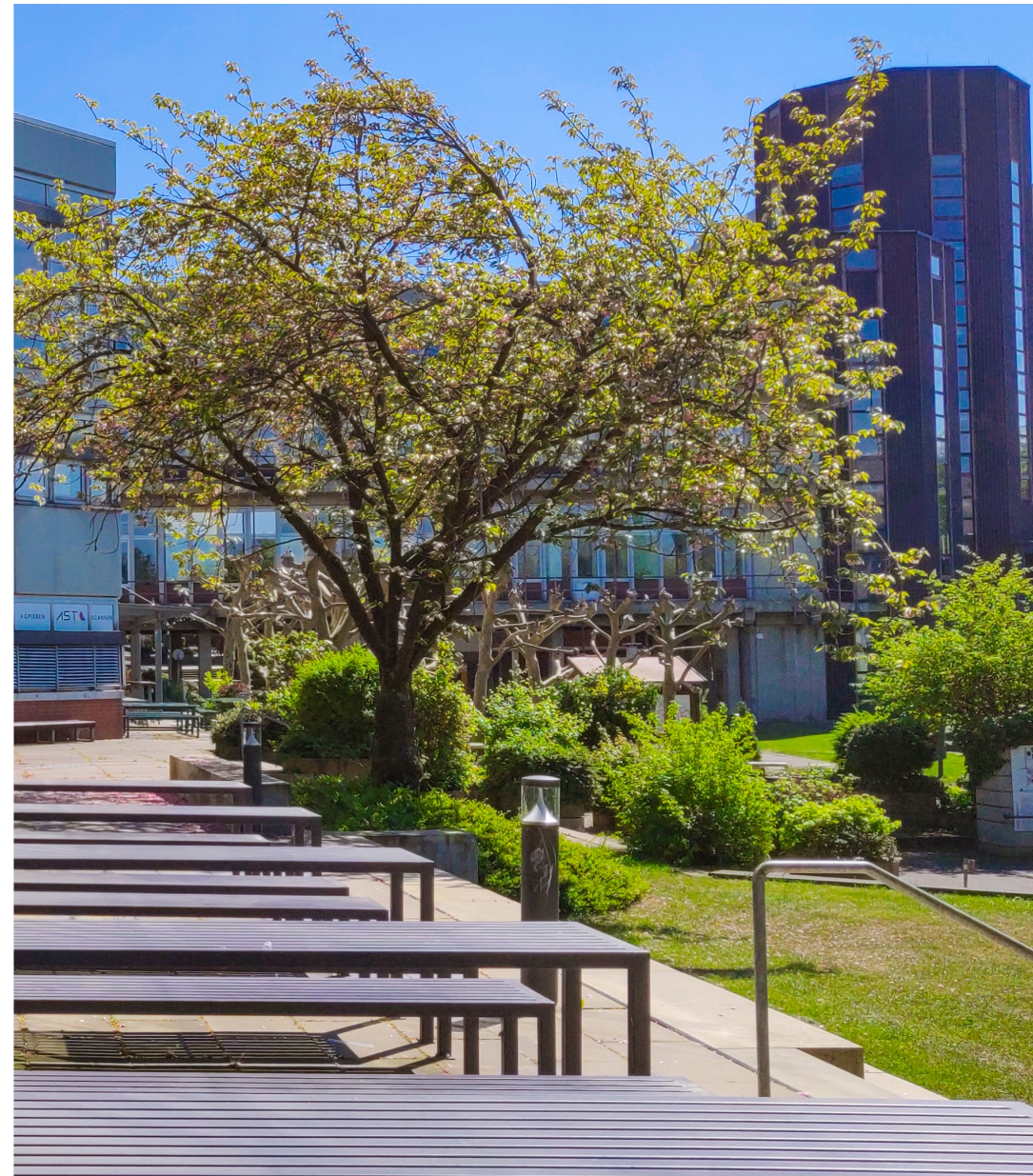




# Introduction to the Computer Engineering Master Program

Welcome Week Winter Semester 23/24

Prof. Dr. Marco Platzner · 04 October 2023





# Agenda

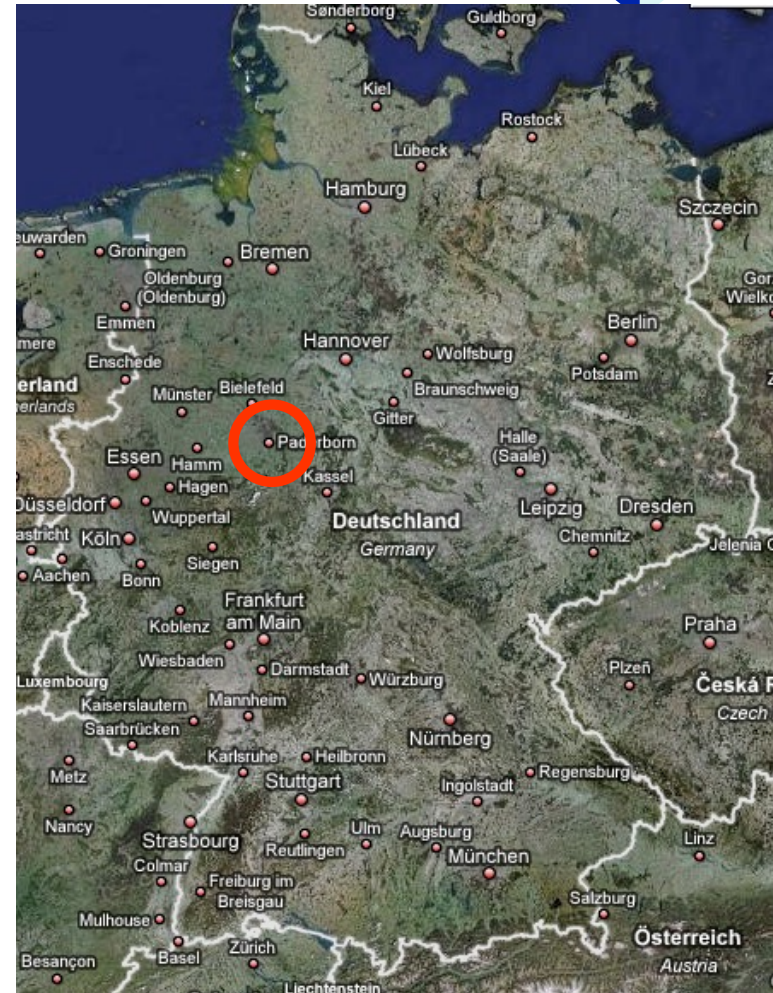
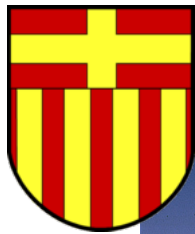
- 1. Paderborn University (UPB)**
