Subdivided Module Catalogue

for the Subject

# Computer Science

as a Master's with 1 major

with the degree "Master of Science"

(120 ECTS credits)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

# Course of Studies - Contents and Objectives

The objective of the Master of Computer Science degree program is to impart in-depth knowledge of scientific research, fields of application and principles in computer science, in particular with regard to algorithmic thinking and mathematical reasoning.

Based on the foundation that the student has acquired in a bachelor's degree program, these abilities permit him/her to work independently, broaden and deepen his/her area of expertise, and transfer his/her expertise to new tasks. The student will thus be prepared to face the diverse tasks that he/she will be confronted with by society. The student will further prove his/her methodological competence, creativity and flexibility by solving problems using methods in computer science. A degree in this course of studies allows the student to pursue a scientific career, for example, at a doctoral level.

The master's program focuses on enhancing the capacity for abstraction, for precise analytical thinking, for the ability to structure complex connections, and for an independent application of methods in computer science to address specific problems, for perseverance in solving difficult problems and for qualified scientific research. The student demonstrates these abilities in the master's exam. Passing the exam, the student is awarded a higher professional degree. With his/her master's thesis, the student demonstrates his/her ability to work independently on a restricted computer science problem by applying established or adapted methods in accordance with scientific standards.

In particular, students of the master's program in Computer Science have the possibility of specialising in one of the following areas:
1. Algorithms and Theory,
2. Software Engineering,
3. Internet Technology,
4. Intelligent Systems,
5. Embedded Systems,
6. Aerospace Engineering, Astronautics and Space Technology and
7. Human-Computer-Interaction.

By focusing on one of these areas, the student augments his/her expertise in the respective area.

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# Abbreviations used

Course types: **E** = field trip, **K** = colloquium, **O** = conversatorium, **P** = placement/lab course, **R** = project, **S** = seminar, **T** = tutorial, **Ü** = exercise, **V** = lecture

Term: **SS** = summer semester, **WS** = winter semester

Methods of grading: **NUM** = numerical grade, **B/NB** = (not) successfully completed

Regulations: **(L)ASPO** = general academic and examination regulations (for teaching-degree programmes), **FSB** = subject-specific provisions, **SFB** = list of modules

Other: **A** = thesis, **LV** = course(s), **PL** = assessment(s), **TN** = participants, **VL** = prerequisite(s)

# Conventions

Unless otherwise stated, courses and assessments will be held in German, assessments will be offered every semester and modules are not creditable for bonus.

# Notes

Should there be the option to choose between several methods of assessment, the lecturer will agree with the module coordinator on the method of assessment to be used in the current semester by two weeks after the start of the course at the latest and will communicate this in the customary manner.

Should the module comprise more than one graded assessment, all assessments will be equally weighted, unless otherwise stated below.

Should the assessment comprise several individual assessments, successful completion of the module will require successful completion of all individual assessments.

# In accordance with

the general regulations governing the degree subject described in this module catalogue:

>  **ASPO2009**

associated official publications (FSB (subject-specific provisions)/SFB (list of modules)):

>  **24-Mar-2014 (2014-7)**

This module handbook seeks to render, as accurately as possible, the data that is of statutory relevance according to the examination regulations of the degree subject. However, only the FSB (subject-specific provisions) and SFB (list of modules) in their officially published versions shall be legally binding. In the case of doubt, the provisions on, in particular, module assessments specified in the FSB/SFB shall prevail.

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# The subject is divided into

| Abbreviation | Module title | ECTS credits | Method of grading | page |
|---|---|---|---|---|
| **Thesis (30 ECTS credits)** | | | | |
| 10-I=MA-141-m01 | Master Thesis | 30 | NUM | 45 |
| **Compulsory Courses (15 ECTS credits)** | | | | |
| 10-I=SEM3-141-m01 | Seminar | 5 | NUM | 60 |
| 10-I=PRAK-141-m01 | Practical Course | 10 | B/NB | 52 |
| **Compulsory Electives (75 ECTS credits)** | | | | |
| 10-I=3D-141-m01 | 3D Point Cloud Processing | 5 | NUM | 13 |
| 10-I=BS-141-m01 | Operating Systems | 5 | NUM | 29 |
| 10-I=DM-141-m01 | Data Mining | 5 | NUM | 34 |
| 10-I=DB-141-m01 | Databases | 5 | NUM | 31 |
| 10-I=ICG-141-m01 | Interactive Computer Graphics | 5 | NUM | 37 |
| 10-I=KT-141-m01 | Computational Complexity | 5 | NUM | 42 |
| 10-I=KD-141-m01 | Cryptography and Data Security | 5 | NUM | 39 |
| 10-I=OOP-141-m01 | Object oriented Programming | 5 | NUM | 48 |
| 10-I=RAK-141-m01 | Computer Architecture | 5 | NUM | 54 |
| 10-I=RK-141-m01 | Computer Networks and Communication Systems | 8 | NUM | 56 |
| 10-I=WBS-141-m01 | Knowledge-based Systems | 5 | NUM | 67 |
| 10-I=SEM4-141-m01 | Seminar | 5 | NUM | 61 |
| 10-I=PRJ-141-m01 | Project | 5 | B/NB | 53 |
| 10-I=AA-141-m01 | Advanced Automation | 8 | NUM | 14 |
| 10-I=AGIS-141-m01 | Algorithms for Geographic Information Systems | 5 | NUM | 16 |
| 10-I=AG-141-m01 | Computational Geometry | 5 | NUM | 15 |
| 10-I=APA-141-m01 | Approximation Algorithms | 5 | NUM | 25 |
| 10-I=AUT-141-m01 | Automata Theory | 5 | NUM | 26 |
| 10-I=AVS-141-m01 | Avionics Systems | 5 | NUM | 27 |
| 06-HCI=BS-141-m01 | User Interfaces | 5 | NUM | 6 |
| 10-I=BER-141-m01 | Computability Theory | 5 | NUM | 28 |
| 07-BI-141-m01 | Bioinformatics | 5 | NUM | 12 |
| 10-I=CB-141-m01 | Compiler Construction | 8 | NUM | 30 |
| 10-I=DB2-141-m01 | Databases 2 | 5 | NUM | 32 |
| 10-I=DDB-141-m01 | Deductive Databases | 8 | NUM | 33 |
| 10-I=EL-141-m01 | E-Learning | 5 | NUM | 35 |
| 06-MCI=Einf-141-m01 | Introducing to Human-Computer-Interaction | 5 | NUM | 11 |
| 10-I=ES-141-m01 | Embedded Systems | 8 | NUM | 36 |
| 10-I=PA-141-m01 | Program Design and Analysis | 5 | NUM | 49 |
| 10-I=IR-141-m01 | Information Retrieval | 5 | NUM | 38 |
| 06-HCI=IS-141-m01 | Interactive Systems | 5 | NUM | 8 |
| 10-I=KT2-141-m01 | Computational Complexity II | 5 | NUM | 43 |
| 10-I=KI1-141-m01 | Artificial Intelligence 1 for Business Informatics | 5 | NUM | 40 |
| 10-I=KI2-141-m01 | Artificial Intelligence 2 for Business Informatics | 5 | NUM | 41 |
| 10-I=LVS-141-m01 | Performance Evaluation of Distributed Systems | 8 | NUM | 44 |
| 10-I=ML-141-m01 | Mathematical Logic | 5 | NUM | 47 |

