Welcome to Paderborn
October 2021

Introduction to the Master Program in Computer Science
Dr. Harald Selke
Paderborn University Campus

- Main campus in the southern part of the city
- Central institutions like
  - International Office (building I, 4th floor)
  - Central Examination Office (building C, 2nd floor)
  - Notebook Cafe (building I, ground floor)
- Lecture halls, class rooms, work spaces
- Part of the CS Department (building O)

- Smaller campus at Fürstenallee
- Part of the CS Department (building F) – and me
Outline

- Prerequisites
- Elements of the Master Degree Program
- Structure of the Program
- Scope and Schedule
- Examinations

How to contact me

- Email: study-cs@mail.uni-paderborn.de
- Web: https://cs.uni-paderborn.de/en/studies/advice-and-support/academic-advising/
- Twitter: @Study_CS_UPB
- YouTube: https://www.youtube.com/user/FakultaetEIM
- Office: F2.119 in Fuerstenallee building
Prerequisites of the Master Program

What you learnt in your Bachelor program …
- in India, Albania, Indonesia, Pakistan, …

… must match (roughly) what Paderborn students learn in their Bachelor Degree studies.
- The teaching goals of the Paderborn Bachelor Degree Program match the necessary prerequisites.
  - mostly done in German
  - content organization comparable to Master program
  - same teaching staff

Bachelor and Master are designed as a consecutive study program.
Prerequisites of the Master Program

Most important check has already been done before admission!

- We want you to succeed!

- Self-assessment: https://cs.uni-paderborn.de/en/studies/getting-started/information-for-international-students/
# Bachelor Degree Program in Paderborn

<table>
<thead>
<tr>
<th>1</th>
<th>Programming Programming Languages</th>
<th>Modelling</th>
<th>Calculus for Computer Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Software Engineering Database Systems</td>
<td>Data Structures and Algorithms</td>
<td>Digital Design</td>
</tr>
<tr>
<td>3</td>
<td>Software Engineering Project</td>
<td>Computability and Complexity</td>
<td>Computer Architecture</td>
</tr>
<tr>
<td>4</td>
<td>Designing User Interfaces</td>
<td>Module from Algorithms and Complexity</td>
<td>System Software and System Level Programming</td>
</tr>
<tr>
<td>5</td>
<td>Module from Software Engineering</td>
<td>IT Security</td>
<td>Module from Computer Systems</td>
</tr>
<tr>
<td>6</td>
<td>Module from Data and Knowledge</td>
<td>Specialization Module</td>
<td>Bachelor's Thesis</td>
</tr>
</tbody>
</table>
On a more abstract level

Ability to apply foundations of Computer Science

- usage of formal methods to specify problems, structures, systems, languages, …
- formal methods to analyze algorithms
- formal methods to check solutions
- proving properties of algorithms (correctness, performance, …)

Experience in doing practical work

- application of methods and tools for software design and implementation
- solid background in object-oriented concepts
- substantial experience in at least one programming language
- ability to switch to a new programming language within a short time
There’s more to it!

Ability to do scientific work
- searching for and investigating scientific publications
- writing scientific documents
  - adequate structure, clear descriptions and explanations, citations and references, correct English
- developing and giving presentations
- avoid plagiarism https://cs.uni-paderborn.de/en/studies/formalities/notes-on-plagiarism

Check the self-assessments for courses before choosing them:
https://cs.uni-paderborn.de/en/studies/getting-started/information-for-international-students/self-assessment-tests-for-master-lectures/
Study Structure

Six Focus Areas

- Algorithm Design
- Computer Systems
- Data Science
- Intelligence and Data
- Networks and Communication
- Software Engineering

You have to choose one of these areas as specialization area when applying for a master’s thesis.

- No need to decide now, but it’s good to have an idea.
- Yet: Plan ahead and ideally try to you have three modules in the focus area you wish to write your Master’s thesis in after three semesters.
- You can’t start your Master’s thesis without meeting this requirement!
Every student has to

- study three modules in the area of specialization,
- study one module in some other focus area,
- study four more modules in whatever area they like.

Hence every student has to take 8 modules overall.

Most modules are offered once per year.

