Theory of Efficient Algorithms

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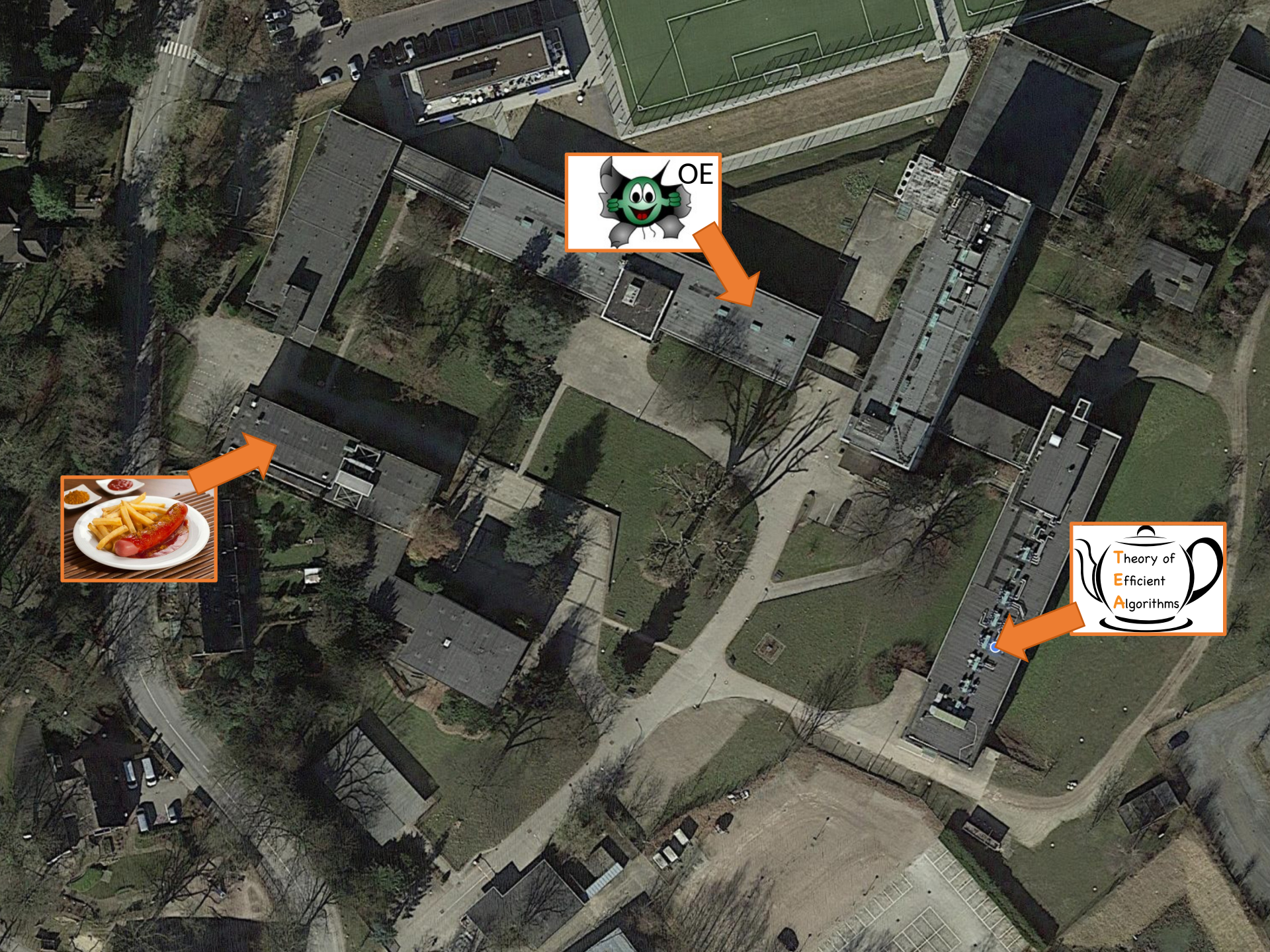
Focus: Design & Analysis of Algorithms