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| 10-I=MI-141-m01 | Medical Informatics | 5 | NUM | 46 |
|---|---|---|---|---|
| 10-I=PEB-141-m01 | Performance Engineering & Benchmarking of Computer Systems | 5 | NUM | 50 |
| 10-I=PM-141-m01 | Professional Project Management | 5 | NUM | 51 |
| 10-I=RAM-141-m01 | Computer Arithmetic | 5 | NUM | 55 |
| 10-I=RO1-122-m01 | Robotics 1 | 8 | NUM | 57 |
| 10-I=RO2-122-m01 | Robotics 2 | 8 | NUM | 58 |
| 10-I=ST-141-m01 | Discrete Event Simulation | 8 | NUM | 64 |
| 06-HCI=ST-141-m01 | Software Technology of Interactive Systems | 5 | NUM | 9 |
| 10-I=SA-141-m01 | Software Architecture | 5 | NUM | 59 |
| 10-I=SPA-141-m01 | Space Automation | 5 | NUM | 62 |
| 10-I=SSD-122-m01 | Spacecraft System Design | 8 | NUM | 63 |
| 10-I=STM-141-m01 | NLP and Text Mining | 5 | NUM | 65 |
| 10-I=VG-141-m01 | Visualization of Graphs | 5 | NUM | 66 |
| 10-I=AKAT-141-m01 | Selected Topics in Algorithms and Theory | 5 | NUM | 17 |
| 10-I=AKSE-141-m01 | Selected Topics in Software Engineering | 5 | NUM | 24 |
| 10-I=AKIT-141-m01 | Selected Topics in Internet Technologies | 5 | NUM | 22 |
| 10-I=AKIS-141-m01 | Selected Topics in Intelligent Systems | 5 | NUM | 21 |
| 10-I=AKES-141-m01 | Selected Topics in Embedded Systems | 5 | NUM | 18 |
| 10-I=AKLR-141-m01 | Selected Topics of Aerospace Engineering | 5 | NUM | 23 |
| 10-I=AKHCI-141-m01 | Selected Topics in HCI | 5 | NUM | 19 |
| 10-I=AKI-141-m01 | Selected Topics in Computer Science | 5 | NUM | 20 |

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| User Interfaces | 06-HCI=BS-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science IX | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

### Contents

The multimodal interaction paradigm simultaneously uses various modalities like speech, gesture, touch, or gaze, to communicate with computers and machines. Basically, multimodal interaction includes the analysis as well as the synthesis of multimodal utterances. This course concentrates on the analysis, i.e., the input processing. Input processing has the goal to derive meaning from signal to provide a computerized description and understanding of the input and to execute the desired interaction. In multimodal systems, this process is interleaved between various modalities and multiple interdependencies exist between simultaneous utterances necessary to take into account for a successful machine interpretation.
In this course, students will learn about the necessary steps involved in processing unimodal as well as multimodal input. The course will highlight typical stages in multimodal processing. Using speech processing as a primary example, they learn about:
1. A/D conversion
2. Segmentation
3. Syntactical analysis
4. Semantic analysis
5. Pragmatic analysis
6. Discourse analysis
A specific emphasize will be on stages like morphology and semantic analysis. Typical aspects of multimodal interdependencies, i.e., temporal and semantic interrelations are highlighted and consequences for an algorithmic processing are derived. Prominent multimodal integration (aka multimodal fusion) approaches are described, including transducers, state machines, and unification.

### Intended learning outcomes

After the course, the students will be able to build their own multimodal interfaces. They will have a broad understanding of all the necessary steps involved and will know prominent algorithmic solutions for each of them. Student will learn about available tools for reoccurring tasks and their pros and cons.

### Courses (type, number of weekly contact hours, language — if other than German)

V + Ü + S (no information on SWS (weekly contact hours) and course language available)

### Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

as specified by the lecturer at the beginning of the course a) written examination (approx. 75 minutes) or b) presentation or presentation of project (approx. 20 minutes) with written elaboration or documentation (approx. 10 pages) or c) oral examination (approx. 30 minutes)
Language of assessment: German, English

### Allocation of places

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### Additional information

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### Workload

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### Teaching cycle

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Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| **Referred to in LPO I** (examination regulations for teaching-degree programmes) |
|---|
| -- |
| **Module appears in** |
| Master's degree (1 major) Computer Science (2014) |

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| **Interactive Systems** | 06-HCI=IS-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science IX | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

This module will give students the opportunity to learn about the specificities of 3D User Interfaces (3DUI) development using Virtual, Augmented or Mixed Reality technologies. The module content will be mainly dedicated to learn and practice the skills essential to the design and implementation of high-quality 3D interaction techniques. Design guidelines as well as classical and innovative 3D Interaction techniques will be studied. In addition, the course will address novel research themes such as 3D interaction for large displays and games; and integrating 3DUIs with mobile devices, robotics, and the environment. Students will be assessed through a group practical project (team work), which will consist of a program, a presentation, a technical report (2 ages) and a video. Previous years, the assignment replicated the IEEE 3DUI Contest 2011, where teams of students competed between each other to find the best solution (see results at https://www.youtube.com/watch?v=gYs-pBW7Agc and https://www.youtube.com/watch?v=gYs-pBW7Agc)

**Intended learning outcomes**

After the course, the students will gain a solid background on the theory and the methods to create your own 3D spatial interfaces. They will have a broad understanding of the particular difficulties of designing and developing spatial interfaces, as well as evaluating then. Students will also learn about traditional and novel 3D input/output devices (e.g, motion tracking system and Head-mounted Display).

