

Theory of Computer Science

A1. Organizational Matters

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A1.1 About this Course

A1.2 Organizational Matters

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Main Objectives

We would like to understand what can be computed

- ▶ **in principle**: decidability/computability
- ▶ **efficiently**: complexity theory

Uncomputable Problems?

Consider functions whose inputs are strings:

```
def program_returns_true_on_input(prog_code, input_str):  
    ...  
    # returns True if prog_code run on input_str returns True  
    # returns False if not  
  
def weird_program(prog_code):  
    if program_returns_true_on_input(prog_code, prog_code):  
        return False  
    else:  
        return True
```



What is the return value of `weird_program` if we run it on its own source code?

Why should we Study the Theory of Computation?

- ▶ Theory is useful
 - ▶ If we want to solve a problem with a computer we need to know what is achievable. Computable? Tractable?
 - ▶ If the problem is not tractable, we might want to consider alternatives, e.g. a tractable variant or an approximation.
 - ▶ Some theoretical concepts have practical applications, e.g. regular expressions.
- ▶ Theory is fun
 - ▶ Often like a brainteaser: E.g. how can we solve a problem exploiting a solver for some other problem?

Content: Theoretical Foundations of Computer Science

- A. **background**
 - ▷ mathematical foundations and proof techniques
- B. **automata theory and formal languages**
(Automatentheorie und formale Sprachen)
 - ▷ What is a computation?
- C. **Turing computability** (Turing-Berechenbarkeit)
 - ▷ What can be computed at all?
- D. **complexity theory** (Komplexitätstheorie)
 - ▷ What can be computed efficiently?
- E. **more computability theory** (mehr Berechenbarkeitstheorie)
 - ▷ Other models of computability

Learning Goals

- ▶ understanding the **capabilities and limitations** of computers
- ▶ working with **formal systems**
 - ▶ comprehending formal **definitions and theorems**
 - ▶ **precise formulation** of definitions, theorems and proofs
 - ▶ analyzing formal problems **precisely**

A1.2 Organizational Matters

People

Lecturer

Gabi Röger

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Assistant

David Speck

- ▶ **email:** davidjakob.speck@unibas.ch
- ▶ **office:** room 04.003, Spiegelgasse 5

People

Tutors

Tobias Aschwanden

- ▶ **email:** `tobias.aschwanden@unibas.ch`

Maria Desteffani

- ▶ **email:** `maria.desteffani@unibas.ch`

Benedikt Heuser

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Elagkian Rajendram

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Course Format

- ▶ 6 CP main course + 2 CP for exercises
- ▶ separate enrolment and evaluation
- ▶ can and should be taken in parallel

Time & Place

Lectures

- ▶ Monday 14:15–16:00
- ▶ Wednesday 16:15–18:00
- ▶ Alte Universität, lecture hall -101

Exercise Sessions (starting March 2/3)

- ▶ Monday 12:15–14:00 with Benedikt Pharmazentrum, Labor U1075
- ▶ Monday 16:15–18:00 with Maria Rosshofgasse 2 (Schnitz), room S 01
- ▶ Tuesday 12:15–14:00 with Elagkian Spiegelgasse 1, Seminarraum U1.001
- ▶ Tuesday 16:15–18:00 with Tobias Spiegelgasse 1, Seminarraum 00.003

Exercises

Exercise sheets (homework assignments):

- ▶ mostly theoretical exercises
- ▶ on ADAM every Wednesday after the lecture
- ▶ may be solved in **groups of 2**
- ▶ due Wednesday the following week
(upload to Adam at <https://adam.unibas.ch/>)
- ▶ submission PDFs must be created with \LaTeX
→ **ADAM workspace: template and introduction to \LaTeX**

Exercises

Exercise sessions:

- ▶ discussion of previous exercise sheet (common problems)
- ▶ questions about current exercise sheet
- ▶ questions about the course
- ▶ if time: work on the homework assignment
- ▶ participation voluntary but highly recommended

important: please fill in the survey on ADAM for the group assignment until **Wednesday** (February 18).

Enrolment

- ▶ MOnA: <https://services.unibas.ch/>
- ▶ **deadline:** March 16
- ▶ better today for the course, so that you get all relevant emails and access to the ADAM workspace
- ▶ enrolment for exercise after we made the group assignment

Evaluation of Main Course (6 CP)

- ▶ **written exam**, 6 ECTS credits, graded 1-6
- ▶ 9 July 2026, 14:00-16:00,
Biozentrum, Maurice E. Müller Saal U1.111
- ▶ admission to exam: **no prerequisites**
- ▶ must **register** for exam during March 30 – April 13
↪ see <https://philnat.unibas.ch/de/examen/>
- ▶ grade for course determined exclusively by the exam
- ▶ if you fail: **one** repeat attempt (within one year)

Last lecture (May 27): Q&A session for exam preparation

Evaluation of Exercises (2 CP)

- ▶ pass/fail evaluation
- ▶ to pass the exercises, you need 50% of the exercise marks

Resources

- ▶ **Adam:** central starting point and exercises
<https://adam.unibas.ch/>
- ▶ **Website:** course information, slides
- ▶ **Discord:** for your interaction with each other
feel free to use a pseudonym

Course Material

course material:

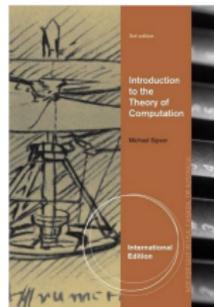
- ▶ slides (online)
- ▶ textbooks (see next slides)
- ▶ additional material **on request**

Course Material

Textbooks (English)

Introduction to the Theory of Computation
by Michael Sipser (3rd edition)

- ▶ covers most of the course
- ▶ also contains advanced topics beyond the scope of this course



Textbook (German)

Theoretische Informatik – kurz gefasst
by Uwe Schöningh (5th edition)

- ▶ covers the course
- ▶ some concepts defined a bit differently (e.g. PDAs)



Prerequisites

- ▶ basic proof techniques
(direct proof, proof by contradiction, ...)
- ▶ basic programming skills

Plagiarism

Plagiarism

Plagiarism is presenting someone else's work, ideas, or words as your own, without proper attribution.

For example:

- ▶ Using someone's text without citation
- ▶ Paraphrasing too closely
- ▶ Using information from a source without attribution
- ▶ Passing off AI-generated content as your own original work

Long-term impact:

- ▶ You undermine your own learning.
- ▶ You start to lose confidence in your ability to think, write, and solve problems independently.
- ▶ Damage to academic reputation and professional consequences in future careers

Plagiarism in Exercises

- ▶ You may discuss material from the course, including the exercise assignments, with your peers.
- ▶ **But:** You have to independently write down your exercise solutions (in your team).
- ▶ Help from an LLM is acceptable to the same extent as it is acceptable from someone who is not a member of your team.

Immediate consequences of plagiarism:

- ▶ 0 marks for the exercise sheet (first time)
- ▶ exercises failed (second time)

If in doubt: check with us what is (and isn't) OK **before submitting**
Exercises too difficult? We are happy to help!