Algorithms for Distributed Systems

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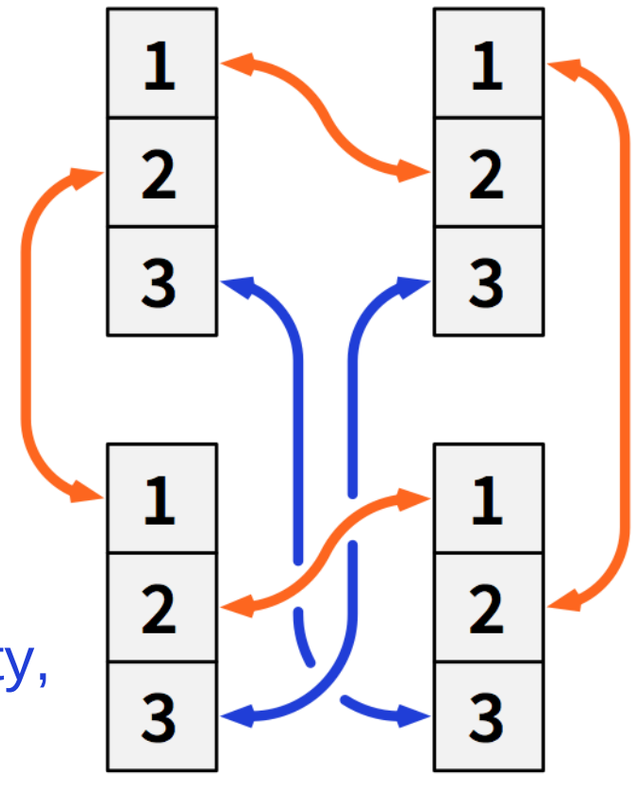
SoSe 25

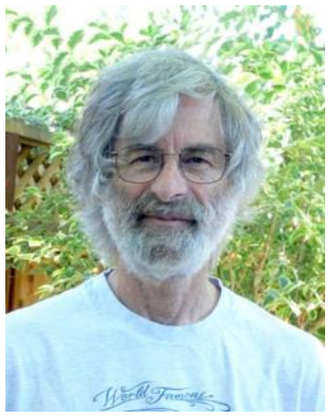
https://www.tu.berlin/en/eninet



Some slides based on slides by Jukka Suomela, Aalto University, and Pierre Fraigniaud, Irif, Paris

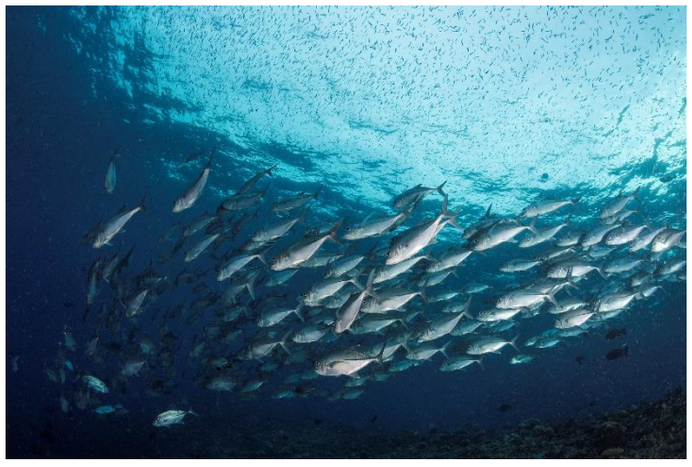
What Are Distributed Systems?

“You know you have a distributed system when the crash of a computer you’ve never heard of stops you from getting any work done.”
(Leslie Lamport)



Distributed Systems

In this course (often): A collection of autonomous computing entities collaborating for solving a task in absence of any coordinator

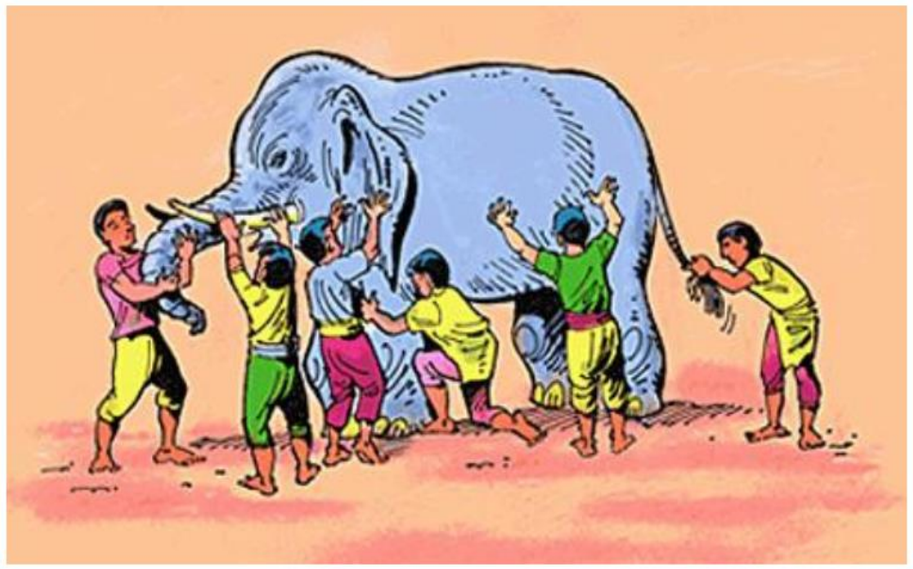


Why this Course?

