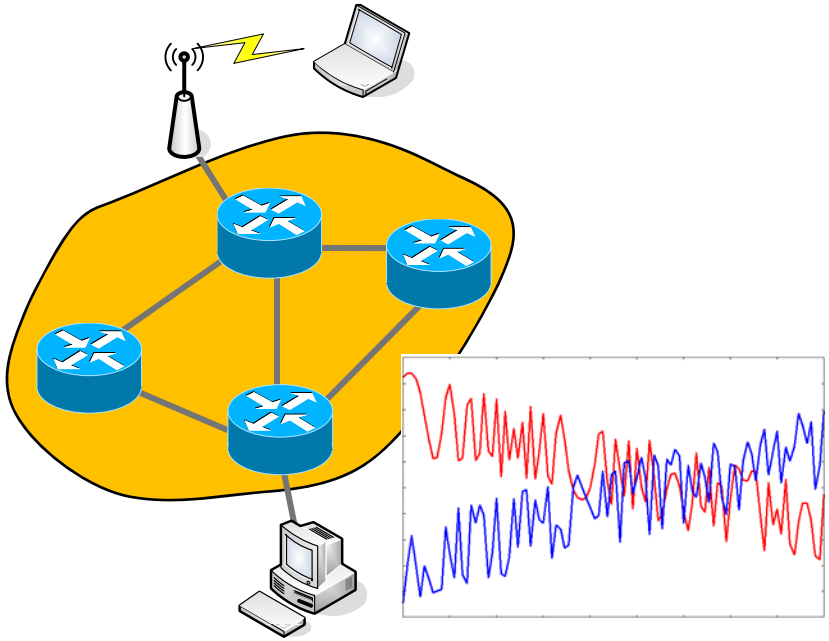
Freie Universität Berlin

Modeling and Performance Analysis with Simulation