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü + S (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

as specified by the lecturer at the beginning of the course a) written examination (approx. 75 minutes) or b) presentation or presentation of project (approx. 20 minutes) with written elaboration or documentation (approx. 10 pages) or c) oral examination (approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| **Software Technology of Interactive Systems** | 06-HCI=ST-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science IX | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

This course provides an introduction into the requirements, concepts, and engineering art of highly interactive human-computer systems. Such systems are typically found in perceptual computing, Virtual, Augmented, Mixed Reality, computer games, and cyber-physical systems. Lately, these systems are often termed Real-Time Interactive Systems (RIS) due to their common aspects.
The course covers theoretical models derived from the requirements of the application area as well as common hands-on and novel solutions necessary to tackle and fulfill these requirements. The first part of the course will concentrate on the conceptual principles characterizing real-time interactive systems. Questions answered are: What are the main requirements? How do we handle multiple modalities? How do we define the timeliness of RIS? Why is it important? What do we have to do to assure timeliness? The second part will introduce a conceptual model of the mission-critical aspects of time, latencies, processes, and events necessary to describe a system's behavior. The third part introduces the application state, it's requirements of distribution and coherence, and the consequences these requirements have on decoupling and software quality aspects in general. The last part introduces some potential solutions to data redundancy, distribution, synchronization, and interoperability. Along the way, typical and prominent state-of-the-art approaches to reoccurring engineering tasks are discussed. This includes pipeline systems, scene graphs, application graphs (aka field routing), event systems, entity and component models, and others. Novel concepts like actor models and ontologies will be covered as alternative solutions. The theoretical and conceptual discussions will be put into a practical context of today's commercial and research systems, e.g., X3D, instant reality, Unity3d, Unreal Engine 4, and Simulator X.

**Intended learning outcomes**

After the course, the students will have a solid understanding of the boundary conditions defined by both, the physiological and psychological characteristics of the human users as well as by the architectures and technological characteristics of today's computer systems. Participants will gain a solid understanding about what they can expect from today's technological solutions. They will be able to choose the appropriate approach and tools to solve a given engineering task in this application area and they will have a well-founded basis enabling them to develop alternative approaches for future real-time interactive systems.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü + S (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

as specified by the lecturer at the beginning of the course a) written examination (approx. 75 minutes) or b) presentation or presentation of project (approx. 20 minutes) with written elaboration or documentation (approx. 10 pages) or c) oral examination (approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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| Teaching cycle |
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| -- |
| **Referred to in LPO I**  (examination regulations for teaching-degree programmes) |
| -- |
| **Module appears in** |
| Master's degree (1 major) Computer Science (2014) |

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| **Introducing to Human-Computer-Interaction** | 06-MCI=Einf-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science IX | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | undergraduate | -- |

**Contents**

Human-computer interaction is concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them. This course gives an introduction to the principle biological, physiological, and psychological constraints as defined by the human user and relates these constraints to the conceptual and technical solutions of today's computer systems and existing as well as prospective interaction metaphors between humans and computers. The course covers topics in the area of human perception and cognition, memory and attention, the design of interactive systems, prominent evaluation methods, the principles of computer systems, typical input processing techniques, interface technology, and examples of typical interaction metaphors, from text-based input to graphical desktops to multimodal interfaces. Accompanying lab work will introduce students to typical tasks in this field, i. e. prominent evaluation methods and prototyping of interfaces.

**Intended learning outcomes**

At the end of the course, the students will have developed a broad understanding of the principles underlying the design of interfaces between human users and computer systems. They will understand the constraints and capabilities of current user interfaces, and they will have learned about the necessary steps involved in user-centred design and development approaches.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü + S (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

as specified by the lecturer at the beginning of the course a) written examination (approx. 75 minutes) or b) presentation or presentation of project (approx. 20 minutes) with written elaboration or documentation (approx. 10 pages) or c) oral examination (approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

--

**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | | Abbreviation |
|---|---|---|
| **Bioinformatics** | | 07-BI-141-m01 |

| Module coordinator | | Module offered by |
|---|---|---|
| holder of the Chair of Bioinformatics | | Faculty of Biology |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | undergraduate | -- |

**Contents**

Fundamental principles of bioinformatics.

**Intended learning outcomes**

Students are proficient in methods for the analysis of DNA and protein databases.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
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| Module title | Abbreviation |
|---|---|
| **3D Point Cloud Processing** | 10-I=3D-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science XVII | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Laser scanning, Kinect and camera models, basic data structures (lists, arrays, oc-trees), calculating normals, k-d trees, registration, features, segmentation, tracking, applications for airborne mapping, applications to mobile mapping.

**Intended learning outcomes**

Students understand the fundamental principles of all aspects of 3D point cloud processing and are able to communicate with engineers / surveyors / CV people / etc. Students are able to solve problems of modern sensor data processing and have experienced that real application scenarios are challenging in terms of computational requirements, in terms of memory requirements and in terms of implementation issues.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

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Subdivided Module Catalogue for the Subject
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UNIVERSITÄT
WÜRZBURG
Julius-Maximilians-

| Module title | Abbreviation |
|---|---|
| **Advanced Automation** | 10-I=AA-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science VII | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 8 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Advanced topics in automation systems as well as instrumentation and control engineering, for example from the field of sensor data processing, actuators, cooperating systems, mission and trajectory planning.

**Intended learning outcomes**

The students have an advanced knowledge of selected topics in automation systems. They are able to implement advanced automation systems.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I**  (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| **Computational Geometry** | 10-I=AG-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science I | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

In many areas of computer science -- for example robotics, computer graphics, virtual reality and geographic information systems -- it is necessary to store, analyse, create or manipulate spatial data. This class is about the algorithmic aspects of these tasks: We will acquire techniques that are needed to plan and analyse geometric algorithms and data structures. Every technique will be illustrated with a problem in the practical areas listed above.

