 Modules for Computing Science

Kernmodule

inf900 - Group Project

<table>
<thead>
<tr>
<th>Module label</th>
<th>Group Project</th>
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<tbody>
<tr>
<td>Module code</td>
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<td>Credit points</td>
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<td>Workload</td>
<td>720 h</td>
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<tr>
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<tr>
<td></td>
<td>Master's Programme Engineering of Socio-Technical Systems (Master) &gt; Systems Engineering</td>
</tr>
<tr>
<td>Contact person</td>
<td>Module responsibility</td>
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<td>Die im Modul Lehrenden</td>
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<tr>
<td>Authorized examiners</td>
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</tbody>
</table>

Entry requirements

Skills to be acquired in this module
The students get familiar with different software development aspects in a team. Apart from software engineering knowledge and skills they develop key competences like project management, teamwork, problem solving competence and conflict management.

Additionally, students develop special knowledge, skills and competences from the project group topic.

Professional competence
The students:
- characterise and apply computer science basics (algorithms, data structures, programming, basics of practical, technical and theoretical computer science)
- define and describe essential mathematical, logical and physical basics of computer science
- define and illustrate the core disciplines of computer science (theoretical, practical and technical computer science)

Methodological competence
The students:
- examine problems, use formal methods to phrase and analyze them appropriately
- evaluate problems by the use of technical and scientific literature
- reflect on a scientific topic and write a scientific seminar paper under guidance and present their findings

Social competence
The students:
- integrate criticism into their own actions
- respect team decisions
- communicate with users and experts convincingly

Self-competence
The students:
- take on project management tasks
- pursue the overall and special computer science development critically
- implement innovative professional activities effectively and independently
- recognise their abilities and extend them purposefully
- reflect their self-perception and actions with regard to professional, methodological and social aspects
- develop and reflect self-developed hypotheses to theories independently
- work in their field independently

Module contents
Cooperative development of a large-scale computer science project. This project generally includes the (further) development of a hard or software system.

Reader's advisory
According to the assigned task
| **Links** | https://www.uni-oldenburg.de/informatik/studium-lehre/infos-zum-studium/projektgruppen-im-masterstudium/ |
| **Languages of instruction** | German, English |
| **Duration (semesters)** | 2 Semester |
| **Module frequency** | semi-annual |
| **Module capacity** | unlimited |
| **Reference text** | Dieses Modul ist im Rahmen der Projekte FiIF und FoL konzipiert worden |
| **Modullevel** | AS (Akzentsetzung / Accentuation) |
| **Modulart** | Pflicht o. Wahlpflicht / compulsory or optional |
| **Lern-/Lehrform / Type of program** | PG |
| **Vorkenntnisse / Previous knowledge** | - Programmierkurs  
- Softwaretechnik  
- Soft Skills |
| **Examination** | **Time of examination** | **Type of examination** |
| **Final exam of module** | Im Stud.IP nach Bekanntgabe der einzelnen Gruppen und Themen | Active involvement, presentation, final report, project assessment |
| **Course type** | Project group |
| **SWS** | 8.00 |
| **Frequency** | SuSe and WiSe |
| **Workload attendance** | 112 h |
Angewandte Informatik

inf131 - Advanced Topics in Human Computer Interaction

<table>
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<th>Module label</th>
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<tr>
<td>Workload</td>
<td>180 h</td>
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Used in course of study
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's Programme Computing Science (Master) > Praktische Informatik
- Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction

Contact person
- Module responsibility
  - Susanne Boll-Westermann
  - Die im Modul Lehrenden

Authorized examiners
- Die im Modul Lehrenden

Entry requirements

Skills to be acquired in this module
This course aims to provide a sample of some of the most recent and significant advances in this exciting area. Topics may include: situational awareness, designing for attention, ambient/peripheral interaction, computer support cooperative work and social computing (CSCW), ubiquitous and context-aware computing, haptic and gestural interaction, audio interaction, gaze-based interaction, biometric interfaces, and embedded, physical and tangible computing, mobile and wearable interfaces. This course is explicitly not focused on the methods used in HCI practice (i.e., user-centered design cycle), but rather focuses on (recent) research.

Course prerequisite: Mensch-Maschine-Interaktion (Human Computer Interaction)

Professional competences:
The students:
- Demonstrate a systematic understanding of knowledge and critical awareness of a selection of the recent research advances in the area of HCI
- Evaluate and critique recent developments in the field of HCI on scientific and technological grounds
- Develop ability to conceptualize, design, implement, and evaluate user-centered systems and techniques.
- Plan and implement exploratory projects directed at envisioning and prototyping novel interactive artifact

Methodological competences:
The students:
- Analyze, review and critique research papers
- Carry out original research from start to finish
- Summarize and present research findings
- Work in a team to produce and evaluate prototypes of novel interactive artifact

Social competences:
The students:
- Work collaboratively in groups to analyze and review research papers
- Summarize and present research findings to rest of class
- Discuss how HCI concepts and methods can be applied in analysis, design, and evaluation of interactive technologies.
- Discuss social and ethical implications of interactive technologies

Self-competences:
The students:
- Be comfortable tackling original research questions
- Aptitude in conceptualizing and running both qualitative and quantitative HCI experiments
- Ability to summarize, analyze, and critique published (peer-review) research papers
**Module contents**

HCI is a fast-growing field, where scientific research in this area crosses multiple disciplines. The body of theoretical and empirical knowledge that can inform the design of effective systems is rapidly developing, which underscores the importance of current research in the field.

This course aims to provide a sample of some of the most recent and significant advances in this exciting area. Topics may include: situational awareness, designing for attention, ambient/peripheral interaction, computer support cooperative work and social computing (CSCW), ubiquitous and context-aware computing, haptic and gestural interaction, audio interaction, gaze-based interaction, biometric interfaces, and embedded, physical and tangible computing, mobile and wearable interfaces.

**Structure of the Module:**

The course will consist of lectures and lab sessions. Lab sessions will cover assignments (writing paper reviews, presentations, and peer assessment). In addition to assignments and a final exam, a small part of the course includes a mini group-based HCI project.

Lectures: 2 hours per week  
Lab: 2 hours per week

This lecture will be held in English. All assignment submissions and exams will be in English.

The primary audience for this class are Master students of Computer Science following the Human Computer Interaction track.

**Reader's advisory**

**Suggested reading:**


**Links**

<table>
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<tr>
<th>Language of instruction</th>
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<td>Pflicht o. Wahlpflicht / compulsory or optional</td>
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<td>Lern-/Lehrform / Type of program</td>
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<td>Vorkenntnisse / Previous knowledge</td>
<td>Interaktive Systeme</td>
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<td>Examination</td>
<td>Time of examination</td>
</tr>
<tr>
<td>Final exam of module</td>
<td>At the end of the lecture period</td>
</tr>
<tr>
<td>Type of examination</td>
<td>Project and oral exams</td>
</tr>
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</table>

**Grading:**

Missing the exam
If you cannot attend the exam with valid reasons (medical reason, exam schedule conflicts), you need to inform us before the exam, and submit a scanned copy of the evidence (medical certificate, course registration, boarding passes) within 5 days after the exam.

- If the reason for missing the exam is valid, you will do your first try of the exam for the parts that you missed on the same date as the second chance exam.
- If the reason is not valid, you will not get any score from that exam. If your overall score passed the course, you will not have a chance to take the exam again.

Grading:
Your grade will be calculated as follows:

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<tr>
<td>Final</td>
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<tr>
<td>Assignments A01-03</td>
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<tr>
<td>Mini HCI research project</td>
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# Course Type Details

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<tr>
<td>Lecture</td>
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<td>2.00</td>
<td>SuSe or WiSe</td>
<td>28 h</td>
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<tr>
<td>Practical</td>
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<td>2.00</td>
<td>SuSe or WiSe</td>
<td>28 h</td>
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**Total time of attendance for the module**: 56 h
inf303 - Fuzzy Control and Artificial Neural Networks in Robotics and Automation

Module label
Fuzzy Control and Artificial Neural Networks in Robotics and Automation

Module code
inf303

Credit points
6.0 KP

Workload
180 h

Used in course of study
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's Programme Computing Science (Master) > Technische Informatik
- Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodulle
- Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
- Master's Programme Engineering Physics (Master) > Schwerpunkt: Renewable Energies

Contact person
Module responsibility
- Sergej Fatikow
- Die im Modul Lehrenden

Authorized examiners
- Sergej Fatikow
- Die im Modul Lehrenden

Entry requirements

Skills to be acquired in this module
Experts in different branches try to approach their application-specific control and information processing problems by using fuzzy logic and artificial neural networks (ANN). The experiences gathered up to now prove robotics and automation technology to be predestined fields of application of both these approaches. The major topics of the course are control problems in robotics and automation technology, principles of fuzzy logic and ANN and their practical applications, comparison of conventional and advanced control methods, combination of fuzzy logic and ANN in control systems. The course gives a comprehensive treatment of these advanced approaches for interested students.

Professional competence
The students:
- recognise control problems in robotics and automation technology,
- name principles of fuzzy logic and ANN and their practical applications,
- compare conventional and advanced control methods,
- characterise the combination of fuzzy logic and ANN in control systems

Methodological competence
The students:
- will acquire knowledge of the tools, methods and applications in fuzzy logic and ANN
- deepen their knowledge for the practical use of the given methods
- can use common software tools for design and application of fuzzy logic and ANN

Social competence
The students:
- gain experience in interdisciplinary work
- are integrated into the recent research work

Objective of the module / skills:

Self-competence
The students:
- are able to transfer the gained knowledge for later use in their theses or studies for AM&R
- can Design (complex) fuzzy logic controller and ANN systems
- reflect their (control) solutions by using methods learned in this course

Module contents
- Control problems in robotics and automation technology
- Basic ideas of fuzzy logic and ANN
- Principles of fuzzy logic
- Fuzzy logic of rule-based systems
- ANN models
- ANN learning rules
- Multilayer perceptron networks and backpropagation
- Associative networks
- Self-organizing feature maps
- PID design principles
- Design of fuzzy control systems
- Fuzzy logic application examples
- Design of ANN control systems
- ANN application examples
- Fuzzy + Neuro: principles and applications

Reader's advisory

Essential:

- Lecture notes (available at the secretariat, A1-3-303) in book form

Recommended:


Secondary Literature:

- Altrock, M. O. R.: Fuzzy Logic, R. Oldenbourg Verlag, 1993
- Kahlert, J. und Hubert, F.: Fuzzy-Logik und Fuzzy-Control, Vieweg, 1993
- Kratzer, K.P.: Neuronale Netze, Carl Hanser, 1993
- Lawrence, J.: Neuronale Netze, Systhema Verlag, München, 1992
- Patterson, D.W.: Künstliche neuronale Netze, Prentice Hall, 1996
- Pham, D.T. a200
- Schulte, U.: Einführung in Fuzzy-Logik, Franzis-Verlag, München, 1993
- Zakharian, S. Ladewig-Riebler, P. und Thöer, St.: Neuronale Netze für Ingenieure, Vieweg, Wiesbaden, 1998
- Zimmermann H.-J. (Hrsg.): Datenanalyse, VDI-Verlag, 1995

Links

<table>
<thead>
<tr>
<th>Languages of instruction</th>
<th>English , German</th>
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<tr>
<td>Duration (semesters)</td>
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<td>Exercises</td>
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Total time of attendance for the module: 56 h
### Module: Environmental Information Systems

**Module code**: inf501  
**Credit points**: 6.0 KP  
**Workload**: 180 h

**Used in course of study**
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's Programme Environmental Modelling (Master) > Mastermodule
- Master's Programme Sustainability Economics and Management (Master) > Additional Modules

**Contact person**
- Module responsibility: Ute Vogel-Sonnenschein  
- Authorized examiners: Die im Modul Lehrenden

**Entry requirements**
- Skills to be acquired in this module:
  - Professional competence: The students: - apply basic processing algorithms to classify and process data - compare, evaluate and design data structures to store spatial data efficiently - apply basic functions of a geo-information system - describe, evaluate and apply basic geostatistics processes - evaluate and apply multicriteria decision making processes
  - Methodological competence: The students: - use geoinformation systems for environmental application - use data mining tools for data analysis
  - Social competence: The students: - solve tasks in teams of 2-3 students - present and discuss their solutions in class
  - Self-competence: The students: - reflect their own behaviour with regard to the methods of environmental informatics

**Module contents**
- Content of the Module: Environmental information systems make information about the general environmental state available for public management and public facilities, enterprises or interested citizens. The collection, storage and evaluation of this information is interesting for computer science. Within the scope of the lecture we will examine the processing of environmental information step-by-step, this means: - problems of data acquisition and data processing, - data structures and database concepts for an efficient access to (usually) spatial data, - introduction of data analysis (in particular from geostatistics and data mining), - introduction of multicriteria decision processes, as well as - the supply of data supported by meta data. The module "Umweltinformationssysteme" is accompanied by the module "Modellbildung in Simulation ökologischer Systeme". The subjects of "Modellbildung in Simulation ökologischer Systeme" represent the dynamic aspects of environmental systems (mainly of ecological systems). Nevertheless, the modules can be taken independently from each other.

**Reader's advisory**

**Links**
- Language of instruction: German
- Duration (semesters): 1 Semester
- Module frequency: jährlich
- Module capacity: unlimited
- Reference text: Associated with the module: - inf500 Modellbildung und Sim. ökol. Systeme
- Modullevel: BC (Basiscurriculum / Base curriculum)
- Modulart: je nach Studiengang Pflicht oder Wahlpflicht
- Modulart: je nach Studiengang Pflicht oder Wahlpflicht

**Vorkenntnisse / Previous knowledge**
- Informationssysteme I
- Grundlagen der Statistik

**Examination**
- Time of examination: Second and third week after the end of the lecture period - retake before the upcoming lecture period
- Type of examination: Practical exercises and oral examination or portfolio

**Course type**
- **Lecture**: 3.00 SWS - SuSe - 42 h
- **Exercises**: 1.00 SWS - SuSe - 14 h

**Total time of attendance for the module**: 56 h
# inf502 - Simulation

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  - Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
  - Master's Programme Computing Science (Master) > Angewandte Informatik
  - Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering |
| Contact person       | Module responsibility
  - Axel Hahn
  - Jürgen Sauer
| Authorized examiners |  
  - Axel Hahn
  - Jürgen Sauer |
| Entry requirements   | Simulation is a major tool for gaining knowledge about systems and their behavior. It can be used to gain system understanding and prediction future system status. The module covers mathematical basic as well as a basic simulation technology. The module completes itself by addressing application examples. By seminar and practical work, the students get hands on experience of simulation technologies. |
|                      | **Professional competence**                     |
|                      | The students:  
  - get an overview on methods, tools and application areas of simulation. They know what simulation can do and what are its limitation. Covered application are mainly in transportation and production domain. |
|                      | **Methodological competence**                   |
|                      | The students:  
  - know simulation technologies and model building basics. They understand the handling of time and problems of discretization. After lecture students can solve problems with simulation. This includes modelling, use of simulation environment and evaluation of results. Cause of practical use, the independent handling of research questions and the use of simulation as research method will be learned. |
|                      | **Social competence**                           |
|                      | The students:  
  - gain team and social skills by self-organized development of simulation. |
|                      | **Self-competence**                             |
|                      | The students:  
  - can apply simulation technologies on scientific research questions. |
| Module contents      | In lectures the students get background information and simulation basics. Then they apply their knowledge by developing an own simulation by using state of the art simulation environments |
| Reader's advisory    |  
| Languages of instruction | German, English |
| Duration (semesters) | 1 Semester                                      |
| Module frequency     | annualy                                         |
| **Module capacity** | unlimited |
| **Modullevel** | AS (Akzentsetzung / Accentuation) |
| **Modulart** | je nach Studiengang Pflicht oder Wahlpflicht |
| **Lern-/Lehrform / Type of program** | V+S+P |
| **Vorkenntnisse / Previous knowledge** | Programmierkenntnisse vornehmlich in Java sind zwingend erforderlich |
| **Lern-/Lehrform / Type of program** | V+S+P |
| **Vorkenntnisse / Previous knowledge** | Programmierkenntnisse vornehmlich in Java sind zwingend erforderlich |

| **Final exam of module** | Anmeldung 2 Wochen nach Vorlesungsbeginn | M (Seminar / Projektbericht) |

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<td>Practical</td>
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<td>1.00</td>
<td>SuSe</td>
<td>14 h</td>
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**Total time of attendance for the module**

56 h
inf510 - Energy Information Systems

Module label Energy Information Systems

Module code inf510

Credit points 6.0 KP

Workload 180 h

Used in course of study
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's Programme Engineering Physics (Master) > Schwerpunkt: Renewable Energies
- Master's Programme Environmental Modelling (Master) > Mastermodule

Contact person

Module responsibility
- Sebastian Lehnhoff
- Die im Modul Lehrenden

Authorized examiners
- Sebastian Lehnhoff
- Die im Modul Lehrenden

Entry requirements

Skills to be acquired in this module
The students will learn different approaches to integrate distributed facilities, the regulatory framework, relevant standards and architecture concepts of energy management systems and will be able to apply this knowledge.

Professional competence
The students:
- develop and evaluate IT-architectures for energy management systems
- model objects of this domain appropriately
- model energy information systems
- realise and differentiate advanced tasks of decentralised energy management systems

Methodological competence
The students:
- identify problems of energy management, analyse these problems systematically and provide solutions
- apply different simulation approaches of decentralised plants and consumers

Social competence
The students:
- discuss solutions for energy management systems in the group
- develop use cases in teams
- present self-developed solutions

Self-competence
The students:
- reflect their actions with regard to structuring and decomposing systems
- reflect their own use of power as a limited resource

Module contents
This module provides the computer science basics for energy management. It provides the requirements of energy supply information systems with the focus on technical components and the requirements of decentralised and renewable energy plants.

These are:
- Architectures for energy information systems, e.g. SOA, Seamless Integration Architecture (IEC TC 57), OPC-UA
- Norms and standards of energy industry data models (CIM, 61850)
- Systematisation of energy information system requirements based on ontologies
- Development, analysis and adaption of energy industry reference models and processes
- Methods and technologies to support energy industry processes
- Methods and algorithms to support decision processes of the decentralised energy plants control
- Smart Grid plant communication, particularly for load management
- Methods for modelling and simulation of power supply system dynamics
Reader's advisory

- Crastan V.: "Elektrische Energieversorgung II", Springer 2004

Links

<table>
<thead>
<tr>
<th>Language of instruction</th>
<th>English</th>
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<tbody>
<tr>
<td>Duration (semesters)</td>
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<td>Modulart</td>
<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
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<tr>
<td>Lern-/Lehrform / Type of program</td>
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Vorkenntnisse / Previous knowledge

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<th>Examination</th>
<th>Time of examination</th>
<th>Type of examination</th>
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<tbody>
<tr>
<td>Final exam of module</td>
<td>At the end of the semester</td>
<td>Student research project or presentation</td>
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<table>
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<th>Comment</th>
<th>SWS</th>
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<tbody>
<tr>
<td>Lecture</td>
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<td>2.00</td>
<td>WiSe</td>
<td>28 h</td>
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<tr>
<td>Seminar</td>
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<td>2.00</td>
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<td>28 h</td>
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Total time of attendance for the module 56 h
inf511 - Smart Grid Management

Module label  Smart Grid Management
Module code  inf511
Credit points  6.0 KP
Workload  180 h

Used in course of study
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's Programme Engineering Physics (Master) > Schwerpunkt: Renewable Energies
- Master's Programme Environmental Modelling (Master) > Mastermodule
- Master's Programme Postgraduate Programme Renewable Energy (Master) > Mastermodule

Contact person
Module responsibility
- Sebastian Lehnhoff
- Die im Modul Lehrenden

Authorized examiners
- Sebastian Lehnhoff
- Die im Modul Lehrenden

Entry requirements

Skills to be acquired in this module
After successful completion of the course the students should be able to understand the existing structures and technical basis of energy systems to produce, transfer and distribute electricity and their interaction and dependency on each other. They should have developed an understanding for necessary IT- and process control technology components, methods and processes to control and operate electrical energy systems. The students are able to estimate and evaluate the requirements and challenges of ICT and computer science which are caused by the development and integration of unforeseeable fluctuations of decentralised plants. The students will be able to estimate the influence of distributed control concepts and algorithms for decentralised plants and consumers in the so called Smart Grid energy systems. Regarding the requirements the students will be able to analyse the safety, reliability, realtime capability and flexibility of Smart Grid energy systems.

Professional competence
The students:
- understand the existing structures and the technical basis of energy systems producing, transferring and distributing electricity and their interaction and dependency on each other.
- develop an understanding for necessary IT- and process control technology components, methods and processes to control and operate electrical energy systems.
- estimate and evaluate the requirements and challenges of ICT and computer science which are caused by the development and integration of unforeseeable fluctuations of decentralised plants.
- estimate the influence of distributed control concepts and algorithms for decentralised plants and consumers in the so called Smart Grid energy systems.

Methodological competence
The students:
- analyse the safety, reliability, realtime capability and flexibility of Smart Grid energy systems
- use advanced mathematical methods to calculate networks

Social competence
The students:
- create solutions in small teams
- discuss their solutions

Self-competence
The students:
- reflect their own use of electricity as a limited resource

Module contents
Content of the Module: In this course information technology, economical energy industry and technical basic knowledge and methods are analysed by using concrete Smart Grid approaches. The basic calculation methods for an intelligent grid management are introduced.

This module deals with the technical and economical framework for a permissable electrical network as well as
The course focuses on mathematical modeling and calculation methods to analyze conditions of electrical energy networks (in stationary conditions). These include:

- The organization of the EU energy market (regulatory framework, responsibility in liberalization of electrical energy systems)
- Establishment and operation of electrical energy supply networks (network topology, statutory duties of supply, supply quality/system services, malfunctions and protection systems)
- Intelligent network management (Smart Grids), aggregation forms, machine learning approaches

Suggested reading:

- Crastan V.: "Elektrische Energieversorgung II", Springer 2004

Links

<table>
<thead>
<tr>
<th>Language of instruction</th>
<th>English</th>
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<tr>
<td>Duration (semesters)</td>
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<td>Modulart</td>
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<td>Lern-/Lehrform / Type of program</td>
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Previous knowledge

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<td>Oral exam</td>
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<th>Frequency</th>
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Total time of attendance for the module: 56 h
inf513 - Energy Informatics Practical

Module label: Energy Informatics Practical
Module code: inf513
Credit points: 6.0 KP
Workload: 180 h

Used in course of study:
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodul der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodul

Contact person:
- Module responsibility
  - Sebastian Lehnhoff
- Authorized examiners
  - Die im Modul Lehren den

Entry requirements:
Programming with JAVA

Skills to be acquired in this module:
Successfully completing this lecture will enable the students to mathematically model simple controllable electrical generators and consumers and to simulate them together with appropriate control algorithms within smart grid scenarios. To achieve this goal, students will start with deriving computational models from physical models and evaluate them. In order to manage the integration of control algorithms, students are taught the principles of cosimulation using the "mosaik" smart grid co-simulation framework as an example.

Students will be able to understand and apply distributed, agent-based control schemes to decentralized energy generators and/ or consumers. As a result, students are able to analyze the requirements for successful application to real power balancing regarding capacity utilization, robustness, and flexibility. In addition, students learn the foundations of planning and conducting simulation based experiments as well as the interpretation of the results. Special attention will be paid on establishing a balance between the results’ precision and robustness and the necessary effort (design of experiments) in order to gain as much insight into interdependencies with as few experiments as possible.

