



Research Methodology in Computer Science - Introduction -

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Course Material

http://didattica.cs.unicam.it/doku.php?id=didattica:magistrale:rm:ay_2021:main





Motivation

Why are we here?

- We want your studies to end at the right place ..



Thanks to Prof. Alta van der Merwe

Why are we here?

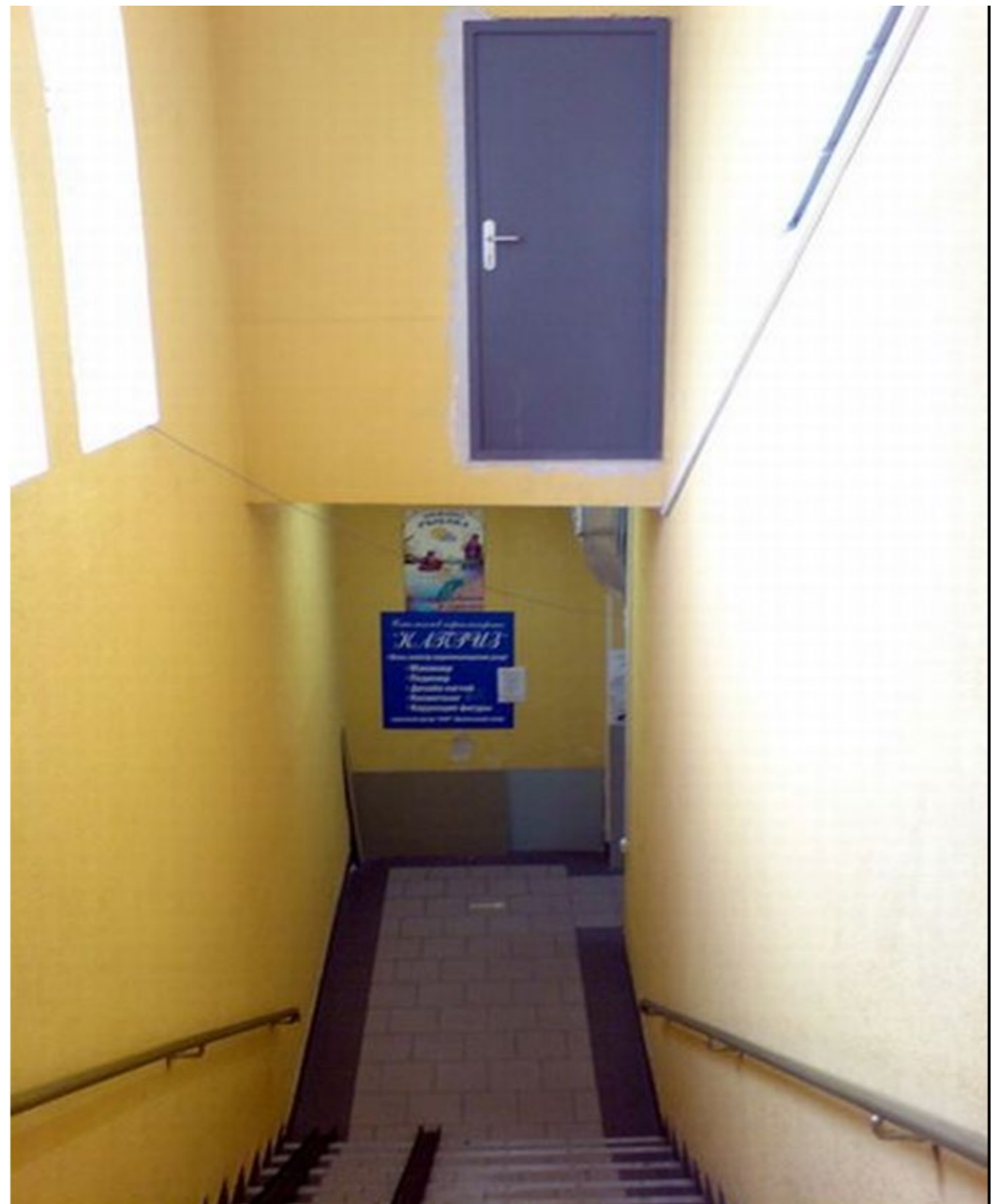
- We want to understand what we are busy with ..



Thanks to Prof. Alta van der Merwe

Why are we here?

- We want to end with a well-constructed thesis ..



Thanks to Prof. Alta van der Merwe

Why are we here?

- We don't want to do unnecessary work due to bad planning ..



Thanks to Prof. Alta van der Merwe

Why are we here?

- We don't want any surprises after the examination process ..



Thanks to Prof. Alta van der Merwe

In writing a good thesis

- You should be able to:
 - Complete a good research-based work and present it in a well-structured and well-written manner in a reasonable time.
- You prove to your university (and the research community) that you can do it.
- Victory is walking out with a degree in your hand!
- Writing a good thesis is a skill that can be learned

Thanks to Prof. Alta van der Merwe

Things to remember ..

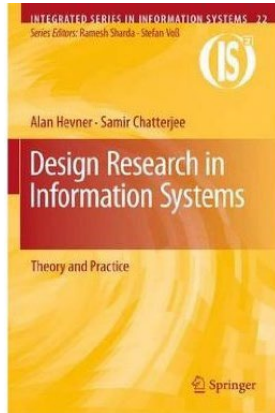
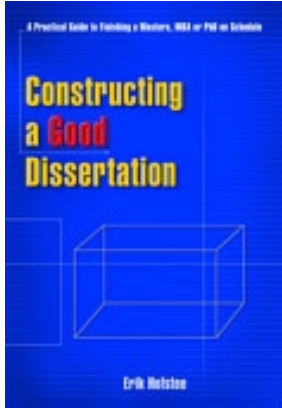
- Few people will ever read your work ..
- Three factors that are predictive whether or not you will complete your thesis:
 - ◆ If it is your **goal** and focus on that – you will complete.
 - ◆ You need to know your **process**. What to do, how to do it, and when to do it.
 - ◆ You need **discipline**. Many many hours!