- Distributed Systems
- Online Computation
- Resource Management
- Stochastic Processes
- Robot Coordination
- …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Theory of
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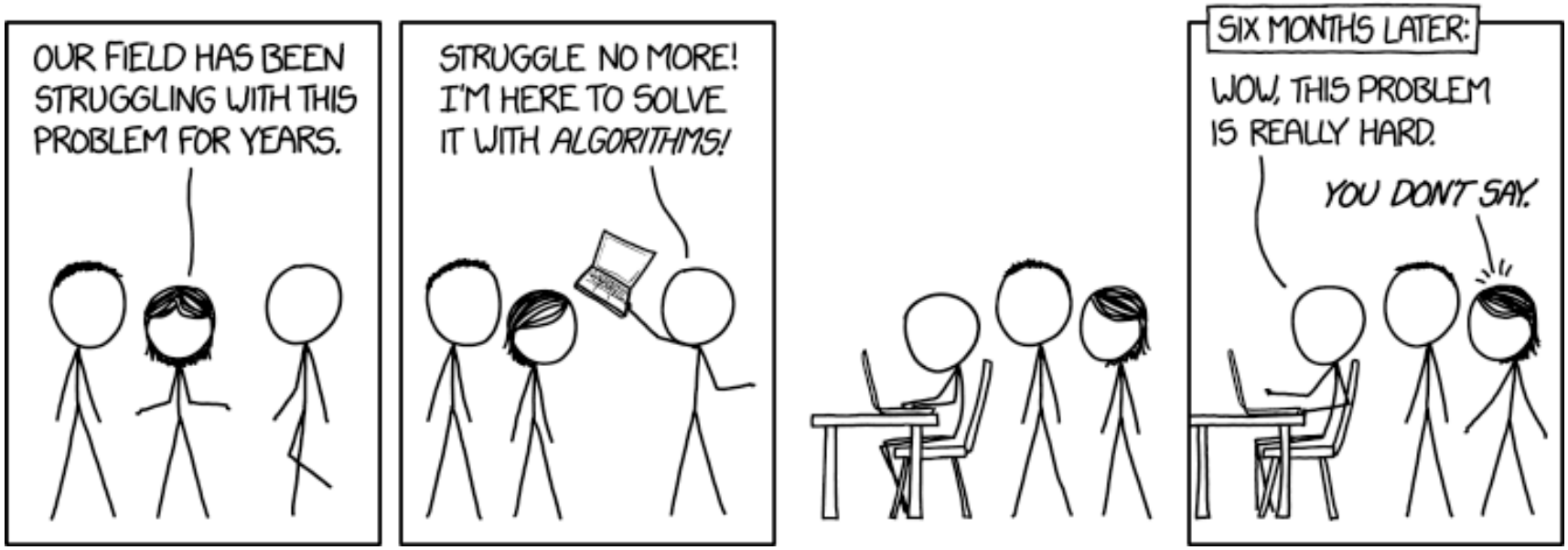
Theory of Efficient Algorithms



- many problems are hard **Why?** **What part of the problem?** **How hard?**
- we need a systematic way to solve them **What means "solve"?** **How?**
- we need quality guarantees **Which?** **How strong?** **Possible?**

Teaching

Teaching Overview

Winter Term

InfM-Kryp: Cryptography

Wahlpflichtbereich Theorie

Summer Term

InfM-MDAE: Methods of Algorithm Design

Wahlpflichtbereich Theorie

Winter + Summer Term

Master Project

Always

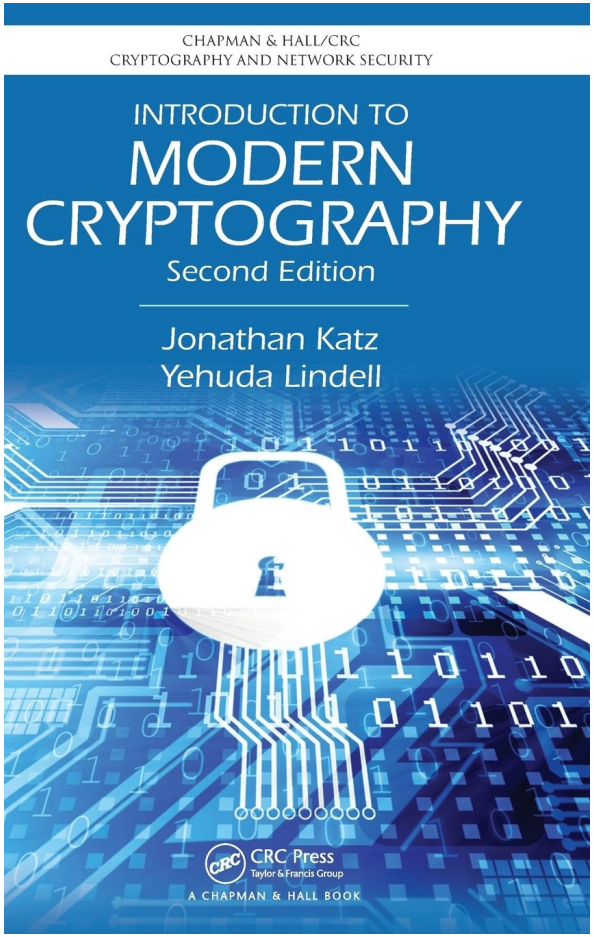
Master's Thesis

talk to me

Cryptography

Module InfM-Kryp

- (Why) Is today's cryptography safe?
- mathematical foundations to understand cryptographic protocols
- How to quantify cryptographic security?