Professional competence
The students:
- derive and evaluate computational models from physical models
- use the "mosaik" smart grid co-simulation framework
- analyze the requirements for successful applications to real power balancing regarding capacity utilization, robustness, and flexibility
- name the foundations of planning and conducting simulation based experiments as well as the interpretation of the results
- are aware of the balance between the results’ precision and robustness and the necessary effort (design of experiments) in order to gain as much insight into interdependencies with as few experiments.

Methodological competence
The students:
- model simple controllable electrical generators and consumers
- simulate simple controllable electrical generators and consumers with appropriate control algorithms within smart grid scenarios
- apply distributed agent-based control schemes to decentralized energy generators and/ or consumers
- evaluate simulation results
- search information and look into methods to implement models
- propose hypothesis and check their validity with design of experiments methods

Social competence
The students:
- apply the pair programming development technique
- discuss design decisions
- identify work packages and are responsible for it

Self-competence
The students:
- reflect on their own use of power as a limited resource
- accept and use criticism to develop their own behaviour
In this practical course students:

- model controllable, modulating electrical energy generators and consumers,
- put their hands on mosaic (installation, description and configuration of scenarios, conduction of simulations),
- learn the principles of agent-based heuristics for optimization problems in future smart grid scenarios,
- learn about the challenges of implementing agent-based mechanisms (multi-criticality, convergency, quality) on the training,
- learn the foundations for choice and design of simulation based experiments.

Suggested reading:

**Smart Grids:**

**Multiagentensysteme:**

**Co-Simulation**

**Versuchsplanung:**
- Klein, B.: "Versuchsplanung - DoE", Oldenbourg, 2011

Links
- http://mosaik.offis.de

Language of instruction
- German

Duration (semesters)
- 1 Semester

Module frequency
- jährlich

Module capacity
- unlimited

Reference text
- Elective module in the master specialization area (energy computer science).
- Associated with the modules:
  - Energieinformationssysteme
  - Smart Grid Management

Modullevel
- AS (Akzentsetzung / Accentuation)

Modulart
- je nach Studiengang Pflicht oder Wahlpflicht

Vorkenntnisse / Previous knowledge
- Programmierung mit Java
- Programmierung mit Python

Examination
- Time of examination
- Type of examination

Final exam of module
- At the end of the semester
- Oral exam

Course type
- Practical

SWS
- 4.00

Frequency
- SuSe
| Workload attendance | 56 h |
### inf520 - Management of Information Systems in Health Care

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<tr>
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| Used in course of study |  • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik  
  • Master's Programme Computing Science (Master) > Angewandte Informatik |
| Contact person| Module responsibility  
  • Rainer Röhrig  
  • Die im Modul Lehrenden  
  Authorized examiners  
  • Rainer Röhrig  
  • Die im Modul Lehrenden |

#### Entry requirements

<table>
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<tr>
<th>Skills to be acquired in this module</th>
<th>Professional competence</th>
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<td>The students:</td>
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</table>
|                                      | • know healthcare information systems and their functions  
|                                      | • know clinical software architectures and apply their IT strategies  
|                                      | • know and apply system integration standards, methods (including medical technology) and risk management  
|                                      | • know and apply clinical information systems and maintain them  
|                                      | • know the legal and regulatory framework (including data privacy) for the operation of healthcare IT systems  
|                                      | • implement simple data analyses on care data  
|                                      | • know and apply procurement processes and changes |

#### Module contents

| Basics of the healthcare system |
| Basics of the medical documentation |
| Healthcare information systems / clinical information systems / intensive care information systems (PDMS) |
| PDMS parameters, including interface terminology and semantic standards |
| Data privacy and security |
| System integration and interoperability (HL7, ...) |
| Hospital financing / DRG-System: regulatory framework and implementation |
| Care data analyses |
| Requirements engineering |
| Procurement project and risk management |

#### Reader's advisory

Wird im Modul bekannt gegeben

#### Language of instruction

German

#### Duration (semesters)

1 Semester
<table>
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**Lern-/Lehrform / Type of program**

**Vorkenntnisse / Previous knowledge**
- Medizin für Informatiker
- Informationssysteme / Datenbanken

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**Total time of attendance for the module** 56 h
inf522 - Information Processing in Bio-Medical Research

Module label: Information Processing in Bio-Medical Research
Module code: inf522
Credit points: 6.0 KP
Workload: 180 h

Used in course of study:
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering

Contact person:
Module responsibility
- Rainer Röhrig
- Die im Modul Lehrenden

Authorized examiners
- Die im Modul Lehrenden
- Rainer Röhrig

Entry requirements:

Skills to be acquired in this module:
The students are aware of the requirements of biomedical research information processing and technologies. They know, develop and evaluate approaches.

Professional competences:
The students:
- Know the principles of biomedical research and identify resulting requirements and develop appropriate solutions
- Know the regulatory guidelines and assess the suitability of (IT) solutions or develop them
- Plan, apply, evaluate, report and assess IT solution evaluation studies
- Are aware of the biomedical research responsibility and the ethical challenges

Methodological competences:
The students:
- Search literature systematically
- Plan and assess clinical studies
- Develop concepts for a data privacy and GCP conform study management
- Know and apply medical classification systems
- Validate and run software for clinical trials, cohorts and registries
- Plan and assess healthcare IT studies

Social competences:
The students:
- Present solutions/results
- Discuss studies constructively, professionally and appropriately
- Discuss ethical biomedical research problems from different points of view

Self-competences:
The students:
- Reflect their own values and attitudes in the context of medical and biomedical research border areas
- Reflect their self-capacity with regard to the responsibility and the workload during the implementation of studies and the operation of study information systems

Module contents:
- Basics / Biomedical research theory
- Systematic literature research, repositories
- Study schedule and method design
- Biomedical research regulatory framework
- Biomedical research ethics
- IT infrastructure in research / IT components incl. molecular medicine
- (Data) privacy
- Operating of software for clinical trials, cohorts and registries
- Clinical study report standards (Equator-Network), review process
- Evaluation of healthcare IT (GEP-HI and STARE-HI) / evidence based healthcare informatics

<table>
<thead>
<tr>
<th>Reader's advisory</th>
<th>Wird im Modul bekannt gegeben</th>
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<td>Lern-/Lehrform / Type of program</td>
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<tr>
<td>for the module</td>
<td>56 h</td>
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</table>
### Module Contents

Content of the Module:
This module provides medical software development processes. The module deals with normative software requirements with the focus on patient privacy and quality management. Contents are the declaration of conformity based on medical product classes and software security classes. The software security is focused on software quality, tests and verification, validation as well as quality and risk management. The software life cycle provides security related systems and software as well as software architecture and different process models.

### Reader’s Advisory

wird im Modul bekannt gegeben

### Links

- [ ]

### Languages of Instruction

- German
- English
<table>
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Total time of attendance for the module 56 h
inf524 - Introduction to Medicine for Computer Science Students

Module label: Introduction to Medicine for Computer Science Students

Module code: inf524

Credit points: 6.0 KP

Workload: 180 h

Used in course of study:
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's Programme Computing Science (Master) > Nicht Informatik

Contact person:

- Module responsibility: Rainer Röhrig, Die im Modul Lehrenden
- Authorized examiners: Rainer Röhrig, Die im Modul Lehrenden

Entry requirements:

Skills to be acquired in this module:

Ziele des Moduls:
Das Ziel des Moduls ist den Studierenden ein Basiswissen aus der Humanmedizin zu vermitteln. Dies soll bei einer Berufswahl oder Schwerpunkten der Medizinischen Informatik / Medizintechnik das Verständnis der Domäne erleichtern und Grundlagen für eigene Fragestellungen und Ideen zur Anwendung von Methoden der Informatik in der Medizin führen.

Fachkompetenzen
Die Studierenden:

- lernen die Grundlagen der medizinischen Terminologie (Terminologia Anatomica) und Anatomie des menschlichen Körpers kennen und können die wichtigsten Strukturen in der Fachsprache benennen
- kennen die Grundlagen der Physiologie des menschlichen Körpers und können die wesentlichen Körperfunktionen beschreiben
- erhalten Einblicke in pathophysiologische Vorgänge des menschlichen Körpers und die damit verbundenen Auswirkungen auf die Funktion des menschlichen Organismus
- kennen Regelkreise des menschlichen Körpers zur Aufrechterhaltung wichtiger körperlicher Funktionen und wissen, dass diese Regelkreise als Möglichkeit in Vorgänge des menschlichen Körpers einzutreftgen genutzt werden können
- kennen Referenzwerte wichtiger physiologischer Parameter und können Schlussfolgerungen auf Körperfunktionen ableiten

Methodenkompetenzen
Die Studierenden:

- kennen die sich aus den physiologischen Vorgängen des menschlichen Körpers ergebenen möglichen Messverfahren
- wenden Messverfahren an, um Körperfunktionen des Menschen zu beschreiben und zu bewerten. Sie können Anwendungsbeklempfe und Beispiele der Interpretation benennen
- kennen Einflussgrößen, die die Interpretation von Ergebnissen aus Messverfahren beeinflussen sowie Grenzen von Messverfahren
- lernen die protokollgeführte Durchführung von Untersuchungen und die standardisierte Dokumentation dieser Ergebnisse

Sozialkompetenzen
Die Studierenden:

- erfahren durch regelhafte Rollenwechsel - sie übernehmen sowohl die Rolle des Probanden wie auch die der Versuchsleitung - einen wertschätzenden Umgang miteinander.
- lernen Anhand von Grenzsituationen in der Medizin die Auseinandersetzung mit ethischen Fragestellungen kennen.
- beschreiben die bei Messverfahren gewonnenen Daten detailliert und betrachten diese kritisch mit anderen Studierenden
- integrieren fachliche und sachliche Kritiken in ihre eigenen Handlungsabläufe
- lernen an simulierten Beispielen aus dem klinischen Alltag die zur Gewährleistung einer Patientensicherheit notwendigen standardisierten Abläufe

Selbstkompetenzen
Die Studierenden:

- setzen sich mit der Funktion, der Leistungsfähigkeit des eigenen Körpers auseinander aber auch mit dessen Grenzen
• setzen sich mit dem Lebenszyklus von Zeugung, Geburt, Adoleszenz, Erwachsenenheit und Altern auseinander

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<th>Module contents</th>
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<td></td>
<td>Einführung, Terminologia Anatomica, Räumliche Orientierung (am Skelett)</td>
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<td>Herz-Kreislauf-System</td>
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<td>Gynäkologie</td>
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<td>Das Organ Blut / Labormedizin</td>
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<td>Fallbeispiel aus der Medizin: Anästhesie / Intensivmedizin</td>
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<td>Pharmakologie</td>
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<td>Bildgebende Verfahren</td>
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</tbody>
</table>

Zu den Vorlesungen gibt es jeweils Übungsaufgaben zur Vertiefung, bzw. zum Lernen des Stoffes und 2-4 stündige Praktika mit Untersuchungen. Übungen und Praktika:

- Räumliche Orientierung (am Skelett)
- Eschreiben muskulärer Bewegungsabläufe
- EKG ableiten und auswerten
- Spirometrie
- Ultraschalluntersuchungen
- Histologie / Mikroskopie
- Labormedizin
- Gynäkologie
- Standardisierte Einleitung einer Narkose am Phantom

Reader's advisory

• Speckmann / Wittkowski, Handbuch Anatomie, h.f. ulmann publishing GmbH 2015, ISBN 978-3-8480-0878-0

Links

https://www.uni-oldenburg.de/versorgungsforschung/abteilungen/medizininformatik/lehre/

Language of instruction

German

Duration (semesters)

1 Semester

Module frequency

jährlich

Module capacity

unlimited

Reference text

Die Durchführung der Veranstaltung erfolgt in Kooperation mit verschiedenen Professuren der Departments. Für Humanmedizin, sowie der Anatomie der Fakultät VI.

Modullevel

AS (Akzentsetzung / Accentuation)

Modulart

je nach Studiengang Pflicht oder Wahlpflicht

Lern-/Lehrform / Type of program

Vorkenntnisse / Previous knowledge

Examination

Time of examination

Type of examination

Final exam of module

Am Ende der Vorlesungszeit / Anfang des Folgesemesters

KL

Course type

Comment

SWS

Frequency

Workload attendance

Lecture

2.00

WiSe

28 h

Exercises

2.00

WiSe

28 h

Total time of attendance for the module

56 h
inf533 - Probabilistic Modelling I

Module label: Probabilistic Modelling I
Module code: inf533
Credit points: 3.0 KP
Workload: 90 h

Used in course of study:
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodule
- Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering

Contact person:
Module responsibility:
- Claus Möbus
- Die im Modul Lehrenden

Authorized examiners:
- Claus Möbus
- Die im Modul Lehrenden

Entry requirements:
Skills to be acquired in this module:
Probabilistic Bayesian models are generated with special tools (e.g. BUGS, JAGS, STAN) or domain specific programming languages (WebPPL, PyMC3, ...etc.). If they mimic cognitive processes of humans (e.g. pilots, drivers) or animals they could be used as cooperative assistance systems in technical or financial systems like cars, robots, or recommenders.

Professional competence:
The students:
- learn to map problem to model classes to come up with practical solutions

Methodological competence:
The students:
- acquire basic skills in the design, implementation, and identification of probabilistic models with Bayesian methods
- acquire knowledge about alternative non-Bayesian machine learning methods

Social competence:
The students:
- learn to present and discuss probabilistic theories, methods, and models.

Self-competence:
The students:
- reflect and evaluate chances and limitations of probabilistic approaches
- learn to deliberate on machine-learning alternatives

Module contents:
Theories, methods, and examples of Bayesian models with practical applications

Reader's advisory:
Recent eBooks, eTutorials

Links:
http://www.uni-oldenburg.de/en/computingscience/lcs/probabilistic-programming/

Languages of instruction:
German, English

Duration (semesters):
1 Semester

Module frequency:
jährlich

Module capacity:
unlimited

Reference text:
Associated with the module:
- inf534 Probabilistic Modelling II
<table>
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<th>Modullevel</th>
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**inf534 - Probabilistic Modelling II**

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  - Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
  - Master's Programme Computing Science (Master) > Angewandte Informatik
  - Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodule
  - Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction |
| Contact person       |  
  - Module responsibility
    - Claus Möbus
    - Die im Modul Lehrenden
  - Authorized examiners
    - Claus Möbus
    - Die im Modul Lehrenden |
| Entry requirements   |  
  - Skills to be acquired in this module
    - Probabilistic models are generated with special tools (e.g. BUGS, JAGS, STAN) or domain specific programming languages (WebPPL, PyMC3, … , etc.). If they mimic cognitive processes of humans (e.g. pilots, drivers) or animals they could be used as cooperative assistance systems in technical or financial systems like cars, robots, or recommenders. In this part of the seminar we read, present, and discuss recent research papers.
    - Professional competence: The students:
      - learn to connect problem- with model classes to come up with practical solutions
    - Methodological competence
      - The students:
        - acquire advanced skills in the design, implementation, and identification of probabilistic models with Bayesian methods
        - acquire knowledge about alternative machine learning methods
    - Social competence
      - The students:
        - learn to present and discuss probabilistic theories, methods, and models
    - Self-competence
      - The students:
        - reflect and evaluate chances and limitations of probabilistic approaches
        - learn to deliberate on machine-learning alternatives |
<p>| Module contents      | Theories, methods, and examples of Bayesian models with practical applications |
| Reader's advisory    | Recent publications                        |
| Links                | <a href="http://www.uni-oldenburg.de/en/computingscience/lcs/probabilistic-programming/">http://www.uni-oldenburg.de/en/computingscience/lcs/probabilistic-programming/</a> |
| Language of instruction | German                                  |
| Duration (semesters) | 1 Semester                                |
| Module frequency     | halbjährlich                               |
| Module capacity      | unlimited                                  |
| Reference text       | Associated with the module:               |
|                      | inf533 Probabilistische Modellierung I     |</p>
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| Vorkenntnisse / Previous knowledge | - Grundkenntnisse Progammierung |

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<td>seminar talk, reflective written summary</td>
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| SWS | 2.00 |
| Frequency | SuSe |
| Workload attendance | 28 h |
inf535 - Computational Intelligence I

Module label: Computational Intelligence I
Module code: inf535
Credit points: 6.0 KP
Workload: 180 h

Used in course of study:
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction
- Master's Programme Environmental Modelling (Master) > Mastermodule

Contact person:
Module responsibility:
- Oliver Kramer
- Die im Modul Lehrenden

Authorized examiners:
- Oliver Kramer
- Die im Modul Lehrenden

Entry requirements:

Skills to be acquired in this module:
Professional competence:
The students:
- recognise optimisation problems
- implement simple algorithms of heuristic optimisation
- critically discuss solutions and selection of methods
- deepen previous knowledge of analysis and linear algebra

Methodological competence:
The students:
- deepen programming skills
- apply modelling skills
- learn about the relation between problem class and method selection

Social competence:
The students:
- cooperatively implement content introduced in lecture
- evaluate own solutions and compare them with those of their peers

Self-competence:
The students:
- evaluate own skills with reference to peers
- realize personal limitations
- adapt own problem solving approaches with reference to required method competences

Module contents:
Computational Intelligence comprises intelligent and adaptive methods for optimisation and learning. The module "Computational Intelligence I" concentrates on methods for evolutionary optimisation and heuristic approaches. The exercises introduce and deepen practical aspects of the implementation and algorithmic design, also taking into account application aspects.

Overview of Content:
- foundations of optimisation
- genetic algorithms and evolution strategies
- parameter control and self-adaptation
- runtime analysis
- swarm algorithms
- constrained optimisation
- multi-objective optimisation
- meta-modeling
### Reader's advisory


### Links

- **Languages of instruction**: English, German
- **Duration (semesters)**: 1 Semester
- **Module frequency**: jährlich
- **Module capacity**: unlimited
- **Modul level**: AS (Akzentsetzung / Accentuation)
- **Modulart**: je nach Studiengang Pflicht oder Wahlpflicht

### Lern-/Lehrform / Type of program

- **Vorkenntnisse / Previous knowledge**: Grundlagen der Statistik

### Final exam of module

- **Time of examination**: At the end of the lecture period
- **Type of examination**: Written or oral exam

<table>
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<td>Exercises</td>
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<td>2.00</td>
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**Total time of attendance for the module**: 56 h
inf536 - Computational Intelligence II

Module label  Computational Intelligence II
Module code  inf536
Credit points  6.0 KP
Workload  180 h

Used in course of study
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction
- Master's Programme Environmental Modelling (Master) > Mastermodule

Contact person
Module responsibility
- Oliver Kramer
Authorized examiners
- Die im Modul Lehrenden
- Oliver Kramer

Entry requirements
Skills to be acquired in this module
Professional competence
The students:
- Recognise machine learning problems
- Implement simple algorithms of machine learning
- Critically discuss solutions and selection of methods
- Deepen previous knowledge of analysis and linear algebra

Methodological competence
The students:
- Deepen programming skills
- Apply modelling skills
- Learn about the relation between problem class and method selection

Social competence
The students:
- Cooperatively implement content introduced in lecture
- Evaluate own solutions and compare them with those of their peers

Self-competence
The students:
- Evaluate own skills w.r.t. peers
- Realise personal limitations
- Adapt own problem solving approaches w.r.t. required method competences

Module contents
Computational Intelligence comprises intelligent and adaptive methods for optimisation and learning. The module "Computational Intelligence II" concentrates on methods for machine learning and data mining. The exercises introduce and deepen practical aspects of the implementation and algorithmic design, also taking into account application aspects.

Overview of Content:
- Foundations of learning and classification
- Nearest neighbouring methods
- Model selection and parameter tuning
- Regression
- Support vector and kernel methods
- Clustering
- Dimensionality reduction
Reader's advisory

- HASTIE, T., TIBSHIRANI, R., FRIEDMAN, J.H.: The Elements of Statistical Learning, Springer 2009

Links

<table>
<thead>
<tr>
<th>Languages of instruction</th>
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<tr>
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<tr>
<td>Modularart</td>
<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
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<tr>
<td>Lern-/Lehrform / Type of program</td>
<td>V+Ü</td>
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</table>
| Vorkenntnisse / Previous knowledge | - inf535 Computational Intelligence I  
- Statistik |
| Final exam of module    | At the end of the semester | Written or oral exam |

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<th>SWS</th>
<th>Frequency</th>
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<td>2.00</td>
<td>SuSe</td>
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Total time of attendance for the module: 56 h
### inf537 - Intelligent Systems

<table>
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<tr>
<td>Credit points</td>
<td>6.0 KP</td>
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<tr>
<td>Workload</td>
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<td>Master's Programme Computing Science (Master) &gt; Angewandte Informatik</td>
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<tr>
<td></td>
<td>Master's Programme Engineering of Socio-Technical Systems (Master) &gt; Embedded Brain Computer Interaction</td>
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<tr>
<td></td>
<td>Master's Programme Engineering of Socio-Technical Systems (Master) &gt; Human-Computer Interaction</td>
</tr>
<tr>
<td></td>
<td>Master's Programme Engineering of Socio-Technical Systems (Master) &gt; Systems Engineering</td>
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<tr>
<td>Contact person</td>
<td>Module responsibility</td>
</tr>
<tr>
<td></td>
<td>- Jürgen Sauer</td>
</tr>
<tr>
<td></td>
<td>- Die im Modul Lehrenden</td>
</tr>
<tr>
<td>Entry requirements</td>
<td><strong>Professional competence</strong> The students: - name the structure of agent-based systems - use problem-solving methods for complex problems - characterise the application area of process planning - evaluate the suitability of processes regarding to specific problems <strong>Methodological competence</strong> The students: - assign problem-solving methods to different problems <strong>Social competence</strong> The students: - implement selected methods in small teams <strong>Self-competence</strong> The students: - develop own solutions for given problems</td>
</tr>
<tr>
<td>Links</td>
<td><a href="http://www.wi-ol.de">www.wi-ol.de</a></td>
</tr>
<tr>
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<td>German, English</td>
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<td>Duration (semesters)</td>
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<td>Dieses Modul ist im Rahmen der Projekte FiF und FoL konzipiert worden</td>
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**inf538 - Management of IT-Services**

**Module label**: Management of IT-Services

**Module code**: inf538

**Credit points**: 6.0 KP

**Workload**: 180 h

**Used in course of study**:
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik

**Contact person**

Module responsibility
- Jorge Marx Gomez
- Jürgen Sauer
- Die im Modul Lehrenden

Authorized examiners
- Jorge Marx Gomez
- Jürgen Sauer
- Die im Modul Lehrenden

**Entry requirements**

**Skills to be acquired in this module**

- **Professional competence**
  - The students: charactrise problems that occur during the operation of large-scale operating systems
  - characterise conceptional, technical, economical and organizational problem-solving processes
  - use these concepts to solve problems validly
- **Methodological competence**
  - The students: describe a current problem area based on information from the internet and literature
- **Social competence**
  - The students: present their findings on a problem area
  - discuss their results regarding a specific application area
- **Self-competence**
  - The students: reflect actual concepts with regard to specific application areas

**Module contents**

- **Content of the Module:** "Adaptive Computing" deals with the field of concepts and solutions to manage large scale application systems or dynamic data centers. Technically oriented solutions like the configuration of data centers such as the hard- and software virtualization, the high availability, the storage management and the identity management are not the only contributions of Adaptive Computing. Others are organisational aspects of companies, such as personnel planning and service agreements. This module provides and compiles current topics of Adaptive Computing. The module also presents and evaluates several Adaptavie Computing technologies. Current HW-/ SW-concepts of large-scale application systems, strategies, service management and security concepts are specifically included. The lecture introduces current concepts and solutions for the management of dynamic data centers. Among others, the following subjects are provided: - IT-Strategy, -Organisation - ITIL (overview) - Service-Management Tools (e.g. OTRS) - Outsourcing - Security (policies, privacy, data security, safety) - Spatial design of data centers - HW-Strategies: Cluster, Storage, ...