Thanks to Prof. Alta van der Merwe

Acknowledgement

- I am thankful to Prof. Alta van der Merwe from University of Pretoria – she was an inspiration and I use some of her slide
- Some material is from a course I taught at FHNW with Prof. H. F. Witschel and Prof. T. Hanne.

Literature



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What is Research?

Definitions of Research

- Make a Google Search and get a definition of what is research
- Research is ...

... the systematic investigation into and study of materials and sources in order to establish facts and reach new conclusions.

... a process of systematic inquiry that entails collection of data: documentation of critical information and analysis and interpretation of the data/information, in accordance with suitable methodologies set by specific professional fields and academic disciplines.

... a careful consideration of study regarding a particular concern or problem using scientific methods.

What is Research

Research is something that people undertake to find out things in a systematic way, thereby creating some new knowledge

What does «New» and «Relevant» mean?

- A “yes” answer to one of the following questions :
 - ◆ Will a known gap in the body of knowledge be filled?
 - ◆ Will previous research be replicated and expanded by looking at a different category of participants, environment, and/or constructs/variables?
 - ◆ Will previous research be expanded by more thoroughly examining some identifiable aspect?
 - ◆ Are there specific, identifiable, and documented problems with the currently available solutions?

(Creswell, 2005)

What is not research?

Research is **not** ...

... just information gathering

- ◆ *A student going to the library and reading information on African Elephants is not doing research*

... rearranging facts

- ◆ *A student writing a report on behavior of pendulums without analyzing data is not doing research*

... finding out something individually unknown

- ◆ *A student finding learning how to model a business process is not doing research – there are numerous studies on it*

... writing a computer program

- ◆ *Research is about new insights or contributions or methods; a program is an artifact to can be used to demonstrate or proof of new methods.*

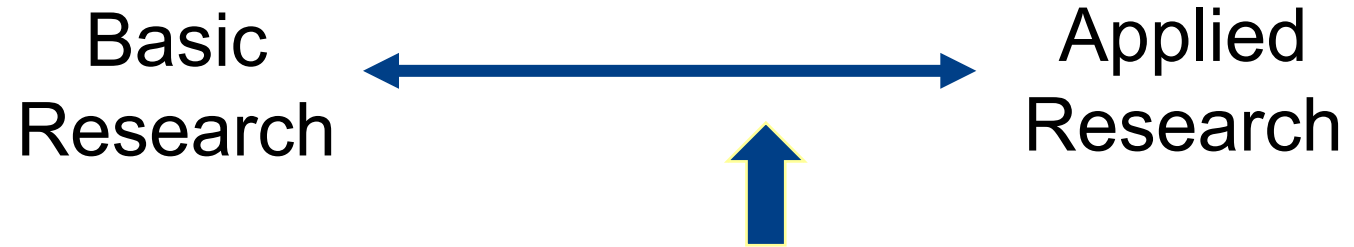
Criteria for Research

- **Originality:** Finding out something what we don't know
- **Significance:** What we want to find out must be sufficiently interesting for others, e.g.
 - ◆ of **general** interest
 - ◆ of interest in a research community
 - ◆ of interest for other practitioners
- **Validity/Evidence:** Others must be convinced that the research result is valid
 - ◆ having applied an accepted research methodology

Criteria
for new
knowledge

Criteria for
systematic
approach

Basic vs Applied Research



Intention

Expand **general** knowledge

Improve understanding of a **particular** problem

Result

Universal principles

Solution to a **particular** problem
(→ not research)



Examples

Is the following research?

- You are running a shop for do-it-yourself products. To decide how many products you have to order from the supplier, when you are running out of stock for some products, you compare the sales of the last weeks with the products you still have on stock and also take into account the delivery periods for the products.
- Is this research?

Is the following research?

- Your mother bakes the best cakes in the world. She uses a recipe that she got from her grandmother. To be able to bake a bigger cake, she experimented with the combination of ingredients and found that if she wanted a cake that is double the size she'd need to double all the ingredients except for the eggs, where she should take 5 instead of 4.
- Is this research?

thanks to Alta van der Merwe for this example!

Is the following research?

- The university faced the problem that students are cheating when doing home assignments. You write a system that compares students' contributions and checks whether two assignments are copies of each other. You want to publish your unique approach to compare texts.
- Is this research?

Research must have a Contribution to the Body of Knowledge

- New insights: Originality
- Uniqueness: Originality
- Generalisable: Significance
- Comparison: Validity
- Testing: Validity



AHA moment!



The Research Process

The Academic Method

- Academic research: explaining the unexplained.
- You will at the most basic level have to:
 - ◆ Identify a research problem
 - ◆ Find out what other academics have written
 - ◆ Develop a research question or thesis about it (make a guess about the solution or take a stand about something)
 - ◆ Figure out a way to answer your research question
 - ◆ Apply that to your thesis
 - ◆ Analyse your results
 - ◆ Come to a conclusion.

Research Process and the Structure of your Thesis

	Creating a software artefact	Structure of a research paper
Problem	Cheating of students ...	Introduction
Question	What are the similarity characteristics of assignments	
What do we know?	Existing approaches for text comparison and classification	Literature Review
What do we want to do? How?	Plan!	Research Methodology
What did we do?	Build the software ...	<Body of work>
Is it working?	Testing	Evaluation
Why is it worth something?	General approach for text similarity	Conclusion

Research Process

The research process is meant as a guidance for you