Every module has 6 ECTS points

- belongs to one or more focus areas (of the six).
- consists of exactly one class (from that focus area).
- is described in the module handbook (Modulhandbuch).
- If a module belongs to more than one focus area, you can move it later to meet the specialization area requirement.
# Master Degree Program in Paderborn (Example)

<table>
<thead>
<tr>
<th>1</th>
<th>Module I</th>
<th>Module II</th>
<th>Module III</th>
<th>Module IV</th>
<th>Module V</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Project Group</td>
<td>Module VI</td>
<td>Seminar I</td>
<td>Extracurricular Studies</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Module VII</td>
<td>Module VIII</td>
<td>Seminar II</td>
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<tr>
<td>4</td>
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<td></td>
<td>Master’s Thesis</td>
<td></td>
</tr>
</tbody>
</table>
# Master Degree Program in Paderborn (Example I)

<table>
<thead>
<tr>
<th>1</th>
<th>Advanced Computer Architecture (Computer Systems)</th>
<th>Advanced Algorithms (Algorithm Design)</th>
<th>Information Retrieval (Data Science)</th>
<th>Designing code analyses … (SE)</th>
<th>Foundations of Knowledge Graphs (I&amp;D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Project Group</td>
<td>Game Theory (Algorithm Design)</td>
<td></td>
<td>Seminar I</td>
<td>Extracurricular Studies</td>
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<tr>
<td>4</td>
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<td>Master’s Thesis</td>
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</tbody>
</table>
## Master Degree Program in Paderborn (Example II)

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<tbody>
<tr>
<td>2</td>
<td>Game Theory (Algorithm Design)</td>
<td></td>
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<td></td>
<td>Seminar I</td>
</tr>
<tr>
<td>3</td>
<td>Project Group</td>
<td>Foundations of Cryptography (Algorithm Design)</td>
<td>Routing and Data Management in Networks (Algorithm Design)</td>
<td></td>
<td>Seminar II</td>
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<tr>
<td>4</td>
<td>Master’s Thesis</td>
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<td>Extracurricular Studies</td>
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### Master Degree Program in Paderborn (Example III)

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<table>
<thead>
<tr>
<th></th>
<th>Project Group</th>
<th>Game Theory (Algorithm Design)</th>
<th>Seminar I</th>
<th>Seminar II</th>
<th>Extracurricular Studies</th>
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<tbody>
<tr>
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</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Foundations of Cryptography (Algorithm Design)</th>
<th>VLSI Testing (Computer Systems)</th>
<th>Master’s Thesis</th>
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<tbody>
<tr>
<td>1</td>
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<td>4</td>
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</table>
Module Handbook

Contains detailed descriptions of all courses

- Content
- Type of exam
- Language of instruction (> 90% are in English)
- When to expect: winter or summer semester

- Also contains lists which module is in which focus areas.

- Updated each semester, see https://cs.uni-paderborn.de/en/studies/advice-and-support/academic-advising/

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<table>
<thead>
<tr>
<th>Module number:</th>
<th>Workload (h):</th>
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<tbody>
<tr>
<td></td>
<td>180</td>
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</table>

<table>
<thead>
<tr>
<th>Semester number</th>
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<tbody>
<tr>
<td></td>
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</tbody>
</table>

1. Module structure:
   - Course
     - a) Logic Programming for Artificial Intelligence

2. Options within the module:
   - none

3. Admission requirements:
   - Prerequisites of course Logic Programming
   - Relevant courses: Logic Programming, Artificial Intelligence

4. Contents:
   - Logic Programming
   - Artificial Intelligence
   - Formal Languages
   - Computational Logic
   - Constraint Solvers
   - Program Development
   - Knowledge Representation
   - Automated Reasoning

5. Learning outcomes and competences:
   - Students learn
     - factual knowledge about
     - methodological knowledge, including
     - transfer skills

   - the ability to define domain specific languages
   - the ability to implement interpreters for domain specific languages
   - the ability to develop small question answering systems
   - the ability to develop software for theorem provers or constraint solvers solving puzzles

   - the ability to transfer the methodologies and skills gained to other data sources, knowledge representation formats, or calculi
   - the ability to transfer the parsing and semantics knowledge to domain specific languages

   - normative evaluation skills including the ability to assess
     - the suitability and limitations of different data and knowledge representation formats for different tasks
     - the suitability of different programming paradigms for different projects
     - the effort and feasibility of projects aiming natural language understanding
     - the effort and feasibility of projects aiming at automated translation

   - Non-cognitive Skills
   - Learning Competence
   - Learning Motivation

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>a) Written or oral examination</td>
<td>90-120 min or 40 min</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/GT</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) 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.
Modules in Algorithm Design

- Advanced Algorithms
- Advanced Complexity Theory
- **Advanced Distributed Algorithms and Data Structures**
- Algorithms for Highly Complex Virtual Scenes
- Clustering Algorithms
- Combinatorial Optimization
- Efficiency in Games

- Foundations of Cryptography
- **Game Theory**
- Introduction to Quantum Computation
- Quantum Algorithms
- Quantum Complexity Theory
- Real World Crypto Engineering
- Routing and Data Management in Networks
- Web Security
Modules in Computer Systems

