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**
   - a. Program structure
   - b. Study elements
   - c. 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, 4th floor)
    - Central Examination Office (building C, 2nd 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)

<table>
<thead>
<tr>
<th>Origin</th>
<th>Students</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>19,076</td>
<td>100 %</td>
</tr>
<tr>
<td>Federal state of North Rhine-Westphalia</td>
<td>14,586</td>
<td>77 %</td>
</tr>
<tr>
<td>Other German federal states</td>
<td>2,174</td>
<td>11 %</td>
</tr>
<tr>
<td>Foreign countries</td>
<td>2,316</td>
<td>12 %</td>
</tr>
</tbody>
</table>

### INTERNATIONAL STUDENTS

<table>
<thead>
<tr>
<th>Continent</th>
<th>Students</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>390</td>
<td>17 %</td>
</tr>
<tr>
<td>America</td>
<td>46</td>
<td>2 %</td>
</tr>
<tr>
<td>Asia</td>
<td>1,355</td>
<td>58 %</td>
</tr>
<tr>
<td>Australia</td>
<td>1</td>
<td>0 %</td>
</tr>
<tr>
<td>Europe</td>
<td>524</td>
<td>23 %</td>
</tr>
<tr>
<td>Total</td>
<td>2,316</td>
<td>100 %</td>
</tr>
</tbody>
</table>
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?

- Research
- Development
- Management
- Technical Monitoring
- Measurement and Test Engineering
- Production
- Training
- Marketing and Sales
- Consulting and Project Management

Prof. Dr. Marco Platzner ∙ Introduction to the Computer Engineering Master Program ∙ 04 October 2023
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
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 [link to plagiarism notes]

[link to plagiarism notes]
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

<table>
<thead>
<tr>
<th>Compulsory Modules (24 CP)</th>
<th>Elective Modules from Focus Area (24 CP)</th>
<th>Further Elective Modules (18 CP)</th>
<th>Project Group (18 CP)</th>
<th>Module Scientific Workstyle (6 CP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Semester (Winter term)</td>
<td>Statistical Signal Processing</td>
<td>Module #1</td>
<td>Module #1</td>
<td>Seminar (4 CP)</td>
</tr>
<tr>
<td></td>
<td>Advanced Computer Architecture</td>
<td>Module #2</td>
<td>Module #2</td>
<td>Languages, Writing, … (2 CP)</td>
</tr>
<tr>
<td></td>
<td>Circuit and System Design</td>
<td>Module #3</td>
<td>Module #3</td>
<td></td>
</tr>
<tr>
<td>2nd Semester (Summer term)</td>
<td>Advanced Networked Systems</td>
<td>Module #4</td>
<td>Module #4</td>
<td></td>
</tr>
</tbody>
</table>

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</tr>
</thead>
<tbody>
<tr>
<td>3rd Semester (Winter term)</td>
<td>Further Elective Modules (18 CP)</td>
<td>Project Group Computer Engineering</td>
<td>Seminar (4 CP)</td>
<td>Languages, Writing, … (2 CP)</td>
</tr>
<tr>
<td></td>
<td>Module #1</td>
<td>Project Group Computer Engineering</td>
<td>Seminar (4 CP)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Module #2</td>
<td>Project Group Computer Engineering</td>
<td>Seminar (4 CP)</td>
<td></td>
</tr>
<tr>
<td></td>
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<td>Project Group Computer Engineering</td>
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<th>Project Group (18 CP)</th>
<th>Module Scientific Workstyle (6 CP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4th Semester (Summer term)</td>
<td>Master Thesis (30 CP)</td>
<td></td>
<td>Master Project (27 CP)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Workplan (3 CP)</td>
<td></td>
<td>Master Project (27 CP)</td>
<td></td>
</tr>
</tbody>
</table>
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)

CP or ECTS Credits
- 1 CP = 30 hours workload
- 30 CP per semester
- Master program has 120 CP in total

• 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)

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 Contents:
    Contents of the course Advanced Computer Architecture:
    The course teaches concepts and methods used in modern processor architecture to exploit the
    available parallelism at the levels of instructions, data and threads.
    - Fundamentals of computer architectures (refresher)
    - Memory hierarchy design
    - Instruction-level parallelism
    - Data-level parallelism: Vector, SIMD and GPU architectures
    - Thread-level parallelism
    - Warehouse-scale computer

5 Learning outcomes and competences:
    After attending the course, the students
    - are able to explain principles of modern memory hierarchies,
    - to analyze different levels of parallelism,
    - to assess the suitability of different architectural concepts and thus
    - to evaluate modern developments in computer architecture.

