ACADEMIC SKILLS IN COMPUTER SCIENCE

Lecture 1: Introduction and Motivation

Markus Krötzsch
Knowledge-Based Systems

TU Dresden, 2nd April 2019
Course Tutors

Markus Krötzsch
Lectures

Maximilian Marx
Exercises
Organisation

Lectures
Tuesday, DS 3 (11:10–12:40), APB E005

Exercise Sessions (starting 9 April)
Tuesday, DS 5 (14:50–16:20), APB E001

Web Page

Lecture Notes
Slides of current and past lectures will be online.

Modules
INF-AQUA, INF-B-510, INF-B-520, INF-B-530, INF-B-540, MCL-CS – anything else?
Goals and Prerequisites

Goals

• Understand key aspects of the **scientific process**
• Learn how to **write** and **present** in research and technology
• Get to know basic ideas from the **theory of science and knowledge**
• Obtain working knowledge about helpful **tools and methods**, including **LaTeX**
• Discuss aspects of **ethics and quality assurance**

(Non-)Prerequisites

• No particular prior courses needed

Examination

• The examination will be oral
• Most likely including a prepared part (e.g., a short presentation)
Motivation
What is Science?

“a systematic enterprise that builds and organizes knowledge in the form of testable explanations and predictions about the universe.”

– Wikipedia, Science

“3 a: knowledge or a system of knowledge covering general truths or the operation of general laws especially as obtained and tested through scientific method”

– Merriam Webster, Science

“the intellectual and practical activity encompassing the systematic study of the structure and behaviour of the physical and natural world through observation and experiment”

– Oxford English Dictionary, Science

“(ein begründetes, geordnetes, für gesichert erachtetes) Wissen hervorbringende forschende Tätigkeit in einem bestimmten Bereich”

[“research activity producing knowledge (that is justified, systematic, considered certain) in a particular domain”] – Duden, Wissenschaft
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Note on English usage

Traditionally, the word *science* in English only referred to what are now known as the *natural sciences* (astronomy, biology, chemistry, physics, \ldots)

- still common, e.g., “science department”
- increasingly replaced by wider concepts
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Computer science can connect to many of these areas:

- structural science: theoretical CS, formal logic
- engineering science: software and hardware design and building
- social science: communities & online interaction; Web science
- humanities: library studies; ontology and classification; digital humanities
- and many more . . .
What should we believe – and why?

- The Earth is not spherical but flat
- Bacteria exist
- \( P, \neg P \)
- \( \emptyset \) is a set
- It will rain tomorrow
- The Sun will turn into a red giant in approximately 6 billion years
- When humans die, their spirits enter the spirit world where they await resurrection
- If something has been observed many times, then it will also be observed in the future (with high probability).
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Science: Theory and Practice

Scientific theory:
- How is science justified? In fact: is it? What is “scientific”?
- Related: What is knowledge?

Scientific practice:
- What constitutes “valid” science?
- Who can we trust? How can we discover cheats and errors?
- Rules of good scientific behaviour
- And “minor” practical details: how to find research questions? how to publish? how to build a career in science?
**Art or Craft?**

**Research as an Art:** Research is all about creativity, intuition, and talent for solving problems

- Mostly natural?
- Hard to formalise (though many techniques were proposed)
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**Research as a Craft:** Academic research requires many skills that can be acquired through practise

- How to structure, write, and produce reports?
- How to prepare and deliver presentations?
- What makes a sound evaluation or argument?
Academic skills for the non-scientist

“I don’t want a career in research – why should I care?”
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Key aspects are important to everybody, in high-skilled jobs but also in life:
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**Understanding science**

- Be critical – tell facts from lies
- Understand how academic research works and what its weaknesses and limits are
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- Investigate a topic in detail
- Turns guesses & hopes into knowledge
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**Presenting results**
- Author reports, technical documents, etc.
- Present to audiences
- Your near future: seminar talks, project thesis, MSc thesis and defence
Live Survey: Student Haves and Wants
Lecture Outline (1)

- **The Research Process**
  Quality assurance; peer review; publishing in computer science; public education

- **Information Gathering**
  finding literature; how & what to cite; bibliometrics; research questions; reading

- **Writing**
  goals & genres; structuring scientific reports; specific parts; style; layout; language

- **Typesetting in Computer Science: LaTeX**
  key concepts; document structure guidelines; bibliographies; figures & Tikz

- **Presentations**
  goals & genres; structuring presentations; general considerations presentation technique
  media usage: slides, board, multimedia, etc.
Lecture Outline (2)

- **Theory of Science and Knowledge**
  Knowledge; Popper; critical theory; (un)scientific methods; argument and reason; (in)validation

- **Empirical evaluations**
  Goals, structure and content; experimental design; simple statistical evaluation; (mis)representing results; reproducibility

- **Ethics**
  scientific misconduct; (co-)authorship; conflicts of interest; ethical guidelines

- **Further advanced topics** (time permitting)