SS 2011



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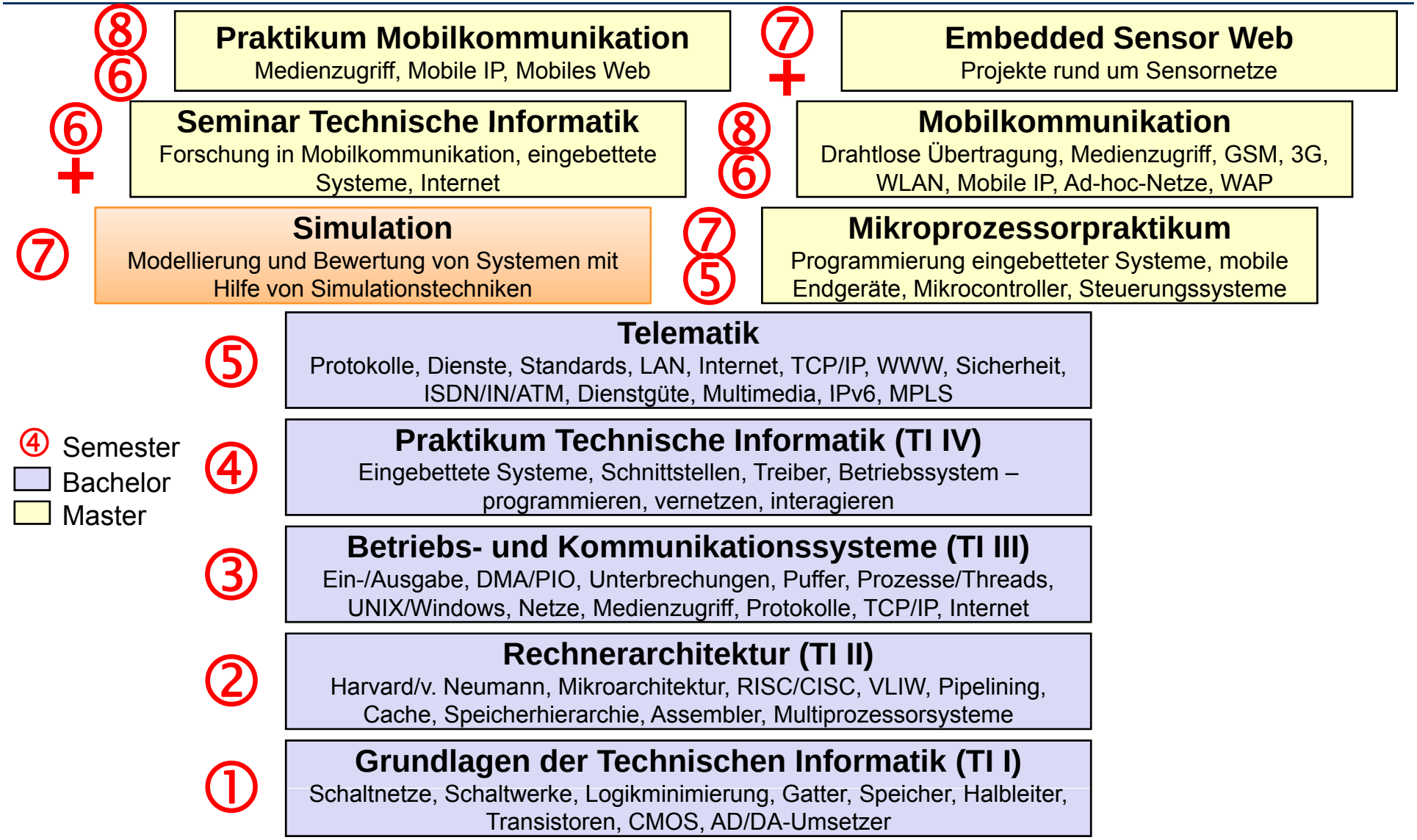
Chapter 0