- 2. Computer Engineering and Information Technology**
- 3. Prerequisites**
- 4. Master Computer Engineering**
  - Program structure
  - Study elements
  - Registration and exams
- 5. Getting Started and Getting Information**

# Paderborn University (UPB)



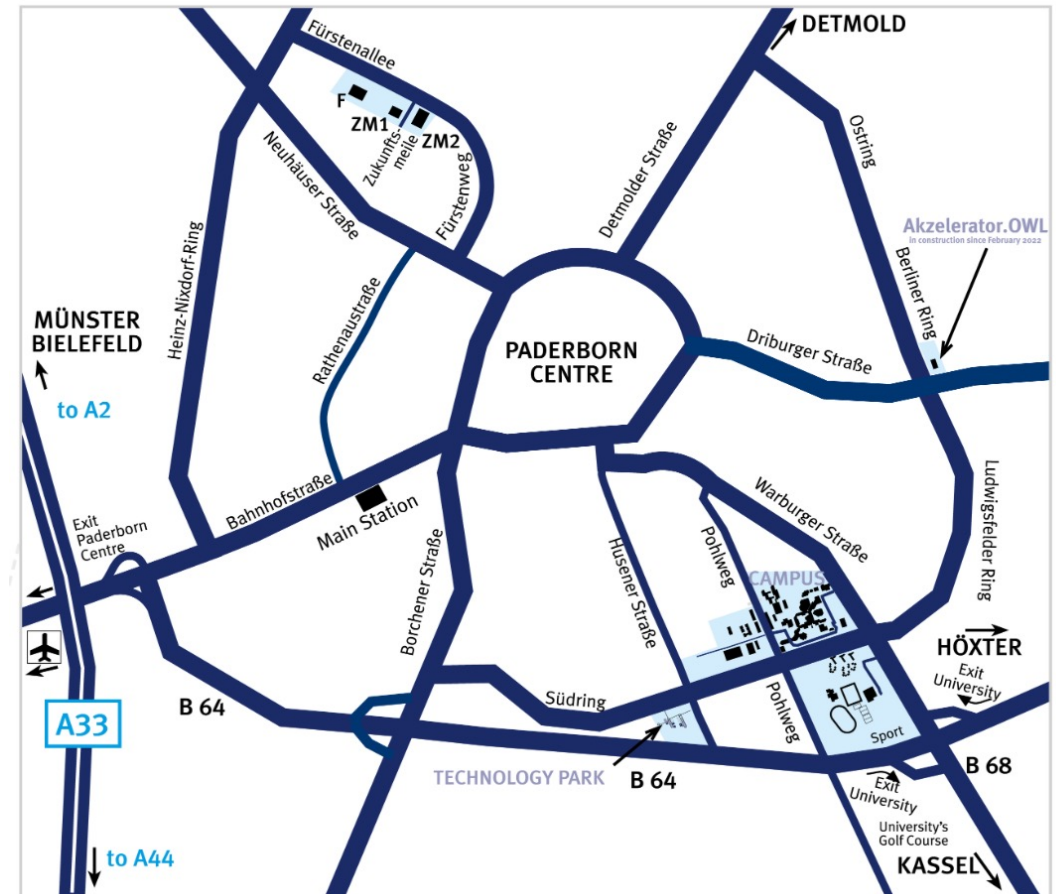
## Where is Paderborn?

