and technical challenges or is related to existing challenges. Convince the reader that the problem addressed in this

thesis has not been solved prior to this project.

This section should also demonstrate the need for the research and show that the author is knowledgeable about the area in question. Also, it establishes the starting point of your study. Describe in more detail the motivation you have already mentioned in the introduction, and define and delimit the specific research area.

Problem (optional)

Sometimes, the problem that you want to address is complex and needs to be described systematically. In this case, this section serves to describe the problem you want to solve in more technical detail and to expand on the problem description in the introduction. However, it also serves as a basis for setting the research objectives, formulating the research hypotheses or the research questions.

It should indicate why the proposed research should be conducted and enable the researcher to systematically describe the problem and reflect on its significance. It is important that the problem is clear to the reader and that it can be clearly identified. The question why this research needs to be done should be answered clearly.

Methodology

Extract the key point of your research and formulate questions to answer them. Put the research questions in bullet form (RQ1, RQ2, ...), and for each one, justify why it is important to answer it. If you are conducting engineering research instead of empirical research, it is better to formulate research objectives, research questions can then be used in the evaluation part.

If possible, state hypotheses and describe what led to these hypotheses. You should be able to interpret all possible outcomes with respect to your hypotheses and/or questions, no matter the fact, if they are concurrent with your assumption or not.

Describe your contribution with respect to concepts, theory, and technical goals. Ensure that the scientific and engineering challenges stand out so that the reader can easily recognize that you are planning to solve an advanced problem.

Then describe the methods and techniques used to solve or form the basis of the approach. Various scientific approaches are appropriate for different challenges and project goals. Outline and justify the ones that you have selected. For example, different research methods are, design science [1], case study [2], survey [3] and experiment [4]. These are just a few, there are many more. Every different kind of problem requires a different approach/method.

Write down the main steps of your methodology in bullet format. Think about these steps as those you will perform over the whole duration of your thesis project. Sometimes, especially in engineering research, you perform steps in iterations; if so, then indicate that.

Threats to Validity

Think about your thesis project and identify potential threats to validity. Are any flaws in the analysis, limitations on the applicability? Think primarily about external and internal validity; perhaps also about construct and conclusion validity. For instance, are your results generalizable? Do your results apply to practical cases, and can you translate them into another context? Furthermore, is the conclusion you draw warranted? Does your conclusion cover alternative explanations? Provide evidence.

What are the limitations of your solution, give a brief outlook on how these could be addressed. In which scope is your solution valid, what is possible and what not?

Why did you choose not to address some problem you are aware of? If so, clearly explain the reason not addressing them. For example, the literature you will not review or the methodology you are not using; explain why you decided not to use them.

References

Reference all sources that are cited in your proposal using, e.g., the APA, Harvard, or IEEE style.

[1] A. Collins, D. Joseph, and K. Bielaczyc, "Design research: Theoretical and methodological issues," *The Journal of the Learning Sciences*, vol. 13, no. 1, pp. 15–42, 2004.

[2] A. M. Wilkinson, *The scientist's handbook for writing papers and dissertations*. 1991.

[3] V. Grover, "A tutorial on survey research: From constructs to theory," *Retrieved on*, vol. 28, no. 7, p. 2009, 1997.

[4] V. R. Basili, R. W. Selby, and D. H. Hutchens, "Experimentation in software engineering," *IEEE Transactions on software engineering*, no. 7, pp. 733–743, 1986.

[5] C. Wohlin, P. Runeson, M. Hst, M. C. Ohlsson, B. Regnell, and A. Wessln, *Experimentation in Software Engineering*. Springer Publishing Company, Incorporated, 2012.

[6] W. Booth, G. Colomb, J. Williams, J. Bizup, and W. FitzGerald, *The Craft of Research, Fourth Edition*. Chicago Guides to Writing, Editing, and Publishing, University of Chicago Press, 2016.

[7] J. W. Creswell, *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage, 2013.

[8] B. Kitchenham, L. Pickard, and S. Pfleeger, "Case studies for method and tool evaluation," *IEEE Software*, vol. 12, no. 4, pp. 52–62, 1995.

[9] J. McKay and P. Marshall, "Shaping a process model for action research," in *Pacific Asia Conference on Information Systems*, 2001.

[10] P. Runeson and M. Höst, "Guidelines for conducting and reporting case study research in software engineering," *Empirical Softw. Engg.*, vol. 14, p. 131–164, apr 2009.

[11] V. Vaishnavi and W. Kuechler, "Design research in information systems." last updated August 16, 2009, Jan. 2004.

Consent for Publication and Colloquium Attendance

As publicly funded researchers, we aim to contribute to the research community by publishing this work, so other researchers can use and further develop this knowledge. I agree that my thesis will be permanently and publicly stored on research gate[1] or a university publication server. It can then be indexed by, for instance, Google Scholar so that it can be found and referenced by other researchers.
We are also committed to open software. I agree to put the created software under a BSD-style license or another license agreed with the supervisors. The planned license is stated in the proposal.

.....	.....
Date	Signature

Registration

As soon as this proposal is accepted, you are allowed to start the registration process. Note that the start of the registration will give you a hard deadline by the exam office. Extensions are not possible, unless something unforeseen happened that is not in the responsibility of the thesis student. It is usually advisable to get into the topic a bit more before registering.

Colloquium

More information about the colloquiums, for instance, dates, location, and List of Confirmation are available on the chair's website.

[1] `https://www.researchgate.net/`