**Intended learning outcomes**

The students are able to decide which algorithms or data structures are suitable for the solution of a given geometric problem. The students are able to analyse new problems and to come up with their own efficient solutions based on the concepts and techniques acquired in the lecture.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| **Algorithms for Geographic Information Systems** | 10-I=AGIS-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science I | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Algorithmic foundations of geographic information systems and their application in selected problems of acquisition, processing, analysis and presentation of spatial information. Processes of discrete and continuous optimisation. Applications such as the creation of digital height models, working with GPS trajectories, tasks of spatial planning as well as cartographic generalisation.

**Intended learning outcomes**

The students are able to formalise algorithmic problems in the field of geographic information systems as well as to select and improve suitable approaches to solving these problems.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

--

**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | | Abbreviation |
|---|---|---|
| **Selected Topics in Algorithms and Theory** | | 10-I=AKAT-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science I | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Selected topics in algorithmics and theory.

**Intended learning outcomes**

The students understand the basic approach of algorithmic and theoretical computer science. They are able to understand the solutions to complex problems in this area and to apply them to similar questions.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

--

**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | | Abbreviation |
|---|---|---|
| **Selected Topics in Embedded Systems** | | 10-I=AKES-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| Dean of Studies Informatik (Computer Science) | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Selected topics in embedded systems.

**Intended learning outcomes**

The students possess specialised knowledge in the area of embedded systems. They are able to understand solutions to complex problems in this area and to transfer them to related questions.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| **Selected Topics in HCI** | 10-I=AKHCI-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science IX | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Selected topics in HCI.

**Intended learning outcomes**

The students understand the basic approach of human-computer interaction. They are able to understand the solutions to complex problems in this area and to transfer them to related questions.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | | Abbreviation |
|---|---|---|
| **Selected Topics in Computer Science** | | 10-I=AKI-141-m01 |

| Module coordinator | | Module offered by |
|---|---|---|
| Dean of Studies Informatik (Computer Science) | | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Selected topics in computer science.

**Intended learning outcomes**

The students are able to understand the solutions to complex problems in computer science and to transfer them to related questions.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| **Selected Topics in Intelligent Systems** | 10-I=AKIS-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science VI | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Selected topics in intelligent systems.

**Intended learning outcomes**

The students possess an advanced knowledge in the area of intelligent systems. They are able to understand solutions to complex problems in this area and to transfer them to related questions.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | | Abbreviation |
|---|---|---|
| **Selected Topics in Internet Technologies** | | 10-I=AKIT-141-m01 |

| Module coordinator | | Module offered by |
|---|---|---|
| holder of the Chair of Computer Science III | | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Selected topics in computer communication, for example design aspects of future internet structures: setup and control structures of the internet, multicast protocols, protocols for multimedia communication, optical networks, control mechanisms for redundant and real-time communication networks, p2p networks, ad-hoc networks, or -- new concepts and technologies in mobile communication: digital modulation, signal propagation, channel coding, modern transmission technologies (adaptive modulation and coding, hybrid ARQ, OFDM, MIMO), mac layer, mobileIP, routing in ad-hoc networks, vertical handover, UMTS IP multimedia subsystem, or -- planning and management methods in telecommunication networks: planning methods (forward engineering, reverse engineering), network management paradigms (central and decentral), framework for network management (IETF traffic engineering, ITU-T TMN, OSI management), planning and management methods (IP management mechanisms, network design, measurement, acquisition and evaluation of traffic and performance data, visualisation, result handling, simulation and analysis of networks), management tools, outlook and perspectives, or -- other current topics.

**Intended learning outcomes**

The students have a knowledge of advanced and current topics in the management and design of modern wired and wireless communication systems.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| **Selected Topics of Aerospace Engineering** | 10-I=AKLR-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science VIII | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Selected topics in aerospace engineering, for example: satellite communication, rocket science, propulsion systems, sensors and actuators for orientation control, perturbation of orbits, interplanetary orbits, rendezvous and docking, design of space ships, design of planetary bases, life support systems, special aspects of operations, payloads, optical systems, RADAR, earth monitoring, thermo management, structure of space ships, special areas of navigation, space environment, environment simulation, verification and test of space faring systems, space astronomy and planet missions, space medicine and biology, material science, quality management, space law, aeroflight topics, avionics for airplanes, air traffic control, areal navigation, pilot interfaces, air traffic control, air traffic management.

**Intended learning outcomes**

The students possess an advanced knowledge about the respective topic of the selected area and are able to consider these foundations in their future plans of air or spaceborne systems.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| **Selected Topics in Software Engineering** | 10-I=AKSE-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science II | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) | |
|---|---|---|---|
| 5 | numerical grade | -- | |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Selected topics in software engineering.

**Intended learning outcomes**

The students possess an advanced knowledge about selected aspects of software engineering.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | | Abbreviation |
|---|---|---|
| **Approximation Algorithms** | | 10-I=APA-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science I | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

The task of finding the optimal solution for a given problem is omnipresent in computer science. Unfortunately, there are many problems without an efficient algorithm for an optimal solution. As a result, in practice, methods are used which do not always give the optimal solution but always give good solutions. This lecture will discuss drafting and analysing techniques for algorithms which have a proven approximation quality. With the help of practical optimisation problems, the lecture will introduce students to important drafting techniques such as greedy, local search, scaling as well as methods based on linear programming.

**Intended learning outcomes**

The students are able to analyse easy approximation methods in terms of their quality. They understand fundamental drafting techniques such as greedy, local search and scaling as well as methods based on linear programming and are able to apply these to new problems.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | | Abbreviation |
|---|---|---|
| **Automata Theory** | | 10-I=AUT-141-m01 |

| Module coordinator | | Module offered by |
|---|---|---|
| Dean of Studies Informatik (Computer Science) | | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Finite automata, regular languages, star-free languages, natural equivalence relations, predicate logic with words, language acceptance through monoids, syntactic monoid, predicate logical and algebraic characterisation of regular languages and star-free languages, two-way automata.

**Intended learning outcomes**

The students possess a fundamental and applicable knowledge in the areas of finite automata, regular languages, star-free languages, natural equivalence relations, predicate logic with words, language acceptance through monoids, syntactic monoid, predicate logical and algebraic characterisation of regular and star-free languages, two-way automata.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

--

**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| Avionics Systems | 10-I=AVS-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science VIII | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

The course *Avionik-Systeme* (*Avionics Systems*) offers an overview of software, hardware, sensors, actuators and communication of airplanes and satellites: 1. software module and the software structure 2. control 3. ground control, 4. sensors and actuators, 5. sensor fusion, 6. reliability

**Intended learning outcomes**

At the end of the course, the students should be familiar with typical structures of avionic systems for satellites and airplanes. They should be able to design these. They should be able to program simple controls.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

--

**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| **Computability Theory** | 10-I=BER-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| Dean of Studies Informatik (Computer Science) | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Gödel numbering, computable functions, decidable and countable sets, halting problem, m-reducibility, creative and productive sets, relative computability, Turing reduction, countable degrees, arithmetic hierarchy.

