ACADEMIC SKILLS IN COMPUTER SCIENCE

Lecture 1: Introduction and Motivation

Markus Krötzsch
Knowledge-Based Systems

TU Dresden, 2nd April 2019

Introduction and Organisation

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
`https://iccl.inf.tu-dresden.de/web/Academic_Skills_in_Computer_Science_(SS2019)`

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

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, . . .)
- still common, e.g., "science department"
- increasingly replaced by wider concepts

The German term "Wissenschaft" has always been more comprehensive, and includes social sciences, humanities, engineering sciences, and structural (mathematical) sciences.

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 ≠ NP"

"∅ 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)."

Who can we trust?

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)

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?"

Key aspects are important to everybody, in high-skilled jobs but also in life:

Understanding science

- Be critical – tell facts from lies
- Understand how academic research works and what its weaknesses and limits are

Conducting research

- Investigate a topic in detail
- Turns guesses & hopes into knowledge

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)
  Self management? More writing technique? Reviewing? Proposals and
  applications?