- Population of 156'000
- First mentioned in 777
- First university founded 1614
- Current university founded 1972



## Paderborn University

- Main campus in the southern part of the city
  - Lecture halls, classrooms, workspaces
  - Part of the CS and EE departments
  - Central institutions such as
    - International Office (building I, 4<sup>th</sup> floor)
    - Central Examination Office (building C, 2<sup>nd</sup> floor)
    - Notebook Cafe (building I, ground floor)
- Smaller campus at “Fürstenallee”
  - Lecture halls, classrooms, workspaces
  - Part of the CS and EE departments





## Paderborn University (Statistics as of 2022)

- Students 19,076
- Total staff 2,099 + 707 externally funded
- Academic staff 1,349 + 661 externally funded
- Finances 274,130 T€ + 63,799 T€ external funds



### ORIGIN OF STUDENTS (WS 2021/22)

|   |        |       |
|---|--------|-------|
| Total                                   | 19,076 | 100 % |
| Federal state of North Rhine-Westphalia | 14,586 | 77 %  |
| Other German federal states             | 2,174  | 11 %  |
| Foreign countries                       | 2,316  | 12 %  |

### INTERNATIONAL STUDENTS

| Continent | Students | Percent |
|-----------|----------|---------|
| Africa    | 390      | 17%     |
| America   | 46       | 2%      |
| Asia      | 1,355    | 58%     |
| Australia | 1        | 0%      |
| Europe    | 524      | 23%     |
| Total     | 2,316    | 100%    |



## Paderborn University

- Key research areas
  - Digital humanities
  - Intelligent technical systems
  - Sustainable materials, processes and products
  - Optoelectronics and photonics
  - Transformation and education
- Faculties
  - Faculty for Arts and Humanities
  - Faculty for Business Administration and Economy
  - Faculty for Science
  - Faculty for Mechanical Engineering
  - Faculty for **Computer Science, Electrical Engineering and Mathematics**





## Faculty of Computer Science, Electrical Engineering and Mathematics

- Departments
  - Computer Science
  - Electrical Engineering and Information Technology
  - Mathematics
- Study programs
  - **Computer Science** (BA, MA)
  - **Computer Engineering** (BA, MA)
  - Electrical Engineering (BA, MA)
  - **Electrical Systems Engineering** (MA)
  - Mathematics (BA, MA)
  - Industrial Mathematics (BA, MA)
  - Teacher Training in EE, CS, Maths (BA, MA)
  - **Optoelectronics and Photonics** (MA)
  - Industrial Engineering (EE + economy) (BA, MA)
  - Business Informatics (BA, MA)

**can be studied in English**





# Computer Engineering and Information Technology



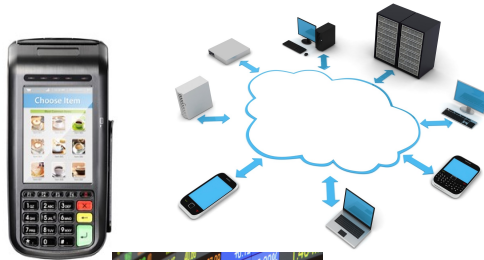
# Information Technology



... timely and entertaining infotainment



... modern and energy-efficient mobility



... networked and secure business



... progress in medicine

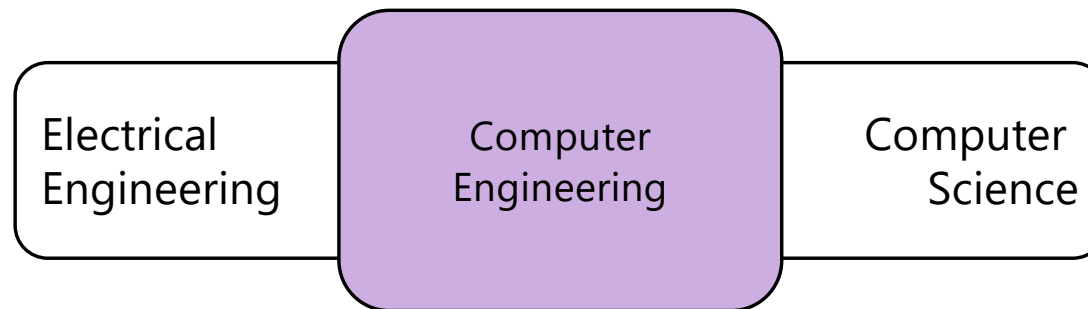
... and many more!