Motivation, why Simulation?, and some organizational issues

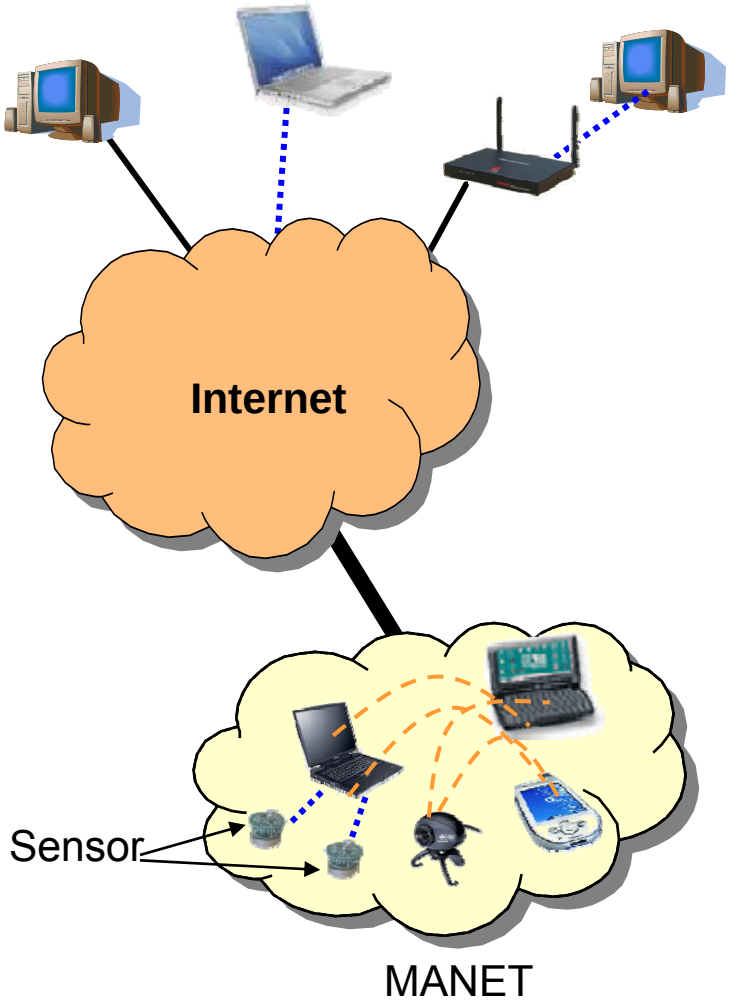
Structure/content of CST-Lectures



Overview of participants

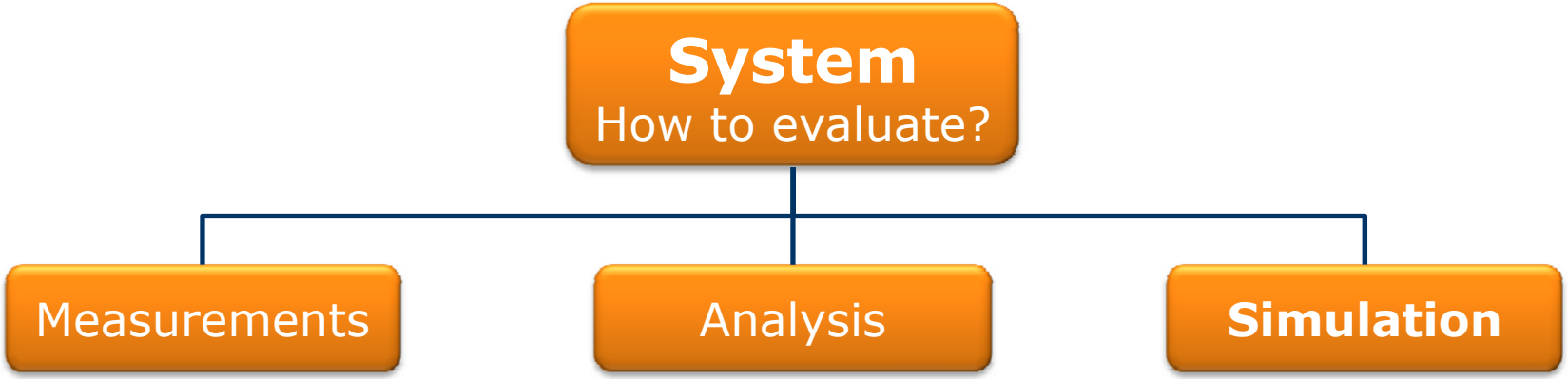
Research topics

- Network architectures and communication protocols
  - Wired networks
    - Local Area Network (LAN)
    - Internet
  - Wireless networks
    - GSM, 3GPP, UMTS, LTE
    - Wireless Local Area Network (WLAN)
    - Mobile Ad-hoc Network (MANET)
    - Wireless Mesh Network (WMN)
    - Wireless Sensor Network (WSN)
  - Protocols
    - HTTP, TCP/UDP, IP
    - IEEE 802.11a,b,g
  - Internet of Things
    - Anytime, Anywhere, Anything