**Reader's advisory**


**Links**

**Language of instruction**: German

**Duration (semesters)**: 1 Semester

**Module frequency**: jährlich

**Module capacity**: unlimited

**Modullevel**: AS (Akzentsetzung / Accentuation)

**Modulart**: je nach Studiengang Pflicht oder Wahlpflicht

**Lern-/Lehrform / Type of program**

**Vorkenntnisse / Previous knowledge**

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**Course type** | Comment | SWS | Frequency | Workload attendance |
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**Total time of attendance for the module**: 56 h
**inf551 - Maritime Systems**

**Module label**
Maritime Systems

**Module code**
inf551

**Credit points**
6.0 KP

**Workload**
180 h

**Used in course of study**
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering

**Contact person**
Module responsibility
- Axel Hahn
- Die im Modul Lehrenden

**Entry requirements**
**Skills to be acquired in this module**
The module deals with the economic aspects and synergy effects of maritime sub-areas. In addition to the basic knowledge of the maritime sub-areas, current approaches from research are taught. The basic ship parameters are examined with regard to their economic efficiency, stability calculations and ship dynamics are derived and effects of the ship hull, propellers and systems on the economic efficiency of a ship are considered. The focus here is on understanding economic thinking and the interaction of the sub-areas. Furthermore, future-oriented solutions and trends will be discussed. **Professional competence** The students - name the basics of planning and control of operational logistics in a shipyard - name the basics of planning of economic design - recognise the application possibilities of simulation in design, construction and dynamics - identify the basic maritime sub-areas and their synergies
**Methodological competence** The students - Link relations with tree structures - Illustrate the questions and concepts of the design process
**Social competence** The students - Present computational problem solving to groups - Discuss their outcomes appropriately - Implement solutions of given problems in teams - Accept criticism of their peer group as valuable contributions
**Self-competence** The students - reflect their self-image and their actions of their results

**Module contents**

**Reader's advisory**

**Links**
http://www.wi-ol.de

**Languages of instruction**
German, English

**Duration (semesters)**
1 Semester

**Module capacity**
unlimited

**Modullevel**
AS (Akzentsetzung / Accentuation)

**Modullevel**
AS (Akzentsetzung / Accentuation)

**Modulart**
Wahlmodul / Opportunity

**Modulart**
Wahlmodul / Opportunity

**Lern-/Lehrform / Type of program**
V+Ü

**Lern-/Lehrform / Type of program**
V + Ü

**Vorkenntnisse / Previous knowledge**
Transportsysteme, Analysis, Differentialgleichungen, lineare Algebra, Mechanik

**Vorkenntnisse / Previous knowledge**
Transportsysteme, Analysis, Differentialgleichungen, lineare Algebra, Mechanik

**Examination**
Time of examination
Type of examination
Final exam of module
at the end of the lecture period
practical exercises and oral examination

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<th>Workload attendance</th>
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<td>2.00</td>
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<td>28 h</td>
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**inf584 - Special Topics in 'Energy Informatics' I**

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<td>Contact person</td>
<td>Module responsibility</td>
</tr>
<tr>
<td></td>
<td>• Sebastian Lehnhoff</td>
</tr>
<tr>
<td></td>
<td>• Die im Modul Lehrenden</td>
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<tr>
<td></td>
<td>Authorized examiners</td>
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<tr>
<td></td>
<td>• Sebastian Lehnhoff</td>
</tr>
<tr>
<td></td>
<td>• Die im Modul Lehrenden</td>
</tr>
</tbody>
</table>

**Entry requirements**

Skills to be acquired in this module

This module integrates current developments in the field in adequate study courses.

**Professional competences**

The students:

- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

**Methodological competences**

The students:

- evaluate and apply tools, technology and methods sophisticatedly
- combine new and original approaches and methods creatively
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research

**Social competences**

The students:

- support team process by their abilities

**Self-competences**

The students:

- pursue the overall and special computer science development critically
- implement innovative professional activities effectively and independently

**Module contents**

See assigned course description

**Reader's advisory**

As announced in course

**Links**

Language of instruction | German
Duration (semesters)    | 1 Semester
Module frequency         | unregelmäßiger
Module capacity          | unlimited
Modullevel               | AS (Akzentsetzung / Accentuation)
Modulart                 | je nach Studiengang Pflicht oder Wahlpflicht
Lern-Lehrform / Type of program | 2 Veranst. aus V, S, Ü, P, PR
Vorkenntnisse / Previous knowledge |
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inf585 - Special Topics in 'Energy Informatics' II

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**Contact person**

Module responsibility
- Sebastian Lehnhoff
- Die im Modul Lehrenden

Authorized examiners
- Sebastian Lehnhoff
- Die im Modul Lehrenden

**Entry requirements**

**Skills to be acquired in this module**

- This module integrates current developments in the field in adequate study courses.

**Professional competences**

The students:
- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

**Methodological competences**

The students:
- evaluate and apply tools, technology and methods sophisticatedly
- combine new and original approaches and methods creatively
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research

**Social competences**

The students:
- support team process by their abilities

**Self-competences**

The students:
- pursue the overall and special computer science development critically
- implement innovative professional activities effectively and independently

**Module contents**

See assigned course description

**Reader's advisory**

As announced in course

**Links**

Language of instruction: German

Duration (semesters): 1 Semester

Module frequency: unregelmäßi

Module capacity: unlimited

Modullevel: AS (Akzentsetzung / Accentuation)

Modulart: je nach Studiengang Pflicht oder Wahlpflicht

Lern-/Lehrform / Type of program: 2 Veranst. aus V, S, Ü, P, PR

Vorkenntnisse / Previous knowledge

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inf586 - Current Topics in 'Energy Informatics' I

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<th><strong>Module contents</strong></th>
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### inf588 - Special Topics in 'Medical Informatics' I

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<td>- Andreas Hein</td>
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#### Entry requirements

**Skills to be acquired in this module**

This module integrates current developments in the field in adequate study courses.

**Professional competences**

The students:

- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

**Methodological competences**

The students:

- evaluate and apply tools, technology and methods sophisticatedly
- combine new and original approaches and methods creatively
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research

**Social competences**

The students:

- support team process by their abilities

**Self-competences**

The students:

- pursue the overall and special computer science development critically
- implement innovative professional activities effectively and independently

**Module contents**

See assigned course description, e.g. „Medizinische Bildverarbeitung“ or „Standard und Systeme für die Kommunikation in der Medizin“

**Reader's advisory**

As announced in course

**Links**

- **Language of instruction**: German
- **Duration (semesters)**: 1 Semester
- **Module frequency**: unregelmäßig
- **Module capacity**: unlimited
- **Modullevel**: AS (Akzentsetzung / Accentuation)
- **Modulart**: je nach Studiengang Pflicht oder Wahlpflicht
- **Lern-Lehrform / Type of program**: 2 Veranst. aus V, S, Ü, P, PR
- **Vorkenntnisse / Previous knowledge**:
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inf589 - Spezielle Themen aus dem Gebiet "IT im Gesundheitswesen" II

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inf590 - Current Topics in 'Medical Informatics' I

Module label | Current Topics in 'Medical Informatics' I
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Module code | inf590
Credit points | 3.0 KP
Workload | 90 h
Used in course of study | • Master's Programme Computing Science (Master) > Angewandte Informatik

Contact person
Module responsibility
- Andreas Hein
- Die im Modul Lehrenden

Authorized examiners
- Andreas Hein
- Die im Modul Lehrenden

Entry requirements

Skills to be acquired in this module
This module integrates current developments in the field in adequate study courses.

Professional competences
The students:
- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

Methodological competences
The students:
- examine tasks with technical and research literature, write an academic article and present their solutions academically
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
- schedule time processes and resources

Social competences
The students:
- communicate with users and experts convincingly

Self-competences
The students:
- pursue the overall and special computer science development critically
- develop and reflect self-developed hypotheses to theories independently

Module contents
See assigned course description

Reader’s advisory
As announced in course

Links

Language of instruction | German
Duration (semesters) | 1 Semester
Module frequency | unregelmäßig
Module capacity | unlimited
Modulelevel | AS (Akzentsetzung / Accentuation)
Modulart | je nach Studiengang Pflicht oder Wahlpflicht
Lern-/Lehrform / Type of program | S oder V (2 SWS)
Vorkenntnisse / Previous knowledge
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inf591 - Aktuelle Themen aus dem Gebiet "IT im Gesundheitswesen" II

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<td>Module responsibility</td>
</tr>
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<td>• Andreas Hein</td>
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<td>• Die im Modul Lehrenden</td>
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**Professional competences**
The students:

- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

**Methodological competences**
The students:

- examine tasks with technical and research literature, write an academic article and present their solutions academically
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
- schedule time processes and resources

**Social competences**
The students:

- communicate with users and experts convincingly

**Self-competences**
The students:

- pursue the overall and special computer science development critically
- develop and reflect self-developed hypotheses to theories independently

<table>
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<td>Lern-/Lehrform / Type of program</td>
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| SWS                       | 2.00                     |                             |

| Frequency                 | WiSe                     |                             |

| Workload attendance       | 28 h                     |                             |
inf594 - Current Topics in 'Learning and Cognitive Systems' I

Module label
Current Topics in 'Learning and Cognitive Systems' I

Module code
inf594

Credit points
3.0 KP

Workload
90 h

Used in course of study
• Master's Programme Computing Science (Master) > Angewandte Informatik

Contact person
Module responsibility
  • Claus Möbus
  • Die im Modul Lehrenden

Authorized examiners
  • Claus Möbus
  • Die im Modul Lehrenden

Entry requirements

Skills to be acquired in this module
This module integrates current developments in the field in adequate study courses.

Professional competences
The students:

  • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
  • recognise and evaluate applied techniques and methods of their subject and are aware of their limits
  • identify, structure and solve problems/tasks, also in new or developing subject areas
  • apply state of the art and innovative methods to solve problems, if necessary from other disciplines
  • are aware of the current limits and contribute to the development of computer science research and technology
  • discuss and evaluate recent computer science developments

Methodological competences
The students:

  • examine tasks with technical and research literature, write an academic article and present their solutions academically
  • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
  • schedule time processes and resources

Social competences
The students:

  • communicate with users and experts convincingly

Self-competences
The students:

  • pursue the overall and special computer science development critically
  • develop and reflect self-developed hypotheses to theories independently

Module contents
See assigned course description, e.g. „Kognitive Modellierung“, „KI und Wissensrepräsentation“

Reader's advisory
As announced in course

Links

Language of instruction
German

Duration (semesters)
1 Semester

Module frequency
unregelmäßig

Module capacity
unlimited

Modullevel
AS (Akzentsetzung / Accentuation)

Modulart
je nach Studiengang Pflicht oder Wahlpflicht

Lern-/Lehrform / Type of program
S oder V (2 SWS)

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inf595 - Current Topics in 'Learning and Cognitive Systems' II

Module label
Current Topics in 'Learning and Cognitive Systems' II

Module code
inf595

Credit points
3.0 KP

Workload
90 h

Used in course of study
- Master's Programme Computing Science (Master) > Angewandte Informatik

Contact person
Module responsibility
- Claus Möbus
- Die im Modul Lehrenden

Authorized examiners
- Claus Möbus
- Die im Modul Lehrenden

Entry requirements
Skills to be acquired in this module
This module integrates current developments in the field in adequate study courses.

Professional competences
The students:
- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
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Methodological competences
The students:
- examine tasks with technical and research literature, write an academic article and present their solutions academically
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
- schedule time processes and resources

Social competences
The students:
- communicate with users and experts convincingly

Self-competences
The students:
- pursue the overall and special computer science development critically
- develop and reflect self-developed hypotheses to theories independently

Module contents
See assigned course description

Reader's advisory
As announced in course

Links
Language of instruction
German

Duration (semesters)
1 Semester

Module frequency
unregelmäßig

Module capacity
unlimited

Modullevel
AS (Akzentsetzung / Accentuation)

Modulart
je nach Studiengang Pflicht oder Wahlpflicht

Lern-/Lehrform / Type of program
S oder V (2 SWS)

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inf596 - Spezielle Themen aus dem Gebiet "Computational Intelligence" I

Module label: Spezielle Themen aus dem Gebiet "Computational Intelligence" I
Module code: inf596
Credit points: 6.0 KP
Workload: 180 h

Used in course of study:
- Master's Programme Computing Science (Master) > Angewandte Informatik

Contact person:
Module responsibility:
- Oliver Kramer
- Die im Modul Lehrenden

Authorized examiners:
- Oliver Kramer
- Die im Modul Lehrenden

Entry requirements:
Skills to be acquired in this module:
This module integrates current developments in the field in adequate study courses.

Professional competences
The students:
- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
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- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

Methodological competences
The students:
- evaluate and apply tools, technology and methods sophisticatedly
- combine new and original approaches and methods creatively
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research

Social competences
The students:
- support team process by their abilities

Self-competences
The students:
- pursue the overall and special computer science development critically
- implement innovative professional activities effectively and independently

Module contents:
See assigned course description, e.g. „Medizinische Bildverarbeitung“ or „Standard und Systeme für die Kommunikation in der Medizin“

Reader's advisory:
As announced in the according course

Links:
Language of instruction: German
Duration (semesters): 1 Semester
Module frequency: unregelmäßig
Module capacity: unlimited
Modullevel: AS (Akzentsetzung / Accentuation)
Modulart: je nach Studiengang Pflicht oder Wahlpflicht
Lern-Lehrform / Type of program: 2 Veranst. aus V, S, Ü, P, PR

Vorkenntnisse / Previous knowledge:

60 / 308
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inf597 - Spezielle Themen aus dem Gebiet "Computational Intelligence" II

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<td>Oliver Kramer</td>
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**Entry requirements**

**Skills to be acquired in this module**

This module integrates current developments in the field in adequate study courses.

**Professional competences**

The students:

- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

**Methodological competences**

The students:

- evaluate and apply tools, technology and methods sophisticatedly
- combine new and original approaches and methods creatively
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research

**Social competences**

The students:

- support team process by their abilities

**Self-competences**

The students:

- pursue the overall and special computer science development critically
- implement innovative professional activities effectively and independently

**Module contents**

See assigned course description

**Reader's advisory**

As announced in course

**Links**

**Language of instruction**

German

**Duration (semesters)**

1 Semester

**Module frequency**

unregelmäßig

**Module capacity**

unlimited

**Modullevel**

AS (Akzentsetzung / Accentuation)

**Modulart**

je nach Studiengang Pflicht oder Wahlpflicht

**Lern-/Lehrform / Type of program**

2 Veranst. aus V, S, Ü, P, PR

**Vorkenntnisse / Previous knowledge**


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inf598 - Current Topics in 'Computational Intelligence' I

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**Contact person**
- Module responsibility
  - Oliver Kramer
  - Die im Modul Lehrenden
- Authorized examiners
  - Oliver Kramer
  - Die im Modul Lehrenden

**Entry requirements**

**Skills to be acquired in this module**

This module integrates current developments in the field in adequate study courses.

**Professional competences**
The students:

- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

**Methodological competences**
The students:

- examine tasks with technical and research literature, write an academic article and present their solutions academically
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
- schedule time processes and resources

**Social competences**
The students:

- communicate with users and experts convincingly

**Self-competences**
The students:

- pursue the overall and special computer science development critically
- develop and reflect self-developed hypotheses to theories independently

**Module contents**
See assigned course description

**Reader's advisory**
As announced in course

**Links**

**Language of instruction**
German

**Duration (semesters)**
1 Semester

**Module frequency**
unregelmäßig

**Module capacity**
unlimited

**Modullevel**
AS (Akzentsetzung / Accentuation)

**Modulart**
je nach Studiengang Pflicht oder Wahlpflicht

**Lern-/Lehrform / Type of program**
S oder V (2 SWS)

**Vorkenntnisse / Previous knowledge**
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inf599 - Aktuelle Themen aus dem Gebiet "Computational Intelligence" II

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<td>1 Semester</td>
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<tr>
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<tr>
<td>Module capacity</td>
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</tr>
<tr>
<td>Modullevel</td>
<td>AS (Akzentsetzung / Accentuation)</td>
</tr>
<tr>
<td>Modulart</td>
<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
</tr>
<tr>
<td>Lern-/Lehrform / Type of program</td>
<td>S oder V (2 SWS)</td>
</tr>
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<td>Vorkenntnisse / Previous knowledge</td>
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<tr>
<td>Examination</td>
<td>Time of examination</td>
</tr>
<tr>
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<tr>
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<td>At the end of the lecture period</td>
</tr>
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</table>

**Course type**

Course or seminar

**SWS**

2.00

**Frequency**

WiSe

**Workload attendance**

28 h
inf604 - Business Intelligence I

<table>
<thead>
<tr>
<th>Module label</th>
<th>Business Intelligence I</th>
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<tbody>
<tr>
<td>Module code</td>
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<tr>
<td>Credit points</td>
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<tr>
<td>Workload</td>
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<td></td>
<td>Master of Education Programme (Vocational and Business Education) Computing Science (Master of Education) &gt; Mastermodule</td>
</tr>
<tr>
<td></td>
<td>Master's Programme Business Informatics (Master) &gt; Akzentsetzungsmodule der Informatik</td>
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<td></td>
<td>Master's Programme Computing Science (Master) &gt; Angewandte Informatik</td>
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<tr>
<td>Contact person</td>
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<tr>
<td>Module responsibility</td>
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</tr>
<tr>
<td></td>
<td>Jorge Marx Gomez</td>
</tr>
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<td>Die im Modul Lehrenden</td>
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<td>Authorized examiners</td>
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</tr>
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</tr>
</tbody>
</table>

Entry requirements

Skills to be acquired in this module

<table>
<thead>
<tr>
<th>Objective of the module/skills:</th>
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</thead>
<tbody>
<tr>
<td>Current module provides basics of business intelligence with focus on enterprises and strong emphasis on data warehousing technologies. Students of the course are provided with knowledge, which reflects current research and development in a data analytic domain.</td>
</tr>
</tbody>
</table>

Professional competence

The students:

- name and recognize the role of business intelligence as part of daily business process
- being able to analyse advantages and disadvantages of different approaches and methods of the data analytics and being able to apply them in simple case studies
- obtain theoretical knowledge about data collection and modelling processes, including most applicable approaches and best practices

Methodological competence

The students:

- being able to execute typical tasks of business intelligence, and also being able to deepen knowledge on different approaches and methods
- gain a hands on experience and being able to understand advantages and disadvantages of different methods and being able to use obtained knowledge in most efficient ways

Social competence

The students:

- build solutions based on case studies given to the group, for example solving the issue of a factless fact table
- discuss solutions on a technical level
- present obtained case studies solutions as part of the exercises

Self-competence

The students:

- critically review provided data and information

Module contents

Data warehouse technology together with business intelligence are increasingly being used by business in order to get better decision support and enrich ongoing processes with data-rich decisions. Data warehouse technology enables an integration of data from heterogeneous sources, whether business intelligence builds data processing on top of it. For instance, business intelligence allows to build reporting on very large volumes of data (including historical) coming primary from data warehouse.

As part of the current module following contents are taught:

- Definition and scope of business intelligence.
- Procedures and objectives of data warehousing.
- Process of extracting, transforming and loading (ETL) of data.
- Phases of data modelling, data capturing and reporting in conjunction with a plausible case studies/scenarios.
- Prospects for further and evolving topics for business intelligence (e.g. Adaptive Business Intelligence, In-Memory Computing, etc.)
- Introduction to Data Mining.
- Case studies based practical exercises and assessments in order to impart practical knowledge.

Reader's advisory

- Marx Gómez, Rautenstrauch, Cissek (2008): Einführung in die Business Intelligence mit SAP NetWeaver 7.0.

Links
http://www.wi-ol.de

Languages of instruction
German, English

Duration (semesters)
1 Semester

Module frequency
jährlich

Module capacity
unlimited

Modullevel
AS (Akzentsetzung / Accentuation)

Modulart
Wahlpflicht / Elective

Lern-/Lehrform / Type of program
V + Ü

Vorkenntnisse / Previous knowledge

Examination
Time of examination
Type of examination
Final exam of module
At the end of the lecture period
Written exam max. 120 minutes

Course type
Comment
SWS
Frequency
Workload attendance
Lecture
2.00
WiSe
28 h
Exercises
2.00
WiSe
28 h

Total time of attendance for the module
56 h
inf607 - Business Intelligence II

Module label: Business Intelligence II
Module code: inf607
Credit points: 6.0 KP
Workload: 180 h

Used in course of study:
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik

Contact person:
Module responsibility:
- Jorge Marx Gomez
- Die im Modul Lehrenden

Authorized examiners:
- Jorge Marx Gomez
- Die im Modul Lehrenden

Entry requirements:

Skills to be acquired in this module:
Current module provides advanced business intelligence, data science with focus on enterprises and strong emphasis on big data and data analytics. Students of the course are provided with knowledge, which reflects current research and development in a data analytics domain.

Professional competence:
The students:
- name and recognize the role of data analytics / data science as part of a daily business process in a particular company
- able to organize from management perspective data analytics project
- being able to analyse advantages and disadvantages of different approaches and methods of the data analytics and being able to apply them in simple case studies
- obtain theoretical knowledge about data collection and modelling processes, including state of the art approaches and available best practices

Methodological competence:
The students:
- being able to execute typical tasks of data analytics, and also being able to proceed deeper with respect to different approaches and methods
- gain a hands on experience and being able to understand advantages and disadvantages of different methods and being able to use obtained knowledge

Social competence:
The students:
- build solutions based on case studies given to the group, for example design of regression model based on provided dataset
- discuss solutions on a technical level
- present obtained case studies solutions as part of the exercises

Self-competence:
The students:
- critically review provided offered information

Module contents:
After current course students will get advanced knowledge in the domains such as business intelligence and data analytics. Besides that, students will have a chance to have a deeper look into related technical fields such as InMemory Computing, Data Mining and Machine Learning, Big Data Processing with Distributed Systems (e.g. Apache Hadoop / Spark) from both, research and practical, perspectives. Students will be provided with real-world experience gather from business intelligence and data science related projects. Materials of the course are believed to be justified with current demands of data analytics market. Thus, providing students with relevant knowledge in order to give them advantages in future job.

