Prof. Dr.-Ing. Jochen Schiller
Computer Systems & Telematics
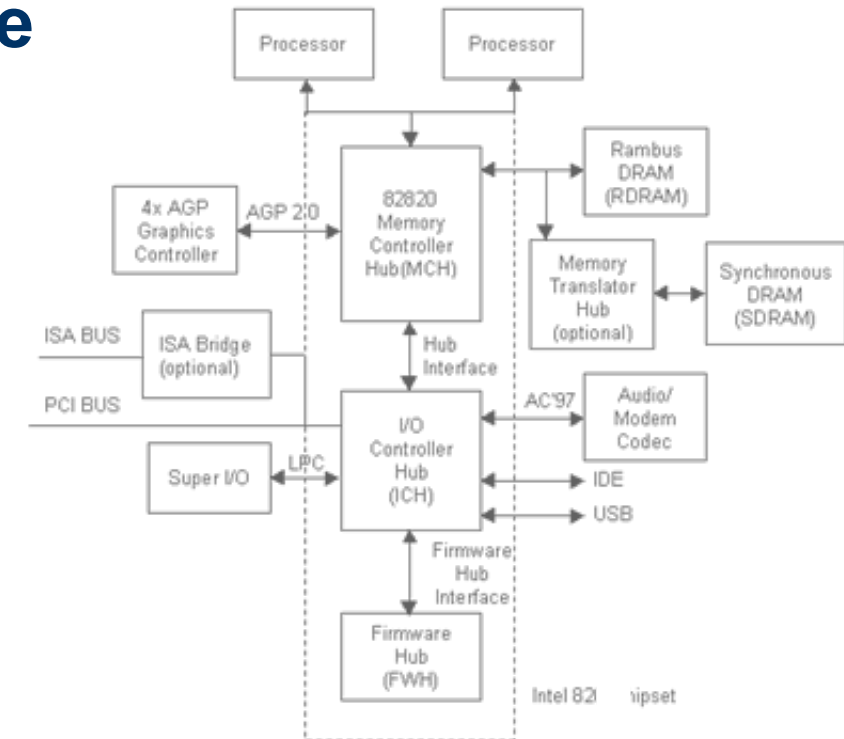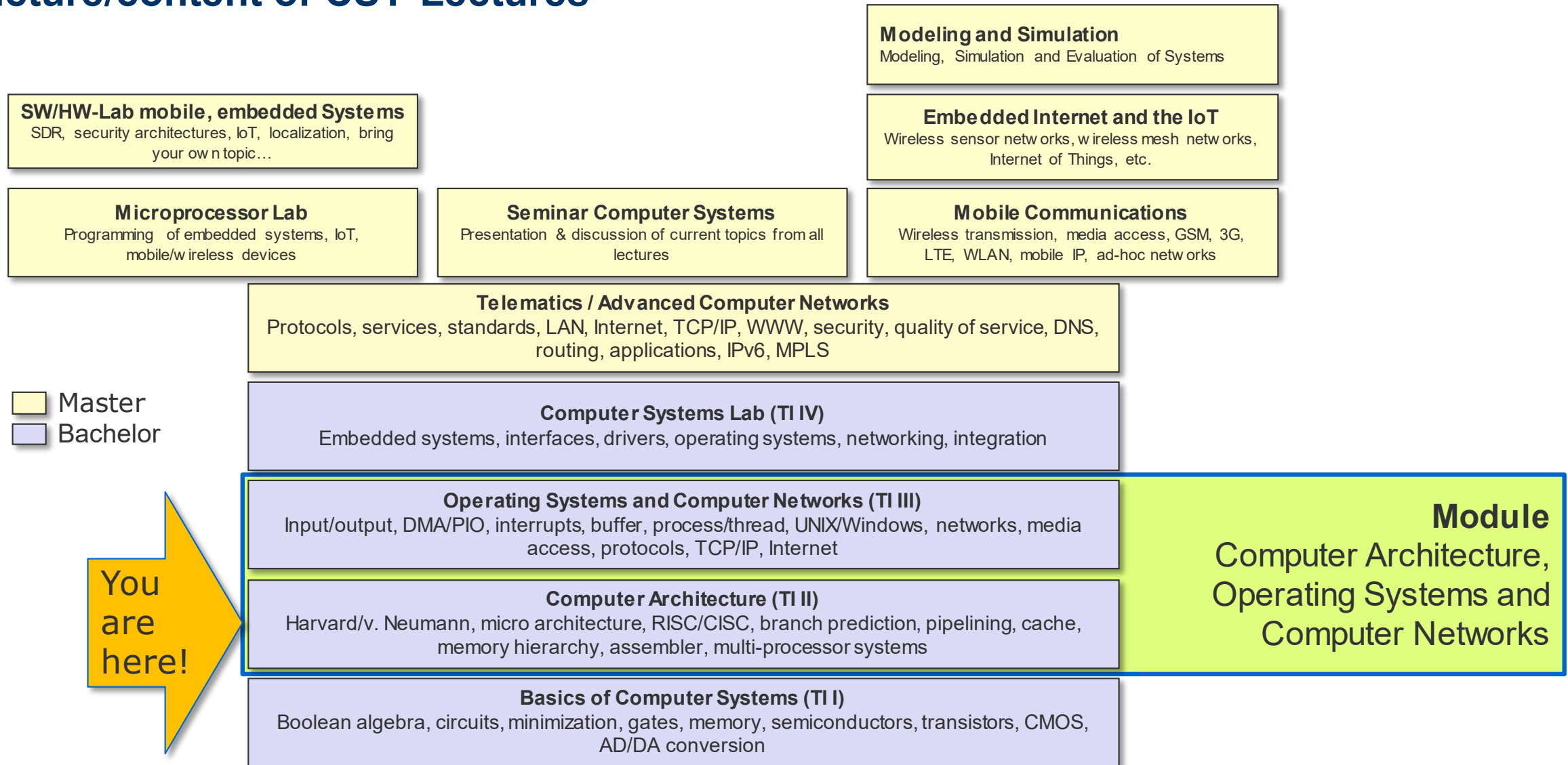
Freie Universität Berlin