Topics of this course

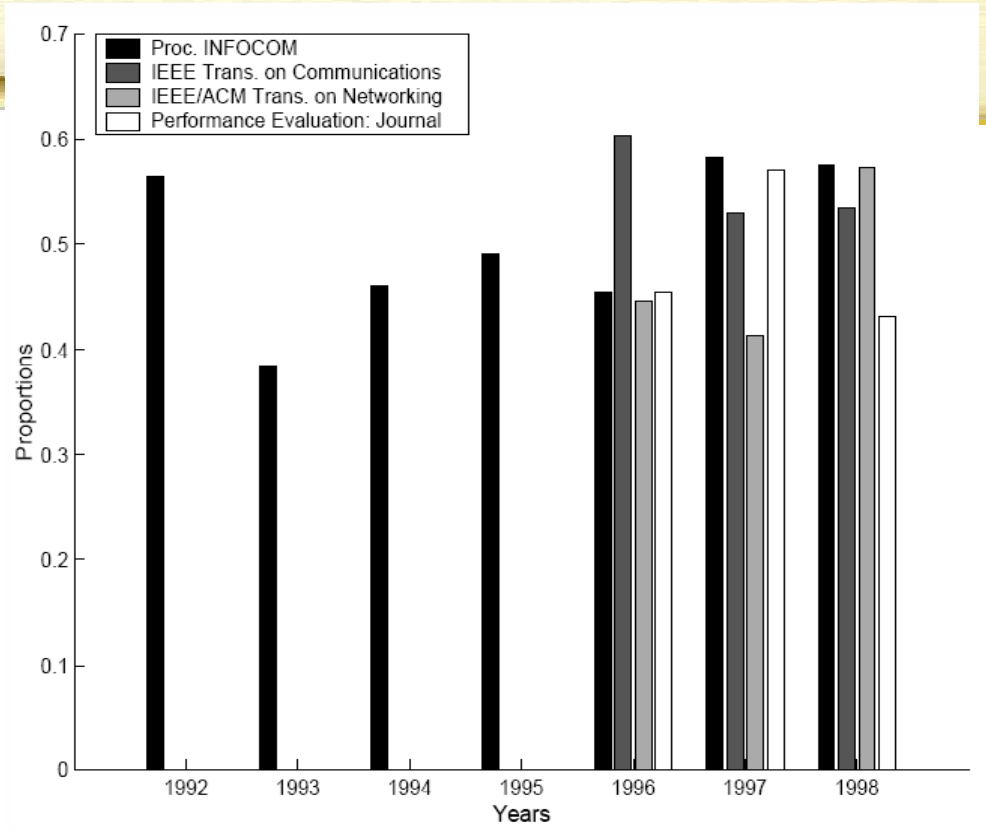
- Given a system, how do you evaluate its performance?



Why a course about simulation?

- *A survey of 2246 research papers on networks (1992-1998)*
- *About **51%** of papers reported results from simulation*

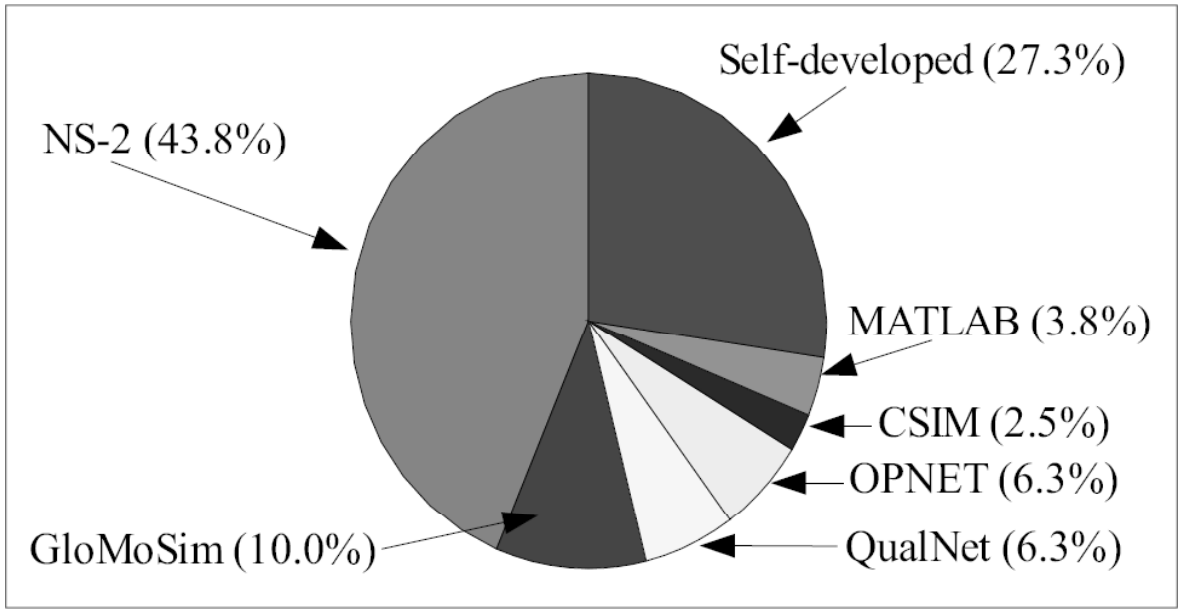
Pawlikowski et al., "On Credibility of Simulation Studies of Telecommunication Networks", IEEE Comms., Jan. 2002.