**Intended learning outcomes**

The students possess a fundamental and applicable knowledge in the areas of Gödel numbers, countable functions, decidable and countable sets, halting problem, m-reducibility, creative and productive sets, relative computability, Turing reduction, countable degrees, arithmetic hierarchy.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| **Operating Systems** | 10-I=BS-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science II | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | undergraduate | -- |

**Contents**

Batch, time sharing, real-time virtual machines, system calls, processes and threads, cooperating processes, schedulers, process synchronisation, semaphores, monitors, critical regions, deadlocks, dynamic memory management, segmentation, paging, file systems, interfaces, directory structure, network file systems, hard drive organisation, basics of MS operating systems.

**Intended learning outcomes**

The students possess knowledge and practical skills in building and using essential parts of operating systems.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| **Compiler Construction** | 10-I=CB-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science II | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 8 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Lexical analysis, syntactic analysis, semantics, compiler generators, code generators, code optimisation.

**Intended learning outcomes**

The students possess knowledge in the formal description of programming languages and their compilation. They are able to perform transformations between them with the help of finite automata, push-down automata and compiler generators.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| **Databases** | 10-I=DB-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| Dean of Studies Informatik (Computer Science) | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | undergraduate | -- |

**Contents**

Relational algebra and complex SQL statements; database planning and normal forms, XML data modelling; transaction management.

**Intended learning outcomes**

The students possess knowledge about data modelling and queries in SQL, transactions as well as about easy data modelling in XML.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| **Databases 2** | 10-I=DB2-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| Dean of Studies Informatik (Computer Science) | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Data warehouses and data mining; web databases; introduction to Datalog.

**Intended learning outcomes**

The students have advanced knowledge about relational databases, XML and data mining.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes)
If announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English if agreed upon with the examiner

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)
Master's degree (1 major) Business Information Systems (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| Deductive Databases | 10-I=DDB-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| Dean of Studies Informatik (Computer Science) | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 8 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Syntax and semantics of logic programs; data structures, program structures and applications for Prolog; analytical methods for Datalog; negation and stratification; disjunctive logic programs.

**Intended learning outcomes**

The students possess expertise in working with Prolog and Datalog (including negation and disjunction).

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

--

**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| **Data Mining** | 10-I=DM-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| Dean of Studies Informatik (Computer Science) | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Foundations in the following areas: definition of data mining and knowledge discovery in databases, process model, relationship to data warehouse and OLAP data preprocessing, data visualisation, unsupervised learning methods (cluster- and association methods), supervised learning (e. g. Bayes classification, KNN, decision trees, SVM), learning methods for special data types, further learning paradigms.

**Intended learning outcomes**

The students possess a theoretical and practical knowledge of typical methods and algorithms in the area of data mining and machine learning. They are able to solve practical knowledge discovery problems with the help of the knowledge acquired in this course and by using the KDD process. They have acquired experience in the use or implementation of data mining algorithms.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | | Abbreviation |
|---|---|---|
| **E-Learning** | | 10-I=EL-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science VI | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Learning paradigms, learning system types, author systems, learning platforms, standards for learning systems, intelligent tutoring systems, student models, didactics, problem-oriented learning and case-based training systems, adaptive tutoring systems, computer-supported cooperative learning, evaluation of learning systems.

**Intended learning outcomes**

The students possess a theoretical and practical knowledge about eLearning and are able to assess possible applications.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English if agreed upon with the examiner

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)
Master's degree (1 major) Business Information Systems (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| Embedded Systems | 10-I=ES-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| Dean of Studies Informatik (Computer Science) | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 8 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Models of embedded systems, implementation methods (ASIC, AISIP, micro controller), verification of embedded systems, implementation planning static, periodic and dynamic, binding problems, hardware synthesis, software synthesis.

**Intended learning outcomes**

The students are familiar with the technical possibilities for the design of embedded systems and master the most important techniques for the modelling, verification and optimisation of such systems in hardware and software.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | | Abbreviation |
|---|---|---|
| **Interactive Computer Graphics** | | 10-I=ICG-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science IX | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Computer graphics studies methods for digitally synthesising and manipulating visual content. This course specifically concentrates on interactive graphics with an additional focus on 3D graphics as a requirement for many contemporary as well as for novel human-computer interfaces and computer games. The course will cover topics about light and images, lighting models, data representations, mathematical formulations of movements, projection as well as texturing methods. Theoretical aspects of the steps involved in ray-tracing and the raster pipeline will be complemented by algorithmical approaches for interactive image syntheses using computer systems. Accompanying software solutions will utilise modern graphics packages and languages like OpenGL, GLSL and/ or DirectX.

**Intended learning outcomes**

At the end of the course, the students will have a broad understanding of the underlying theoretical models of computer graphics. They will be able to implement a prominent variety of these models, to build their own interactive graphics applications and to choose the right software tool for this task.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| **Information Retrieval** | 10-I=IR-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| Dean of Studies Informatik (Computer Science) | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

IR models (e. g. Boolean and vector space model, evaluation), processing of text (tokenising, text properties), data structures (e. g. inverted index), query elements (e. g. query operations, relevance feedback, query languages and paradigms, structured queries), search engine (e. g. architecture, crawling, interfaces, link analysis), methods to support IR (e. g. recommendation systems, text clustering and classification, information extraction).

**Intended learning outcomes**

The students possess theoretical and practical knowledge in the area of information retrieval and have acquired the technical know-how to create a search engine.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English if agreed upon with the examiner

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I**  (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)
Master's degree (1 major) Business Information Systems (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | | Abbreviation |
|---|---|---|
| **Cryptography and Data Security** | | 10-I=KD-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| Dean of Studies Informatik (Computer Science) | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Private key cryptography systems, Vernam one-time pad, AES, perfect security, public key cryptography systems, RSA, Diffie-Hellman, Elgamal, Goldwasser-Micali, digital signature, challenge-response methods, secret sharing, millionaire problem, secure circuit evaluation, homomorphous encryption.