## What is Computer Engineering?

- Construction, analysis and evaluation of computers and computer-controlled systems
  - Such systems consist of **hardware AND software**
  - Knowledge and skills from **Electrical Engineering AND Computer Science** required
  - Key discipline of information technology with great demand for graduates





## Where Do We Find Computer Engineers?






## Computer Engineering at Paderborn University

- Internationally accepted profile (IEEE/ACM curriculum guidelines)
- Jointly developed and operated by the
  - Department of Computer Science and the
  - Department of Electrical Engineering & Information Technology

Computer Science | **Computer Engineering** | Electrical Engineering

Bachelor   
Master  

**Bachelor**   
**Master**  

Bachelor   
Master  



## Prerequisites





## Compatibility of Bachelor Programs

- Bachelor and Master Computer Engineering at UPB are consecutive study programs
- What you have learned in your preceding Bachelor program must roughly match what students have learned in the UPB Bachelor program
- This has been checked before admission but in case you realize deficits in individual courses
  - Ask lecturers about suitable materials for self-study
  - Discuss contents of CE Bachelor courses with local students
  - Work on your own to compensate deficits





## What we Expect

- Ability to apply foundations of CS and EE
- Experience with practical work in hardware/software systems
- Initial training in scientific work (seminar, thesis project)
  - searching for and analyzing scientific publications
  - writing scientific documents: adequate structure, clear descriptions and explanations, citations and references, correct use of the English language
  - creating and giving presentations
  - avoiding plagiarism <https://cs.uni-paderborn.de/en/studies/formalities/notes-on-plagiarism>