Why a course about simulation?

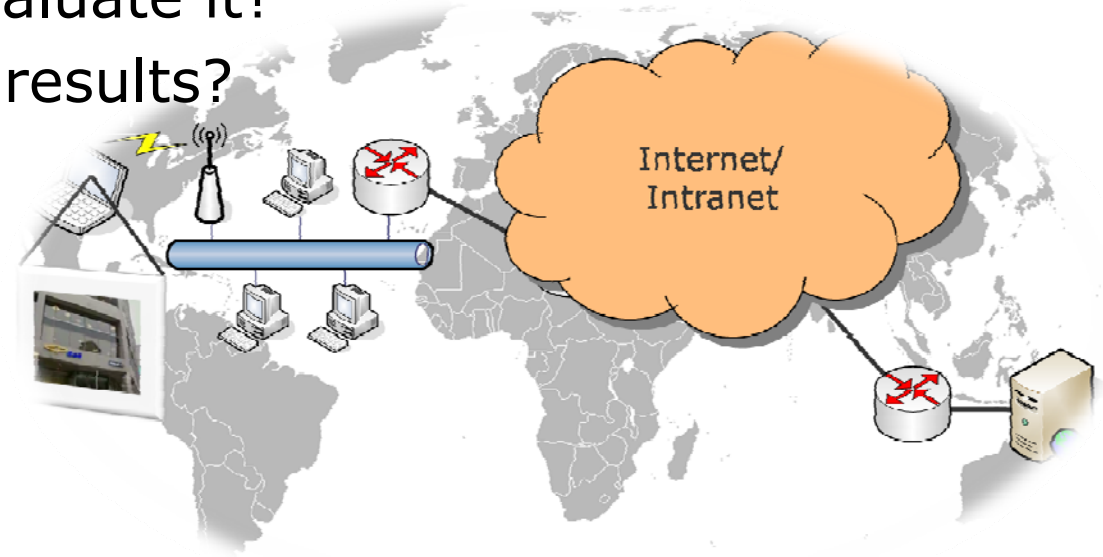
- *Survey of all 151 papers published in Proceedings of the ACM International Symposium on Mobile Ad Hoc Networking and Computing in 2000-2005*
- *About **75.5%** of the papers reported results from simulation*

S. Kurowski et al. "MANET Simulation Studies: The Incredibles", Mobile Computing and Communications Review., no. 4, 2005.



Topics of this course

- What is a system?
- What is a model?
- What is an experiment?
- What is performance and how to measure it?
- On what does performance depend?
- How to build a model?
- How to numerically evaluate it?
- How to interpret such results?



Topics of this course

- At the end of this course, you should …
  - know about **simulation principles**
  - be able to build **models** of systems
  - be able to identify suitable **performance metrics**
  - be able to **design and implement** simple discrete event simulation programs
  - have some experience with a modern **simulation tool**
  - be able to **design** effective **experiments**
  - be familiar with basic **statistical questions**
  - know how to **evaluate** (simulation) experiment results
  - be aware of **common pitfalls**

- Focus is on practical aspects of implementing a simulator and simulation programs.

Topics of this course

- This course does not deal with/is not a ...
  - mathematical analysis tools for performance evaluation
  - experimental approaches
  - probability and statistics course
  - programming course
  - computer networking course

- However, **all these topics** will be touched or needed in some degree.

Prerequisities

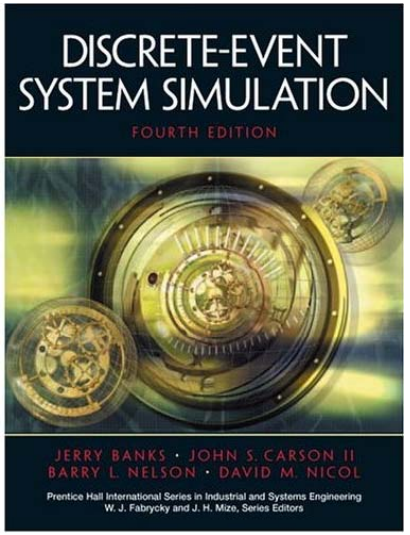
- Basics of probability theory and statistics
- Programming language
  - Python
  - C/C++
  - Java
- Package for statistical computations
  - R
  - Octave
  - Numpy/Scipy
- Spreadsheet tools
  - OpenOffice.Calc
  - MS Excel
- Knowledge about
  - Data communication and computer networks