**Intended learning outcomes**

The students possess a fundamental and applicable knowledge in the areas of private key cryptography systems, Vernam one-time pad, AES, perfect security, public key cryptography, RSA, Diffie-Hellman, Elgamal, Goldwasser-Micali, digital signature, challenge-response method, secret sharing, millionaire problem, secure circuit evaluation, homomorphous encryption

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| **Artificial Intelligence 1 for Business Informatics** | 10-I=KI1-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science VI | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Intelligent agents, uninformed and heuristic search, constraint problem solving, search with partial information, propositional and predicate logic and inference, knowledge representation.

**Intended learning outcomes**

The students possess theoretical and practical knowledge about artificial intelligence in the area of agents, search and logic and are able to assess possible applications.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English if agreed upon with the examiner

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)
Master's degree (1 major) Business Information Systems (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| **Artificial Intelligence 2 for Business Informatics** | 10-I=KI2-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science VI | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) | |
|---|---|---|---|
| 5 | numerical grade | -- | |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Planning, probabilistic closure and Bayesian networks, utility theory and decidability problems, learning from observations, knowledge while learning, neural networks and statistical learning methods, reinforcement learning, processing of natural language.

**Intended learning outcomes**

The students possess theoretical and practical knowledge about artificial intelligence in the area of probabilistic closure, learning and language processing and are able to assess possible applications.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English if agreed upon with the examiner

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)
Master's degree (1 major) Business Information Systems (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| **Computational Complexity** | 10-I=KT-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| Dean of Studies Informatik (Computer Science) | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Complexity measurements and classes, general relationships between space and time classes, memory consumption versus computation time, determinism versus indeterminism, hierarchical theorems, translation methods, P-NP problem, completeness problems, Turing reduction, interactive proof systems.

**Intended learning outcomes**

The students possess a fundamental and applicable knowledge in the areas of complexity measurements and classes, general relationships between space and time classes, memory consumption versus computation time, determinism versus indeterminism, hierarchical theorems, translation methods, P-NP problem, completeness problems, Turing reduction, interactive proof systems.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

--

**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| **Computational Complexity II** | 10-I=KT2-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| Dean of Studies Informatik (Computer Science) | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Properties of NP-complete sets, autoreducibility, interactive proof systems, polynomial time hierarchy, complexity of probabilistic algorithms.

**Intended learning outcomes**

The students possess a fundamental and applicable knowledge in the areas of properties of NP-complete sets, autoreducibility, interactive proof systems, polynomial time hierarchies, complexity of probabilistic algorithms.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

--

**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | | Abbreviation |
|---|---|---|
| **Performance Evaluation of Distributed Systems** | | 10-I=LVS-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science III | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 8 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Traffic theoretic models, fundamental concepts of theory of probability, transformation techniques, stochastic processes, methods for performance analysis of technical systems, queue-/traffic theory, analysis of Markov, non-Markov and time critical systems, matrix analytical method, practical examples for performance analysis of computer systems and networks: throughput and goodput analysis and other characteristics.

**Intended learning outcomes**

The students possess the methodic knowledge and the practical skills necessary to model technical systems by means of the theory of probability and mathematical statistics.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

UNIVERSITÄT
WÜRZBURG
Julius-Maximilians-

| Module title | | | Abbreviation |
|---|---|---|---|
| **Master Thesis** | | | 10-I=MA-141-m01 |

| Module coordinator | | Module offered by | |
|---|---|---|---|
| Dean of Studies Informatik (Computer Science) | | Institute of Computer Science | |

| ECTS | Method of grading | | Only after succ. compl. of module(s) |
|---|---|---|---|
| 30 | numerical grade | | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Researching and writing on a complex problem in computer science within a given time frame and adhering to the principles of good scientific practice.

**Intended learning outcomes**

The students are able to research and write on a complex topic in computer science, adhering to the principles of good scientific practice.

**Courses** (type, number of weekly contact hours, language — if other than German)

C (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written thesis (approx. 75 to 150 pages)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

--

**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | | | Abbreviation |
|---|---|---|---|
| **Medical Informatics** | | | 10-I=MI-141-m01 |

| Module coordinator | | Module offered by | |
|---|---|---|---|
| holder of the Chair of Computer Science VI | | Institute of Computer Science | |

| ECTS | Method of grading | Only after succ. compl. of module(s) | |
|---|---|---|---|
| 5 | numerical grade | -- | |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Electronic patient folder, coding of medical data, hospital information systems, operation of computers in infirmary and functional units, medical decision making and assistance systems, statistics and data mining in medical research, case-based training systems in medical training.

**Intended learning outcomes**

The students possess theoretical and practical knowledge about the application of computer science methods in medicine.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | | Abbreviation |
|---|---|---|
| **Mathematical Logic** | | 10-I=ML-141-m01 |

| Module coordinator | | Module offered by |
|---|---|---|
| Dean of Studies Informatik (Computer Science) | | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Propositional logic, first-order predicate logic, proof and deduction, Gödel's completeness theorem, Tarski theorem, Gödel's incompleteness theorem, undecidability and nonaxiomatisability of elemental arithmetic.

**Intended learning outcomes**

The students possess a fundamental and applicable knowledge in the areas of propositional logic, first-order predicate logic, proof and deduction, Gödel's completeness theorem, Tarski theorem, Gödel's incompleteness theorem, undecidability and nonaxiomatisability of elemental arithmetic.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | | Abbreviation |
|---|---|---|
| **Object oriented Programming** | | 10-I=OOP-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| Dean of Studies Informatik (Computer Science) | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | undergraduate | -- |

**Contents**

Polymorphism, generic programming, meta programming, web programming, templates, document management.

**Intended learning outcomes**

The students are proficient in the different paradigms of object-oriented programming and have experience in their practical use.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

--

**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| **Program Design and Analysis** | 10-I=PA-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science II | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Program analysis, model creation in software engineering, program quality, test of programs, process models.