# Master Computer Engineering



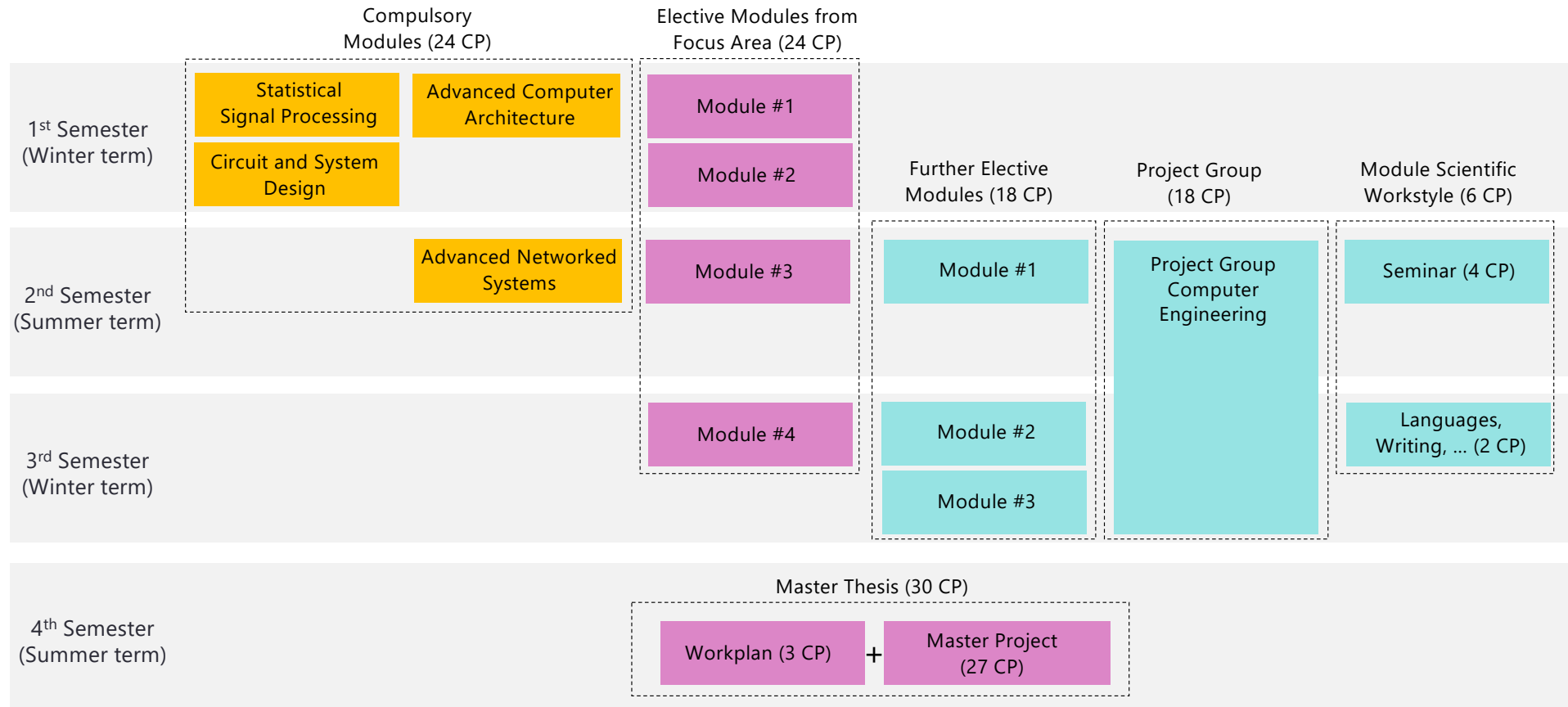


## Master Computer Engineering – Key Facts

- (Nominal) duration of 4 semesters including the Master's thesis
- Degree "Master of Science (M.Sc.)" awarded
- Provides expert knowledge and methods
- Qualifies for advanced jobs in industry and academia (e.g., PhD studies)



# Study Plan – Example





## Focus Areas of the Computer Engineering (CE) Master

- Embedded Systems
- Nano/Microelectronics
- Computer Systems
- Communication and Networks
- Signal, Image and Speech Processing
- Control and Automation





## Modules

- Modules are basic building blocks of the study program
- Modules may combine several courses, but in CE mostly one module = one course
- There are compulsory and elective modules
- Modules have an assigned workload, measured in ECTS credits or credit points (CP)
- Details are described in the Module Handbook (published every semester on the web)





## Module Handbook – Example “Advanced Computer Architecture”

- 6 CP module = 180 hours workload
- 15 weeks teaching period in each term
- Workload splits into
  - contact time (lecture, exercise, lab)
  - self-study time (during the teaching period and also outside the teaching period for exam preparation)

| Pflichtmodul Informatik II           |   |                                 |                                      |                       |                      |                        |
|--------------------------------------|---|---------------------------------|--------------------------------------|-----------------------|----------------------|------------------------|
| Computer Science II                  |   |                                 |                                      |                       |                      |                        |
| <b>Module number:</b><br>M.079.01252 | <b>Workload (h):</b><br>180   | <b>Credits:</b><br>6            | <b>Regular Cycle:</b><br>winter term |                       |                      |                        |
|                                      | <b>Semester number:</b><br>beliebig   | <b>Duration (in sem.):</b><br>1 | <b>Teaching Language:</b><br>en      |                       |                      |                        |
| 1                                    | <b>Module structure:</b>  |                                 |                                      |                       |                      |                        |
|                                      | <b>Course</b>   | <b>form of teaching</b>         | <b>contact-time (h)</b>              | <b>self-study (h)</b> | <b>status (C/CE)</b> | <b>group size (TN)</b> |
| a)                                   | L.079.05724<br>Advanced Computer Architecture   | L3<br>Ex2                       | 75                                   | 105                   | CE                   | 50/25                  |
| 2                                    | <b>Options within the module:</b><br>none   |                                 |                                      |                       |                      |                        |
| 3                                    | <b>Admission requirements:</b><br><i>Prerequisites of course Advanced Computer Architecture:</i><br><b>Recommended Proficiencies</b><br>Basic knowledge in computer architecture. |                                 |                                      |                       |                      |                        |

5 h contact time / week (3 h lecture + 2 h exercise) x 15 weeks = 75 h contact time  
75 h contact time + 105 h self-study = 180 h = 6 CP





