

Seminar: Recreational Computer Science

1. Organization, Seminar Schedule & Topics

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Universität Basel

September 25, 2017

Recreational Computer Science

Topic of the Seminar

Recreational Computer Science

... from Langton's Ant to Turing's Subway

- inspired by [recreational mathematics](#)
- packages interesting topics in entertaining presentations
- wide range of topics
 - from theoretical computer science to algorithmic problems
- easily understandable (popular science) introductions but [scientific background](#)

Example: Langton's Ant

Very simple rules

- On white tile: paint tile black, turn 90° right, move one step forward
- On black tile: paint tile white, turn 90° left, move one step forward

Example: Langton's Ant

Started on white plane

- builds several patterns in the first few hundred steps
- then very chaotic behaviour for a few thousand steps
- then building infinite "highway"



Example: Langton's Ant

simple rules define really complex system

- seems to build a highway on all finite initial configurations
- but Turing-complete with infinite initial configurations

Example of a [cellular automaton](#)

Organizational Matters

Target Audience and Prerequisites

Target audience

- BSc students of computer science and related subjects

Prerequisites

- ability to work independently
 - programming skills (for the software project)
- ... or willingness to acquire these on the fly

Format

Seminar format

- Theoretical part + programming project
- 6 ECTS points
- evaluation: graded

Learning Goals

Learning goals

Seminar: dealing with scientific literature

- reading and understanding
- explaining and presenting
- comparing and discussing

Project: implementing efficient problem solvers

- practice in programming
- clean and efficient code (↔ code reviews)
- evaluation of algorithms (↔ scientific experiments)

Meetings

- | | | |
|---------|-------------|---|
| 25. Sep | 16:15–18:00 | Introduction (today) |
| 2. Oct | 16:15–18:00 | How to prepare a seminar paper
and presentations |
| 11. Nov | 9:00–18:00 | Seminar presentations |
| 12. Nov | 9:00–18:00 | Seminar presentations |
| 16. Dec | 9:00–18:00 | Project presentations |

Room 00.003, Spiegelgasse 1

Requirements I

Requirements to pass

- Write a seminar paper
 - 10–12 pages, LaTeX
 - first version due on Oct 29, second version on Nov 26

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 - 1–2 pages
 - due on Nov 3

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- Give a seminar presentation
 - 35 mins plus discussion
 - submit slides on Nov 8
 - final (polished) version of slides due on Nov 10

Requirements I

Requirements to pass

- Write a seminar paper
 - 10–12 pages, LaTeX
 - first version due on Oct 29, second version on Nov 26
- Write a peer review
 - 1–2 pages
 - due on Nov 3
- Give a seminar presentation
 - 35 mins plus discussion
 - submit slides on Nov 8
 - final (polished) version of slides due on Nov 10
- Actively participate in discussions

Requirements II

Requirements to pass (continued)

- Submit an implementation for the programming project
 - due on Dec 8

Requirements II

Requirements to pass (continued)

- Submit an implementation for the programming project
 - due on Dec 8
- Give a project presentation
 - 15-18 mins plus discussion

Requirements II

Requirements to pass (continued)

- Submit an implementation for the programming project
 - due on Dec 8
- Give a project presentation
 - 15-18 mins plus discussion
- Participate in all weekend meetings

Grading

Grading

- Seminar paper (15+15%)
- Peer review (10%)
- Seminar presentation (15%)
- Participation in discussions (10%)
- Implementation for the programming project (20%)
- Project presentation (15%)

The aspects will be individually graded on a scale of 1.0-6.0, and the overall grade for the seminar will be determined as a weighted average of the components.

Peer Reviewing

- you get a seminar paper written by someone else
- and give written feedback
- feedback is anonymous
- aim: learn through change of perspective

Programming Project

- programming project is related to seminar topic
- clarify the following aspects with the advisor of your topic:
 - programming language
 - project description
- when?
 - as soon as you have a sufficient overview of the topic
 - no later than Nov 14

People



Malte Helmert



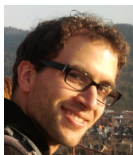
Gabi Röger



Florian Pommerening



Silvan Sievers



Jendrik Seipp



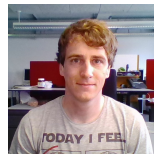
Manuel Heusner



Salomé Erikssoon



Thomas Keller



Cedric Geissmann

People: Organizers

Organizers (and advisors)

Dr. Gabriele Röger

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- **office:** Spiegelgasse 1, room 04.005

Prof. Dr. Malte Helmert

- **email:** malte.helmert@unibas.ch
- **office:** Spiegelgasse 1, room 06.004

People: Advisors

- Spiegelgasse 1, room 04.001
 - Dr. Thomas Keller
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- Spiegelgasse 5, room 04.001
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 - Cedric Geissmann
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 - Silvan Sievers
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Material & Registration

Seminar homepage

<http://cs.unibas.ch/hs2017/>

- description of seminar
- slides

Adam

<https://adam.unibas.ch/>

- additional materials
- in particular recreational introductions to topics

Registration:

- <https://services.unibas.ch/>

Plagiarism

Plagiarism

- **plagiarism:** passing off someone else's work as your own
- consequence: failing the seminar
- if in doubt, **ask us!**

In case of recurrence, exclusion from course of studies possible.

Language

- seminar paper in English or German
- peer review in English (or German if ok for paper author)
- presentations in English (or German if all participants agree)
- programming language by agreement with advisor

Questions on Organization

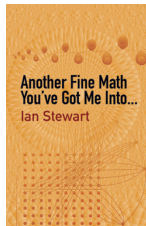
Questions?