Lecture

- definitions + theorems + proofs
- (black-/white-) board + slides
- integrated exercises

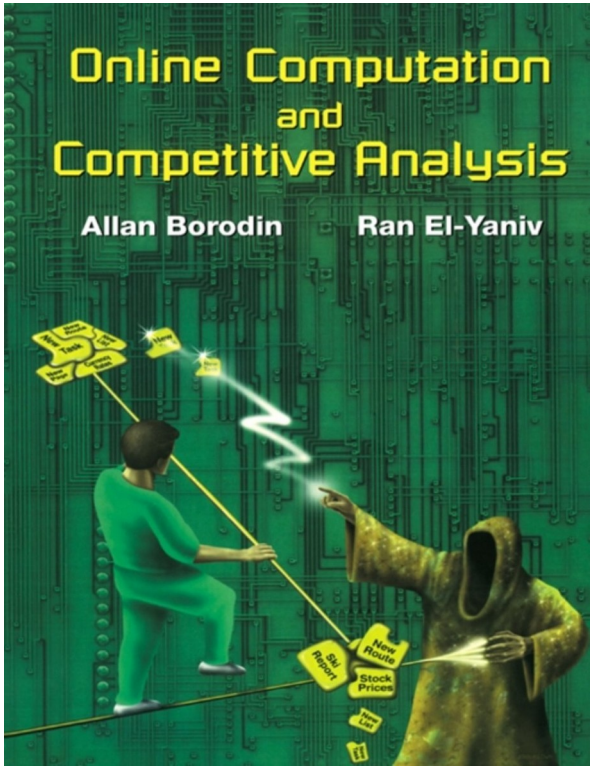
Seminar

- block and/or running

Methods of Algorithm Design

Module InfM-MDAE

- approximation & online algorithms
- quality guaranties under uncertainty
- how to design & analyze optimization algorithms



Lecture

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Seminar

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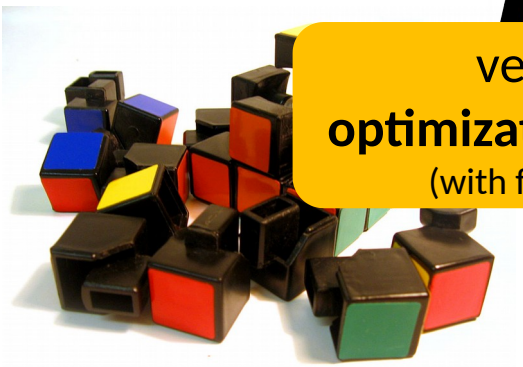
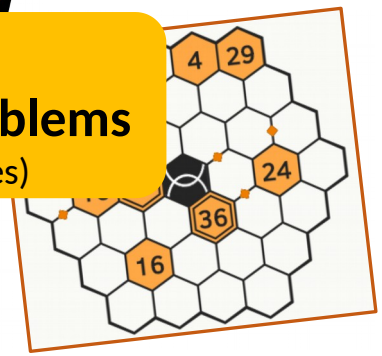
Algorithmic Games in TCS

Master Project

- games are fun because they are complex
  - Rubik's Cube
  - 2048
  - Rikudo
  - Tetris
  - Super Mario Bros.
  - …





very hard
optimization problems
(with funny images)