| 4  | <p><b>Contents:</b></p> <p><i>Contents of the course Advanced Computer Architecture:</i><br/>The course teaches concepts and methods used in modern processor architecture to exploit the available parallelism at the levels of instructions, data and threads.</p> <ul style="list-style-type: none"> <li>• Fundamentals of computer architectures (refresher)</li> <li>• Memory hierarchy design</li> <li>• Instruction-level parallelism</li> <li>• Data-level parallelism: Vector, SIMD and GPU architectures</li> <li>• Thread-level parallelism</li> <li>• Warehouse-scale computer</li> </ul>   |                              |                                |                   |                                |    |                             |                              |      |
|----|---|------------------------------|--------------------------------|-------------------|--------------------------------|----|-----------------------------|------------------------------|------|
| 5  | <p><b>Learning outcomes and competences:</b></p> <p>After attending the course, the students</p> <ul style="list-style-type: none"> <li>• are able to explain principles of modern memory hierarchies,</li> <li>• to analyze different levels of parallelism,</li> <li>• to assess the suitability of different architectural concepts and thus</li> <li>• to evaluate modern developments in computer architecture.</li> </ul> <p><b>Non-cognitive Skills</b></p> <ul style="list-style-type: none"> <li>• Team work</li> <li>• Learning competence</li> </ul>   |                              |                                |                   |                                |    |                             |                              |      |
| 6  | <p><b>Assessments:</b></p> <p><input checked="" type="checkbox"/> Final module exam (MAP)    <input type="checkbox"/> Module exam (MP)    <input type="checkbox"/> Partial module exams (MTP)</p> <table border="1"> <thead> <tr> <th>zu</th> <th>Type of examination</th> <th>Duration or scope</th> <th>Weighting for the module grade</th> </tr> </thead> <tbody> <tr> <td>a)</td> <td>Written or oral examination</td> <td>90-120 minutes or 40 minutes</td> <td>100%</td> </tr> </tbody> </table> <p>The responsible lecturer announces type and duration of assessment modalities in the first three weeks of the lecture period at latest.</p> | zu                           | Type of examination            | Duration or scope | Weighting for the module grade | a) | Written or oral examination | 90-120 minutes or 40 minutes | 100% |
| zu | Type of examination   | Duration or scope            | Weighting for the module grade |                   |                                |    |                             |                              |      |
| a) | Written or oral examination   | 90-120 minutes or 40 minutes | 100%                           |                   |                                |    |                             |                              |      |
| 7  | <p><b>Study Achievement:</b></p> <table border="1"> <thead> <tr> <th>zu</th> <th>Type of achievement</th> <th>Duration or Scope</th> <th>SL / QT</th> </tr> </thead> <tbody> <tr> <td>a)</td> <td>Written exercises</td> <td></td> <td>CA</td> </tr> </tbody> </table> <p>Within the first three weeks of the lecture period each respective lecturer will specify the manner in which the course achievement will be conducted.</p>  | zu                           | Type of achievement            | Duration or Scope | SL / QT                        | a) | Written exercises           |                              | CA   |
| zu | Type of achievement   | Duration or Scope            | SL / QT                        |                   |                                |    |                             |                              |      |
| a) | Written exercises   |                              | CA                             |                   |                                |    |                             |                              |      |
| 8  | <p><b>Prerequisites for participation in examinations:</b></p> <p>Passing of course achievement</p>   |                              |                                |                   |                                |    |                             |                              |      |
| 9  | <p><b>Prerequisites for assigning credits:</b></p> <p>The credit points are awarded after the module examination was passed.</p>  |                              |                                |                   |                                |    |                             |                              |      |

|    |  |
|----|--|
| 10 | <p><b>Weighing for overall grade:</b></p> <p>The module is weighted as 6 credits.</p>  |
| 11 | <p><b>Reuse in degree courses or degree course versions :</b></p> <p>Masterstudiengang Computer Engineering v3 (CEMA v3)</p>   |
| 12 | <p><b>Module coordinator:</b></p> <p>Prof. Dr. Marco Platzner</p>  |
| 13 | <p><b>Other Notes:</b></p> <p><i>Remarks of course Advanced Computer Architecture:</i></p> <p><b>Implementation method</b></p> <ul style="list-style-type: none"> <li>• Lecture with projector and board</li> <li>• Interactive exercises in the lecture room item Computer-based exercises with simulation tools</li> <li>• Analysis of case studies</li> </ul> <p><b>Learning Material, Literature</b></p> <ul style="list-style-type: none"> <li>• Lecture slides and exercise sheets</li> <li>• Exercise sheets and technical documentation for the for the computer-based exercises</li> <li>• Hennessey, Patterson: Computer Architecture: A Quantitative Approach (5th edition or newer), Morgan Kauf- mann, 2012.</li> <li>• Information about alternative and additional literature as well as teaching material on the course's website and in the lecture slides</li> </ul> |





## Course (6 CP)

- Comprise typically lecture + exercise and/or lab
  - Exercises can be paper & pencil exercises or programming assignments
  - Sometimes lab work
  - May require to pass a course achievement (e.g., a programming assignment, short report, ...) to be able to register for the exam
- Special case: Course “Languages, Writing and Presentation Techniques” (2 CP)
  - You can choose any course offer from Paderborn University in above topics
  - Use it to individually strengthen your professional skills







## Seminar (4 CP)

- Seminars train scientific work style
  - Be aware and learn about good practices and, importantly, avoid the problem of plagiarism (!)
- What is done in a seminar?
  - Lecturers propose a set of topics
  - Students select or are assigned a topic
  - Perform literature search
  - Read, analyze and compare selected literature
  - Prepare and give a presentation with slides
  - Submit a written report
- Seminars do not belong to specific focus areas