Contents of the course

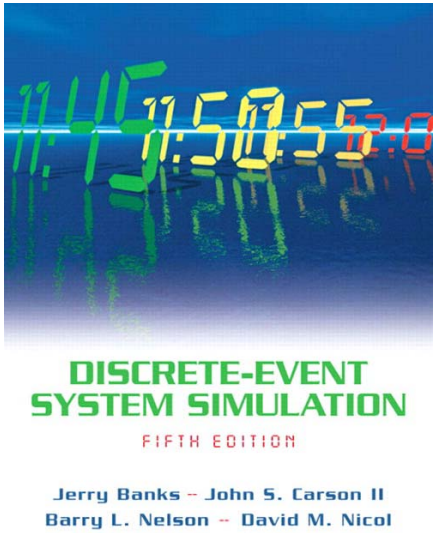
Chapter	Topic
1	Introduction to simulation
2	Simulation examples
3	General principles of discrete-event simulations
4	Introduction to network simulators
5	Statistical models in simulations
6	Random-number generation
7	Random-variate generation
8	Queuing models
9	Input modeling
10	Verification and validation of simulation models
11	Output analysis for a single model
12	Comparison and evaluation of alternative system designs
13	Design of experiments

Literature

- Main source of this course:
  - Jerry Banks, John Carson, Barry L. Nelson, David Nicol: ***Discrete-Event System Simulation***, Fourth Edition, 2005, Prentice Hall
  - Fifth Edition, 2010, Prentice Hall

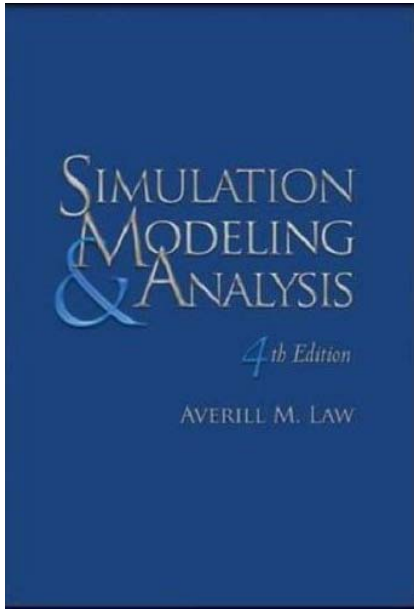


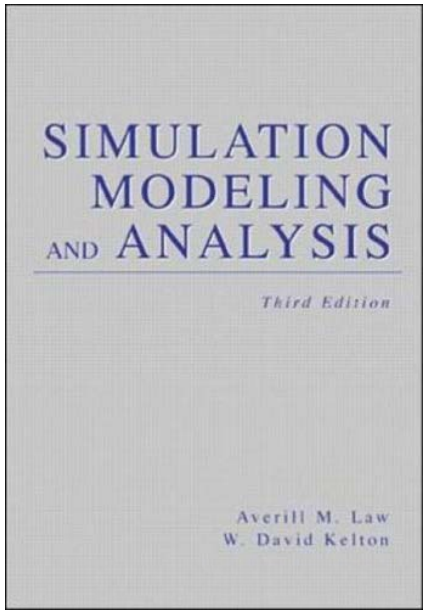
- General book on simulation with applications on
  - Manufacturing
  - Computer systems
  - Communication networks