Reader's advisory:
- Jürgen Cleve, Uwe Lämmel (2014): “Data mining” (Deutsch)
- Max Bramer (2013): “Principles of data mining” (English)
- Ian Witten, Eibe Frank, Mark Hall (2011): “Data mining : practical machine learning tools and techniques” (English)
<table>
<thead>
<tr>
<th>Links</th>
<th><a href="http://www.wi-ol.de/">http://www.wi-ol.de/</a></th>
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<tr>
<td>Languages of instruction</td>
<td>German, English</td>
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<tr>
<td>Duration (semesters)</td>
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<tr>
<td>Module frequency</td>
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<td>Module capacity</td>
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<td>Modullevel</td>
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<td>Modulart</td>
<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
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<td>Lern-/Lehrform / Type of program</td>
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### Previous knowledge

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<td>Written exam (max. 120 min.)</td>
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<table>
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<td>Seminar</td>
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<td>2.00</td>
<td>SuSe</td>
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| Total time of attendance for the module | 56 h |
inf650 - Transport Systems

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<td>Credit points</td>
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<td>Workload</td>
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<td>Master's Programme Computing Science (Master) &gt; Angewandte Informatik</td>
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<td>Master's Programme Engineering of Socio-Technical Systems (Master) &gt; Embedded Brain Computer Interaction</td>
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<tr>
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</tr>
<tr>
<td></td>
<td>Axel Hahn</td>
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<tr>
<td></td>
<td>Die im Modul Lehrenden</td>
</tr>
<tr>
<td>Authorized examiners</td>
<td>Axel Hahn</td>
</tr>
<tr>
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<td>Die im Modul Lehrenden</td>
</tr>
<tr>
<td>Entry requirements</td>
<td>Objective of the module/skills:</td>
</tr>
<tr>
<td></td>
<td>The Module Transport systems deals with planning and controlling systems of internal and external company logistics as well as public transport. It provides basic knowledge and recent research topics. The focus is on a resource orientated holistic view of company logistics as well as the planning of transport infrastructure. Furthermore, trends such as autonomous vehicles and intelligent transport systems are discussed.</td>
</tr>
<tr>
<td></td>
<td>Professional competence</td>
</tr>
<tr>
<td></td>
<td>The students:</td>
</tr>
<tr>
<td></td>
<td>- name the basics of planning and controlling company logistics</td>
</tr>
<tr>
<td></td>
<td>- assess transport systems of companies</td>
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<td></td>
<td>- name methods and approaches of computer aided transport systems and classify them</td>
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<td></td>
<td>- characterise software to plan complex logistics</td>
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<tr>
<td></td>
<td>Methodological competence</td>
</tr>
<tr>
<td></td>
<td>The students:</td>
</tr>
<tr>
<td></td>
<td>- display topics and concepts of transport systems</td>
</tr>
<tr>
<td></td>
<td>- simulate transport and its systems with appropriate methods</td>
</tr>
<tr>
<td></td>
<td>Social competence</td>
</tr>
<tr>
<td></td>
<td>The students:</td>
</tr>
<tr>
<td></td>
<td>- work in groups</td>
</tr>
<tr>
<td></td>
<td>- discuss their results appropriately</td>
</tr>
<tr>
<td></td>
<td>Self-competence</td>
</tr>
<tr>
<td></td>
<td>The students:</td>
</tr>
<tr>
<td></td>
<td>- realise their limits while working on a project containing aspects of modelling and implementation</td>
</tr>
<tr>
<td></td>
<td>- question the presentation of their results</td>
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<tr>
<td>Module contents</td>
<td>Transport and logistics concepts</td>
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<tr>
<td></td>
<td>Data acquisition of company logistics</td>
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<tr>
<td></td>
<td>Planning- and simulation software for complex logistics- and transport processes</td>
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<td></td>
<td>Energy- and resource efficient transport systems</td>
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<tr>
<td></td>
<td>Resource oriented transport cost calculations (e.g. CO2, noise pollution)</td>
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<tr>
<td></td>
<td>Planning models for transport infrastructure</td>
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<tr>
<td>Reader's advisory</td>
<td>Suggested reading:</td>
</tr>
<tr>
<td></td>
<td>72 / 308</td>
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</table>
Links: [http://wi-ol.de](http://wi-ol.de)

Languages of Instruction: German, English

Duration (semesters): 1 Semester

Module frequency: jährlich

Module capacity: unlimited

Reference text: Dieses Modul ist im Rahmen der Projekte FiIF und FoL konzipiert worden

Modullevel: AS (Akzentsetzung / Accentuation)

Modulart: je nach Studiengang Pflicht oder Wahlpflicht

Lern-/Lehrform / Type of program: V+Ü

Vorkenntnisse / Previous knowledge: Produktionsorientierte Wirtschaftsinformatik

### Examination

<table>
<thead>
<tr>
<th>Examination</th>
<th>Time of examination</th>
<th>Type of examination</th>
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<tbody>
<tr>
<td>Final exam of module</td>
<td>At the end of the lecture period</td>
<td>Exercises and written exam</td>
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### Course type

<table>
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<tr>
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<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload attendance</th>
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<tbody>
<tr>
<td>Lecture</td>
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<td>Exercises</td>
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<td>2.00</td>
<td>SuSe</td>
<td>28 h</td>
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### Total time of attendance for the module

56 h
W1 - Environmental Management Information Systems I

Module label: Environmental Management Information Systems I
Module code: inf651
Credit points: 6.0 KP
Workload: 180 h

Used in course of study:
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's Programme Environmental Modelling (Master) > Mastermodule
- Master's Programme Sustainability Economics and Management (Master) > Additional Modules

Contact person:
Module responsibility: Jorge Marx Gomez
Authorized examiners:
- Jorge Marx Gomez
- Die im Modul Lehrenden

Entry requirements:
Skills to be acquired in this module:

This module completes the knowledge and abilities gained in the field of Environmental Informatics and it creates a strong reference to up to date topics in the field of sustainability. The content taught in this module can directly be applied in an upcoming study and professional career.

Professional competence:
The students:
- are able to classify and explain the sustainability paradigm
- are aware of the current status of sustainability reporting
- are able to define and to model material flows
- have obtained know-how in the field of corporate environmental management information systems (CEMIS)

Methodological competence:
The students:
- implement CEMIS
- apply different techniques and methods to case studies
- develop new case studies in teams

Social competence:
The students:
- are supposed to work in teams and therefore have to identify working packages and have to take on responsibility for the jobs assigned to them
- present and discuss their own results with the team and the other members of the course

Self-competence:
The students:
- learn about their own limitations and learn to accept criticism in order to strengthen their own abilities

Module contents:
This course teaches methods, approaches and techniques in the field of information processing in order to support solutions to problems that arise from companies' impact on the environment. In particular, ICT supported approaches of production-integrated environmental protection, environmental controlling and reporting are introduced and discussed. In order to enable the integration of such approaches into environmental protection, environmental management and its systems are taught as well.

The content in detail:
- environmental management as a basis for sustainability
- sustainability and material flow management
- strategic environmental management
- eco-controlling life cycle
- characteristics and system architectures of CEMIS
- standard software systems
• environmental accounting systems

Reader's advisory


Links
http://www.wi-ol.de

Duration (semesters)
1 Semester

Module frequency
jährlich

Module capacity
unlimited

Module level
AS (Akzentsetzung / Accentuation)

Module art
je nach Studiengang Pflicht oder Wahlpflicht

Lern-/Lehrform / Type of program
V+Ü

Vorkenntnisse / Previous knowledge

Examination

Time of examination
At the end of the lecture period
type of examination: exercises and written exam (max. 120 min.)

Final exam of module

Course type
Lecture
Exercises

Comment

SWS
2.00
2.00

Frequency
SuSe
SuSe

Workload attendance
28 h
28 h

Total time of attendance for the module
56 h
inf652 - Production-oriented Business Informatics

<table>
<thead>
<tr>
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<tbody>
<tr>
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<td>Workload</td>
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<td>Master's Programme Computing Science (Master) &gt; Angewandte Informatik</td>
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<td></td>
<td>Axel Hahn</td>
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<td>Die im Modul Lehrenden</td>
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<td>Axel Hahn</td>
</tr>
<tr>
<td></td>
<td>Die im Modul Lehrenden</td>
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</tbody>
</table>

**Entry requirements**

**Skills to be acquired in this module**

The module deepens the contents of the modules „Wirtschaftsinformatik“ and „Wirtschaftsinformatik/Informationsmanagement“. The students will be able to contextualise IT systems and their functions in companies. They are able to participate in the implementation of IT systems in companies. The students know the essential tasks of materials management, production planning and controlling, warehousing, acquisition and supply chain management.

**Professional competence**

The students:

- name and differentiate the basics of business informatics and information management
- classify IT systems and their functions in companies
- name and characterise the essential tasks of materials management, production planning and controlling, warehousing, acquisition and supply chain management

**Methodological competence**

The students:

- transfer a holistic development process of production planning and control
- implement IT systems in businesses

**Social competence**

The students:

- participate in implementing IT systems in companies
- construct and present computational solutions to groups and within their work group
- integrate professional and objective criticism in their own and others’ results

**Self-competence**

The students:

- recognize the planning horizon for IT systems
- reflect their role and skills to implement IT systems in businesses

**Module contents**

The module “Production-oriented Business Informatics” deals especially with production planning and control processes affected by process planning tasks, as well as classic problems of industrial production. The lecture is focussed on the application of information systems in industrial production companies. Priorities are order flow business processes and PPS-/ERP-Systems. Case studies and demonstrations illustrate the application of these systems.

**Reader's advisory**

- Kurbel, Karl: Produktionsplanung und -steuerung im Enterprise Resource Planning und Supply Chain Management, Oldenbourg Verlag, 2005
- Further literature will be announced in the lecture

**Links**

**Language of instruction**

German
<table>
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<th>Duration (semesters)</th>
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<tbody>
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<td>Module frequency</td>
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<td>V+Ü</td>
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<tbody>
<tr>
<td>Examination Time of examination</td>
<td>Type of examination</td>
</tr>
<tr>
<td>Final exam of module At the end of the lecture period</td>
<td>Exercises and written exam</td>
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<th>Frequency</th>
<th>Workload attendance</th>
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Total time of attendance for the module 56 h
### inf653 - ERP Technologies

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<td>6.0 KP</td>
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<td>Workload</td>
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<td>Master's Programme Computing Science (Master) &gt; Angewandte Informatik</td>
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</table>

#### Contact person
- Module responsibility
  - Jorge Marx Gomez
  - Die im Modul Lehren
- Authorized examiners
  - Jorge Marx Gomez
  - Die im Modul Lehren

#### Entry requirements

#### Skills to be acquired in this module

#### Learning objectives:
- Generation of understandings into the working approaches and tasks of ERP systems
- Examining components of ERP systems
- Generating knowledge about important aspects of the operation processes of ERP systems, such as data storage and processing, user management, and system maintenance.

#### Professional competence
- The students:
  - describe ERP systems in compliance with functions and technologies
  - identify state-of-the-art and future architectures of ERP systems
  - discuss the usage of core technologies (also in practical case studies, for example with SAP NetWeaver)

#### Methodological competence:
- The students:
  - categorize fundamental technologies in combination with other enterprise-wide information systems
  - apply the presented methods in practical contexts

#### Social Competence:
- The students:
  - construct solutions to given problems in groups
  - present solutions to computing science problems before groups

#### Self-competence:
- The students:
  - recognize the limits of their capacity in implementing and customizing of business application systems

#### Module contents

#### The module provides the following content:
- Overview of the components of ERP systems and their functionality and administration
- In-depth analysis of ERP system architecture under consideration of surface structures and user management in ERP systems, with focus on data storage, particularly the used data models and database structures, backup and recovery strategies
- Deployment of ERP applications in form of application service providing, including the technical characteristics of this business model, especially Special Administration, delimitation and monitoring tasks for systems, which at the same time be provided several customers

Lecture will be accompanied by SAP case studies.

#### Reader's advisory

<table>
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<tr>
<th>Links</th>
<th><a href="http://www.wi-ol.de">http://www.wi-ol.de</a></th>
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| Total time of attendance for the module | 56 h |
inf654 - Mobile Commerce

Module label: Mobile Commerce
Module code: inf654
Credit points: 6.0 KP
Workload: 180 h

Used in course of study:
- Master of Education Programme (Vocational and Business Education) Computing Science (Master of Education) > Mastermodule
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik

Contact person:
Module responsibility: Jorge Marx Gomez
Authorized examiners: Jorge Marx Gomez, Die im Modul Lehrenden

Entry requirements:
Skills to be acquired in this module:

Professional competence:
The students:
- define and encompass MC
- explain the development stages of MC
- are aware of the current developments within MC and are able to classify them
- get to know technical essentials, functionalities and standards of wireless ICT
- assess the fields of application and limitations of wireless ICT
- examine the relevant mobile devices and their respective operating systems, know their characteristics and evaluate their fields of application
- examine market participants, assess business models, optimize business processes
- gain insight into specifics via examples and exercises

Methodological competence:
The students:
- get to know security aspects and specifics of mobile application design
- prototypically develop an Android application
- prepare and give presentations
- develop a concept of a business model for an Android application

Social competence:
The students:
- work on their project in groups of three

Self-competence:
The students:
- reflect their own group-dynamic activities in respect of a mutual goal (successfully finish their project)

Module contents:
See above

Reader's advisory:
- Also all materials provided within the lecture

Links:
http://vba.wi-ol.de

Language of instruction: German
Duration (semesters): 1 Semester
Module frequency: jährlich
Module capacity: unlimited
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Total time of attendance for the module 56 h
inf655 - IT-Controlling

Module label  IT-Controlling
Module code  inf655
Credit points  6.0 KP
Workload  180 h

Used in course of study
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik

Contact person
Module responsibility
- Jorge Marx Gomez
- Die im Modul Lehrenden

Authorized examiners
- Jorge Marx Gomez
- Die im Modul Lehrenden

Entry requirements

Skills to be acquired in this module
This module emphasizes the importance of IT-Controlling within an enterprise. The students gain knowledge on practically orientated technologies in order to leave a better understanding for the application and conversion possibilities of IT-Controlling.

Professional competence
The students:

- name general tasks and functions of IT-Controlling.
- recognize the importance strategical IT-Controlling applications.
- learn strategies and methods of IT-Controlling.
- identify the existence of an IT-Strategy as a pre condition of IT-Controlling.
- know about the risks of IT-Outsourcing.
- use IT-Controlling tools (e.g. information systems, portfolio analysis, benchmarking IT-Reporting).

Methodological competence
The students:

- use their knowledge by independently compiled presentations on recent IT-Controlling subjects.

Social competence
The students:

- discuss their results essentially and appropriately in this subject.
- present their subjects to the group.

Self-competence
The students:

- understand and analyse their own state of knowledge.
- reflect their own effects on groups

Module contents
The employment of information technologies for enterprises is usually a key factor. By the change of our society to an information society, information gains more and more importance and takes a central role within ICT systems. The specifics of the ICT area cannot be supported by the classical economic controlling. The application of a strategical IT-Controlling becomes more and more important. The result of a study shows that in the meantime in about 80% of the German enterprises an ICT strategy was compiled. However, the study makes also clear, that about two out of three enterprises use no methods of strategical IT-Controlling. The new discipline of IT-Controlling provides plans and methods to avoid isolated applications.

Reader's advisory
-Gadatsch, A: IT-Controlling: Praxiswissen für IT-Controller und Chief Information Officer. Springer Verlag, 2012

Links
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**Vorkenntnisse / Previous knowledge**

**Examination**

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**Course type**

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**Total time of attendance for the module**

56 h
inf657 - Product Engineering

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<td>Workload</td>
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<td>Master's Programme Engineering of Socio-Technical Systems (Master) &gt; Systems Engineering</td>
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Contact person

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<tr>
<td>Axel Hahn</td>
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<td>Die im Modul Lehrenden</td>
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<tr>
<td>Axel Hahn</td>
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Entry requirements

Skills to be acquired in this module

Focus of this module is to learn and apply the product engineering process. A project will enable the students to design a product from the idea to the prototype. More specifically, a systematic, partial domain-specific, approach to solve technical problems and aspects of project management will be learned. Regular meetings are used to train the presentation capabilities of the students and to schedule working packages within the teams.

Professional competence

The students:

- learn and try out the handling of virtual and physical prototypes
- learn and try out the construction and validation of virtual prototypes with the aid of CAD-applications
- learn and combine different basic development concepts from the mechanical engineering, microelectronics, control engineering and software engineering

Methodological competence

The students:

- learn and try out project management concepts
- learn and recognise the connections of different development concepts from different fields, e.g. mechanical engineering, control engineering, microelectronics and software engineering
- develop own products with creativity techniques
- schedule and organise the product development supported by project management techniques independently
- learn the systematic refining of their own product idea with SysML
- design and test products with state-of-the-art CAD-applications

Social competence

The students:

- impart their structure and mode of action to other people
- develop their own products in small teams
- present their solutions to groups
- integrate criticism to their solutions
- support other groups by giving appropriate criticism

Self-competence

The students:

- recognise and reflect their own limitations to get familiar and to plan a project in an unknown field (e.g. maritime construction/industries)

Module contents

This module is a lecture accompanied by a hands-on project. The students work on one product development task. The product development starts with the idea-finding/brainstorming process which is used to create a digital product concept. During the semester a digital prototype will be created and validated by its initial requirements. Finally, a physical prototype is produced with a 3D-Printer (Rapid Prototyping). The progress of the project has to be documented and presented at different milestones.

Reader's advisory


<table>
<thead>
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**Vorkenntnisse / Previous knowledge**

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<td>Written exam or oral exam, or written documentation or Presentation or Portfolio</td>
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**Total time of attendance for the module** 56 h
Inf659 - Environmental Management Information Systems II

Module label: Environmental Management Information Systems II
Module code: inf659
Credit points: 6.0 KP
Workload: 180 h

Used in course of study:
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's Programme Environmental Modelling (Master) > Mastermodule
- Master's Programme Sustainability Economics and Management (Master) > Additional Modules

Contact person:
Module responsibility: Jorge Marx Gomez
Authorized examiners: Jorge Marx Gomez

Entry requirements:
Skills to be acquired in this module:

Professional competence:
The students:
- will obtain extensive knowledge in the field of CEMIS
- know emerging research questions and challenges as well as software solutions and projects

Methodological competence:
The students:
- find their own solutions or apply already existing approaches to new and unsolved questions in the field
  of CEMIS
- capture required data, analyse it and present it to their team or the whole group

Social competence:
The students:
- are supposed to work in teams and therefore have to identify working packages and have to take on
  responsibility for the jobs assigned to them
- present and discuss their own results with the team and the other members of the course

Self-competence:
The students:
- learn about their own limitations and learn to accept criticism in order to strengthen their own abilities

Module contents:
A strong social pressure forces enterprises to question their current way of implementing their business and to
include different aspects of sustainability into their strategies and operational actions. Such a rethinking of one's
business is supported by corporate environmental management information systems. Such systems aim at
optimising the energy and resource usage, emission and waste minimisation as well as production integrated
environmental protection. Of course they support the fulfillment of legal requirements such as waste
management or hazardous material handling.

The module will cover:
- recent and emerging research questions and topics related to the field of CEMIS as well as Business
  Environmental Informatics.
- discussion and hands-on experience of standard software systems and newly established solutions.
- applying the knowledge obtained to the definition of new as well as on solving new case studies.
Marx Gómez, Jorge, Scholtz, Brenda (Eds.) (2016): Information Technology in Environmental Engineering. Springer International Publishing

Hershey (PA), London

- Rautenstrauch, C. (1999), Betriebliche Umweltinformationssysteme. Springer-Verlag

Links
http://www.wi-ol.de

Languages of instruction
German, English

Duration (semesters)
1 Semester

Module frequency
jährlich

Module capacity
unlimited

Reference text
Type and language of program will be announced prior to the beginning of the course

Modullevel
AS (Akzentsetzung / Accentuation)

Modular
je nach Studiengang Pflicht oder Wahlpflicht

Lern-/Lehrform / Type of program
V (2 SWS), Ü (2 SWS) oder SE
Nach Ankündigung zu Beginn der Veranstaltung (2SWS V + 2 SWS Ü oder Blockseminar)

Vorkenntnisse / Previous knowledge

Final exam of module
Usually 2 weeks after the end of the lecture period
Seminar paper and presentation or term paper

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Total time of attendance for the module
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inf660 - Sustainability Informatics

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Type and language of program will be announced prior to the beginning of the course. The course is recognised as a practical project in the Master's programme Sustainability Economics and Management.

Used in course of study
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik

Contact person
- Module responsibility
  - Jorge Marx Gomez
  - Barbara Bremer-Rapp
- Authorized examiners
  - Jorge Marx Gomez
  - Barbara Bremer-Rapp

Entry requirements

Skills to be acquired in this module
After finishing this course, students should be able to set up a sustainability report tailored for different target groups for any kind of organization.

The students will be enabled to know and apply different available standards and guidelines as well as to estimate the influence of data defects and the feasibility of recent information and communication technology.

This course emphasizes the importance of sustainability reporting as a means of an organization's communication (internal and external) and provides an overview on relevant indicators, standards and guidelines. Based on that the handling of data defects and missing data as well as different approaches of reporting will be discussed. In addition, the specific requirements of different target groups regarding content and presentation of a report will be discussed as well.

Professional competence

The students:
- are aware of different indicators, standards and guidelines and know when to apply which.
- know different approaches of data capturing, interpolation of missing or corrupt data as well as the influence of each of these issues on the validity of a report.
- implement concepts for tailored target group orientation.

Methodological competence

The students:
- prepare a small sustainability report based on their decision which standard or guideline to use.
- capture existing data and analyse it.
- prepare a tailored target oriented presentation of their results.

Social competence

The students:
- are supposed to work in teams and therefore have to identify working packages and have to take on responsibility for the jobs assigned to them.
- present and discuss their own results with the team and the other members of the course

Self-competence

The students:
- learn about their own limitations and learn to accept criticism in order to strengthen their own abilities

Module contents

The following topics will be covered in this module:
- different definitions of the term sustainability.
- the importance of sustainability reporting as a means of an organization's communication.
- LCA, environmental accounting, supply chain management as data sources.
- semantic, comparability and transformation of indicators, standards and guidelines.
interpolation and interpretation of data defects.
- how to report (e.g. knowledge management, document engineering, integrated reporting, different target groups).

Reader's advisory


Links
http://vlba.wi-ol.de

Languages of instruction
German, English

Duration (semesters)
1 Semester

Module frequency
unlimited

Reference text
Die Lehrveranstaltung wird im Masterstudiengang Sustainability Economics and Management als practical project anerkannt.

Modullevel
AC (Aufbaucurriculum / Composition)

Modulart
je nach Studiengang Pflicht oder Wahlpflicht

Lern-Lehrform / Type of program

Vorkenntnisse / Previous knowledge

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Total time of attendance for the module
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### Inf661 - Digital Transformation

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#### Used in course of study
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik

#### Contact person
- Module responsibility
  - Jorge Marx Gomez
  - Die im Modul Lehrenden
- Authorized examiners
  - Jorge Marx Gomez
  - Die im Modul Lehrenden

#### Entry requirements

#### Skills to be acquired in this module

After successful completion of the lecture, the students should be able to define enabler and actors of a digital transformation within the context of a model company. Furthermore, key competences such as Cloud Computing or IoT are used to make potential exploitation by new digital business models visible. The results will be evaluated. The lecture explains basic properties of a digital transformation for companies and shows specific development potential. By forming and building a model company, students are able to create a realistic and practical scenario. A final documentation reveals the degree of fulfilment and the students point of view on the scenario.