1. **Real-world systems are often large-scale and distributed**
2. **New perspective to theory of computation**
3. **Modelling nature**

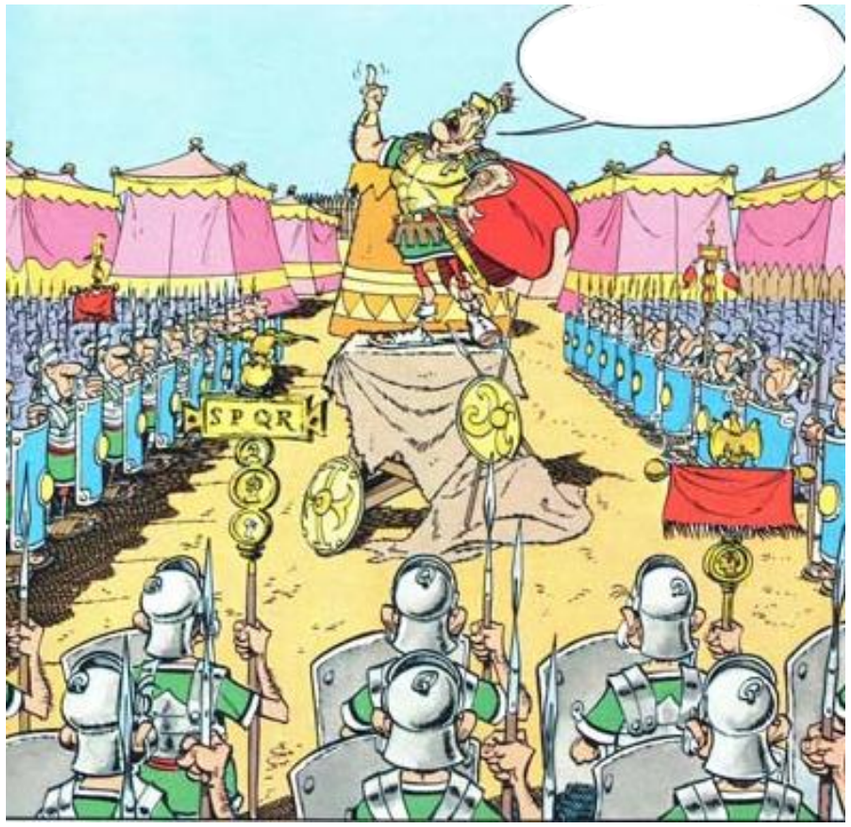
Distributed Algorithms

- Large-scale systems require scalable algorithms
- And the ability to deal with failures and uncertainty
- Distributed systems are large beasts: and each individual or constituting component can often only see a small part
- Often it is hard or impossible to obtain a global snapshot!



Parallel vs. Distributed

Parallel computing



Distributed computing

Performance

> exaFLOPS (10^{18} op./s)

Coping with uncertainty

spatial and temporal

Rough Plan

Part 1: Distributed graph algorithms and models (coloring, broadcast, lower bounds…)

Part 2: Distributed communication algorithms (consensus, quorum systems, impossibility results …)

Part 3: Applications (voting, machine learning, chemical networks, …)

WARNING:
(Some) THEORY

80% theory

(definitions, algorithms, theorems, …)

20% practice

(understanding its applications…)

Organization

General Information

- **Area:**
  - Bachelor: Computer Engineering, Information Systems Management
  - Master: Computer Science, Computer Engineering, Information Systems Management and Elektrotechnik

- **Workload and credits for module**
  - 4 SWS
  - 6 credit points

- **Times and Rooms**
  - Online: https://isis.tu-berlin.de/course/view.php?id=42226
  - Course: Wednesday 16:15 - 17:45 MA 005
  - Tutorial: Wednesday 14:15 - 15:45 MA 005

INET and Teaching Team

- **Lectures:**
  - Prof. Dr. Stefan Schmid
  - Dr. Darya Melnyk
- **Tutorials:**
  - Julien Dallot
  - Mitja Krebs

- **INET**
  - https://www.tu.berlin/en/eninet

Course Structure

- **Before the lecture: quiz**
  - Voluntary – but we encourage you to keep up with the quizzes
- **A tutorial a week after the lecture**
  - Solving exercises in groups
- **At the end of the course - Exam**
  - Written exam for about 90 minutes
  - Questions about the course and tutorial material

Preparation Quiz

- **Bonus for the exam:**
  - With each quiz, you can collect points
  - Collecting **75%** of all points will give you a **bonus of 0.3**

- **How it works:**
  - Additional material (e.g., short article or video) posted before each lecture
  - This material introduces the topic of the next lecture
  - Familiarize yourself with the material
  - Complete the corresponding quiz on ISIS

Forums in ISIS Course Room

- **Announcements – Forum**
  - Used for organizational things around the lecture and tutorials
  - Reminding you of deadlines, dates and new content
  - Please subscribe to this forum to not miss any important information!

- **Discussion – Forum**
  - Possibility for you to ask questions and discuss course material **with your peers**
  - You are encouraged to actively take part in the discussions

Reading Material

- Principles of Distributed Computing: https://disco.ethz.ch/courses/podc_allstars/
- Distributed Algorithms: https://jukkasuomela.fi/da2020/
- Networks, Crowds, and Markets: https://www.cs.cornell.edu/home/kleinber/networks-book/
- The Science of Blockchain: https://www.amazon.de/Science-Blockchain-Roger-Wattenhofer/dp/1522751831
- Mathematical and Algorithmic Foundations of the Internet: http://ndl.ethernet.edu.et/bitstream/123456789/77633/1/91.pdf
- Mastering Distributed Algorithms: https://www.amazon.de/Roger-Wattenhofer/dp/B086BDVMB5/