Non-cognitive Skills
    - Team work
    - Learning competence

6 Assessments:

<table>
<thead>
<tr>
<th>Type of examination</th>
<th>Duration or scope</th>
<th>Weighting for the module grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written or oral examination</td>
<td>90-120 minutes or 40 minutes</td>
<td>100%</td>
</tr>
</tbody>
</table>

The responsible lecturer announces type and duration of assessment modalities in the first three weeks of the lecture period at latest.

7 Study Achievement:

<table>
<thead>
<tr>
<th>Type of achievement</th>
<th>Duration or Scope</th>
<th>SL / QT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written exercises</td>
<td>CA</td>
<td></td>
</tr>
</tbody>
</table>

Within the first three weeks of the lecture period each respective lecturer will specify the manner in which the course achievement will be conducted.

8 Prerequisites for participation in examinations:
    Passing of course achievement

9 Prerequisites for assigning credits:
    The credit points are awarded after the module examination was passed.

10 Weighing for overall grade:
    The module is weighted as 6 credits.

11 Reuse in degree courses or degree course versions:
    Masterstudiengang Computer Engineering v3 (CEMA v3)

12 Module coordinator:
    Prof. Dr. Marco Platzner

13 Other Notes:
    Remarks of course Advanced Computer Architecture:
    Implementation method
    - Lecture with projector and board
    - Interactive exercises in the lecture room item Computer-based exercises with simulation tools
    - Analysis of case studies

Learning Material, Literature
    - Lecture slides and exercise sheets
    - Exercise sheets and technical documentation for the for the computer-based exercises
    - Information about alternative and additional literature as well as teaching material on the course's website and in the lecture slides
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 (!)

<table>
<thead>
<tr>
<th>Grading scheme</th>
<th>very good</th>
<th>good</th>
<th>satisfactory</th>
<th>sufficient</th>
<th>failed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0, 1.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.7, 2.0, 2.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.7, 3.0, 3.3</td>
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</tr>
<tr>
<td>3.7, 4.0</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>5.0</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
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 1st, 2nd or 3rd 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

<table>
<thead>
<tr>
<th>You have to …</th>
<th>ECTS CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>… complete the four compulsory modules</td>
<td>24</td>
</tr>
<tr>
<td>… complete four modules in your chosen focus area</td>
<td>24</td>
</tr>
<tr>
<td>… complete three modules in whatever area</td>
<td>18</td>
</tr>
<tr>
<td>… complete a seminar and a course in Languages, Writing, …</td>
<td>6</td>
</tr>
<tr>
<td>… complete a project group</td>
<td>18</td>
</tr>
<tr>
<td>… complete a Master’s thesis (must be from your focus area)</td>
<td>30</td>
</tr>
<tr>
<td>Adding up to</td>
<td>120</td>
</tr>
</tbody>
</table>

It is your own responsibility to meet these criteria!
Getting Information

• CE program website: 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/
  - Department of Electrical Engineering and Information Technology: ei.uni-paderborn.de/en/

• Campus management system: paul.upb.de

• E-Learning platform Panda for individual modules: panda.uni-paderborn.de

• International office: www.uni-paderborn.de/en/studies/international-office

• Central study advice center: zsb.uni-paderborn.de/en/
Contact

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  sybille.hellebrand@uni-paderborn.de

Please use your official mail-account ("IMT-account") for communication
We wish you a successful & enriching study experience at Paderborn University!