Module Guide

High Performance Computing / Quantum Computing

Faculty Computer Science

Examination regulations 01.10.2021

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HPC-M-01 PHYSICS FOR HIGH PERFORMANCE COMPUTING/QUANTUM COMPUTING

Module code	HPC-M-01
Module coordination	Prof. Dr. Thomas Störtkuhl
Course number and name	HPC-M-01 Physics for HPC/QC
Lecturer	Prof. Dr. Thomas Störtkuhl
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	postgraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weight	5/90
Language of Instruction	English

Module Objective

Physics for High Performance Computing / Quantum Computing builds the basic foundations of reasoning in physics as well as fundamental understanding of quantum mechanics -- the basic building blocks of quantum computing.

Mathematical structures and reasoning such as fields, vector spaces, and Hilbert spaces are (re-)visited. These mathematical structures are then used to argue about quantum mechanical laws and models such as the uncertainty principle and operators that build the foundation of quantum computing.

Students learn to know basic quantum mechanical effects and are able to calculate the answers to questions about known quantum mechanical effects. They understand the basic principles behind qunatum mechanical effects which build the foundations of both, quantum computing, and, partly, also traditional computing and communication. They are able to understand and argue about these effects using mathematical and physical reasoning.

Applicability in this and other Programs

This module lays the basics in understanding quantum mechanics and quantum computing.

Entrance Requirements

keine

Learning Content

- Mathematical foundations
  - Matrices & vectors
  - Fields, norms, vector spaces
- Physical background
  - Properties and limits of classical mechanics
  - Measurements
- Quantum mechanics
  - Models of quantum mechanics
  - Uncertainty principle
  - Applying operators
- Quantum Computing
  - Introduction of Qubits / Qubit registers
  - manipulation of Qubits via unitary matrices
  - first quantum computing algorithms

Teaching Methods

Lecture with exercises

Recommended Literature

Specified in the lecture

HPC-M-02 COMPUTER ARCHITECTURES FOR COMPUTING/QUANTUM COMPUTING

Module code	HPC-M-02
Module coordination	Prof. Dr. Helena Liebelt
Course number and name	HPC-M-02 Computer Architectures for HPC/QC
Lecturers	Dr. Atanas Atanasov Prof. Dr. Peter Faber NN NN PK AI/IAS/CS
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	postgraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weight	5/90
Language of Instruction	English

Module Objective

This course shows the building blocks of modern HPC and QC systems: Today's HPC systems are mainly built as clusters of interconnected compute nodes that may be accessed from a frontend. Intra-node performance in these systems is crucial.

QC systems, on the other hand, are based on (architecture dependent) quantum mechanical effects that can be described by a common theoretical framework. This framework can be used in simulators to develop algorithms for QC systems.

Students know and understand the architectrual principles of HPC and QC systems. They are able to develop algorithms for HPC or QC systems according to a provided specification. They are able to assess the correct approach to a specified problem for a HPC or a QC architecture.

Applicability in this and other Programs

Building blocks of HPC and/or QC systems are discussed here; this can be used in system design as well as programming and developing HPC/QC architectures or developing/designing for these architectures.

Entrance Requirements

Knowledge in physics / quantum mechanics is advantageous

Learning Content

Concepts of modern computer systems:

- Building blocks of modern HPC systems
  - Cluster architecture (interconnected compute nodes)
  - Using HPC compute-nodes for computation
  - Programming frameworks for high (intra-node) performance
- Principles of QC systems
  - Quantum models of computation
  - QC simulators / QC processors
  - Programming frameworks for QC

Teaching Methods

Lecture with exercises

Recommended Literature

Specified in the lecture

HPC-M-03 NETWORKS FOR COMPUTING/QUANTUM COMPUTING

Module code	HPC-M-03
Module coordination	Prof. Dr. Peter Faber
Course number and name	HPC-M-03 Networks for HPC/QC
Lecturer	Prof. Dr. Andreas Wölfl
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	postgraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weight	5/90
Language of Instruction	English

Module Objective

Networking Basics:

After completing the lecture students will be able to name and describe the major network protocols and technologies for building networks. They will be able to explain the fundamental architectural principles in networks, such as the ISO/OSI model and the Internet protocol stack. Students participating in this lecture can name the different network topologies, describe different network architectures and performance metrics. Participants of this lecture will be able to explain all relevant aspects of connecting to a network. They will be able to use different network analysing tools, such as Wireshark and Windows networking utilities for getting system information and troubleshooting networking problems.