Literature

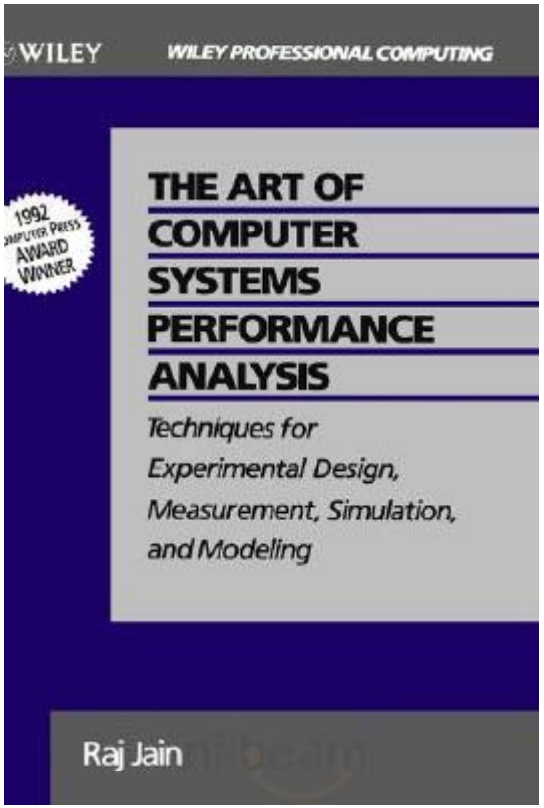
- Second source of this course:
  - Averill M. Law: ***Simulation Modeling and Analysis***, 2007, McGrawHill
- General book on simulation





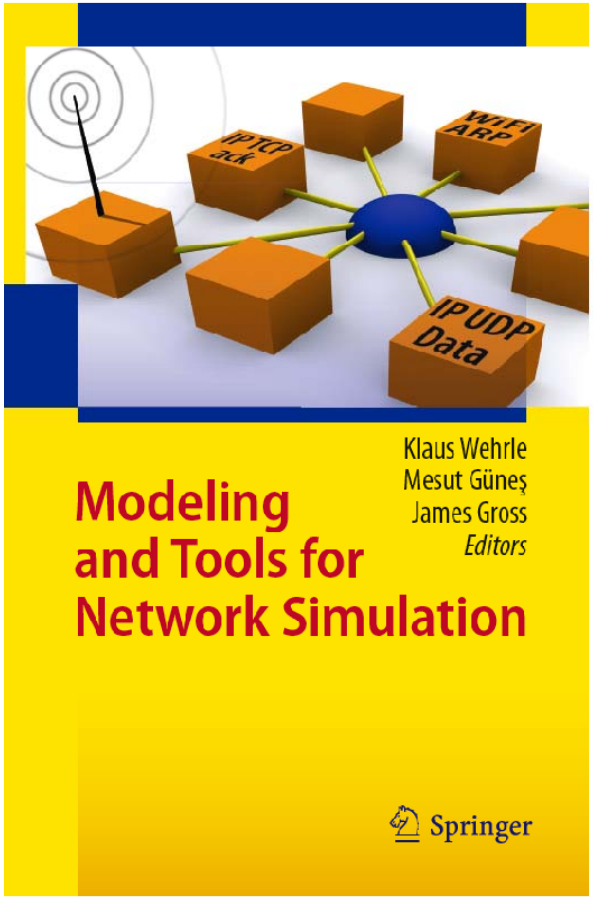
Literature

- Additional source of this course:
  - Raj Jain: ***The Art of Computer Systems Performance Analysis***, 1991, John Wiley & Sons
- General book on performance analysis, deals with
  - Measurements
  - Simulation
  - Queueing theory
  - Experiment design