Seminar Topics

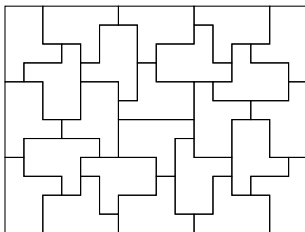
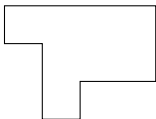
Ian Stewart



- British mathematician
- many popular-science books and mathematical columns in scientific magazines
 - “Mathematical Recreations” column in *Scientific American*
 - “Visions Mathématiques” column in *Pour la Science*



Topic #1



Topic #1: Tile and Error

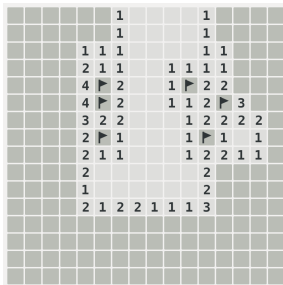
- tiling problems with polyominoes

Topic #2

Topic #2: A Subway Named Turing

- Turing machines
- simulated by subway systems

Topic #3



Topic #3: Million-Dollar Minesweeper

- NP-complete problems
- polynomial reduction

Topic #4

Topic #4: Monks, Blobs and Common Knowledge

- epistemic logic
- expressing knowledge about knowledge
- “A knows that B knows that C does not know that ...”

Topic #5

Topic #5: A Partly True Story

- fuzzy logic
- degree of truth for vague information

Topic #6

Topic #6: The Ultimate in Anty-particles

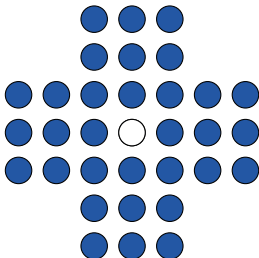
- Langton's ant
- cellular automata

Topic #7

Topic #7: How Many Guards in the Gallery?

- art gallery problem on polygonal maps
- where to place a minimum number of “guards” in a polygon so that together they can “see” everything?

Topic #8



Topic #8: Unbang the Bane and the Army of the Antigods

- Peg Solitaire
- pagoda function to prove unsolvability of some problems

Topic #9

Topic #9: Defend the Roman Empire!

- Integer programming

$$\begin{aligned} &\text{maximize} && 2x - 3y + z && \text{subject to} \\ & && x + 2y + z && \leq 10 \\ & && x && - z \leq 0 \\ & && x \geq 0, && y \geq 0, && z \geq 0 \end{aligned}$$

Topic #10

Topic #10: Murder at Ghastleigh Grange

- property of planar graphs with Hamiltonian cycle

Topic #11

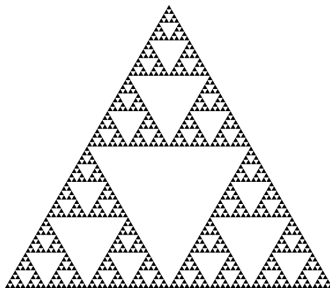
Topic #11: The Interrogator's Fallacy

- conditional probabilities

Topic #12

Topic #12: The Lion, the Llama and the Lettuce

- farmer/wolf/goat problem, towers of hanoi
- Sierpinski triangle
- state space search

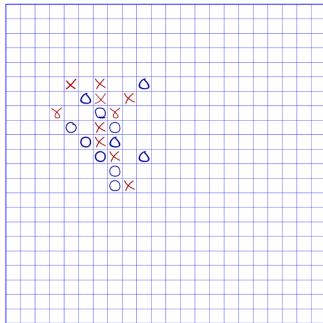


Topic #13

Topic #13: Concentration: a Winning Strategy

- optimal strategies for Memory

Topic #14



Topic #14: A shepherd takes a sheep shot

- Five in a Row-like games

Topic #15

Topic #15: Passage to Pentagonia

- number of paths from A to B in a graph
- matrix multiplication

Topic #16

Topic #16: Knights of the flat torus

- knight's tours on different shapes
- Hamiltonian paths/cycles

Topic #17

Topic #17: Maxdoch Murwell, Market Manipulator

- game theory

Topic #18

Topic #18: The Group-theorist of Notre Dame

- permutation groups

Topic #19

Topic #19: A Dickey Business

- optimal strategies for a class of two-person games

Topic #20

Topic #20: A Strategy for Subsets

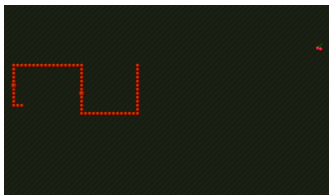
- subset takeaway game
- combinatorial game theory

Topic #21

Topic #21: FRACTRAN programming language

- program is list of fractions
- internal state of interpreter is a positive integer
- each iteration multiplies state with the first fraction in the list that results in an integer
- Turing-complete

Topic #22



Topic #22: Snake

- Complexity of configuration problem

Next Steps

Assignment of Topics

- We will send you the link to a poll
- Number of the option = number of the topic in these slides
- Mark **at least 3** topics with **Yes**
- Mark **at least 5** topics positively: **Yes** or **(Yes)**
- until **September 28 (next Thursday)**

Then:

- Paper assignment and supervisors announced October 2.
- **Start** reading the paper and contact supervisor **ASAP**

Important Dates

- 28 Sep Have preferred topics marked
- 2 Oct Second meeting & topic assignment
- 29 Oct Seminar paper due (first version)
- 3 Nov Peer review due
- 8 Nov Slides due (first version)
- 9/10 Nov Feedback on slides from advisor
- 10 Nov Slides due (final version)
- 11/12 Nov Seminar presentations
- 14 Nov Have programming project clarified
- 26 Nov Seminar paper due (final version)
- 8 Dec Implementation due
- 16 Dec Project presentations