**Intended learning outcomes**

The students are able to analyse programs, to use testing frameworks and metrics as well as to judge program quality.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English if agreed upon with the examiner

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)
Master's degree (1 major) Business Information Systems (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | | | Abbreviation | |
|---|---|---|---|---|
| **Performance Engineering & Benchmarking of Computer Systems** | | | 10-I=PEB-141-m01 | |

| Module coordinator | | | Module offered by | |
|---|---|---|---|---|
| holder of the Chair of Computer Science II | | | Institute of Computer Science | |

| ECTS | Method of grading | | Only after succ. compl. of module(s) | |
|---|---|---|---|---|
| 5 | numerical grade | | -- | |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Introduction to performance engineering of commercial software systems, performance measurement techniques, benchmarking of commercial software systems, modelling for performance prediction, case studies.

**Intended learning outcomes**

The students possess a fundamental and applicable knowledge in the areas of performance metrics, measurement techniques, multi-factorial variance analysis, data analysis with R, benchmark approaches, modelling with queue networks, modelling methods, resource demand approximation, petri nets.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

--

**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| **Professional Project Management** | 10-I=PM-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science III | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | Simultaneous completion of module 10-I=PRJ is recommended. |

**Contents**

Project goals, project assignment, project success criteria, business plan, environment analysis and stakeholder management, initialisation, definition, planning, execution/control, finishing of projects, reporting, project communication and marketing, project organisation, team building and development, opportunity and risk management; conflict and crisis management, change and claim management; contract and procurement management, quality management, work techniques, methods and tools; leadership and social skills in project management, program management, multiproject management, project portfolio management, PMOs; peculiarities of software projects; agile project management/SCRUM, combination of classic and agile methods.

**Intended learning outcomes**

The students possess practically relevant knowledge about the topics of production management and/or professional project management. They are familiar with the critical success criteria and are able to initiate, define, plan, control and review projects.

**Courses** (type, number of weekly contact hours, language — if other than German)

V (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

--

**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | | Abbreviation |
|---|---|---|
| **Practical Course** | | 10-I=PRAK-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| Dean of Studies Informatik (Computer Science) | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 10 | (not) successfully completed | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Completion of a practical task.

**Intended learning outcomes**

The practical allows participants to work on a problem in computer science in teams.

**Courses** (type, number of weekly contact hours, language — if other than German)

P (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written elaboration of practical work (approx. 5 to 15 pages)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | | Abbreviation |
|---|---|---|
| **Project** | | 10-I=PRJ-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| Dean of Studies Informatik (Computer Science) | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | (not) successfully completed | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Completion of a practical task.

**Intended learning outcomes**

The practical allows participants to work on a problem in computer science in teams.

**Courses** (type, number of weekly contact hours, language — if other than German)

R (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

project report (approx. 10 to 15 pages) and presentation of project (approx. 15 to 30 minutes)
Assessment offered: The project will not be repeated; there will not be another project with the same topic. Assessment can, therefore, only be offered for the project offered in the respective semester.
Language of assessment: German, English

**Allocation of places**

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**Additional information**

Each project is offered one time only.

**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| **Computer Architecture** | 10-I=RAK-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| Dean of Studies Informatik (Computer Science) | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | undergraduate | -- |

**Contents**

Instruction set architectures, command processing through pipelining, statical and dynamic instruction scheduling, caches, vector processors, multi-core processors.

**Intended learning outcomes**

The students master the most important techniques to design fast computers as well as their interaction with compilers and operating systems.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

--

**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | | Abbreviation |
|---|---|---|
| **Computer Arithmetic** | | 10-I=RAM-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science II | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Spaces of numerical computation, raster and rounding, definition and implementation of computational arithmetic and interval calculation.

**Intended learning outcomes**

The students possess knowledge about the spaces of numerical computation, raster and roundings, definition and implementation of computational arithmetic and interval calculation. They master the application of algorithms.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

--

**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| **Computer Networks and Communication Systems** | 10-I=RK-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science III | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 8 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Properties of computer and communication systems: data traffic in distributed systems. Performance analysis of computer networks and communication systems: problem statement and introduction to method architecture and structure of computer networks: network structure, network access, access methods, digital transfer hierarchies, dataflow control and traffic control, transfer network. Communication protocols: fundamental principles and ISO architecture models. Internet: structure and basic mechanism, TCP/IP, routing, network management. Mobile communication networks: fundamental concepts, GSM, UMTS. Future communication systems and networks.

**Intended learning outcomes**

The students possess an intricate knowledge of the structure of computer networks and communication systems as well as fundamental principles to rate these systems.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

--

**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| **Robotics 1** | 10-I=RO1-122-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science XVII | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 8 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

History, applications and properties of robots, direct kinematics of manipulators: coordinate systems, rotations, homogenous coordinates, axis coordinates, arm equation. Inverse kinematics: solution properties, end effector configuration, numerical and analytical approaches, examples of different robots for analytical approaches. Workspace analysis and trajectory planning, dynamics of manipulators: Lagrange-Euler model, direct and inverse dynamics. Mobile robots: direct and inverse kinematics, propulsion system, tricycle, Ackermann steering, holonomes and non-holonome restrictions, kinematic classification of mobile robots, posture kinematic model. Movement control and path planning: roadmap methods, cell decomposition methods, potential field methods. Sensors: position sensors, speed sensors, distance sensors.

**Intended learning outcomes**

The students master the fundamentals of robot manipulators and vehicles and are, in particular, familiar with their kinematics and dynamics as well as the planning of paths and task execution.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + T (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 90 minutes)
Language of assessment: English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

--

**Module appears in**

Master's degree (1 major) Space Science and Technology (2012)
Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| Robotics 2 | 10-I=RO2-122-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science XVII | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 8 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Foundations of dynamic systems, controllability and observability, controller design through pole assignment: feedback and feed-forward, state observer, feedback with state observer, time discrete systems, stochastic systems: foundations of stochastics, random processes, stochastic dynamic systems, Kalman filter: derivation, initialising, application examples, problems of Kalman filters, extended Kalman filter.