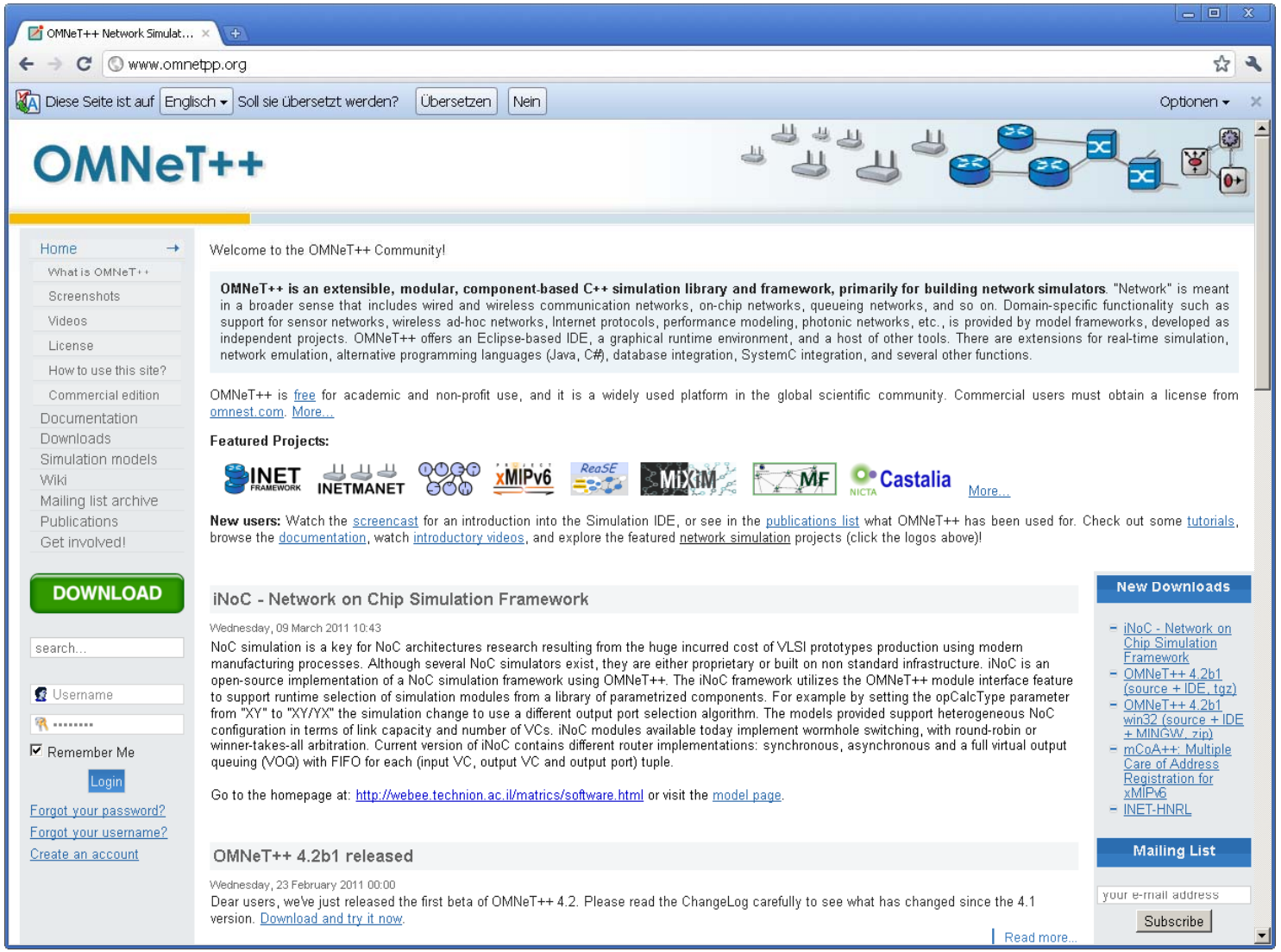


Literature

- Additional source of this course:
  - Klaus Wehrle, Mesut Güneş, James Gross: ***Modeling and Tools for Network Simulation***, 2010, Springer, ISBN 978-3-642-12330-6
- Special book on how to model various layers of the ISO/OSI model for networks simulations
- Website:
  http://www.springer.com/computer/communication+networks/book/978-3-642-12330-6



Simulation tool to use ...



Organizational

- Lecture
  - Friday, 10–12, Takustr. 9, Room SR 049
- Tutorials
  - Thursday, 10–12, Takustr. 9, Room SR 046

- Office hours
  - Prof. Güneş: Tuesday, 15:00-16:00h, Takustr. 9, Room 154

- News and updates
  - http://cst.mi.fu-berlin.de/

- Literature and Materials
  - Available on the homepage of the class