Building on the basic part, modern network technologies are introduced: The students get to know modern networking technologies and their properties; they are able to understand the use of certain networking topolgies and can explain why specific design techniques are applicable in a particular situation.

Applicability in this and other Programs

Architecture in particular of HPC systems and computing centres

Entrance Requirements

keine

Learning Content

Basics:

This part represents is an introduction to networks used today. It deals with the construction, the functionality and the design of networks and protocols. On the basis of the ISO/OSI Model network and computer protocols are discussed. Media Access Control protocols of the lower layer are discussed together with network topologies with respect to their medium access mechanism. Topics of discussion include classic technologies like Ethernet. On network and transport layer, the TCP/IP protocol is introduced. The Exercise component of the module will help students reflect the content of the lecture. The Lab Practice component of the module faces practical aspects including use of network analyzing tools. The lecture and lab practice also includes topics such specialized industrial networks or protocols, e.g. the CAN and PROFINET.

Advanced topics:

Building on the basic part, modern network technologies are introduced: Massively parallel cluster systems today use high-performance networking technologies like Infiniband and are connected through non-trivial topologies. Connecting networks in an all-to-all clique is infeasible for large networks, thus, network topology design becomes important.

Teaching Methods

- Lecture
- Exercise
- Lab Practice

Recommended Literature

Basics:

- L. Peterson: Computer Networks: A Systems Approach, 5th edition
- Tannenbaum: Computer Networks, 5th edition

Further literature as specified in the course

HPC-M-04 SOFTWARE ENGENEERING

Module code	HPC-M-04
Module coordination	Prof. Dr. Helena Liebelt
Course number and name	HPC-M-04 Software Engineering
Lecturers	Prof. Dr. Marcus Barkowsky Prof. Bernhard Zeller
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	postgraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weight	5/90
Language of Instruction	English

Module Objective

The Students know and understand important design patterns. They are able to apply these design patterns and are able to argue about advantages and disadvantages of a specific design.

They also have aquired an understanding of the practical uses in software engineering and are able to follow a structured approach towards a software design.

Applicability in this and other Programs

Software design and programming lectures

Entrance Requirements

keine

Learning Content

Advanced methods of software engineering:

- Design patterns
- Applications in software development
- System design

Teaching Methods

Lecture with exercises

HPC-M-05 HIGH PERFORMANCE COMPUTING/QUANTUM COMPUTING PROGRAMMING LAB

Module code	HPC-M-05
Module coordination	Prof. Dr. Peter Faber
Course number and name	HPC-M-05 HPC/QC Programming Lab
Lecturers	Prof. Dr. Peter Faber Prof. Dr. Helena Liebelt Prof. Dr. Thomas Störtkuhl
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	postgraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	StA
Weight	5/90
Language of Instruction	English

Module Objective

The students learn to know different programming frameworks for modern computer architectures. They know theoretical foundations and can argue about asymptotic behaviour following from these theories. They are also aware of the limits of asympotic aspects and have gained practical experience in the use of frameworks for HPC and QC programming. They are able to implement a small algorithm using at least one of these frameworks according to a given specification.

Applicability in this and other Programs

Software design and programming lectures

Entrance Requirements

keine

Learning Content

Modern methodologies of HPC and QC programming:

During the course, theoretical concepts of programming for (parallel) HPC and QC systems are presented, e.g., (absolute, relative) speedup, parallel efficiency, Amdahl's law, Brent's Theorem. These theoretical concepts are then applied to real-life problems, and modern frameworks for these computational concepts are presented and discussed.

This may include, e.g.:

- OpenMP (intra-node parallelism)
- MPI (inter-node parallelism)
- Intel Quantum Simulator / SDK (quantum computing simulator / framework)
- further QC frameworks

Teaching Methods

Lab sessions and exercises, usually in teams

Recommended Literature

Victor Victor Eijkhout, Introduction to High Performance Scientific Computing; 2016; Lulu; https://web.corral.tacc.utexas.edu/CompEdu/pdf/stc/EijkhoutIntroToHPC.pdf

Further literature as specified during the course

HPC-M-06 OPTIMIZATION METHODS

Module code	HPC-M-06
Module coordination	Prof. Dr. Peter Faber
Course number and name	HPC-M-06 Optimization Methods
Lecturer	Prof. Dr. Peter Faber
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	postgraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	StA
Weight	5/90
Language of Instruction	English

Module Objective

The students gain an understanding of the construction of modern optimizing compilers and their run-time systems. They understand how certain optimization techniques work, why specific programming patterns may improve performance and others may prohibit optimizations. They are able to apply their knowledge and use appropriate techniques at the appropriate place. Ideally, the students can work on an optimization pass for themselves.