#### Professional competence

The students:
- recognize basic properties and facts of a digital transformation for companies
- develope different terms of digital transformation
- expose actual introduction projects
- compile practical knowledge by dividing goals of enabler and acteurs of a digital transformation
- obtain basic knowledge of key competences such as IT-Security, Data Analytics, Big Data, Cloud Computing
- identify digital business models within the specific development potential

#### Methodological competence

The students:
- determine and analyse required information
- prepare the given information for specific target groups
- destablish an analytical understanding of digital enterprise structures within key competences and applications

#### Social competence

The students:
- work in groups, identify work packages and take on responsibility for the jobs assigned to them
- discuss and introduce the results on a functional level

#### Self-competence

The students:
- reflect their actions on the basis of self defined objectives
- analyse their own state of knowledge

#### Module contents

Within the lecture the upcoming topics are discussed:
- definition and introduction of digital transformation
- success factors, market changes and introductory projects
- enabler of a digital transformation (competences, applications and structures)
- digital business models and networks
- acteurs of a digital transformation
- industry 4.0 in the context of a digital transformation
Reader's advisory


Links

http://www.wi-ol.de

Languages of instruction

German, English

Duration (semesters)

1 Semester

Module frequency

unlimited

Modullevel

AC (Aufbaucurriculum / Composition)

Modulart

je nach Studiengang Pflicht oder Wahlpflicht

Lern-/Lehrform / Type of program

Referat, Projekt oder Klausur. Bekanntgabe zu Beginn der Veranstaltung

Vorkenntnisse / Previous knowledge


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Course type | Comment | SWS | Frequency | Workload attendance |
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Lecture | | 2.00 | SuSe | 28 h |
Exercises | | 2.00 | SuSe | 28 h |

Total time of attendance for the module

56 h
inf663 - Application Area Maritime

Module code
inf663

Credit points
6.0 KP

Workload
180 h

Used in course of study
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering

Contact person
Module responsibility
  - Axel Hahn
Authorized examiners
  - Axel Hahn
  - Die im Modul Lehrenden

Entry requirements
Skills to be acquired in this module
Professional competences:
The students gain knowledge about ship handling and navigation and learn to understand maritime transportation as a system of systems with systems on board for stability, propulsion and steering as for bridge resource management. They understand the latter as a mayor contribution to organize navigation as a hierarchical team concept of a safety critical sociotechnical system. The students are aware of the special technical and physical challenges of navigation.

Methodological competences:
The students can apply system engineering methods to describe, analyse and design maritime systems. By looking on maritime transporation the gain transferable knowledge on other cyber physical systems. Students learned to how systems can deal with harsh environmental conditions in a resilient way.

Social competences:
Maritime transportation is a mayor basis of a global economy. Typically, students do not have an understanding of these transportation systems nor their technical and systemic challenges. Therefore, the student knows the concepts of maritime transportation and its role in international transportation networks after finishing this module.

Self-Competences:
Especially their competences cover an understanding as maritime transportation as a systems of system with high requirements on reliability, dependability and safety in combination with efficiency to be competitive in a global economy.

Module contents
The module consists of a lecture and an exercise part:
Lecture: - Maritime Transportation in global and local supply chains, Base concepts of ship handling and navigation, maritime system dynamics, bridge resource management, eNAvigation and high automation systems.
Seminar: Covering aspects of maritime transportation

Reader's advisory
Bernhard Berking, Werner Huth (Herausgeber), Handbuch Nautik 1: Navigatorische Schiffsführung, Seehafen Verlag, 2010

Links
Language of instruction
English

Duration (semesters)
1 Semester

Module capacity
unlimited

Modullevel
AS (Akzentsetzung / Accentuation)

Modulart
Pflicht o. Wahlpflicht / compulsory or optional

Lern-/Lehrform / Type of program
V+S

Vorkenntnisse / Previous knowledge

Examination
Time of examination
Type of examination

Final exam of module
At the end of the lecture period
Oral exam and documentation

Course type
Comment
SWS
Frequency
Workload attendance

Lecture
2.00
SuSe and WiSe
28 h
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**Total time of attendance for the module**

56 h
inf690 - Special Topics in 'Business Informatics' I

Module label                                      Special Topics in 'Business Informatics' I
Module code                                       inf690
Credit points                                    6.0 KP
Workload                                         180 h
Used in course of study                          • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
                                                  • Master's Programme Computing Science (Master) > Angewandte Informatik
Contact person
                                           Module responsibility
                                           - Axel Hahn
                                           - Jorge Marx Gomez
                                           - Jürgen Sauer
Authorized examiners
                                           - Die im Modul Lehrenden
Entry requirements
Skills to be acquired in this module
This module integrates current developments in the field in adequate study courses.

Professional competences
The students:
- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer
  science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and
  technology
- discuss and evaluate recent computer science developments

Methodological competences
The students:
- evaluate and apply tools, technology and methods sophisticatedly
- combine new and original approaches and methods creatively
- evaluate problems/tasks, including new or developing subject areas of their discipline and
- apply computer science methods for solutions and research

Social competences
The students:
- support team process by their abilities

Self-competences
The students:
- pursue the overall and special computer science development critically
- implement innovative professional activities effectively and independently

Module contents
See assigned course description
Reader's advisory
As announced in course
Links
Language of instruction                           German
Duration (semesters)                              1 Semester
Module frequency                                 unregelmäßig
Module capacity                                  unlimited
Modullevel                                       AS (Akzentsetzung / Accentuation)
Modullevel                                       AS (Akzentsetzung / Accentuation)
Modulart                                        je nach Studiengang Pflicht oder Wahlpflicht
Modulart                                        je nach Studiengang Pflicht oder Wahlpflicht
Lern-/Lehrform / Type of program                  2 Veranst. aus V, S, Ü, P, PR
Lern-/Lehrform / Type of program                  2 courses out of V, S, Ü, P, PR
Vorkenntnisse / Previous knowledge
Examination                                      Time of examination
Final exam of module                             At the end of the lecture period
Course type                                      VA-Auswahl

Type of examination
Portfolio or presentation or oral exam
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**inf691 - Special Topics in 'Business Informatics' II**

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| Used in course of study           | - Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik  
                                 | - Master's Programme Computing Science (Master) > Angewandte Informatik            |

**Contact person**

- Jorge Marx Gomez
- Axel Hahn
- Jürgen Sauer

**Authorized examiners**

- Die im Modul Lehrenden

**Entry requirements**

**Skills to be acquired in this module**

This module integrates current developments in the field, especially with a focus on corporate environmental management information systems, in adequate study courses.

**Professional competences**

The students:
- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

**Methodological competences**

The students:
- evaluate and apply tools, technology and methods sophisticatedly
- combine new and original approaches and methods creatively
- evaluate problems/tasks, including new or developing subject areas of their discipline and
- apply computer science methods for solutions and research

**Social competences**

The students:
- support team process by their abilities

**Self-competences**

The students:
- pursue the overall and special computer science development critically
- implement innovative professional activities effectively and independently

**Module contents**

See assigned course description

**Reader's advisory**

As announced in course

**Links**

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**Vorkenntnisse / Previous knowledge**

**Examination**

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inf692 - Special Topics in 'Business Informatics' III

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**Entry requirements**

Skills to be acquired in this module

This module integrates current developments in the field, especially with a focus on business intelligence, in adequate study courses.

**Professional competences**

The students:
- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

**Methodological competences**

The students:
- evaluate and apply tools, technology and methods sophisticatedly
- combine new and original approaches and methods creatively
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research

**Social competences**

The students:
- support team process by their abilities

**Self-competences**

The students:
- pursue the overall and special computer science development critically
- implement innovative professional activities effectively and independently

**Module contents**

See assigned course description

**Reader's advisory**

As announced in course

**Links**

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**Vorkenntnisse / Previous knowledge**

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inf693 - Special Topics in 'Business Informatics' IV

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Skills to be acquired in this module
This module integrates current developments in the field in adequate study courses.

**Professional competences**
The students:
- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

**Methodological competences**
The students:
- evaluate and apply tools, technology and methods sophisticatedly
- combine new and original approaches and methods creatively
- evaluate problems/tasks, including new or developing subject areas of their discipline and
- apply computer science methods for solutions and research

**Social competences**
The students:
- support team process by their abilities

**Self-competences**
The students:
- pursue the overall and special computer science development critically
- implement innovative professional activities effectively and independently

Module contents
See assigned course description

Reader's advisory
As announced in course

Links

Language of instruction
German

Duration (semesters)
1 Semester

Module frequency
unregelmäßig

Module capacity
unlimited

Modulelevel
AS (Akzentsetzung / Accentuation)

Moduleart
je nach Studiengang Pflicht oder Wahlpflicht

Lern-/Lehrform / Type of program
2 Veranst. aus V, S, Ü, P, PR (4SWS)

Vorkenntnisse / Previous knowledge

Examination
Time of examination
At the end of the lecture period
Type of examination
Portfolio or presentation or oral exam

Course type
VA-Auswahl
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inf694 - Current Topics in 'Business Informatics' I

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• Master’s Programme Computing Science (Master) > Angewandte Informatik |
| Contact person | Module responsibility                      |
|               | • Jorge Marx Gomez                         |
|               | • Axel Hahn                                |
|               | • Jürgen Sauer                              |
|               | Authorized examiners                       |
|               | • Die im Modul Lehrenden                    |

**Entry requirements**

Skills to be acquired in this module

This module integrates current developments in the field in adequate study courses.

**Professional competences**
The students:
- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

**Methodological competences**
The students:
- examine tasks with technical and research literature, write an academic article and present their solutions academically
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
- schedule time processes and resources

**Social competences**
The students:
- communicate with users and experts convincingly

**Self-competences**
The students:
- pursue the overall and special computer science development critically
- develop and reflect self-developed hypotheses to theories independently

**Module contents**

See assigned course description

**Reader's advisory**

As announced in course

**Links**

**Language of instruction**

German

**Duration (semesters)**

1 Semester

**Module frequency**

unregelmäßig

**Module capacity**

unlimited

**Modullevel**

AS (Akzentsetzung / Accentuation)

**Modullevel**

AS (Akzentsetzung / Accentuation)

**Modulart**

je nach Studiengang Pflicht oder Wahlpflicht

**Modulart**

je nach Studiengang Pflicht oder Wahlpflicht

**Lern-/Lehrform / Type of program**

S oder V (2 SWS)

**Lern-/Lehrform / Type of program**

S oder V (2 SWS)

**Vorkenntnisse / Previous knowledge**

Examination

Time of examination

Type of examination

Final exam of module

At the end of the lecture period

Presentation or oral exam

102 / 308
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### Module label
Current Topics in 'Business Informatics' II

### Module code
inf695

### Credit points
3.0 KP

### Workload
90 h

### Used in course of study
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik

### Contact person
Module responsibility
- Jorge Marx Gomez
- Axel Hahn
- Jürgen Sauer

Authorized examiners
- Die im Modul Lehrenden

### Entry requirements

#### Skills to be acquired in this module
This module integrates current developments in the field, especially with a focus on corporate environmental management information systems, in adequate study courses.

#### Professional competences
The students:
- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

#### Methodological competences
The students:
- examine tasks with technical and research literature, write an academic article and present their solutions academically
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
- schedule time processes and resources

#### Social competences
The students:
- communicate with users and experts convincingly

#### Self-competences
The students:
- pursue the overall and special computer science development critically
- develop and reflect self-developed hypotheses to theories independently

### Module contents
See assigned course description

### Reader's advisory
As announced in course

### Links

#### Language of instruction
German

#### Duration (semesters)
1 Semester

#### Module frequency
unregelmäßig

#### Module capacity
unlimited

#### Modullevel
AS (Akzentsetzung / Accentuation)

#### Modulart
je nach Studiengang Pflicht oder Wahlpflicht

#### Lern-Lehrform / Type of program
S oder V (2 SWS)

### Exam

#### Examination
At the end of the lecture period

#### Type of examination
Presentation or oral exam
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### inf696 - Current Topics in 'Business Informatics' III

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  - Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik  
  - Master's Programme Computing Science (Master) > Angewandte Informatik |
| Contact person     | Module responsibility                       |
|                    | - Jorge Marx Gomez                          |
|                    | - Axel Hahn                                 |
|                    | - Jürgen Sauer                               |
| Authorized examiners |  
  - Die im Modul Lehrenden                      |

### Entry requirements

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<th>This module integrates current developments in the field, especially with a focus on business intelligence, in adequate study courses.</th>
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</table>
| **Professional competences**         | The students:  
  - define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general  
  - recognise and evaluate applied techniques and methods of their subject and are aware of their limits  
  - identify, structure and solve problems/tasks, also in new or developing subject areas  
  - apply state of the art and innovative methods to solve problems, if necessary from other disciplines  
  - are aware of the current limits and contribute to the development of computer science research and technology  
  - discuss and evaluate recent computer science developments |
| **Methodological competences**       | The students:  
  - examine tasks with technical and research literature, write an academic article and present their solutions academically  
  - evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research  
  - schedule time processes and resources |
| **Social competences**               | The students:  
  - communicate with users and experts convincingly |
| **Self-competences**                 | The students:  
  - pursue the overall and special computer science development critically  
  - develop and reflect self-developed hypotheses to theories independently |

### Module contents

<table>
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### Reader's advisory

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<th>As assigned in course</th>
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### Links

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### Examination

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inf697 - Current Topics in 'Business Informatics' IV

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<td>Module responsibility</td>
</tr>
<tr>
<td></td>
<td>‣ Jorge Marx Gomez</td>
</tr>
<tr>
<td></td>
<td>‣ Axel Hahn</td>
</tr>
<tr>
<td></td>
<td>‣ Jürgen Sauer</td>
</tr>
<tr>
<td>Authorized examiners</td>
<td>Die im Modul Lehrenden</td>
</tr>
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</table>

**Skills to be acquired in this module**

This module integrates current developments in the field in adequate study courses.

**Professional competences**

The students:
- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

**Methodological competences**

The students:
- examine tasks with technical and research literature, write an academic article and present their solutions academically
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
- schedule time processes and resources

**Social competences**

The students:
- communicate with users and experts convincingly

**Self-competences**

The students:
- pursue the overall and special computer science development critically
- develop and reflect self-developed hypotheses to theories independently

**Module contents**

See assigned course description

**Reader's advisory**

As assigned in course

**Links**

- Language of instruction: German
- Duration (semesters): 1 Semester
- Module frequency: unregelmäßig
- Module capacity: unlimited
- Modullevel: AS (Akzentsetzung / Accentuation)
- Modullevel: AS (Akzentsetzung / Accentuation)
- Modulart: je nach Studiengang Pflicht oder Wahlpflicht
- Modulart: je nach Studiengang Pflicht oder Wahlpflicht
- Lern-Lehrform / Type of program: S oder V (2 SWS)
- Lern-Lehrform / Type of program: S oder V (2 SWS)
- Vorkenntnisse / Previous knowledge
- Examination: Time of examination
- Type of examination
- Final exam of module: At the end of the lecture period
- Presentation or oral exam
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</table>
Technische Informatik

inf300 - Hybrid Systems

Module label
Hybrid Systems

Module code
inf300

Credit points
6.0 KP

Workload
180 h

Used in course of study
- Master's Programme Computing Science (Master) > Technische Informatik
- Master's Programme Computing Science (Master) > Theoretische Informatik
- Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodul
- Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering

Contact person
Module responsibility
- Martin Georg Fränzle

Authorized examiners
- Die im Modul Lehrenden

Entry requirements

Skills to be acquired in this module
The module gives an introduction to hybrid discrete-continuous systems, as arising by embedding digital hardware into physical environments, and it elaborates on state of the art methods for the mathematical modelling and the analysis of such systems. It thus provides central competences for understanding and designing reliable cyber-physical systems.

Professional competence
The students:
- characterise formal models of cyber-physical systems: hybrid automata, hybrid state transition systems
- name domain-specific system requirements: safety, stability, robustness
- name analysis methods: symbolic state-space exploration, abstraction and abstraction refinement, generalized Lyapunov-Methods
- use state-of-the-art analysis tools
- select and apply adequate modelling and analysis methods for concrete application scenarios
- apply methods to reduce large state spaces and reduce infinite-state systems by abstraction
- know the de-facto industry standards for system modelling and are able to apply the corresponding modelling frameworks and tools

Methodological competence
The students:
- model heterogeneous dynamical systems with adequate modelling and design tools, in particular Simulink/Stateflow
- transfer modelling and analysis methods to other heterogeneous domains, e.g. socio-technical systems

Social competence
The students:
- work in teams
- solve complex modelling, design, and analysis tasks in teams

Self-competence
The students:
- reflect their actions and respect the scope of methods dedicated to hybrid systems

Module contents
Embedded computer systems continuously interact with their environment, which generally comprises state- and time-continuous components. The coupling of the embedded system to its environment thus induces complex interleavings between discrete computational and decision processes and continuous processes. The
resulting processes are neither amenable to the analytic techniques of continuous control nor of discrete mathematics. They instead require a broader, integrated theory: hybrid discrete-continuous systems. The lectures provide an in-depth introduction into a variety of analysis and design methods of these computer-based systems and their recent extensions to cyber-physical systems.

The accompanying hands-on-project enhances the lecture by developing and using design and verification tools.

Reader’s advisory


Links

Languages of instruction: English, German

Duration (semesters) 1 Semester

Module capacity: unlimited

Module level: AS (Akzentsetzung / Accentuation)

Module type: Pflicht oder Wahlpflicht / compulsory or optional

Lern-/Lehrform / Type of program: V+Ü

Vorkenntnisse / Previous knowledge: Bachelor in Computing Science oder Kenntnisse gewöhnlicher Differentialgleichungen

Final exam of module: At the end of the lecture period

Course type Comment SWS Frequency Workload attendance
Lecture
Exercises

Total time of attendance for the module: 56 h
### inf301 - Machine-oriented Systems Engineering

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<td>Workload</td>
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**Used in course of study**
- Master's Programme Computing Science (Master) > Technische Informatik
- Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodule
- Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering

**Contact person**
- Module responsibility
  - Alfred Mikschl
  - Die im Modul Lehrenden
- Authorized examiners
  - Alfred Mikschl
  - Die im Modul Lehrenden

**Entry requirements**
- The module provides practical relevance to the design of digital embedded systems.
  - **Professional competence**
    - The students:
      - characterise the structure of microprocessor systems
      - name control aspects of time sensitive external components
      - program efficient embedded systems
  - **Methodological competence**
    - The students:
      - use specifications from electrical components data sheets
  - **Social competence**
    - The students:
      - work in a team
      - discuss solutions

**Module contents**
- Embedded systems support complex feedback problems, control problems and data processing tasks. They have an important value creation potential for telecommunications, production management, transport and electronics. The functionality of embedded systems is realised by the integration of processors, special hardware and software. The embedded systems design is influenced by the heterogeneity of system architectures, the complexity of systems and technical and economic requirements.

This module gives an initial review of computer architectures. After that embedded systems are introduced by a specific microprocessor. Furthermore, external hardware will be connected to the microprocessor. Besides this, the design of circuit boards will be discussed. The students will design, develop and implement a circuit layout with CAD and programme this embedded system with a Flash-eprom.

**Reader's advisory**
- Lecturers notes, hardware manuals and data sheets, and development tool manuals

**Languages of instruction**
- English, German

**Duration (semesters)**
- 1 Semester

**Module frequency**
- semi-annual

**Module capacity**
- unlimited

**Modullevel**
- AS (Akzentsetzung / Accentuation)

**Modulart**
- Pflicht o. Wahlpflicht / compulsory or optional

**Lern-Lehrform / Type of program**
- V+P

**Vorkenntnisse / Previous knowledge**
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<td>At the end of the lecture period</td>
<td>Portfolio (Design, development and implementation of embedded systems, colloquium)</td>
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**Total time of attendance for the module**

56 h
inf303 - Fuzzy Control and Artificial Neural Networks in Robotics and Automation

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**Used in course of study**
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's Programme Computing Science (Master) > Technische Informatik
- Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodule
- Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
- Master's Programme Engineering Physics (Master) > Schwerpunkt: Renewable Energies

**Contact person**

**Module responsibility**
- Sergej Fatikow
- Die im Modul Lehrenden

**Authorized examiners**
- Sergej Fatikow
- Die im Modul Lehrenden

**Entry requirements**

**Skills to be acquired in this module**
Experts in different branches try to approach their application-specific control and information processing problems by using fuzzy logic and artificial neural networks (ANN). The experiences gathered up to now prove robotics and automation technology to be predestined fields of application of both these approaches. The major topics of the course are control problems in robotics and automation technology, principles of fuzzy logic and ANN and their practical applications, comparison of conventional and advanced control methods, combination of fuzzy logic and ANN in control systems. The course gives a comprehensive treatment of these advanced approaches for interested students.

**Professional competence**
The students:
- recognise control problems in robotics and automation technology,
- name principles of fuzzy logic and ANN and their practical applications,
- compare conventional and advanced control methods,
- characterise the combination of fuzzy logic and ANN in control systems

**Methodological competence**
The students:
- will acquire knowledge of the tools, methods and applications in fuzzy logic and ANN
- deepen their knowledge for the practical use of the given methods
- can use common software tools for design and application of fuzzy logic and ANN

**Social competence**
The students:
- gain experience in interdisciplinary work
- are integrated into the recent research work

**Objective of the module / skills:**

**Self-competence**
The students:
- are able to transfer the gained knowledge for later use in their theses or studies for AMIR
- can Design (complex) fuzzy logic controller and ANN systems
- reflect their (control) solutions by using methods learned in this course

**Module contents**
- Control problems in robotics and automation technology
- Basic ideas of fuzzy logic and ANN
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<tr>
<td>Exercises</td>
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<td>SuSe</td>
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**Workload attendance**
- Lecture: 42 h
- Exercises: 14 h
- **Total time of attendance for the module**: 56 h
inf305 - Medical Technology

Module label: Medical Technology
Module code: inf305
Credit points: 6.0 KP
Workload: 180 h

Used in course of study:
- Master's Programme Computing Science (Master) > Nicht Informatik
- Master's Programme Computing Science (Master) > Technische Informatik
- Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodule
- Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering

Contact person:
Module responsibility:
- Andreas Hein

Authorized examiners:
- Andreas Hein
- Die im Modul Lehrenden

Entry requirements:

Skills to be acquired in this module:
Professional competence:
The students:
- Describe medical diagnosis and therapy methods
- Understand the core concepts of computer-assisted medical interventions
- Are aware of the basic concepts and legal conditions of the development of medical devices
- Define the character of medical devices' software parts and implement them
- Assess the complex interaction of medical products and patients
- Get familiar with the development of medical products within a short period of time

Methodological competence:
The students:
- Recognise the interdisciplinary challenges and accordingly exchange information with other disciplines

Social competence:
The students:
- Present solutions for specific questions

Self-competence:
The students:
- reflect their solutions by using methods learned in this course

Module contents:
- Medical areas and areas of application
- Basic requirements for medical systems (hygiene, MPG, technical security, materials)
- Medical systems:
  - Functional diagnostics (ECG, EMG, EEG)
  - Imaging systems (CT, MRI, ultrasound, PET, SPECT) - Therapy equipment (Laser, RF, Microtherapy)
- Signal processing / monitoring (cardiovascular, hemodynamic, respiratory, metabolic, cerebral)
- Medical Informatics (HIS, DICOM, Telemedicine, VR, image processing).