- Advanced Computer Architecture
- Algorithms for Synthesis and Optimization of Integrated Circuits
- Approximate Computing
- Architektur paralleler Rechnersysteme
- High-Performance Computing
- Reconfigurable Computing
- VLSI Testing
Modules in Data Science

- Advanced Algorithms
- Advanced Distributed Algorithms and Data Structures
- Digitale Sprachsignalverarbeitung
- Data Science in Industrial Applications
- Foundations of Knowledge Graphs
- High-Performance Computing

- Information Retrieval
- Machine Learning I
- Machine Learning II
- Statistical Natural Language Processing
- Topics in Pattern Recognition and Machine Learning
- Topics in Signal Processing
Modules in Intelligence and Data

- Clustering Algorithms
- Computational Argumentation
- Data Science for Physics and Engineering
- Foundations of Knowledge Graphs
- Information Retrieval
- Logic Programming for Artificial Intelligence

- Machine Learning I
- Machine Learning II
- Planning and Heuristic Search
- Statistical Natural Language Processing
- Statistical Signal Processing
Modules in Networks and Communication

- Advanced Distributed Algorithms and Data Structures
- Networked Embedded Systems
- Routing and Data Management in Networks
Modules in Software Engineering

- Build It, Break It, Fix It
- Data-Driven Innovation and Engineering
- Data Science in Industrial Applications
- Designing code analyses for large-scale software systems 1
- Designing code analyses for large-scale software systems 2
- High-Performance Computing
- Kontextuelle Informatik (in German)
- Logic Programming for Artificial Intelligence
- Model-Based Systems Engineering
- Software Quality Assurance
- Software Engineering for Self-Adaptive Systems (°)
Modules in Security (planned new focus area; not yet certain)

- Advanced Distributed Algorithms and Data Structures
- Build It, Break It, Fix It
- Designing code analyses for large-scale software systems 1
- Designing code analyses for large-scale software systems 2
- Foundations of Cryptography
- Introduction to Quantum Computation
- Quantum Complexity Theory
- Real World Crypto Engineering
- Web Security
Seminars are special

- Count for 5 ECTS points
- 2 meeting hours per week or compact on two to three days
- Teacher proposes topics (Seminarthemen)
- Every student selects or is assigned one topic to work on and then
  - prepares a talk with slides (Seminarvortrag)
  - submits a seminar paper (Ausarbeitung)

- You need to work scientifically and be aware of good practices and the problem of plagiarizing in particular!
- Seminars do not belong to specific focus areas. You are free to choose.
- See https://cs.uni-paderborn.de/en/studies/study-elements/seminars-of-computer-science/ for information on how to apply for a seminar.
Project Groups are even more special

- Workload: 20 ECTS points in one year – including semester breaks

- Presentation of all project groups in a public event (Projektgruppenvorstellung) in the last week of teaching season – you should participate to find a group that suits you.

- Interested students apply for a project group and 8 to 16 students are accepted.
  - Ranking by you as well as by the lecturers.

- Working for two semesters on a project (often: concept and implementation of some software)
Project Groups are even more special

- Highly self-organized
- You have to contribute actively!
- You will be evaluated continuously.
- Usually requires at least two days per week being present in Paderborn.

- All our project groups are in English!
- Project groups do not belong to specific focus areas. You can apply to any one.

- All details at https://cs.uni-paderborn.de/en/studies/study-elements/project-groups/
Master’s Thesis (Masterarbeit)

Workload: Full-time for one semester (30 ECTS)

What has to be done?

- Literature review
- Research: develop new results!
- Obey rules of good scientific practice!
- Often: implementation of some software
- Writing a thesis (~ 80-120 pages) on scientific level

All of this: within 6 months (formally checked!)
- First a planning phase (typically 1 month)
- Then the real work (5 months)
Master’s Thesis (Masterarbeit)

Finding an advisor (Betreuer)

- talk to professors working in an area that interests you
- talk to the organizer of your project group
- ask friends

Finding a topic (Thema) is an interactive process between student and advisor

- own ideas?
- project group topic?
- discussion with the (potential) advisor!