Part 1 (WiSe 2018/19): **Seminar + Basics + Goal Outline**

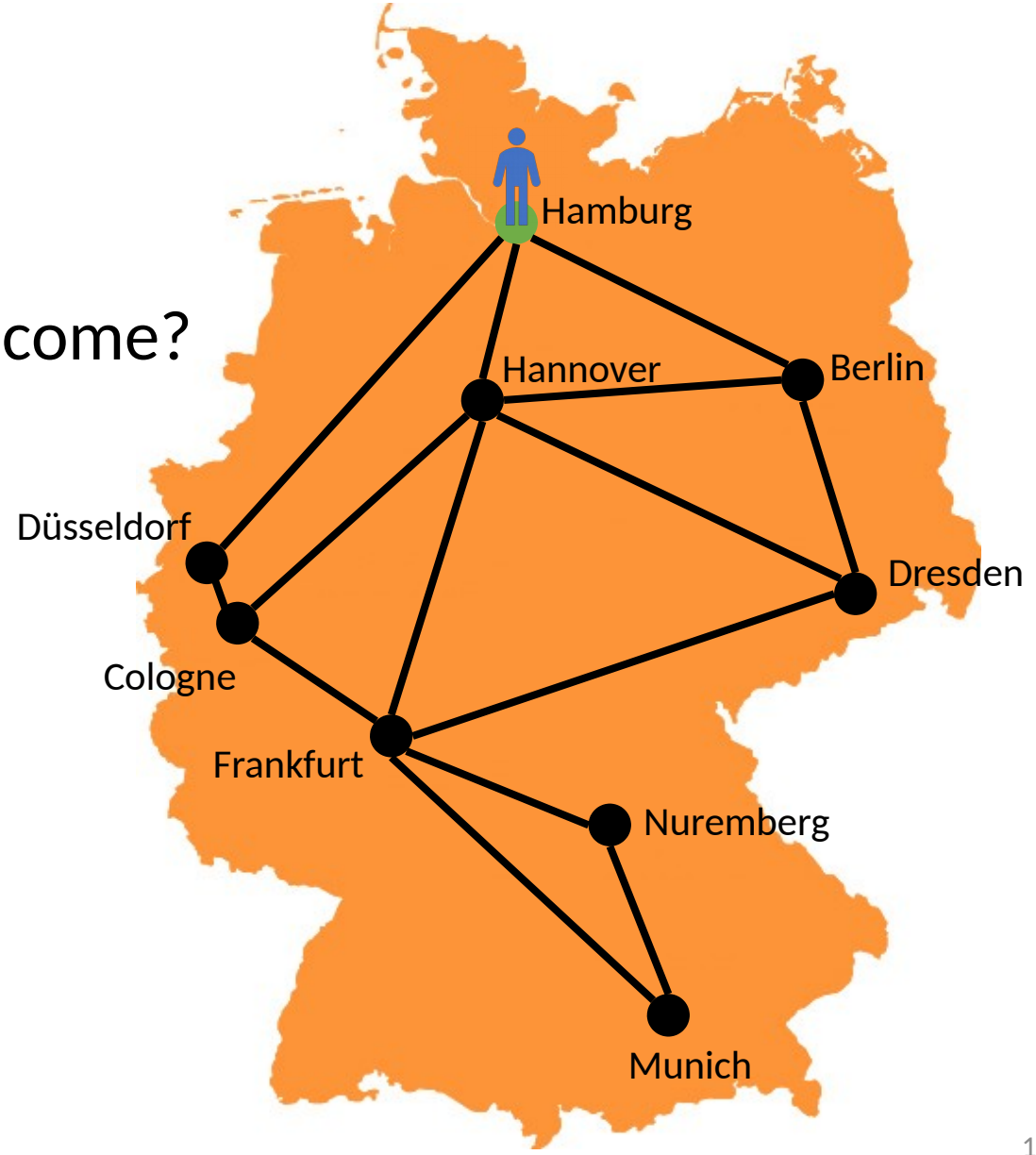
- get to know research papers like
  - "Algorithms for Solving Rubik's Cubes" (2011)
  - "Super Mario Bros. is Harder/Easier Than We Thought" (2016)
- plan both theoretical & implementation work
- start on both

Research Examples

or: some Algorithmic Puzzles

Online Graph Exploration

- cannot be optimal
- But how close can we come?



Randomized Gathering

- robots in the plane
- act in discrete rounds
- instantaneous movement
- not necessarily local

Objective:
Gather in one point

Strategy 1:
go to random robot

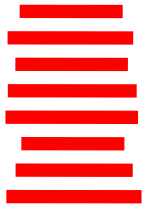
Strategy 2:
go to closest of two random robots

Online Matching on the Line

- n servers on the real line
- n requests on the real line
  - pop up one after another
  - Not known in advance!