**Intended learning outcomes**

The students master all fundamentals that are necessary to understand Kalman filters and their use in applications of robotics. The students possess a knowledge of advanced controller and observer methods and recognise the connections between the dual pairs controllability - observability as well as controller design and observer design. They also recognise the relationship between the Kalman filter as a state estimator and an observer.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + T (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 90 minutes)
Language of assessment: English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

--

**Module appears in**

Master's degree (1 major) Space Science and Technology (2012)
Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | | Abbreviation |
|---|---|---|
| **Software Architecture** | | 10-I=SA-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science II | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Introduction to software architecture, architectural styles and patterns, software metrics, evaluation of architectural styles, software components, interface models and design guidelines, design-by-contract, component-based software engineering, service-oriented architectures, microservice architectures, scalability of databases, cloud-native and serverless computing, continuous integration, continuous delivery, continuous deployment, model-driven architecture

**Intended learning outcomes**

The students possess a fundamental and applicable knowledge about advanced topics in software engineering with a focus on modern software architectures and fundamental approaches to model-driven software engineering.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

--

**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | | Abbreviation |
|---|---|---|
| **Seminar** | | 10-I=SEM3-141-m01 |

| Module coordinator | | Module offered by |
|---|---|---|
| Dean of Studies Informatik (Computer Science) | | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Independent review of a current topic in computer science based on literature and, where applicable, software with written and oral presentation.

**Intended learning outcomes**

The students are able to independently review a current topic in computer science, to summarise the main aspects in written form and to orally present these in an appropriate way.

**Courses** (type, number of weekly contact hours, language — if other than German)

S (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written elaboration (approx. 10 to 15 pages) and oral presentation (approx. 30 to 45 minutes) with subsequent discussion on the topic of the seminar
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | | | Abbreviation |
|---|---|---|---|
| Seminar | | | 10-I=SEM4-141-m01 |

| Module coordinator | | Module offered by | |
|---|---|---|---|
| Dean of Studies Informatik (Computer Science) | | Institute of Computer Science | |

| ECTS | Method of grading | Only after succ. compl. of module(s) | |
|---|---|---|---|
| 5 | numerical grade | -- | |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Independent review of a current topic in computer science based on literature and, where applicable, software with written and oral presentation.

**Intended learning outcomes**

The students are able to independently review a current topic in computer science, to summarise the main aspects in written form and to orally present these in an appropriate way.

**Courses** (type, number of weekly contact hours, language — if other than German)

S (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written elaboration (approx. 10 to 15 pages) and oral presentation (approx. 30 to 45 minutes) with subsequent discussion on the topic of the seminar
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

--

**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| **Space Automation** | 10-I=SPA-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science VII | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

This course teaches the foundations of space automation.

**Intended learning outcomes**

The students master the fundamentals of space automation.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

--

**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

--

**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| **Spacecraft System Design** | 10-I=SSD-122-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science VII | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 8 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Introduction: history of space flight, system design of spacecraft. Space dynamics: two-body dynamics, Kepler orbits, disturbance forces, transfer orbits. Mission analysis: earth and sun-synchronous orbits, shadows, solar angle of incidence. Thermal control of satellites: thermal analysis, thermal design and technologies, verification of thermal designs. Telecommunication: ground contact analysis, data transmission, satellite monitoring (telemetry, telecommando). Structure and mechanisms. Energy systems: primary, secondary, management, power generation: solar cells. On-board data processing. Propulsion systems. Tests (mechanical, electrical). Operation of spacecraft. Ground segment.

**Intended learning outcomes**

The students master system aspects of the layouting of technical systems. Using the example of spacecraft, major subsystems and their integration into a working whole are being analysed.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + T (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 90 minutes)
Language of assessment: English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Space Science and Technology (2012)
Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | | Abbreviation |
|---|---|---|
| **Discrete Event Simulation** | | 10-I=ST-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science III | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 8 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Introduction to simulation techniques, statistical groundwork, creation of random numbers and random variables, random sample theory and estimation techniques, statistical analysis of simulation values, inspection of measured data, planning and evaluation of simulation experiments, special random processes, possibilities and limits of model creation and simulation, advanced concepts and techniques, practical execution of simulation projects.

**Intended learning outcomes**

The students possess the methodic knowledge and the practical skills necessary for the stochastic simulation of (technical) systems, the evaluation of results and the correct assessment of the possibilities and limits of simulation methods.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

--

**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| **NLP and Text Mining** | 10-I=STM-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science VI | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | undergraduate | -- |

**Contents**

Foundations in the following areas: definition of NLP and text mining, properties of text, sentence boundary detection, tokenisation, collocation, N-gram models, morphology, hidden Markov models for tagging, probabilistic parsing, word sense disambiguation, term extraction methods, information extraction, sentiment analysis. The students possess theoretical and practical knowledge about typical methods and algorithms in the area of text mining and language processing mostly for English. They are able to solve problems through the methods taught. They have gained experience in the application of text mining algorithms.

**Intended learning outcomes**

The students possess theoretical and practical knowledge about typical methods and algorithms in the area of text mining and language processing. They are able to solve practical problems with the methods acquired in class. They have gained experience in the application of text mining algorithms.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| **Visualization of Graphs** | 10-I=VG-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science I | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

This course covers the most important algorithms to draw graphs. Methods from the course *Algorithmische Graphentheorie* (*Algorithmic Graph Theory*) such as divide and conquer, flow networks, integer programming and the planar separator theorem will be used. We will become familiar with measures of quality of a graph drawing as well as algorithms to optimise these measures.

**Intended learning outcomes**

The participants get an overview of graph visualisation and become familiar with typical tools. They consolidate their knowledge about the modelling and solving of problems with the help of graphs and graph algorithms.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

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**Teaching cycle**

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**Referred to in LPO I**  (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)

Subdivided Module Catalogue for the Subject
Computer Science
Master's with 1 major, 120 ECTS credits

| Module title | Abbreviation |
|---|---|
| **Knowledge-based Systems** | 10-I=WBS-141-m01 |

| Module coordinator | Module offered by |
|---|---|
| holder of the Chair of Computer Science VI | Institute of Computer Science |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
|---|---|---|
| 5 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
|---|---|---|
| 1 semester | graduate | -- |

**Contents**

Foundations in the following areas: knowledge management systems, knowledge representation, solving methods, knowledge acquisition, learning, guidance dialogue, semantic web.

**Intended learning outcomes**

The students possess theoretical and practical knowledge for the understanding and design of knowledge-based systems including knowledge formalisation and have acquired experience in a small project.

**Courses** (type, number of weekly contact hours, language — if other than German)

V + Ü (no information on SWS (weekly contact hours) and course language available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 60 to 120 minutes); if announced by the lecturer at the beginning of the course, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English

**Allocation of places**

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**Additional information**

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**Workload**

--

**Teaching cycle**

--

**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module appears in**

Master's degree (1 major) Computer Science (2014)