TI II: Computer Architecture

Prof. Dr.-Ing. Jochen Schiller

Computer Systems & Telematics

Freie Universität Berlin, Germany

Structure/content of CST-Lectures

Modeling and Simulation
Modeling, Simulation and Evaluation of Systems

SW/HW-Lab mobile, embedded Systems
SDR, security architectures, IoT, localization, bring your own topic…

Embedded Internet and the IoT
Wireless sensor networks, wireless mesh networks, Internet of Things, etc.

Microprocessor Lab
Programming of embedded systems, IoT, mobile/wireless devices

Seminar Computer Systems
Presentation & discussion of current topics from all lectures

Mobile Communications
Wireless transmission, media access, GSM, 3G, LTE, WLAN, mobile IP, ad-hoc networks

Telematics / Advanced Computer Networks
Protocols, services, standards, LAN, Internet, TCP/IP, WWW, security, quality of service, DNS, routing, applications, IPv6, MPLS

Computer Systems Lab (TI IV)
Embedded systems, interfaces, drivers, operating systems, networking, integration

☐ Master
☐ Bachelor

Operating Systems and Computer Networks (TI III)
Input/output, DMA/PIO, interrupts, buffer, process/thread, UNIX/Windows, networks, media access, protocols, TCP/IP, Internet

You are here!

Computer Architecture (TI II)
Harvard/v. Neumann, micro architecture, RISC/CISC, branch prediction, pipelining, cache, memory hierarchy, assembler, multi-processor systems

Module
Computer Architecture, Operating Systems and Computer Networks

Basics of Computer Systems (TI I)
Boolean algebra, circuits, minimization, gates, memory, semiconductors, transistors, CMOS, AD/DA conversion

Content

1. Introduction
   - Single Processor Systems
   - Historical overview
   - Six-level computer architecture

2. Data representation and Computer arithmetic
   - Data and number representation
   - Basic arithmetic
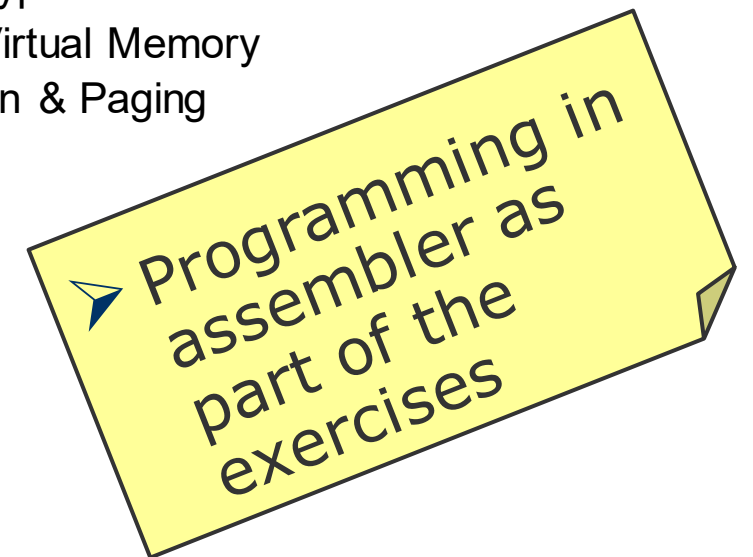
3. Microarchitecture
   - Microprocessor architecture
   - Microprogramming
   - Pipelining