Objective:

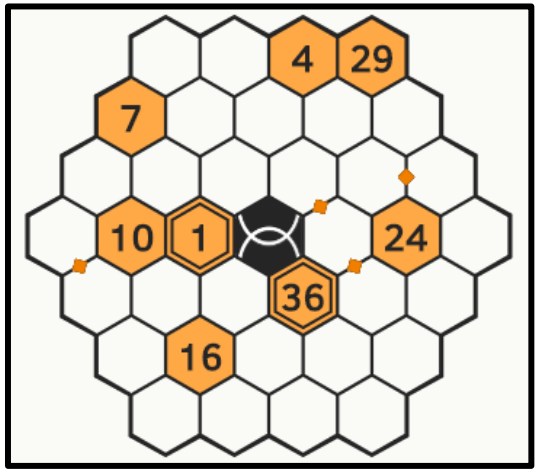
- when a request pops up, match it to an unmatched server
- pay distance request ↔ server

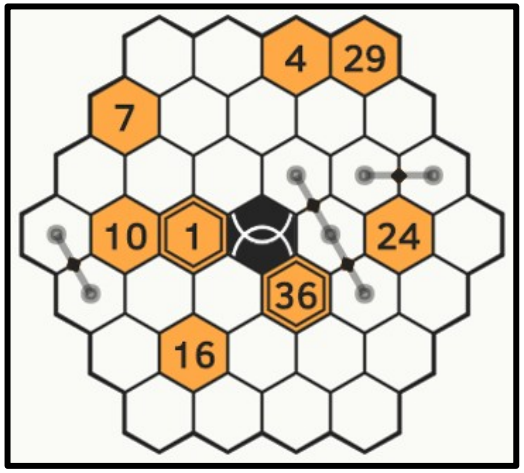


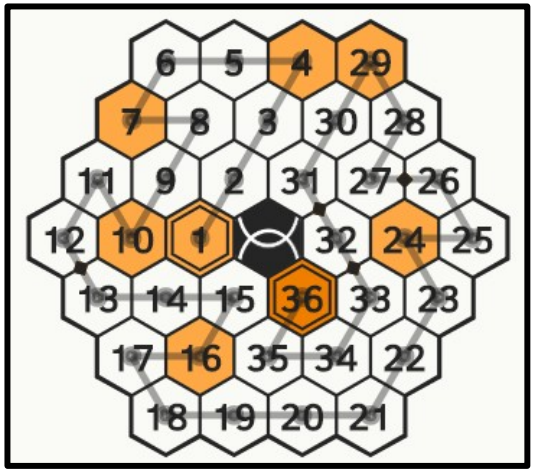
optimal solution

http://www.rikudo-puzzle.com

Rikudo

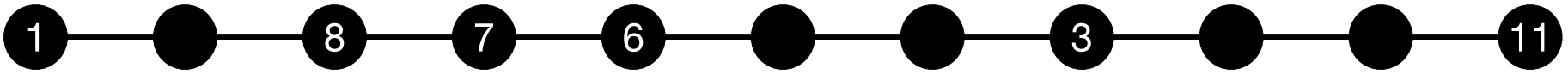


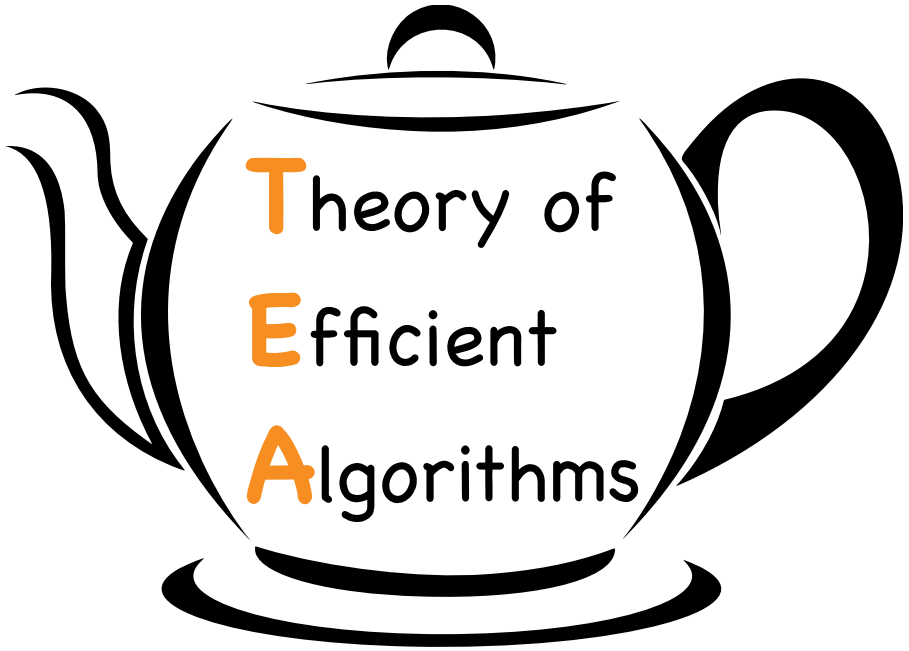




Let's try something simpler: Rikudo on the line

(sort of)





Questions ?

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