## Project Group (18 CP)

- What is done in a project group?
  - A team of typically 6-10 students works on a larger project over two semesters
  - Concept and implementation of a hardware/software system
  - Project management (including documentation) is part of the task
  - Work there is highly self-organized, requires your active contribution
  - Usually requires to be present at least two days per week in Paderborn
- Project groups do not belong to specific focus areas
- A technicality
  - Project groups offered in the CS department run over two semesters (18 CP)
  - Project groups offered in the EE department may consist of two consecutive smaller project groups with 9 CP each





## Master Thesis (30 CP)

- The Master thesis has 30 CP = one semester full-time (!)
  - Duration of 6 months is formally checked
- Master's thesis (advisor) must be from chosen focus area
- Tasks typically included
  - Study of literature on the assigned topic, familiarize with tools
  - Write work plan (proposal), including a time plan
  - Give an initial presentation that covers the topic and the work plan
  - Conceptual work and/or formal work and/or hardware and software development
  - Experiments and evaluation
  - Write a report with ~80-120 pages on a scientific level
  - Give a final presentation that covers the thesis work (defend your decisions and solutions/results)





## Registration

- For a course
  - Register in PAUL for the course, the course achievement, and for the exam (!)
  - Periods for the registrations are displayed in PAUL
  - De-register if you don't want to take an exam. Otherwise, you might get stuck with that course/module.
- For a seminar and for a project group?
  - Different seminars and project groups are offered each semester
  - Assignment process in place that starts at the end of the teaching period for offers in the following semester
  - All upcoming project groups are presented in a public event in the last week of the teaching period
- Finding a topic for a Master thesis
  - Address professors/lecturers/research associates working in the areas of your interest
  - Often, Master theses result from project groups
  - Check out research groups' web pages and boards
  - Defining a topic is often an interactive process between student and potential advisor
  - Often, you can also bring own ideas for discussion





## Exams

- Exams for courses can be in oral or in written form
  - The form has to be announced in class within the first three weeks of the teaching period
- Written exams are usually offered twice a year
  - Either two exams in the semester break following the teaching period, or one exam in each of the two following semester breaks
- Oral exams require individual appointments with the lecturer
- Exams can be repeated twice (three attempts)
- Passed exams cannot be repeated (!)

### Grading scheme

|                 |              |
|-----------------|--------------|
| – 1.0, 1.3      | very good    |
| – 1.7, 2.0, 2.3 | good         |
| – 2.7, 3.0, 3.3 | satisfactory |
| – 3.7, 4.0      | sufficient   |
| – 5.0           | failed       |





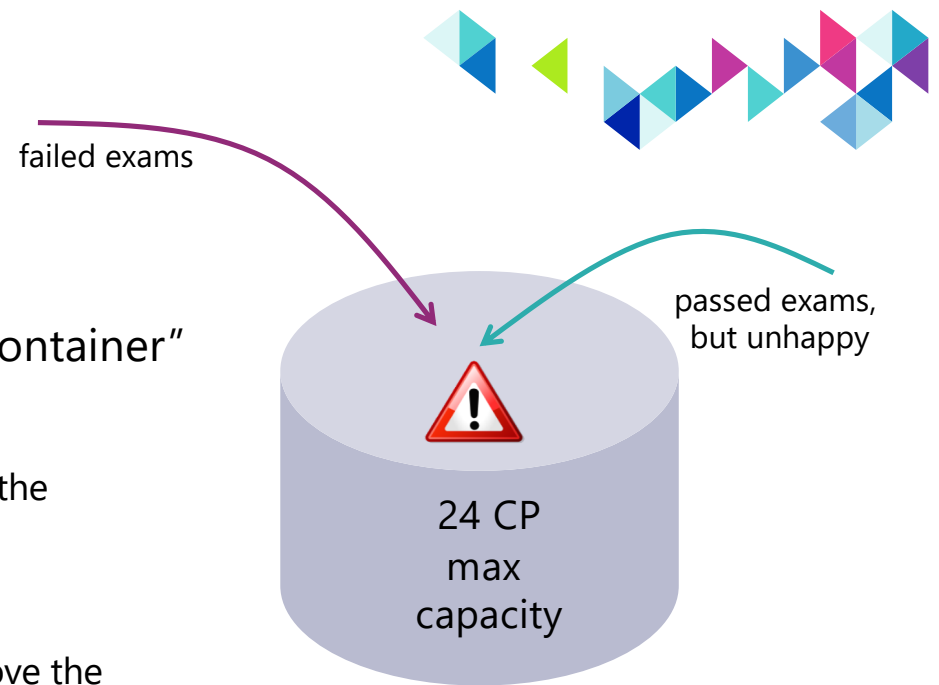
## More on Exams

- Seminars can also be repeated twice
  - Evaluation of the presentation, seminar report, active participation in discussions
- Project groups can also be repeated twice – but you do not want to do that ...
  - Quality of result and reports / presentations as team contributions, individual contribution
- The Master's thesis can only be repeated once, but you really do not want to do that ...
  - Evaluation by the advisor and a co-advisor