Reader's advisory:

essential:
- Lecture slides

recommended:
• Dugas, M.; Schmidt, K.: Medizinische Informatik und Bioinformatik. Springer Verlag, 2003

**secondary literature:**


**Links**

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| Vorkenntnisse / Previous knowledge | - Signal und Bildverarbeitung  
- Regelungstechnik |
| Examination              | Time of examination |
| Final exam of module     | At the end of the lecture periode |
| **Exam Type**            | Portfolio: Hands-on exercises, report, and written or oral exam |
| Course type              | Comment | SWS | Frequency | Workload attendance |
| Lecture                  |          | 3.00 | WiSe      | 42 h |
| Exercises                |          | 1.00 | WiSe      | 14 h |
| **Total time of attendance for the module** | | | | 56 h |
inf307 - Robotics

Module label: Robotics
Module code: inf307
Credit points: 6.0 KP
Workload: 180 h

Used in course of study:
- Master's Programme Computing Science (Master) > Nicht Informatik
- Master's Programme Computing Science (Master) > Technische Informatik
- Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodule
- Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering

Contact person
Module responsibility:
- Andreas Hein
- Die im Modul Lehrenden

Authorized examiners:
- Die im Modul Lehrenden
- Andreas Hein

Entry requirements
Skills to be acquired in this module
Professional competence
The students:
- Name and know the functions and applications of robot systems
- Characterise the basic concepts to program robot systems
- Differentiate between the interaction of mechanical, electrical and software components

Methodological competence
The students:
- Define characteristics and components of robot systems for a specific application
- Design and implement robot system sub-components
- Design and parameterise simple control structures
- Plan the application of robot systems and derive the requirements
- Model electrical and mechanical systems
- Develop and realise simple robot systems

Social competence
The students:
- Solve robot systems problems in team work

Self-competence
The students:
- Reflect their solutions in reference to robot system methods

Module contents
- Integration in production plants / aims / subsystems
- Architectures / classifications (classification of robots)
- Robot components + Computer systems for programming
  - PA-10
  - Lego Mindstorms
- Basics of kinematics
  - Coordinate transformation, homogeneous coordinates, Coordinate transitions
  - Kinematic equation systems, transformation of vectors
- Kinematic
  - Joint types (manipulators) / Wheels, TCP
  - Denavit-Hartenberg-Transformation
  - Forward calculation
  - Backward calculation
- Sensors
- General properties of sensors, parameter
- Simple optical position sensors
- Inductive-, capacitive- and ultrasonic-sensors
- Distance sensors (laser scanner, triangulation sensors)
- Force sensors
- Sensor data preparation
- Planning / Regulation
  - Overall regulation approach, terms, process- and control functions, PID-controller
  - Planning concepts and approaches (On-Line, Off-Line), planning processes, construction and path planning
- Actuators

Reader's advisory

**essential:**
lecture nodes

**recommended:**

**secondary literature:**

**Links**

**Languages of instruction**
German, English

**Duration (semesters)**
1 Semester

**Module capacity**
unlimited

**Modulelevel**
AS (Akzentsetzung / Accentuation)

**Modulart**
Pflicht o. Wahlpflicht / compulsory or optional

**Lern-/Lehrform / Type of program**
V+Ü

**Vorkenntnisse / Previous knowledge**

**Examination**

**Time of examination**
At the end of the lecture period

**Type of examination**
Portfolio: Hands-on exercises, report, and written or oral exam

**Final exam of module**

**Course type**
Lecture
Exercises

**Comment**

**SWS**
3.00
1.00

**Frequency**
SuSe
SuSe

**Workload attendance**
42 h
14 h

**Total time of attendance for the module**
56 h
inf308 - Microrobotics II

Module label  Microrobotics II
Module code     inf308
Credit points   6.0 KP
Workload        180 h

Used in course of study
- Master's Programme Computing Science (Master) > Nicht Informatik
- Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodule
- Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering
- Master's Programme Engineering Physics (Master) > Schwerpunkt: Laser and Optics

Contact person
Module responsibility
- Sergej Fatikow
- Die im Modul Lehrenden
Authorized examiners
- Sergej Fatikow
- Die im Modul Lehrenden

Entry requirements
Skills to be acquired in this module
After having given an established introduction in the module "Microrobotics and Microsystem Technology" this lecture offers a further specialisation in microrobotics. Within the course, all relevant areas (among others the research topics of the division “Microrobotics and Control Engineering (AMiR)” will be presented and analysed. The student will be provided with an insight into current research projects of AMiR and of other research institutes of microrobotics worldwide; here mainly the requirements of industry to microrobots will be discussed. The lecture will be enhanced by practical courses in the research laboratories of AMiR.

Professional competence
The students:
- name and recognise the basic concepts of nanotechnology, in particular, micro- and nanorobotics approaches
- differentiate the development, control and application of micro- and nanorobotics systems
- implement and design application-specific micro- and nanorobotics systems

Methodological competence
The students:
- transfer their control engineering and image processing abilities on interdisciplinary problems
- transfer their hands-on experience to develop controls and applications of microrobotic systems on new tasks

Social competence
The students:
- work in a team

Self-competence
The students:
- reflect their problem-solving behaviour and use hands-on experience to develop, control and application of microrobotics

Module contents
Smart and versatile microrobots; microactuators (piezo-, ferrofluid- and SMA-actuators) for microrobots; real-time image processing in the micro world (SEM, optical microscopy); micro force sensors and tactile sensors for microrobots; microrobot control systems, e.g. neural networks and fuzzy logic; haptic interface for the control of microrobots; neural speech interface for the control of microrobots; robot-based micro- and nanohandling (SEM, optical microscopy); applications: microassembly, nano-testing, cell handling; Micro Air Vehicles (MAVs); multi-robot systems: team behavior, communication, control issues

Reader's advisory
- Lecture notes (can be obtained in secretariate, A1-3-303)

<table>
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<tbody>
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**Total time of attendance for the module:** 56 h
inf311 - Low Energy System Design

Module label: Low Energy System Design
Module code: inf311
Credit points: 6.0 KP
Workload: 180 h

Used in course of study:
- Master's Programme Computing Science (Master) > Technische Informatik
- Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodul
- Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering

Contact person:
Module responsibility:
- Wolfgang Nebel
- Die im Modul Lehrenden

Authorized examiners:
- Die im Modul Lehrenden
- Wolfgang Nebel

Entry requirements:
This module introduces the estimation of power dissipation and optimisation.

Skills to be acquired in this module:

Professional competence
The students:
- Discuss the fundamental problems of power dissipation
- Characterise the requirements-driven design process of embedded systems
- Name power loss analysis and optimization methods
- Design embedded systems with common design and analysis tools
- Design power-optimized embedded systems

Methodological competence
The students:
- Model systems with a hardware description language
- Analyze and model hardware components
- Perform multi-dimensional optimization of systems

Social competence
The students:
- Implement solutions of given problems in teams
- Discuss their outcomes appropriately

Self-competence
The students:
- Acknowledge the limits of their ability to cope with pressure during the modeling process of systems

Module contents
According to Moore's Law the number of integratable transistors on a computer chip doubles every two years. In addition, new circuits are getting faster and faster. This leads not only to an increased functionality of a system, but it also increases the electrical power consumption.

This electrical power consumption is problematic from two different points of view: Firstly, the electrical power must be supplied. Secondly, the resulting heat has to dissipate from the system. An increased power consumption always causes lower battery life and higher energy costs. The heat generation reduces the reliability and life of integrated circuits. The cooling (ceramic housings, cooling elements, fans, etc.) increases the system's costs.

Today the development of heat, caused by power dissipation, needs to be considered during the embedded system design process. This knowledge takes the system's reliability and operation costs into account.

This module introduces the estimation of power dissipation and optimisation.

Reader's advisory:
- Designing CMOS Circuits for Low Power – Dimitros Soudris, Christian Piguet, Costas Goutis
- Low-Power CMOS VLSI Circuit Design – Kaushik Roy, Sharat C. Prasad
- Low-Power Electronics Design – Christian Piguet et al.
- Leakage in Nanometer CMOS Technologies – Siva G. Narendra, Anantha Chandrakasan
- Entwurf von digitalen Schaltungen und Systemen mit HDLs und FPGAs – F. Kesel, R. Bartholomä
- Slides of the module „Eingebettete Systeme I+II“ von Professor Dr.-Ing. Wolfgang Nebel
- Slides and technical readouts of the used hardware and development tools

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<tr>
<th>Links</th>
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<tr>
<td>Languages of instruction</td>
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<td>Duration (semesters)</td>
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<td>Module frequency</td>
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<td>Module capacity</td>
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<td>Modulelevel</td>
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<td>Modulart</td>
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<td>Vorkenntnisse / Previous knowledge</td>
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<td>Final exam of module</td>
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<th>Frequency</th>
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<td>Exercises</td>
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<td>2.00</td>
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Total time of attendance for the module 56 h
# inf331 - Automated and Connected Driving

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<th>Module label</th>
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<td>Credit points</td>
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<td>Workload</td>
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**Used in course of study**
- Master's Programme Computing Science (Master) > Technische Informatik
- Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction

**Contact person**
- Module responsibility
  - Frank Köster
  - Die im Modul Lehrenden

**Authorized examiners**
- Frank Köster
- Die im Modul Lehrenden

**Entry requirements**

**Skills to be acquired in this module**

**Professional competences:**
The students:
- Discuss different levels of automated driving (e.g., SAE-Level) and the differences
- Discuss different levels of connected driving and the differences
- Discuss core-domains of automated vehicles
- Discuss important technological pillars in the areas sense, plan, and act
- Discuss transition between different levels of automation
- Discuss the impact of connected vehicle functions on automated driving
- Discuss the impact of automated vehicle functions on connected driving
- Characterise the impact of automated and connected driving on road traffic
- Characterise the interaction of humans and automated and connected vehicles
- Design an abstract procedure for the change of different levels of automation
- Design a rough vehicle architecture for automated and connected driving

**Methodological competences:**
The students:
- Analyze complex automated and connected vehicles (-> domains)
- Analyze core-functions of automated and connected vehicles (-> functions)

**Social competences:**
The students:
- Work in teams
- Discuss their outcomes appropriately

**Self-competences:**
The students:
- Acknowledge the limits of their ability to cope with pressure during the analysis of complex (automated and connected) socio-technical systems

**Module contents**

- levels of automated driving (e.g., SAE-Level)
- levels of connected driving
- core-domains of automated vehicles
- sense, plan, and act in the context of automated and connected vehicles
- transition between different levels of automation
- selected connected vehicle functions
- selected automated vehicle functions
- human factors and socio-technical systems
- vehicle architectures
Reader's advisory

Suggested reading:


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<tbody>
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<td>V+Ü</td>
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<td>inf201 Technische Informatik, inf203 Eingebettete Systeme I, inf204 Eingebettete Systeme II</td>
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<th>Type of examination</th>
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<td>At the end of the lecture period</td>
<td>Practical work and oral exam</td>
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<td>2.00</td>
<td>SuSe</td>
<td>28 h</td>
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Total time of attendance for the module 56 h
### inf332 - Practice Robotics

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<tr>
<td>Workload</td>
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| Used in course of study | - Master's Programme Computing Science (Master) > Technische Informatik  
                          | - Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction |
| Contact person        | Module responsibility                                  |
|                       | - Andreas Hein                                         |
|                       | - Die im Modul Lehrenden                                |
| Authorized examiners  | - Die im Modul Lehrenden                                |
|                       | - Andreas Hein                                         |
| Entry requirements    | Professional competences:                             |
|                       | The students learn:                                    |
|                       | - Programming of robots (mobile or stationary)         |
|                       | - Implementation of elementary operations              |
|                       | - Integration of operations into a small application scenario |
|                       | - Programming using Robot Operating System (ROS)       |
|                       | Methodological competences:                            |
|                       | The students learn:                                    |
|                       | - Systematic development process with team members     |
|                       | - Systematic evaluation of the application             |
|                       | - Designing a robotic application using basic and advanced robotic concepts |
|                       | Social competences:                                   |
|                       | The students learn:                                    |
|                       | - Project management                                   |
|                       | - Team work                                            |
|                       | - Organization of the team                             |
|                       | Self-competences:                                     |
|                       | The students:                                          |
|                       | - Time management                                      |
|                       | - Autodidactic work (literature search, technical specs, related work) |
| Module contents       | Robotic systems will be provided to the students. They will then define the project/application scenario of the robots by their own and complete the project as a small team with self-organization and work distribution among the team members. The module consists of a lecture and an exercise part: Lecture: 2-3 lectures for introduction onto the module and introduction into the Robot Operating System (ROS) as well as the concepts of the projects. Exercises: After the introduction period, the students will work self-organized to complete the proposed project. Work can be distributed weekly or on as concentrated time blocks. |
| Reader's advisory     | John J. Craig, *Introduction to Robotics: Mechanics and Control*  
<pre><code>                      | Patrick Goebel, *ROS By Example*                        |
</code></pre>
<p>| Links                 | Language of instruction: English                       |
|                       | Duration (semesters): 1 Semester                       |
|                       | Module frequency: Once a year                          |
|                       | Module capacity: unlimited                             |
|                       | Modulelevel: AS (Akzentsetzung / Accentuation)         |
|                       | Modulart: Pflicht o. Wahlpflicht / compulsory or optioal |
|                       | Lern-/Lehrform / Type of program: V+Ü                  |
|                       | Vorkenntnisse / Previous knowledge                     |
|                       | Examination: Time of examination                       |
|                       | Type of examination: Demonstration and written documentation |
|                       | Final exam of module: At the end of the lecture period |
|                       | Course type: Comment SWS Frequency Workload attendance |</p>
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<td>2.00</td>
<td>WiSe</td>
<td>28 h</td>
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**Total time of attendance for the module**

56 h
inf333 - Sensor Technology in the Automotive Domain

Module label  Sensor Technology in the Automotive Domain
Module code inf333
Credit points 6.0 KP
Workload 180 h

Used in course of study
- Master's Programme Computing Science (Master) > Technische Informatik
- Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering

Contact person
Module responsibility
- Frank Köster
- Die im Modul Lehrenden
Authorized examiners
- Die im Modul Lehrenden
- Frank Köster

Entry requirements

Skills to be acquired in this module
This module introduces the principles of sensors and sensor-systems as well as data-fusion in the automotive domain.

Professional competences:
The students:
- Discuss different levels/diverse levels sensor-technologies
- Discuss sensor-data fusion (multi-level fusion)
- Discuss Kalman-Filter
- Discuss in-vehicle data-processing
- Discuss car2cx-technologies
- Design simple multi-sensor systems
- Evaluate multi-sensor systems

Methodological competences:
The students:
- Analyze multi-sensor systems
- Design multi-sensor systems
- Evaluate multi-sensor systems

Social competences:
The students:
- Work in teams
- Discuss their outcomes appropriately

Self-competences:
The students:
- Acknowledge the limits of their ability to cope with pressure during the work on the topics of the module

Module contents
- Sensor-technologies
- Data fusion (multi-level fusion)
- Kalman-Filter
- In-vehicle data-processing
- Car2cx-technologies (ITS G5 and 5G)
- Multi-sensor and multi-level fusion architectures

Reader's advisory
Suggested reading:

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<td>Duration (semesters)</td>
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<td>Module frequency</td>
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<td>2.00</td>
<td>SuSe</td>
<td>28 h</td>
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| Total time of attendance for the module | 56 h |
### inf334 - System Level Design

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<th>System Level Design</th>
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<tr>
<td>Credit points</td>
<td>6.0 KP</td>
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<tr>
<td>Workload</td>
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#### Used in course of study
- Master's Programme Computing Science (Master) > Technische Informatik
- Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering

#### Contact person

**Module responsibility**
- Kim Grüttner

**Authorized examiners**
- Die im Modul Lehrenden
- Kim Grüttner

#### Entry requirements

### Skills to be acquired in this module

#### Professional competences:
The students:

- Ability to describe and analyze system components and architectures using system level description languages SpecC and SystemC
- Capabilities for partitioning and parallelizing of applications

#### Methodological competences:
The students:

- Knowledge of refinement and transformation techniques for transferring an initial specification into a real implementation
- Knowledge of the phases of a system-level design flow
- Knowledge of current design methods and tools in system level design
- Knowledge about formal models of computation of specification languages
- Knowledge of current research results and trends in system level design
- Capabilities for partitioning and parallelizing of applications
- Ability to evaluate and explore design decisions
- Ability to implement a complete system design-to-implementation specification

#### Social competences:
The students:

- Implement solutions of given problems in teams
- Discuss their outcomes appropriately

#### Self-competences:
The students:

- presentation skills
- reflect their solutions by using methods learned in this course

### Module contents
The ever-increasing integration densities of integrated circuits enable the implementation of increasingly powerful and complex systems. This can be on the one hand the integration of several sub-components on the same chip (system-on-chip) or on the other hand the implementation of more powerful algorithms. However, traditional design techniques are hardly able to cope with the increasing complexity of today’s embedded systems. Therefore, in research and practice efforts through new methods and tools, there is a significant increase in productivity in the design process, thus closing the so-called “design productivity gap”. This is achieved, for example, by a stronger abstraction, in which the behavior of components is described only at the algorithmic level and is automatically translated into hardware or software implementations by high-level synthesis techniques. The final system implementation is achieved by means of a structured refinement and exploration processes. Throughout this refinement flow, system properties (for example, timing, energy consumption, chip area and costs) are estimated on each abstraction level and guide the designer in the iterative decision process. By means of techniques such as virtual prototyping, entire systems can be simulated and verified on each refinement layer, even without the availability of a full implementation for all system components.
This module builds on the modules Embedded Systems I and II, deepens the knowledge acquired there for the design of hardware/software systems and expands them with current methods and tools. With SystemC, a language is presented that is already widely used in industry and research for the design and verification of hardware/software systems and supports several abstraction levels from clock cycle accurate hardware description, over transaction level models to process based functional specifications.

Reader's advisory

Suggested reading:

Main textbooks:


Optional books:


Additional reading material posted on Stud.IP

Links

https://www.uni-oldenburg.de/informatik/ehs/lehre/vorlesungen/system-level-design/

Language of instruction

English

Duration (semesters)

1 Semester

Module frequency

once a year

Module capacity

unlimited

Modullevel

AS (Akzentsetzung / Accentuation)

Modularität

Pflicht o. Wahlpflicht / compulsory or optional

Lern-/Lehrform / Type of program

V+Ü

Vorkenntnisse / Previous knowledge

Examination

Time of examination

Type of examination

Final exam of module

at the end of the lecture period

hands-on exercises and oral exam

Course type Comment SWS Frequency Workload attendance

Lecture 2.00 SuSe 28 h

Exercises 2.00 SuSe 28 h

Total time of attendance for the module

56 h
inf335 - Strategy Synthesis

<table>
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<td>o Die im Modul Lehrenden</td>
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<td>o Die im Modul Lehrenden</td>
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<tr>
<td>Entry requirements</td>
<td>The students learn fundamental techniques in strategy synthesis as foundation for high-level control strategies in highly autonomous systems</td>
</tr>
<tr>
<td>Skills to be acquired in this module</td>
<td>The students:</td>
</tr>
<tr>
<td>Professional competences:</td>
<td>The students:</td>
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<tr>
<td></td>
<td>o understand the concepts of open, reactive systems and can explain their relevance</td>
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<tr>
<td></td>
<td>o can provide formal model of open reactive systems and their relevance for system design</td>
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<td>o understand the concept of world models as internal representation of a systems environment</td>
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<td>o understand and can explain the concept of strategies, and relate this to system design</td>
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<td></td>
<td>o understand the relevance of information flow in distributed system</td>
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<td>o understand the relevance of choosing the periphery of world models</td>
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<td>o can formalize system requirements in temporal logic</td>
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<td>o understand the relevance of assumptions in system design</td>
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<tr>
<td>Methodological competences:</td>
<td>The students:</td>
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<tr>
<td></td>
<td>o methods for synthesis of winning strategies in closed systems</td>
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<tr>
<td></td>
<td>o methods for synthesizing remorse-free strategies in open systems</td>
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<td></td>
<td>o methods for determining the perimeter of world models</td>
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<td></td>
<td>o methods for cooperative strategy synthesis</td>
</tr>
<tr>
<td>Social competences:</td>
<td>The students:</td>
</tr>
<tr>
<td></td>
<td>o Work in teams</td>
</tr>
<tr>
<td></td>
<td>o Solve complex modelling, design, and synthesis tasks in teams</td>
</tr>
<tr>
<td>Self-competences:</td>
<td>The students:</td>
</tr>
<tr>
<td></td>
<td>o Reflect their actions and respect the scope of methods for strategy synthesis</td>
</tr>
<tr>
<td>Module contents</td>
<td>The module gives an introduction to the synthesis of control strategies for highly autonomous systems. We first introduce classical game theory and present algorithms for synthesizing strategies for reactive system. We extend this to open systems, and analyze conditions, under which synthesis for distributed systems is decidable. We introduce remorse-free strategies and present compositional approaches to synthesis of remorse-free strategies. We analyze under what conditions world models allow for optimal remorse free strategies. We provide algorithms for computing weakest assumptions on the system environments under which winning strategies exist. We extend this to cooperative strategy synthesis, where multiple players cooperate in achieving jointly the system objectives. We illustrate these concepts with examples from autonomous driving.</td>
</tr>
<tr>
<td>Reader's advisory</td>
<td>Suggested reading:</td>
</tr>
</tbody>
</table>
|                    | o Werner Damm and Bernd Finkbeiner. Automatic compositional synthesis of distributed systems. In Cliff Jones, Pekka Pihlajasara, and Jun Sun, editors, FM 2014: Formal Methods, volume 8442 of Lecture


<table>
<thead>
<tr>
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<tbody>
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</table>
inf336 - Application Area Automotive

Module label
Application Area Automotive

Module code
inf336

Credit points
6.0 KP

Workload
180 h

Used in course of study
- Master's Programme Computing Science (Master) > Technische Informatik
- Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering

Contact person
Module responsibility
- Frank Köster
- Die im Modul Lehrenden

Authorized examiners
- Die im Modul Lehrenden
- Frank Köster

Entry requirements
This module introduces the application area Automotive.

Professional competences: The students:
- Discuss core-concepts of the transportation domain
- Discuss different modes of transportation (focus on the automotive sector)
- Discuss automated and connected driving (short introduction/overview)
- Discuss human factors in the automotive sector
- Discuss traffic infrastructure (focus on intersections)
- Discuss basic principles in traffic management

Methodological competences: The students:
- Analyze vehicle systems
- Analyze traffic infrastructure
- Analyze cooperative vehicle/infrastructure systems
- Analyze socio-technical systems

Social competences: The students:
- Work in teams
- Discuss their outcomes appropriately

Self-competences: The students:
- Acknowledge the limits of their ability to cope with pressure during the work on the topics of the module

Module contents
- Core-concepts of the transportation domain
- Modes of transportation (focus on the automotive sector)
- Automated and connected driving (short introduction/overview)
- Human factors in the automotive sector
- Traffic infrastructure (focus on intersections)
- Basic principles in traffic management

Reader's advisory

Links

Language of instruction
English

Duration (semesters)
1 Semester

Module frequency
once a year

Module capacity
unlimited

Modullevel
AS (Akzentsetzung / Accentuation)

Modulart
Pflicht o. Wahlpflicht / compulsory or optional

Lern-/Lehrform / Type of program
V+Ü

Examination
Time of examination
At the end of the lecture period

Type of examination
Practical Work and oral Exam

Final exam of module
Course type
Comment
SWS
Frequency
Workload attendance
Lecture
2.00
SuSe
28 h
Exercises
2.00
SuSe
28 h

Total time of attendance for the module
56 h
inf338 - Design of Autonomous Systems

Module label
Design of Autonomous Systems

Module code
inf338

Credit points
6.0 KP

Workload
180 h

Used in course of study
- Master's Programme Computing Science (Master) > Technische Informatik
- Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering

Contact person
Module responsibility
- Martin Georg Fränzle
- Die im Modul Lehrenden

Authorized examiners
- Die im Modul Lehrenden
- Martin Georg Fränzle

Entry requirements
Skills to be acquired in this module
Professional competences:
The students are enabled to analyze and build autonomous systems.