Applicability in this and other Programs

Software design and programming lectures

Entrance Requirements

keine

Learning Content

Optimization methods for modern computer architectures are discussed. In particular, theoretical and practical aspects of parallel programming systems for modern high-performance computing systems are highlighted.

This includes insights into the inner workings of optimizing compilers and their run-time systems. Optimization methods employed by these compilers are presented and discussed, as well as performance analysis and respective tools.

Teaching Methods

Lectures, presentations, lab sessions, exercises

Recommended Literature

- Klemm, Michael; Cownie, Jim; High Performance Parallel Runtimes -- Design and Implementation. De Gruyter, Oldenbourg. 2021
- Aho; Lam, Monica Sin-Ling; Sethi, Ravi; Ullman, Jeffrey David. Compilers: Principles, Techniques, and Tools (2 ed.). Boston, Massachusetts, USA. Addison-Wesley. 2006
- Further literature as specified during the course

HPC-M-07 HIGH PERFORMANCE COMPUTING/QUANTUM COMPUTING TECHNOLOGY

Module code	HPC-M-07
Module coordination	Prof. Dr. Helena Liebelt
Course number and name	HPC-M-07 HPC/QC Technology
Lecturers	Prof. Dr. Peter Faber Prof. Dr. Helena Liebelt NN NN PK AI/IAS/CS
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	postgraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	StA
Weight	5/90
Language of Instruction	English

Module Objective

Student are introduced to technological issues particular to HPC and/or QC systems. They know hardware technologies relevant to the area and collected experience in building / setting up systems in hands-on sessions. They are able to set-up (part of) a modern HPC system and install and configure such a system on a small scale.

Applicability in this and other Programs

Hardware / system design for complex modern computing systems

Entrance Requirements

keine

Learning Content

The aim of this course is to discover the technological paticularities of HPC and QC systems.

The module is divided into two parts, both covering theoretical as well as practical aspects including hands-on sessions:

- Hardware
  - Setting up a compute node
  - Rack technologies
  - Cooling aspects
- Software
  - Setting up an operating system
  - Middleware
  - Access and scheduling

Teaching Methods

Lecture with lab sessions / exercises

Recommended Literature

- Andrew S. Tanenbaum; Herbert Bos. Modern Operating Systems. Prentice Hall, 4th ed. 2014
- Evi Nemeth, Garth Snyder, Trent R. Hein et al. Unix and Linux System Administration Handbook. Addison-Wesley, 5th ed. 2018
- Christine Bresnahan, Richard Blum. Mastering Linux system administration. Wiley. 2021. https://ebookcentral.proquest.com/lib/th-deggendorf/detail.action?docID=6658986
- Further literature as indicated in the lecture

HPC-M-08 HIGH PERFORMANCE COMPUTING/QUANTUM COMPUTING INFRASTRUCTURE

Module code	HPC-M-08
Module coordination	Prof. Dr. Helena Liebelt
Course number and name	HPC-M-08 HPC/QC Infrastructure
Lecturer	NN NN PK AI/IAS/CS
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	postgraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weight	5/90
Language of Instruction	English

Module Objective

Students know about questions arising when buidling the infrastructure of computing systems -- usually in data centers.

This includes:

- Heating, Ventilation, Air Conditioning (HVAC)
- Power engineering, incl. dimensioning -- students are able to calculate the required size of devices
- Cooling techniques, incl. dimensioning -- students are able to calculate the required size of devices
- Energy efficiency -- students know about new forms of energy efficient design; they are able to apply such a design and estimate its implications
- Fire protection -- students know legal and functional requirements and can integrate measures into a building plan

Applicability in this and other Programs

Design of complete computing systems

Entrance Requirements

keine

Learning Content

Infrastructure of modern computer systems in computing centers. The following topics belong in this category:

- Building computing centers
- Heating, Ventilation, Air Conditioning (HVAC)
- Power engineering, incl. dimensioning
  - particularly w/ racks
- Cooling techniques, incl. dimensioning
  - particularly w/ racks
- Energy efficiency
- Fire protection
- Legal measures

Teaching Methods

Lectures and exercises

HPC-M-09 SYSTEM DESIGN AND APPLICATION OF HIGH PERFORMANCE COMPUTING/QUANTUM COMPUTING SYSTEMS

Module code	HPC-M-09
Module coordination	Prof. Dr. Helena Liebelt
Course number and name	HPC-M-09 System Design and Application of HPC/QC Systems
Lecturer	Prof. Dr. Helena Liebelt
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	postgraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	StA
Weight	5/90
Language of Instruction	English

Module Objective

Students acquire the ability to design a complex system, considering all levels of detail, from the small details of each building block of a computing system, up to the overview over the whole project.