The Master’s thesis defines your area of specialization – where you need to have three modules completed before you can register the thesis.
German Language Course (Deutschkurs)

- No Master’s degree without German Level A2!
- Language Courses hosted by the International Office
  - You can also take courses externally.
- Typically covers the “General Studies” part (12 ECTS)
- Check https://www.uni-paderborn.de/en/studium/international-office/deutschkurse/
What you need to do to get your degree

<table>
<thead>
<tr>
<th>Every student has to…</th>
<th>ECTS credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>… take three modules from the area of specialization</td>
<td>18</td>
</tr>
<tr>
<td>… take one module in one other area</td>
<td>6</td>
</tr>
<tr>
<td>… take four modules in whatever area</td>
<td>24</td>
</tr>
<tr>
<td>… take two seminar modules</td>
<td>10</td>
</tr>
<tr>
<td>… take part in a project group</td>
<td>20</td>
</tr>
<tr>
<td>… write a Master’s thesis (must be from your specialization area)</td>
<td>30</td>
</tr>
<tr>
<td>… take minor subject, do general studies or take the German language courses</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Adding up to</td>
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<tr>
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<td>120</td>
</tr>
</tbody>
</table>

It is your own responsibility to meet these criteria!
Examinations: Normal modules

Oral or written exam about the class

- Oral exams: individual date with the teacher
- Written exams: usually two dates offered in the semester breaks

Class may include written homework or project work as prerequisite ("course achievement").

You need to register for the exams!

- All with PAUL
- Registration for first exam period: October 25 to November 25
- Registration for second exam period: February 28 to March 11 (subject to change)

De-register if you don’t want to take an exam! Otherwise you might be stuck with that module.
Examinations: Other types

**Seminar:** Evaluation of presentation and seminar paper

**Project group:** Permanent evaluation throughout the project

**Master’s Thesis:** Evaluation by the advisor and a co-advisor

**Language Course:** Language certificate after the course
Examinations: Repetition

**Module** exams can be repeated twice.

**Seminars** can be repeated twice.

**Project group** can be repeated twice (you really don’t want that!).

**Master’s Thesis** can be repeated once.

**German Language Course** can be repeated until the end of days.
Examinations: Compensation

There are (limited) ways

- to shift aside („compensate“) exam failures
  - e.g. failure in one module
  - give up on that one and try another one instead

- to improve exam results
  - e.g. you succeeded in a module exam but with an unsatisfactory result, you can try a different module additionally.
  - You can’t retake a module that you have passed.
Final failure is possible! If …

You have no more options to use compensation and you are no more able to fulfill the requirements:

- 3 modules in the specialization area
- 5 more modules with at least one of them in another area

OR

- three attempts for a project group failed

OR

- one seminar failed three times

OR

- two attempts for a Master’s thesis failed
Common pitfalls

- Deadlines are important. Some things can be amended if you miss a deadline, some can’t or may result in delays of up to a year!

- You need to register for all sorts of things. Do it – and mind the deadlines!

- If you don’t want to finish a course, de-register it and everything associated with it – and mind the deadlines. Otherwise you may be blocked from taking other courses as there is an upper limit of courses you can take.

- Pay your semester fees as early as possible. Otherwise you might not be able to participate in the seminar or project group distribution – which will result in a delay of one semester at least.

- Never miss the first meeting of a course.

- Always – ALWAYS! – visit the first lecture in a semester where all necessary information about the course will be given!
Important Deadlines in this Semester

Until October 29
Registration for modules and courses

Between October 25 and November 25
Course achievement
Qualified participation (if applicable)
Exam

January 21
De-registration from course achievement
De-registration from qualified participation

One week before exam
De-registration from exam

Between February 28 and March 11
Registration for 2nd exam phase, also late registration for course achievement

If you missed this registration phase, you will most likely have to wait for almost one year to take your exam in that course!

Add those dates to your favourite calendar tool with a reminder!
Some more important things

- PAUL is your friend
  - Most important information is sent via the PAUL system or is shown there when you log in.
  - Check your university email address regularly!
  - Check out the PAUL introduction playlist at YouTube

- Many courses use the PANDA system for information and course material.

- Watch out for the project group presentation and attend it!

- Follow us on Twitter (or at least bookmark us in your browser and check regularly) – we will remind you of important deadlines: @CompScience_UPB, @Study_CS_UPB
Schedule

You choose!

- Which specialization area? One out of six.

- Which modules with regular classes? Almost complete freedom!

- Which project group? Each semester enough new project groups start so that every student who wants to participate can do so.

- Which Master’s thesis? Unlimited choice, but must be from your specialization area.
Recommendations for the first semester

Consider workload!
- 30 ECTS points is the officially recommended average workload per term.
- The first semester is tough! (for all the other reasons)

For your first semester:
- Choose classes along your interests.
- It is a good idea to plan for the specialization, but you don’t have to stick with your choice.
- You can not make any mistake as far as the area rules are concerned.
- Remember to de-register if you don’t want to take the module.
Welcome to Paderborn!