Methodological competences:
The students know examples of existing autonomous systems, understand the elements involved in their architectural design and the rationale behind decomposing the problem into obligations for the respective system components. The module furthermore enables the students to analyze existing architectures for autonomous systems with respect to their performance and safety. The students learn how to decompose a problem of designing an autonomous system into an architecture, are able to derive design obligations for its components, and can structure a pertinent safety case. They understand the software and hardware components necessary for achieving system autonomy and are able to design or instantiate these.

Social competences:
The students acquire hands-on experience in designing components for autonomous systems in small teams and present the underlying theory, their particular design decisions, and their personal evaluation to fellow students.

Self-competences:
The students can judge adequacy of their methodological skills for designing particular autonomous solutions. They are able to assess the safety impact of such a solution and are therefore able to develop a personal ethical stance towards its realization.

Module contents
The module consists of a lecture and an exercise part

Reader's advisory

Links
Language of instruction
English

Duration (semesters)
1 Semester

Module frequency
once a year

Module capacity
unlimited

Modullevel
AS (Akzentsetzung / Accentuation)

Modulart
Pflicht o. Wahlpflicht / compulsory or optional

Lern-Lehrform / Type of program
V+Ü

Vorkenntnisse / Previous knowledge

Examination
Time of examination
Type of examination
Final exam of module
Second half of semester
Presentation

Course type
Comment
SWS
Frequency
Workload attendance
Lecture
2.00
WiSe
28 h
Exercises
2.00
WiSe
28 h

Total time of attendance for the module
56 h
inf350 - Special Topics in 'Safety-Critical Systems' I

**Module label**  
Special Topics in 'Safety-Critical Systems' I

**Module code**  
inf350

**Credit points**  
6.0 KP

**Workload**  
180 h

**Used in course of study**  
- Master's Programme Computing Science (Master) > Technische Informatik
- Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodule

**Contact person**

- Module responsibility
  - Andreas Hein
- Authorized examiners
  - Andreas Hein

**Entry requirements**

**Skills to be acquired in this module**

This module integrates current developments in the field in adequate study courses.

**Professional competences**
The students:

- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

**Methodological competences**
The students:

- evaluate and apply tools, technology and methods sophisticatedly
- combine new and original approaches and methods creatively
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research

**Social competences**
The students:

- support team process by their abilities

**Self-competences**
The students:

- pursue the overall and special computer science development critically
- implement innovative professional activities effectively and independently

**Module contents**

See assigned course description, e.g. „Sicherheitsanalysetechniken“, „Zielarchitekturen Eingebetteter Systeme für Automotive-Anwendungen“, „Modellbasierter Systementwurf“, ....

**Reader's advisory**

As announced in course

**Links**

**Language of instruction**  
German

**Duration (semesters)**  
1 Semester

**Module frequency**  
unregelmäßig

**Module capacity**  
unlimited

**Modullevel**  
AS (Akzentsetzung / Accentuation)

**Modularart**  
je nach Studiengang Pflicht oder Wahlpflicht

**Lern-Lehrform / Type of program**

2 Veranst. aus V, Ü, S, P, PR (4SWS)

**Vorkenntnisse / Previous knowledge**
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### inf351 - Special Topics in ‘Safety-Critical Systems’ II

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<td>- Andreas Hein</td>
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<td>- Die im Modul Lehrenden</td>
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<td></td>
<td>- Andreas Hein</td>
</tr>
<tr>
<td></td>
<td>- Die im Modul Lehrenden</td>
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</table>

**Entry requirements**

**Skills to be acquired in this module**

**Professional competences**

The students:

- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

**Methodological competences**

The students:

- evaluate and apply tools, technology and methods sophisticatedly
- combine new and original approaches and methods creatively
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research

**Social competences**

The students:

- support team process by their abilities

**Self-competences**

The students:

- pursue the overall and special computer science development critically
- implement innovative professional activities effectively and independently

<table>
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<tr>
<th><strong>Module contents</strong></th>
<th>See assigned course description, e.g. „Sicherheitsanalysetechniken“, „Modellbasierter Systementwurf“, ...</th>
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<tr>
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inf352 - Current Topics in 'Safety-Critical Systems' I

Module label                   Current Topics in 'Safety-Critical Systems' I
Module code                    inf352
Credit points                  3.0 KP
Workload                       90 h
Used in course of study        • Master's Programme Computing Science (Master) > Technische Informatik
                                • Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodule
Contact person                 Module responsibility
                                • Andreas Hein
                                • Die im Modul Lehrenden
Authorized examiners           • Andreas Hein
                                • Die im Modul Lehrenden
Entry requirements             Skills to be acquired in this module
                                This module integrates current developments in the field in adequate study courses.
                                Professional competences
                                The students:
                                • define and contrast a computer science part, in which they are specialised, in detail or evaluate
                                  computer science in general
                                • recognise and evaluate applied techniques and methods of their subject and are aware of their limits
                                • identify, structure and solve problems/tasks, also in new or developing subject areas
                                • apply state of the art and innovative methods to solve problems, if necessary from other disciplines
                                • are aware of the current limits and contribute to the development of computer science research and
                                  technology
                                • discuss and evaluate recent computer science developments
                                Methodological competences
                                The students:
                                • examine tasks with technical and research literature, write an academic article and present their
                                  solutions academically
                                • evaluate problems/tasks, including new or developing subject areas of their discipline and apply
                                  computer science methods for solutions and research
                                • schedule time processes and resources
                                Social competences
                                The students:
                                • communicate with users and experts convincingly
                                Self-competences
                                The students:
                                • pursue the overall and special computer science development critically
                                • develop and reflect self-developed hypotheses to theories independently

Module contents                 See assigned course description
Reader's advisory              As announced in course
Links                          Language of instruction: German
                                Duration (semesters): 1 Semester
                                Module frequency: unregelmäßig
                                Module capacity: unlimited
                                Module level: AS (Akzentsetzung / Accentuation)
                                Modulart: je nach Studiengang Pflicht oder Wahlpflicht
                                Lern-/Lehrform / Type of program: S oder V (2 SWS)
**Vorkenntnisse / Previous knowledge**

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<th>Type of examination</th>
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**Course type**
- Course or seminar

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</table>
inf353 - CurrentTopics in 'Safety-Critical Systems' II

Module label CurrentTopics in 'Safety-Critical Systems' II

Module code inf353

Credit points 3.0 KP

Workload 90 h

Used in course of study
- Master's Programme Computing Science (Master) > Technische Informatik
- Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodule

Contact person

Module responsibility
- Andreas Hein
- Die im Modul Lehrender

Authorized examiners
- Andreas Hein
- Die im Modul Lehrender

Entry requirements

Skills to be acquired in this module

This module integrates current developments in the field in adequate study courses.

Professional competences

The students:

- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

Methodological competences

The students:

- examine tasks with technical and research literature, write an academic article and present their solutions academically
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
- schedule time processes and resources

Social competences

The students:

- communicate with users and experts convincingy

self-competences

The students:

- pursue the overall and special computer science development critically
- develop and reflect self-developed hypotheses to theories independently

Module contents
See assigned course description

Reader's advisory
As announced in course

Links

Languages of instruction German, English

Duration (semesters) 1 Semester

Module frequency unregelmäßig

Module capacity unlimited

Modulelevel AS (Akzentsetzung / Accentuation)

Modulart je nach Studiengang Pflicht oder Wahlpflicht

Lern-/Lehrform / Type of program S oder V (2SWS)
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<tr>
<td>Frequency</td>
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### inf354 - Special Topics in 'Hybrid Systems' I

<table>
<thead>
<tr>
<th><strong>Module label</strong></th>
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<tr>
<td><strong>Module code</strong></td>
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<tr>
<td><strong>Credit points</strong></td>
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<td><strong>Workload</strong></td>
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| **Used in course of study** | Master's Programme Computing Science (Master) > Technische Informatik  
|                   | Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodule |
| **Contact person** | Module responsibility  
|                   | - Andreas Hein  
|                   | - Martin Georg Fränzle  
|                   | - Die im Modul Lehrenden  
|                   | Authorized examiners  
|                   | - Andreas Hein  
|                   | - Martin Georg Fränzle  
|                   | - Die im Modul Lehrenden |
| **Entry requirements** | This module integrates current developments in the field in adequate study courses. |
| **Skills to be acquired in this module** | Professional competences  
|                   | The students:  
|                   | - define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general  
|                   | - recognise and evaluate applied techniques and methods of their subject and are aware of their limits  
|                   | - identify, structure and solve problems/tasks, also in new or developing subject areas  
|                   | - apply state of the art and innovative methods to solve problems, if necessary from other disciplines  
|                   | - are aware of the current limits and contribute to the development of computer science research and technology  
|                   | - discuss and evaluate recent computer science developments  
|                   | Methodological competences  
|                   | The students:  
|                   | - evaluate and apply tools, technology and methods sophisticatedly  
|                   | - combine new and original approaches and methods creatively  
|                   | - evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research  
|                   | Social competences  
|                   | The students:  
|                   | - support team process by their abilities  
|                   | self-competences  
|                   | The students:  
|                   | - pursue the overall and special computer science development critically  
|                   | - implement innovative professional activities effectively and independently  
<p>| <strong>Module contents</strong> | See assigned course description, e.g. „Modellbasierner Systementwurf“, „Konstruktionsprinzipien ausgewählter Klassen von Fahrzeugfunktionen“ |
| <strong>Reader's advisory</strong> | As announced in course |
| <strong>Links</strong> | |
| <strong>Language of instruction</strong> | German |
| <strong>Duration (semesters)</strong> | 1 Semester |
| <strong>Module frequency</strong> | halbjährlich |
| <strong>Module capacity</strong> | unlimited |
| <strong>Modullevel</strong> | AS (Akzentsetzung / Accentuation) |
| <strong>Modulart</strong> | je nach Studiengang Pflicht oder Wahlpflicht |</p>
<table>
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<tr>
<th>Lern- / Lehrform / Type of program</th>
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<td>Examination</td>
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inf355 - Special Topics in 'Hybrid Systems' II

<table>
<thead>
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<td>Master's Programme Embedded Systems and Microrobotics (Master) &gt; Akzentsetzungsmodule</td>
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Contact person

Module responsibility
- Andreas Hein
- Martin Georg Fränzle
- Die im Modul Lehrenden

Authorized examiners
- Andreas Hein
- Martin Georg Fränzle
- Die im Modul Lehrenden

Entry requirements

Skills to be acquired in this module
This module integrates current developments in the field in adequate study courses.

Professional competences
The students:
- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

Methodological competences
The students:
- evaluate and apply tools, technology and methods sophisticatedly
- combine new and original approaches and methods creatively
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research

Social competences
The students:
- support team process by their abilities

Self-competences
The students:
- pursue the overall and special computer science development critically
- implement innovative professional activities effectively and independently

Module contents
See assigned course description

Reader's advisory
As announced in course

Links

Language of instruction
German

Duration (semesters)
1 Semester

Module frequency
unregelmäßig

Module capacity
unlimited

Modullevel
AS (Akzentsetzung / Accentuation)

Modulart
je nach Studiengang Pflicht oder Wahlpflicht
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<tr>
<td>Examination</td>
<td>Time of examination</td>
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<td>Workload attendance</td>
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inf356 - CurrentTopics in 'Hybrid Systems' I

<table>
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<td>Module code</td>
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<tr>
<td>Credit points</td>
<td>3.0 KP</td>
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| Used in course of study | Master's Programme Computing Science (Master) > Technische Informatik  
|               | Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodule |
| Contact person| Module responsibility  
|               | • Andreas Hein  
|               | • Martin Georg Fränzle  
|               | • Die im Modul Lehrenden  
|               | Authorized examiners  
|               | • Andreas Hein  
|               | • Martin Georg Fränzle  
|               | • Die im Modul Lehrenden |
| Entry requirements | This module integrates current developments in the field in adequate study courses.  
| Skills to be acquired in this module | Professional competences  
|               | The students:  
|               | • define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general  
|               | • recognise and evaluate applied techniques and methods of their subject and are aware of their limits  
|               | • identify, structure and solve problems/tasks, also in new or developing subject areas  
|               | • apply state of the art and innovative methods to solve problems, if necessary from other disciplines  
|               | • are aware of the current limits and contribute to the development of computer science research and technology  
|               | • discuss and evaluate recent computer science developments  
|               | Methodological competences  
|               | The students:  
|               | • examine tasks with technical and research literature, write an academic article and present their solutions academically  
|               | • evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research  
|               | • schedule time processes and resources  
|               | Social competences  
|               | The students:  
|               | • communicate with users and experts convincingly  
|               | Self-competences  
|               | The students:  
|               | • pursue the overall and special computer science development critically  
|               | • develop and reflect self-developed hypotheses to theories independently  
| Module contents | See assigned course description  
| Reader's advisory | As announced in course  
| Links | Languages of instruction | German, English  
| Duration (semesters) | 1 Semester  
| Module frequency | unregelmäßig  
| Module capacity | unlimited  
| Modulelevel | AS (Akzentsetzung / Accentuation)  
| Modular | je nach Studiengang Pflicht oder Wahlpflicht  

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<th>Lern-/Lehrform / Type of program</th>
<th>S oder V (2SWS)</th>
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<tr>
<td>Vorkenntnisse / Previous knowledge</td>
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<tr>
<td>Examination</td>
<td>Time of examination</td>
</tr>
<tr>
<td>Final exam of module</td>
<td>At the end of the lecture period</td>
</tr>
<tr>
<td>Course type</td>
<td>Course or seminar</td>
</tr>
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<tr>
<td>Frequency</td>
<td>SuSe or WiSe</td>
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<tr>
<td>Workload attendance</td>
<td>28 h</td>
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inf357 - Aktuelle Themen aus dem Gebiet "Hybride Systeme" II

<table>
<thead>
<tr>
<th>Module label</th>
<th>Aktuelle Themen aus dem Gebiet &quot;Hybride Systeme&quot; II</th>
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<tbody>
<tr>
<td>Module code</td>
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<tr>
<td>Credit points</td>
<td>3.0 KP</td>
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<tr>
<td>Workload</td>
<td>90 h</td>
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</table>
| Used in course of study       | Master's Programme Computing Science (Master) > Technische Informatik  
                                | Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodule |
| Contact person                | Module responsibility  
                                | - Andreas Hein  
                                | - Martin Georg Fränzle  
                                | - Die im Modul Lehrenden  
                                | Authorized examiners  
                                | - Andreas Hein  
                                | - Martin Georg Fränzle  
                                | - Die im Modul Lehrenden |
| Entry requirements            | This module integrates current developments in the field in adequate study courses. |
| Skills to be acquired in this module | Professional competences  
                                | The students:  
                                | - define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general  
                                | - recognise and evaluate applied techniques and methods of their subject and are aware of their limits  
                                | - identify, structure and solve problems/tasks, also in new or developing subject areas  
                                | - apply state of the art and innovative methods to solve problems, if necessary from other disciplines  
                                | - are aware of the current limits and contribute to the development of computer science research and technology  
                                | - discuss and evaluate recent computer science developments  
                                | Methodological competences  
                                | The students:  
                                | - examine tasks with technical and research literature, write an academic article and present their solutions academically  
                                | - evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research  
                                | - schedule time processes and resources  
                                | Social competences  
                                | The students:  
                                | - communicate with users and experts convincingly  
                                | Self-competences  
                                | The students:  
                                | - pursue the overall and special computer science development critically  
                                | - develop and reflect self-developed hypotheses to theories independently  
<p>| Module contents               | See assigned course description                      |
| Reader's advisory             | As announced in course                               |
| Links                         | Language of instruction: German                     |
| Duration (semesters)          | 1 Semester                                           |
| Module frequency              | unregelmäßig                                         |
| Module capacity               | unlimited                                            |
| Modullevel                    | AS (Akzentsetzung / Accentuation)                    |
| Modulart                      | je nach Studiengang Pflicht oder Wahlpflicht         |</p>
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<thead>
<tr>
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<tr>
<td>Vorkenntnisse / Previous knowledge</td>
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<td>Examination</td>
<td>Time of examination</td>
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<tr>
<td>Final exam of module</td>
<td>At the end of the lecture period</td>
</tr>
<tr>
<td>Course type</td>
<td>Course or seminar</td>
</tr>
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<td>SWS</td>
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<td>Frequency</td>
<td>WiSe</td>
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<td>Workload attendance</td>
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</table>
inf358 - Special Topics in 'Hardware/Software Systems' I

<table>
<thead>
<tr>
<th>Module label</th>
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<tr>
<td>Module code</td>
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<tr>
<td>Credit points</td>
<td>6.0 KP</td>
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<tr>
<td>Workload</td>
<td>180 h</td>
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| Used in course of study          | Master's Programme Computing Science (Master) > Technische Informatik  
|                                  | Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodule |
| Contact person                   | Module responsibility                           |
|                                  | ▪ Andreas Hein                                  |
|                                  | ▪ Wolfgang Nebel                                 |
|                                  | ▪ Die im Modul Lehrenden                        |
| Authorized examiners             | ▪ Andreas Hein                                  |
|                                  | ▪ Wolfgang Nebel                                 |
|                                  | ▪ Die im Modul Lehrenden                        |
| Entry requirements               | This module integrates current developments in the field in adequate study courses. |
| Skills to be acquired in this module | Professional competences                        |
|                                  | The students:                                   |
|                                  | ▪ define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general |
|                                  | ▪ recognise and evaluate applied techniques and methods of their subject and are aware of their limits |
|                                  | ▪ identify, structure and solve problems/tasks, also in new or developing subject areas |
|                                  | ▪ apply state of the art and innovative methods to solve problems, if necessary from other disciplines |
|                                  | ▪ are aware of the current limits and contribute to the development of computer science research and technology |
|                                  | ▪ discuss and evaluate recent computer science developments |
|                                  | Methodological competences                      |
|                                  | The students:                                   |
|                                  | ▪ evaluate and apply tools, technology and methods sophisticatedly |
|                                  | ▪ combine new and original approaches and methods creatively |
|                                  | ▪ evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research |
|                                  | Social competences                              |
|                                  | The students:                                   |
|                                  | ▪ support team process by their abilities        |
|                                  | Self-competences                                |
|                                  | The students:                                   |
|                                  | ▪ pursue the overall and special computer science development critically |
|                                  | ▪ implement innovative professional activities effectively and independently |

<p>| Module contents                   | See assigned course description, e.g. „Spezifikation und Modellierung Eingebetteter Systeme“ |
| Reader's advisory                 | As announced in course |
| Links                             | |
| Language of instruction           | German                                           |
| Duration (semesters)              | 1 Semester                                       |
| Module frequency                  | halbjährlich                                     |
| Module capacity                   | unlimited                                        |
| Modullevel                        | AS (Akzentsetzung / Accentuation)                |
| Modulart                          | je nach Studiengang Pflicht oder Wahlpflicht      |</p>
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<tr>
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<tbody>
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<td>Vorkenntnisse / Previous knowledge</td>
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<tr>
<td>Examination</td>
<td>Time of examination</td>
</tr>
<tr>
<td>Final exam of module</td>
<td>The exam period will be announced during the course</td>
</tr>
<tr>
<td></td>
<td>Type of examination</td>
</tr>
<tr>
<td>Course type</td>
<td>VA-Auswahl</td>
</tr>
<tr>
<td>SWS</td>
<td>2.00</td>
</tr>
<tr>
<td>Frequency</td>
<td>SuSe or WiSe</td>
</tr>
<tr>
<td>Workload attendance</td>
<td>28 h</td>
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</table>
inf359 - Spezielle Themen aus dem Gebiet "Hardware-/Software-Systeme" II

Module label  Spezielle Themen aus dem Gebiet "Hardware-/Software-Systeme" II
Module code inf359
Credit points 6.0 KP
Workload 180 h

Used in course of study
- Master's Programme Computing Science (Master) > Technische Informatik
- Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodule

Contact person
Module responsibility
- Andreas Hein
- Wolfgang Nebel
- Die im Modul Lehrenden

Authorized examiners
- Andreas Hein
- Wolfgang Nebel
- Die im Modul Lehrenden

Entry requirements
Skills to be acquired in this module
This module integrates current developments in the field in adequate study courses.

Professional competences
The students:
- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

Methodological competences
The students:
- evaluate and apply tools, technology and methods sophisticatedly
- combine new and original approaches and methods creatively
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research

Social competences
The students:
- support team process by their abilities

Self-competences
The students:
- pursue the overall and special computer science development critically
- implement innovative professional activities effectively and independently

Module contents
See assigned course description, e.g. „Spezifikation und Modellierung Eingebetteter Systeme“

Reader's advisory
As announced in course

Links
Language of instruction German
Duration (semesters) 1 Semester
Module frequency unregelmäßiger
Module capacity unlimited
Modullevel AS (Akzentsetzung / Accentuation)
Modulart je nach Studiengang Pflicht oder Wahlpflicht
Lern-/Lehrform / Type of program 2 Veranst. aus V, Ü, S, P, PR (4SWS)

Vorkenntnisse / Previous knowledge

Examination

<table>
<thead>
<tr>
<th>Time of examination</th>
<th>Type of examination</th>
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</thead>
<tbody>
<tr>
<td>The exam period will be announced during the course</td>
<td>Exercises or presentation or oral exam</td>
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</table>

Final exam of module

Course type VA-Auswahl

SWS 2.00

Frequency WiSe

Workload attendance 28 h
inf360 - CurrentTopics in 'Hardware/Software Systems' I

<table>
<thead>
<tr>
<th>Module label</th>
<th>CurrentTopics in 'Hardware/Software Systems' I</th>
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<tbody>
<tr>
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<tr>
<td>Credit points</td>
<td>3.0 KP</td>
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<tr>
<td>Workload</td>
<td>90 h</td>
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**Used in course of study**
- Master's Programme Computing Science (Master) > Technische Informatik
- Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodule

**Contact person**
- Module responsibility
  - Andreas Hein
  - Wolfgang Nebel
  - Die im Modul Lehrenden
- Authorized examiners
  - Andreas Hein
  - Wolfgang Nebel
  - Die im Modul Lehrenden

**Entry requirements**

**Skills to be acquired in this module**
- This module integrates current developments in the field in adequate study courses.

**Professional competences**
- The students:
  - Define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
  - Recognise and evaluate applied techniques and methods of their subject and are aware of their limits
  - Identify, structure and solve problems/tasks, also in new or developing subject areas
  - Apply state of the art and innovative methods to solve problems, if necessary from other disciplines
  - Are aware of the current limits and contribute to the development of computer science research and technology
  - Discuss and evaluate recent computer science developments

**Methodological competences**
- The students:
  - Examine tasks with technical and research literature, write an academic article and present their solutions academically
  - Evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
  - Schedule time processes and resources

**Social competences**
- The students:
  - Communicate with users and experts convincingly

**Self-competences**
- The students:
  - Pursue the overall and special computer science development critically
  - Develop and reflect self-developed hypotheses to theories independently

**Module contents**
- See assigned course description, e.g. „Energieeffizienz in der IKT“, „Smart Resource Integration“, ...