4. Instruction Set Architecture
   - CISC vs. RISC
   - Data types, Addressing, Instructions
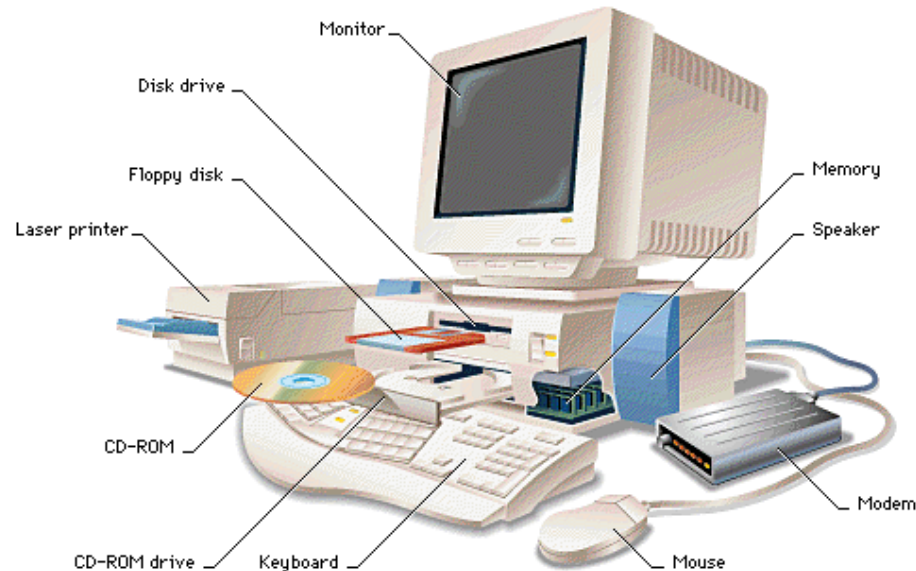   - Assembler

5. Memories
   - Hierarchy, Types
   - Physical & Virtual Memory
   - Segmentation & Paging
   - Caches

➢ Programming in assembler as part of the exercises

Topics of this Course

Have you ever …

- opened the case of a computer?

- assembled a computer from components?

- written a program in Java/Python/Rust/JavaScript?

- written a program in C?

- written a program in Assembler?

Topics of this Course

At the end of this course, you should …
- know the different components of a computer system
- know the internals of a computer
- know how a computer stores data, i.e., text, audio, video
- know how a program is executed
- be able to write small assembler programs
- understand basic arithmetic

This should help you to
- understand computers in general
- understand how high-level
  programming languages are
  translated into machine language
- improve your programming skills
- optimize the performance of your programs

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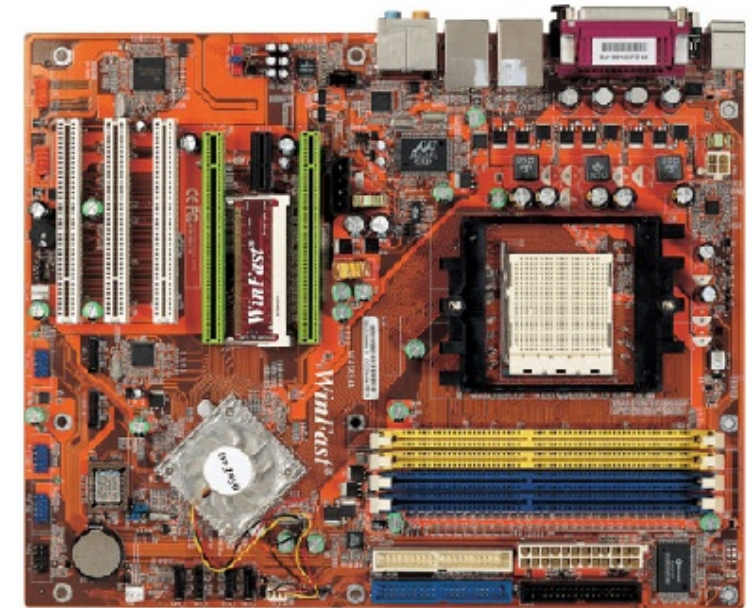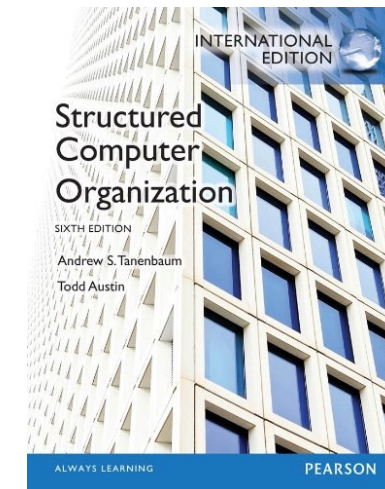
Literature