## Even More on Exams

- For elective modules, compensation is possible: The “Container”
- Shifting (“compensating”) failed exams
  - A failed exam (failed in 1<sup>st</sup>, 2<sup>nd</sup> or 3<sup>rd</sup> attempt) can be moved into the container and another module can be completed instead
- Improving the overall grade
  - If you pass an exam but have an unsatisfactory result, you can move the module into the container and complete a different module instead
- All passed modules in the container are listed in the Transcript of Records as “extra achievements”
- BUT the container size is limited to 24 CP (!)





## Final Failure in the Master Program is Possible, If ...

- You can't pass a compulsory course (or the seminar, or the project group) in 3 attempts
- You can't pass the Master thesis in 2 attempts
- You have no more options to compensate elective courses
  
- Be careful and serious about exams, do not waste examination attempts (!)





## Getting Started and Getting Information





## Plan Your First Semester!

- Check the course catalogue at <https://paul.uni-paderborn.de>
- Navigate to [Overview > Faculty of Computer Science, Electrical Engineering and Mathematics > Computer Science > Computer Engineering Studies \(since WiSe17/18\) > Master Studies Computer Engineering](#)
- Browse through the courses in the compulsory area and areas of specialisation to identify courses you might wish to take in this winter term
- If you don't have an idea yet which focus area to select, don't worry! Just pick modules according to your interests.
- Register for the module as well as the course in it. Also, register for the course achievement (if available) and the exam in the corresponding registration periods – and mind the deadlines (!)
- You can't take a seminar or a project group in your first semester





## Tips

- You are responsible for planning and organizing your study program
  - Selecting courses, visiting lectures, all the registrations, finding seminars / project group / Master thesis
- Form learning groups
  - Query each other, explain subjects to each other; learn for understanding, not just for repetition of materials
  - Team up with other international students, they are faced with the same situation
  - Team up with local students, they likely have done their Bachelor studies here and know the ropes
- Approach professors and research associates if you have questions
  - That is totally fine and usual here (!)
- Learn some German or at least pick it up on the go
  - This will strongly increase your later job prospects in Germany
- When something is not clear or there is a problem, talk to the lecturer, the study advisors, whoever might be able to help. Don't wait too long!





## Common Pitfalls

- Deadlines are indeed important!
  - Some things can be amended if you miss a deadline, others can't and can result in delays of up to one year
  - You are faced with the same situation
- You need to register for all sorts of things!
  - Do it – and mind the deadlines
- If you decide to not go on with course, de-register from it!
  - And from everything associated with the course – and mind the deadlines





## Finally: What You Need to Get the Master's Degree

| You have to ...  | ECTS CP |
|--|---------|
| ... complete the four compulsory modules                       | 24      |
| ... complete four modules in your chosen focus area            | 24      |
| ... complete three modules in whatever area                    | 18      |
| ... complete a seminar and a course in Languages, Writing, ... | 6       |
| ... complete a project group                                   | 18      |
| ... complete a Master's thesis (must be from your focus area)  | 30      |
| Adding up to   | 120     |

**It is your own responsibility to meet these criteria!**





## Getting Information

- CE program website: [www.eim.upb.de/ce/en](http://www.eim.upb.de/ce/en)
  - Links to module handbook and examination regulations
- Websites of the departments and their research groups:
  - Department of Computer Science: [cs.uni-paderborn.de/en/](http://cs.uni-paderborn.de/en/)
  - Department of Electrical Engineering and Information Technology: [ei.uni-paderborn.de/en/](http://ei.uni-paderborn.de/en/)
- Campus management system: [paul.upb.de](http://paul.upb.de)
- E-Learning platform Panda for individual modules: [panda.uni-paderborn.de](http://panda.uni-paderborn.de)
- International office: [www.uni-paderborn.de/en/studies/international-office](http://www.uni-paderborn.de/en/studies/international-office)
- Central study advice center: [zsb.uni-paderborn.de/en/](http://zsb.uni-paderborn.de/en/)





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**Please use your official mail-account (“IMT-account”) for communication**



**We wish you a successful & enriching study  
experience at Paderborn University!**