Similar to the master's thesis, this course builds a cornerstone of the study program, with students being able to apply all their acquired knowledge to an actual project.

Entrance Requirements

Students may draw from all the modules of the course of studies; however, there is no formal requirement of a particular module

Learning Content

Complex system design: In a guided project, the students work on a case study of a complex project, designing a complex computing system from start to finish.

Teaching Methods

Lecture with work on project / exercises, presentations

Recommended Literature

As specified during the lecture

HPC-M-10 ADVANCED MATHEMATICS FOR HIGH PERFORMANCE COMPUTING/QUANTUM COMPUTING

Module code	HPC-M-10
Module coordination	Prof. Dr. Dieter Rummler
Course number and name	HPC-M-10 Advanced Mathematics for HPC/QC
Lecturer	Prof. Dr. Dieter Rummler
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	postgraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weight	5/90
Language of Instruction	English

Module Objective

The student acquires basic knowledge and skills in mathematical definitions, structures, and reasoning. This contains in particular the ability to retrace, evaluate, correct proofs and to prove theorems. The student is competent to apply structured thinking and mathematical reasoning.

Applicability in this and other Programs

This module lays the basics in understanding contexts of higher mathematics.

Entrance Requirements

keine

Learning Content

The goal of this module is to empower the student to use mathematical apporaches in different contexts and apply mathematical readoning.

In this course, these abilities are conveyed using stochastic theoretical and statistical approaches that help in understanding quantum effects and quantum computing approaches.

Teaching Methods

Lectures and exercises

HPC-M-11 ADVANCED MATHEMATICS AND PHYSICS FOR HIGH PERFORMANCE COMPUTING/QUANTUM COMPUTING

Module code	HPC-M-11
Module coordination	Prof. Dr. Thomas Störtkuhl
Course number and name	HPC-M-11 Advanced Mathematics and Physics for HPC/QC
Lecturer	Prof. Dr. Thomas Störtkuhl
Semester	2

Applicability in this and other Programs

This module lays the basics in understanding how to solve numerically physical problems with high performance computers.

Entrance Requirements

keine

Learning Content

- Mathematical foundations
  - Matrices & vectors
  - Fields, norms and vector spaces
  - Convergence
- Physical background
  - physical problems: planet motion
  - Heat conduction, Poisson equation
  - Biharmonic and Stokes equations
  - derivation of fundamental differential equations which govern the physical problem
- Numerical mathematics
  - Norms to measure the error of a computed solution
  - function space
  - linear system of equations
  - theory of iterative solvers for linear system of equations
  - discretization and discretization error
  - discretization for time dependent differential equations
- Numerical examples:
  - computation of a solutions for model problems
  - Poisson, biharmonic and Stokes equations
  - with iterative methods like

- Jacobi, Gauß-Seidel, Successice Overrelaxation iteration
- multigrid approach
- using explicit Euler for discretization of time dependenc
- example demonstration: Python code

Teaching Methods

Lecture with exercises

Recommended Literature

Specified in the lecture

HPC-M-12 FACULTY ELECTIVE I

Module code	HPC-M-12
Module coordination	Prof. Dr. Peter Faber
Course number and name	HPC-M-12 Faculty Elective I
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	compulsory course
Level	postgraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Weight	5/90
Language of Instruction	English

Module Objective

This module allows students to customize their curriculum by choosing an elective out of existing university courses or student research projects provided by university lecturers.

There are three main goals in this module to the benefit of each student. The first goal is to fill knowledge gaps of the student (individuality) identified by the admission test and discussions with the study coordinator. The elective has to be selected in accordance with the study coordinator.

The second goal is to acquire knowledge in current and different upcoming topics of HPC/QC (flexibility).

As a third goal, students should be able to advance in individual higher-level topics (specialization).

Applicability in this and other Programs

corresponding the modules you choose

Entrance Requirements

corresponding the modules you choose

Learning Content

corresponding the modules you choose

Teaching Methods

corresponding the modules you choose

Remarks

corresponding the modules you choose

Recommended Literature

corresponding the modules you choose

HPC-M-13 FACULTY ELECTIVE II

Module code	HPC-M-13
Module coordination	Prof. Dr. Peter Faber
Course number and name	HPC-M-13 Faculty Elective II
Semester	3
Duration of the module	1 semester
Module frequency	annually
Course type	compulsory course
Level	postgraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Weight	5/90
Language of Instruction	English

Module Objective

This module allows students to customize their curriculum by choosing an elective out of existing university courses or student research projects provided by university lecturers.