The course follows (roughly) the books:

- A. S. Tanenbaum, T. Austin:
  Structured Computer Organization, 6. edition,
  Pearson, 2013

  Rechnerarchitektur, 6. Auflage, Pearson Studium,
  2014

- D. A. Patterson, J. L. Hennesy: Computer
  Organization and Design, 5. edition, Morgan
  Kaufmann, 2013

  Rechnerorganisation und -entwurf, 5. Auflage, De
  Gruyter, 2016
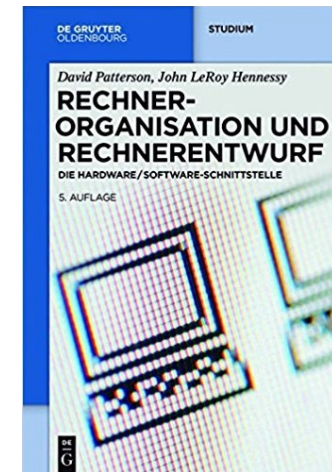
Course Organization

Q&A virtual via Webex meetings – tutorials in real life!

General:

Lecture
- Available online
- Flipped-classroom: Q&A, discussions, Friday, 10-12h c.t., via Webex/HS Taku 9 (hybrid/invitations see whiteboard)

Office Hours
- Jochen Schiller: via email or https://fu-berlin.webex.com/meet/jochen.schiller
- Tutors: during tutorials

News and Updates
- Whiteboard course site (via announcements)

Tutorials
- Groups of approx. 25-30 students
- Time depends on group
- Registration via KVV

Assignments:

New assignments each week
- Available in KVV

Discussion
- During the tutorials

Practical assignments
- @home and in the labs, should work on all platforms
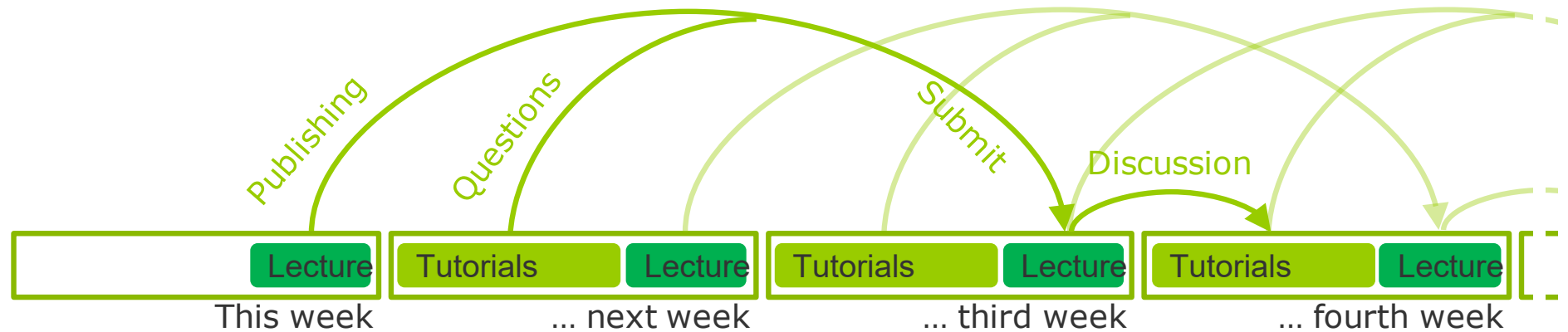- More during Q&A/tutorials

Handing in
➢ *Right on time!*
- Complete electronic workflow!
- Solutions handed in too late will be ignored!

Assignments

Exercises: Available on Fridays in KVV after Q&A

Submission: Two weeks later until start of class (Fri, **8:30**)

Discussion: Three weeks later in tutorials

Criteria for Successful Participation

Active participation in the tutorials is essential!
- Minimum $n-2$ times present

Hand in your assignments on time
- Teamwork is required with 2 students per team

Successful submission of at least $n-2$ assignments

Each student with a correct answer must be able to present the assignment during the tutorials
- At least one presentation during the tutorials

At least 50% of the max. number of points in the exam are required

Only the exam counts for grading!

Exam: to be announced

DO NOT FORGET to register in campus management (grading/exam) and whiteboard (course organisation)

RIOT-OS

The friendly Operating System for the Internet of Things.

http://riot-os.org/