Theory of Computer Science

A1. Organizational Matters

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A1.1 Organizational Matters

A1.2 About this Course

A1.1 Organizational Matters

People

Lecturer

Gabi Röger

- email: `gabriele.roeger@unibas.ch`
- office: room 04.005, Spiegelgasse 1

People

Tutors

Augusto B. Corrêa

- email: `augusto.blaascorrea@unibas.ch`
- office: room 04.001, Spiegelgasse 5

Florian Pommerening

- email: `florian.pommerening@unibas.ch`
- office: room 04.005, Spiegelgasse 1

Time & Place

Lectures

- Monday: 13:15–16:00
- Wednesday: 16:15–18:00
- live on Zoom

Time & Place

Exercise Sessions (starting March 8)

- group 1 (Augusto; in English)
- group 2 (Florian; in German)
- time: Monday 16:15–17:00
- on Zoom

important: please send Florian an email with your preferred language
until Wednesday 23:59 (March 3).

Revised Course Format since 2020

5 hours of lectures every week?!?

- more hands-on experience during the lectures
- bring pen & paper or tablet
- no increase of content
- overall time unchanged (now 5+1, previously 4+2)

Even More Revised Course Format in 2021

- Previously: Mathematical logic was part of the theory course
- Now: Covered in new course on Discrete Mathematics in CS
- We will focus on the standard curriculum and mostly use the freed time to gain a deeper understanding and more intution.

Online Course

- Adam: central starting point and exercises
- Website: course information, slides, additional material
- Zoom: lecture and exercise meetings
  please use your camera
- Discord: for your interaction with each other
  feel free to use a pseudonym
- Slido: feedback during lectures
  join at slido.com

Course Material

Textbook (German)

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

- covers most of the course

Uwe Schöning

Theoretische Informatik
– kurz gefasst

5. Auflage

HochschulTaschenbuch

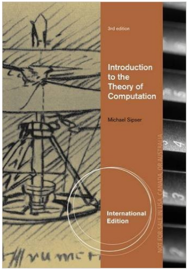
Spektrum

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


3rd edition
Introduction to the Theory of Computation
Michael Sipser
International Edition
NOT FOR SALE IN USA, CANADA, OR AUSTRALIA

Target Audience

target audience:

- B.Sc. Computer Science, 4th semester
- B.A. Computer Science, 4th or 6th semester as an elective or if interested in M.Sc. Computer Science degree
- all other students welcome

prerequisites:

- basic proof techniques (mathematical induction, proof by contradiction, . . .)
- basic programming skills

Enrolment

- MOnA: `https://services.unibas.ch/`
- deadline: March 29
- better today, so that you get all relevant emails

Exam

- written exam, 8 ECTS credits
- June 9, exact time and place TBA
- admission to exam: no prerequisites
- must register for exam during April 12 – April 26
  $\rightsquigarrow$ see `https://philnat.unibas.ch/de/examen/`
- grade for course determined exclusively by the exam
- if you fail: one repeat attempt in FS 2022

Exercises

Exercise sheets (homework assignments):

- mostly theoretical exercises
- some programming exercises

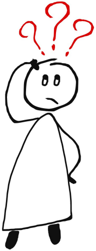
Exercise sessions:

- the tutors and you will decide together how to use the time. Some possibilities:
  - questions about exercise sheets
  - questions about the course
  - discussion of common problems
- participation voluntary but recommended

Exercises

- exercise sheets on ADAM every Wednesday
- may be solved in groups of arbitrary size (recommended: 2–3)
- due Wednesday the following week
  (upload to Adam at `https://adam.unibas.ch/`)
- scans must be legible (no photos, please)
- we appreciate LaTeX submissions

Questions on Organization



Questions?

A1.2 About this Course

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 odd_program(prog_code):
    if program_returns_true_on_input(prog_code, prog_code):
        return False
    else:
        return True
```

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

Solution

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 Berechenbarkeitheorie)
   - ▷ 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

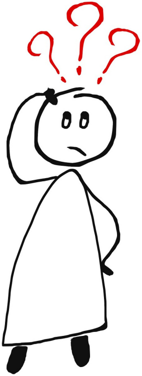
Warning

"Wer's nicht gewohnt ist,
für den ist es ungewohnt."
(Prof. Dr. Th. Ottmann)
[If you are not used to it,
it may be unusual for you.]

What can you do?

- stay on the ball
- do the exercises
- pay attention to details
- ask questions!

Questions about the Course



Questions?