There are three main goals in this module to the benefit of each student. The first goal is to fill knowledge gaps of the student (individuality) identified by the admission test and discussions with the study coordinator. The elective has to be selected in accordance with the study coordinator.

The second goal is to acquire knowledge in current and different upcoming topics of HPC/QC (flexibility).

As a third goal, students should be able to advance in individual higher-level topics (specialization).

Applicability in this and other Programs

corresponding the modules you choose

Entrance Requirements

corresponding the modules you choose

Learning Content

corresponding the modules you choose

Teaching Methods

corresponding the modules you choose

Remarks

corresponding the modules you choose

Recommended Literature

corresponding the modules you choose

HPC-M-14.1 MASTER'S COLLOQUIUM

Module code	HPC-M-14.1
Module coordination	Prof. Dr. Peter Faber
Course number and name	HPC-M-14.1 Master's Colloquium
Lecturers	Prof. Dr. Peter Faber Prof. Dr. Helena Liebelt Prof. Dr. Thomas Störtkuhl
Semester	3
Duration of the module	1 semester
Module frequency	as required
Course type	required course
Level	postgraduate
Semester periods per week (SWS)	2
ECTS	2
Workload	Time of attendance: 30 hours self-study: 30 hours Total: 60 hours
Type of Examination	oral ex. 20 min.
Weight	2/90
Language of Instruction	English

Module Objective

A professional delivery of scientific and technical findings, to be held as presentations, is integral to the successful completion of projects. This includes presenting results achieved in groups and presenting complex linkages within a tight time frame. A further aim is to draw a close correlation between the written project assignment and the presentations held during the seminars.

Students will achieve the following learning objectives:
Professional skills
Students will be able to present the at times difficult technical and scientific relationships outlined in their masters thesis to an expert audience in the form of an oral presentation, and respond to questions about their presentation at an appropriate length.

Methodological skills
Students can intelligibly convey the nature and content of the findings from their masters thesis to an expert audience and present them within a defined time frame.

Soft skills

Students are able to outline the outcomes in a presentation. The scenario of holding a presentation before an expert audience serves as a precursor to numerous similar situations students will encounter during their careers, especially with regard to time constraints and focusing on core messages; as such, this seminar prepares them for similar work-related situations.

Applicability in this and other Programs

The colloquium (seminar) is conducted in partial fulfillment of the master's thesis

Entrance Requirements

keine

Learning Content

In addition to the Master's Thesis, the students present their works in a colloquium, in which the scientific quality and the scientific independence of their respective achievements are evaluated.

Teaching Methods

Presentations, discussions

Remarks

Presentations can actually be held in each semester

HPC-M-14.2 MASTER'S THESIS

Module code	HPC-M-14.2
Module coordination	Prof. Dr. Peter Faber
Course number and name	HPC-M-14.2 Master's Thesis
Lecturer	Prof. Dr. Peter Faber
Semester	3
Duration of the module	1 semester
Module frequency	as required
Course type	required course
Level	postgraduate
Semester periods per week (SWS)	0
ECTS	23
Workload	Time of attendance: 0 hours self-study: 690 hours Total: 690 hours
Type of Examination	master thesis
Weight	23/90
Language of Instruction	English

Module Objective

By producing a master's thesis, the students demonstrate their ability to apply their knowledge and skills acquired during the course of studies in an independently written scientific work on complex tasks. They thus demonstrate they have successfully completed their master's levels studies and acquired the capacity for independent scientific work.

Entrance Requirements

According to §8 of the Study and Examination Regulations, students who have collected at least 40 ECTS credits may register for the master's thesis.

Learning Content

The master's thesis is a written report in a form of a scientific paper. It describes the scientific findings, as well as the way leading to these findings. It contains justifications for decisions regarding chosen methods for the thesis and discarded alternatives. The student's own substantial contribution to the achieved results has to be evident.

The work on the master's thesis is supervised by any of the instructors within the study course (professors or lecturers) or an external instructor. The master's thesis can be written on any subject or topic related to the content of any of the modules of the study course. The students can suggest the topics for their master's theses according to their research or practice preferences. The preparation time of a master's thesis according to the regulations is up to 6 (six) months. However, an extension up to a maximum of 8 months from the registration date is possible (§11 APO). As a general rule, the size of the thesis should not exceed 70 pages.

Teaching Methods

Students perform an independent supervised scientific research work.

Recommended Literature

Recommendations and instructions of writing a master's thesis (available through iLearn).