**Reader’s advisory**
- As announced in course

**Links**

**Language of instruction**
- German

**Duration (semesters)**
- 1 Semester

**Module frequency**
- unregelmäß

**Module capacity**
- unlimited

**Modulelevel**
- AS (Akzentsetzung / Accentuation)

**Modulart**
- je nach Studiengang Pflicht oder Wahlpflicht
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<tbody>
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<td>Vorkenntnisse / Previous knowledge</td>
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<td>Examination</td>
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<tr>
<td>Time of examination</td>
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<tr>
<td>Type of examination</td>
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<td>Final exam of module</td>
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<tr>
<td>At the end of the lecture period</td>
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<tr>
<td>Presentation or oral exam</td>
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<td>2.00</td>
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<td>Frequency</td>
<td>SuSe or WiSe</td>
</tr>
<tr>
<td>Workload attendance</td>
<td>28 h</td>
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</table>
inf361 - Current Topics in 'Hardware/Software Systems' II

Module label: Current Topics in 'Hardware/Software Systems' II
Module code: inf361
Credit points: 3.0 KP
Workload: 90 h

Used in course of study:
- Master's Programme Computing Science (Master) > Technische Informatik
- Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodule

Contact person:
Module responsibility:
- Andreas Hein
- Wolfgang Nebel
- Die im Modul Lehrenden

Authorized examiners:
- Andreas Hein
- Wolfgang Nebel
- Die im Modul Lehrenden

Entry requirements:

Skills to be acquired in this module:

Professional competences:
The students:
- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

Methodological competences:
The students:
- examine tasks with technical and research literature, write an academic article and present their solutions academically
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
- schedule time processes and resources

Social competences:
The students:
- communicate with users and experts convincingly

Self-competences:
The students:
- pursue the overall and special computer science development critically
- develop and reflect self-developed hypotheses to theories independently

Module contents:
See assigned course description, e.g. „Energieeffizienz in der IKT“, „Smart Resource Integration“, ...

Reader's advisory:
As announced in course

Links:

Language of instruction: German
Duration (semesters): 1 Semester
Module frequency: unregelmäßig
Module capacity: unlimited
Modullevel: AS (Akzentsetzung / Accentuation)
Modulart: je nach Studiengang Pflicht oder Wahlpflicht
<table>
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<td>Examination</td>
<td>Time of examination</td>
</tr>
<tr>
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<td>At the end of the lecture period</td>
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<tr>
<td>Course type</td>
<td>Course or seminar</td>
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<td>SuSe or WiSe</td>
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<tr>
<td>Workload attendance</td>
<td>28 h</td>
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</table>
inf366 - Special Topics in 'Microrobotics and Control Engineering' I

Module label
Special Topics in 'Microrobotics and Control Engineering' I

Module code
inf366

Credit points
6.0 KP

Workload
180 h

Used in course of study
- Master's Programme Computing Science (Master) > Technische Informatik
- Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodule

Contact person
Module responsibility
- Andreas Hein
- Sergej Fatikow
- Die im Modul Lehrenden

Authorized examiners
- Andreas Hein
- Sergej Fatikow
- Die im Modul Lehrenden

Entry requirements

Skills to be acquired in this module
This module integrates current developments in the field in adequate study courses.

Professional competences
The students:
- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

Methodological competences
The students:
- evaluate and apply tools, technology and methods sophisticatedly
- combine new and original approaches and methods creatively
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research

Social competences
The students:
- support team process by their abilities

Self-competences**
The students:
- pursue the overall and special computer science development critically
- implement innovative professional activities effectively and independently

Module contents
See assigned course description, e.g. „Nanomontage und Nanohandhabung“

Reader's advisory
As announced in course

Links

Language of instruction
German

Duration (semesters)
1 Semester

Module frequency
jährlich

Module capacity
unlimited
<table>
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<tr>
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<tr>
<td>Modulart</td>
<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
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<tr>
<td>Lern-/Lehrform / Type of program</td>
<td>2 Veranst. aus V, S, Ü, P, PR (4SWS)</td>
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**Vorkenntnisse / Previous knowledge**

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<th>Time of examination</th>
<th>Type of examination</th>
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<tbody>
<tr>
<td>Final exam of module</td>
<td>The exam period will be announced during the course</td>
<td>Portfolio or presentation or oral exam</td>
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</table>

**Course type**

<table>
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<tbody>
<tr>
<td>Frequency</td>
<td>SuSe or WiSe</td>
</tr>
<tr>
<td>Workload attendance</td>
<td>28 h</td>
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</table>
inf367 - Spezielle Themen aus dem Gebiet "Mikrorobotik und Regelungstechnik" II

Module label: Spezielle Themen aus dem Gebiet "Mikrorobotik und Regelungstechnik" II
Module code: inf367
Credit points: 6.0 KP
Workload: 180 h

Used in course of study:
- Master's Programme Computing Science (Master) > Technische Informatik
- Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodule

Contact person:
Module responsibility:
- Andreas Hein
- Sergej Fatikow

Authorized examiners:
- Andreas Hein
- Sergej Fatikow
- Die im Modul Lehrenden

Entry requirements:
Skills to be acquired in this module:
This module integrates current developments in the field in adequate study courses.

Professional competences
The students:
- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

Methodological competences
The students:
- evaluate and apply tools, technology and methods sophisticatedly
- combine new and original approaches and methods creatively
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research

Social competences
The students:
- support team process by their abilities

Self-competences
The students:
- pursue the overall and special computer science development critically
- implement innovative professional activities effectively and independently

Module contents:
See assigned course description

Reader's advisory:
As announced in course

Links:
Language of instruction: German
Duration (semesters): 1 Semester
Module frequency: unregelmäßig
Module capacity: unlimited
Module level: AS (Akzentsetzung / Accentuation)
Modulart: je nach Studiengang Pflicht oder Wahlpflicht
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<tr>
<td><strong>Examination</strong></td>
<td><strong>Time of examination</strong></td>
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<tr>
<td>Final exam of module</td>
<td>The exam period will be announced during the course</td>
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<tr>
<td><strong>Course type</strong></td>
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<td><strong>SWS</strong></td>
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<td><strong>Frequency</strong></td>
<td>SuSe or WiSe</td>
</tr>
<tr>
<td><strong>Workload attendance</strong></td>
<td>28 h</td>
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</table>
Aktuelle Themen aus dem Gebiet "Mikrorobotik und Regelungstechnik" I

<table>
<thead>
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<th>Module label</th>
<th>Aktuelle Themen aus dem Gebiet &quot;Mikrorobotik und Regelungstechnik&quot; I</th>
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<tbody>
<tr>
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<tr>
<td>Credit points</td>
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<td>Workload</td>
<td>90 h</td>
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<td>• Master's Programme Computing Science (Master) &gt; Technische Informatik&lt;br&gt;• Master's Programme Embedded Systems and Microrobotics (Master) &gt; Akzentsetzungsmodule</td>
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</table>

Contact person

Module responsibility

- Andreas Hein
- Sergej Fatikow
- Die im Modul Lehrenden

Authorized examiners

- Andreas Hein
- Sergej Fatikow
- Die im Modul Lehrenden

Entry requirements

Skills to be acquired in this module

This module integrates current developments in the field in adequate study courses.

Professional competences

The students:

- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

Methodological competences

The students:

- examine tasks with technical and research literature, write an academic article and present their solutions academically
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
- schedule time processes and resources

Social competences

The students:

- communicate with users and experts convincingly

Self-competences

The students:

- pursue the overall and special computer science development critically
- develop and reflect self-developed hypotheses to theories independently

Module contents

See assigned course description

Reader's advisory

As announced in course

Links

Language of instruction | German
Duration (semesters)    | 1 Semester
Module frequency         | unregelmäßig
Module capacity          | unlimited
Modullevel               | AS (Akzentsetzung / Accentuation)
Modulart                 | je nach Studiengang Pflicht oder Wahlpflicht
<table>
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<tr>
<th>Lern-/Lehrform / Type of program</th>
<th>S oder V (2 SWS)</th>
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</thead>
<tbody>
<tr>
<td>Vorkenntnisse / Previous knowledge</td>
<td></td>
</tr>
<tr>
<td>Examination</td>
<td>Time of examination</td>
</tr>
<tr>
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<tr>
<td>Course type</td>
<td>Course or seminar</td>
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Module contents
See assigned course description

Reader's advisory
As announced in course

Links
Language of instruction
German
Duration (semesters)
1 Semester
Module frequency
unregelmäßig
Module capacity
unlimited
Modullevel
AS (Akzentsetzung / Accentuation)
Modulart
je nach Studiengang Pflicht oder Wahlpflicht
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inf374 - Special Topics in 'Automotive' I

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**Contact person**

- Module responsibility
  - Andreas Hein
  - Martin Georg Fränzle
  - Die im Modul Lehrenden

- Authorized examiners
  - Andreas Hein
  - Martin Georg Fränzle
  - Die im Modul Lehrenden

**Entry requirements**

**Skills to be acquired in this module**

This module integrates current developments in the field in adequate study courses.

**Professional competences**

- The students:
  - define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
  - recognise and evaluate applied techniques and methods of their subject and are aware of their limits
  - identify, structure and solve problems/tasks, also in new or developing subject areas
  - apply state of the art and innovative methods to solve problems, if necessary from other disciplines
  - are aware of the current limits and contribute to the development of computer science research and technology
  - discuss and evaluate recent computer science developments

**Methodological competences**

- The students:
  - evaluate and apply tools, technology and methods sophisticatedly
  - combine new and original approaches and methods creatively
  - evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research

**Social competences**

- The students:
  - support team process by their abilities

**Self-competences**

- The students:
  - pursue the overall and special computer science development critically
  - implement innovative professional activities effectively and independently

**Module contents**

See assigned course description, e.g. „Zielarchitekturen Eingebetteter Systeme für Automotive-Anwendungen“

**Reader's advisory**

As announced in course

**Links**

Language of instruction: German

Duration (semesters): 1 Semester

Module frequency: halbjährlich

Module capacity: unlimited

Modullevel: AS (Akzentsetzung / Accentuation)

Modulart: je nach Studiengang Pflicht oder Wahlpflicht
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inf375 - Special Topics in 'Automotive' II

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<td>Skills to be acquired in this module</td>
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**Professional competences**

The students:

- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

**Methodological competences**

The students:

- evaluate and apply tools, technology and methods sophisticatedly
- combine new and original approaches and methods creatively
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research

**Social competences**

The students:

- Support team process by their abilities

**Self-competences++**

The students:

- pursue the overall and special computer science development critically
- implement innovative professional activities effectively and independently

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<thead>
<tr>
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172 / 308
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inf376 - Current Topics in 'Automotive' I

Module label: Current Topics in 'Automotive' I
Module code: inf376
Credit points: 3.0 KP
Workload: 90 h

Used in course of study:
- Master's Programme Computing Science (Master) > Technische Informatik
- Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodule

Contact person:
Module responsibility:
- Andreas Hein
- Die im Modul Lehrenden

Authorized examiners:
- Andreas Hein
- Die im Modul Lehrenden

Entry requirements:

Skills to be acquired in this module:

Professional competences:
The students:
- Define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- Recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- Identify, structure and solve problems/tasks, also in new or developing subject areas
- Apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- Are aware of the current limits and contribute to the development of computer science research and technology
- Discuss and evaluate recent computer science developments

Methodological competences:
The students:
- Examine tasks with technical and research literature, write an academic article and present their solutions academically
- Evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
- Schedule time processes and resources

Social competences:
The students:

- Communicate with users and experts convincingly

Self-competences:
The students:

- Pursue the overall and special computer science development critically
- Develop and reflect self-developed hypotheses to theories independently

Module contents:
See assigned course description

Reader's advisory:
As announced in course

Links:

Language of instruction: German
Duration (semesters): 1 Semester
Module frequency: unregelmäßig
Module capacity: unlimited
Modullevell: AS (Akzentsetzung / Accentuation)
Modulart:
je nach Studiengang Pflicht oder Wahlpflicht

Lern-/Lehrform / Type of program:
S oder V (2 SWS)
**Vorkenntnisse / Previous knowledge**

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inf377 - Current Topics in 'Automotive' II

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| Used in course of study | Master's Programme Computing Science (Master) > Technische Informatik  
|               | Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodule |

**Contact person**

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<tr>
<td>Andreas Hein</td>
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**Authorized examiners**

| Andreas Hein          |
| Die im Modul Lehrenden|

**Entry requirements**

**Skills to be acquired in this module**

**Professional competences**

The students:

- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

**Methodological competences**

The students:

- examine tasks with technical and research literature, write an academic article and present their solutions academically
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
- schedule time processes and resources

**Social competences**

The students:

- communicate with users and experts convincingly

**Self-competences**

The students:

- pursue the overall and special computer science development critically
- develop and reflect self-developed hypotheses to theories independently

**Module contents**

See assigned course description

**Reader's advisory**

As announced in course

**Links**

**Language of instruction**

German

**Duration (semesters)**

1 Semester

**Module frequency**

unregelmäßig

**Module capacity**

unlimited

**Module level**

AS (Akzentsetzung / Accentuation)

**Modular**

je nach Studiengang Pflicht oder Wahlpflicht

**Lern-/Lehrform / Type of program**

S oder V (2 SWS)
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inf705 - Practical in Computer Science Education

**Module label**  
Practical in Computer Science Education

**Module code**  
inf705

**Credit points**  
6.0 KP

**Workload**  
180 h

**Used in course of study**  
- Master's Programme Computing Science (Master) > Technische Informatik

**Contact person**

Module responsibility
- Ira Diethelm
- Die im Modul Lehrenden

Authorized examiners
- Ira Diethelm
- Die im Modul Lehrenden

**Entry requirements**

**Skills to be acquired in this module**

**Professional competence**
The students:

- know hard- and software system engineering approaches and use them in practice
- make a qualified and contextual choice of hard- and software designing approaches
- characterise and consider challenges of soft- and hardware systems in education

**Methodological competence**
The students:

- know engineering approaches and use them in new contexts
- evaluate decision making concepts and use them in different domains

**Social competence**
The students:

- cooperate with team members during the development process
- recognize package tasks and resume their responsibilities
- analyse team conflicts and resolve them
- document the software development process in a team
- moderate team meetings and decision making processes appropriately

**Self-competence**
The students:

- reflect their self-perception with regard to the implementation of software systems

**Module contents**

A hard- or software system for education will be designed in this practical course. The requirements analysis of hard- or software systems and the dealing with customers are the main topics of this practical course.

**Reader's advisory**

As announced in course

**Links**

**Language of instruction**  
German

**Duration (semesters)**  
1 Semester

**Module frequency**  
jährlich

**Module capacity**  
unlimited

**Modullevel**  
AS (Akzentsetzung / Accentuation)

**Modulart**  
je nach Studiengang Pflicht oder Wahlpflicht

**Lern-/Lehrform / Type of program**  
P

**Vorkenntnisse / Previous knowledge**

**Examination**

Time of examination  
At the end of the semester

Type of examination  
Practical implementation, presentation and oral exam
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inf710 - Special Topics in 'Computer Science Education' I

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<td>• Ira Diethelm</td>
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<td>• Ira Diethelm</td>
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<td>• Die im Modul Lehrenden</td>
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Entry requirements

Skills to be acquired in this module
This module integrates current developments in the field in adequate study courses.

**Professional competences**
The students:

- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

**Methodological competences**
The students:

- evaluate and apply tools, technology and methods sophisticatedly
- combine new and original approaches and methods creatively
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research

**Social competences**
The students:

- support team process by their abilities

**Self-competences**
The students:

- pursue the overall and special computer science development critically
- implement innovative professional activities effectively and independently

Module contents
See assigned course description

Reader's advisory
As announced in course

Links

Language of instruction
German

Duration (semesters)
1 Semester

Module frequency
unregelmäßig

Module capacity
unlimited

Modulelevel
AS (Akzentsetzung / Accentuation)

Modulart
je nach Studiengang Pflicht oder Wahlpflicht

Lern-Lehrform / Type of program
2 Veranstaltungen aus V, S, Ü, P, PR

Vorkenntnisse / Previous knowledge
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inf711 - Spezielle Themen aus dem Gebiet "Informatik in der Bildung" II

Module label: Spezielle Themen aus dem Gebiet "Informatik in der Bildung" II
Module code: inf711
Credit points: 6.0 KP
Workload: 180 h

Used in course of study: Master's Programme Computing Science (Master) > Technische Informatik

Contact person:
- Module responsibility:
  - Ira Diethelm
  - Die im Modul Lehrenden

- Authorized examiners:
  - Ira Diethelm
  - Die im Modul Lehrenden

- Module counseling:
  - Die im Modul Lehrenden

Entry requirements

Skills to be acquired in this module:
This module integrates current developments in the field in adequate study courses.

Professional competences
The students:
- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

Methodological competences
The students:
- evaluate and apply tools, technology and methods sophisticatedly
- combine new and original approaches and methods creatively
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research

Social competences
The students:
- support team process by their abilities

Self-competences
The students:
- pursue the overall and special computer science development critically
- implement innovative professional activities effectively and independently

Module contents
See assigned course description

Reader's advisory
As announced in course

Links

Language of instruction: German
Duration (semesters): 1 Semester
Module frequency: unregelmäßig
Module capacity: unlimited
Module level: AS (Akzentsetzung / Accentuation)
Modulart: je nach Studiengang Pflicht oder Wahlpflicht
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inf713 - Aktuelle Themen aus dem Gebiet "Informatik in der Bildung" II

Module label: Aktuelle Themen aus dem Gebiet "Informatik in der Bildung" II
Module code: inf713
Credit points: 3.0 KP
Workload: 90 h

Used in course of study: Master's Programme Computing Science (Master) > Technische Informatik

Contact person:
- Module responsibility
  - Ira Diethelm
  - Die im Modul Lehrenden

Authorized examiners:
- Ira Diethelm
- Die im Modul Lehrenden

Entry requirements:

Skills to be acquired in this module:
This module integrates current developments in the field in adequate study courses.

Professional competences
The students:
- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

Methodological competences
The students:
- examine tasks with technical and research literature, write an academic article and present their solutions academically
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
- schedule time processes and resources

Social competences
The students:
- communicate with users and experts convincingly

Self-competences
The students:
- pursue the overall and special computer science development critically
- develop and reflect self-developed hypotheses to theories independently

Module contents: See assigned course description
Reader's advisory: As announced in course

Links:

Language of instruction: German
Duration (semesters): 1 Semester
Module frequency: unregelmäßig
Module capacity: unlimited
Modullevel: AS (Akzentsetzung / Accentuation)
Modulart: je nach Studiengang Pflicht oder Wahlpflicht
Lern-/Lehrform / Type of program: S oder V
Vorkenntnisse / Previous knowledge:
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<th>Examination</th>
<th>Time of examination</th>
<th>Type of examination</th>
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<tr>
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<td>At the end of the lecture period</td>
<td>Presentation or oral exam</td>
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Praktische Informatik

inf100 - Human Computer Interaction

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<td>Credit points</td>
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<tr>
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**Used in course of study**
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Praktische Informatik
- Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodule
- Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction

**Contact person**
Module responsibility
- Susanne Boll-Westermann
- Die im Modul Lehrenden

Authorized examiners
- Susanne Boll-Westermann
- Die im Modul Lehrenden

**Entry requirements**

**Skills to be acquired in this module**

**Professional competence**
The students:
- Name the human-computer interaction core principles
- Characterise the basic elements of the human-centered design of interactive systems

**Methodological competence**
The students:
- Comprehend context of use and user requirements of human-machine interfaces
- Design, develop and evaluate human-machine interfaces
- Conduct experiments with their prototypes

**Social competence**
The students:
- Implement human-computer interfaces in practical hands-on projects in teams
- Evaluate human-machine interfaces with potential users
- Develop and present solutions for Human-Computer Interaction related problems
- Integrate technical and factual comments into own results

**Module contents**
The module introduces the field of human-computer interfaces and their historical context. Moreover, it shows motivating examples of human-computer interaction. The module covers the core principles of human-computer interaction. In detail, the module deals with the design concepts of interactive systems: context of use, requirements and task analysis, human perception capabilities, design process, usability, prototyping and evaluation. During the practical project a concrete human-computer interface will be designed, developed and evaluated according to this concepts.

**Reader's advisory**
- Markus Dahm, Grundlagen der Mensch Computer-Interaktion. Pearson, 2006
- Literature in the reserve shelf in the university bibliography. Link list in Stud.IP.

**Links**
medien.informatik.uni-oldenburg.de/lehre

**Languages of instruction**
German, English

**Duration (semesters)**
1 Semester

**Module frequency**
once a year

**Module capacity**
unlimited
<table>
<thead>
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<tbody>
<tr>
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<td>Lern-/Lehrform / Type of program</td>
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<th>Type of examination</th>
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<tbody>
<tr>
<td>Final exam of module</td>
<td>The completed practical projects will be presented on a single project day, which will take place at the end of the lecture period. The oral exam takes place within the last two weeks of the lecture period. If necessary, re-examinations will take place at the end of the term. Find out more about the schedule on the websites of the department and in Stud.IP.</td>
<td>Practical group project which progress has to be presented regularly during the tutorials. Oral exam on the topics of the lecture. Practical project and oral exam count 50% each to the final grade. Both practical project and oral exam have to be passed individually.</td>
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<table>
<thead>
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<th>Frequency</th>
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<tr>
<td>Tutorial</td>
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<td>2.00</td>
<td>SuSe</td>
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| Total time of attendance for the module | 56 h |
inf105 - Fault Tolerance in Distributed Systems

<table>
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<tr>
<td>Credit points</td>
<td>6.0 KP</td>
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<tr>
<td>Workload</td>
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<td>Master's Programme Embedded Systems and Microrobotics (Master) &gt; Akzentsetzungsmodule</td>
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<tr>
<td>Contact person</td>
<td>Oliver Theel</td>
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<tr>
<td></td>
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<tr>
<td>Authorized examiners</td>
<td></td>
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<td>Die Modulverantwortlichen</td>
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<td></td>
<td>Die im Modul Lehrenden</td>
</tr>
</tbody>
</table>

Entry requirements

Skills to be acquired in this module

This module provides knowledge of fault-tolerant distributed systems. The terminology, structure, conception, core challenges and related implementation concepts will be covered in detail.

Professional competence

The students:

- Assess what a fault-tolerant distributed system is and develop awareness of its capabilities
- Name and discuss common implementations of fault-tolerant distributed systems

Methodological competence

The students:

- Reflect the implementation challenges of a distributed system
- Are able to adapt and evolve implementation concepts of fault-tolerant distributed systems in new contexts

Social competence

The students:

- Solve problems in small teams
- Present their solutions to the members of the tutorial
- Discuss their different solutions with members of the tutorial

Self-competence

The students:

- Accept criticism
- Question their initially applied methods for problem solving
- Question their initial solutions in the light of newly learned methods

Module contents

1) Fault, Error, Failure
2) Failure semantics, Fault tolerance
3) Byzantine agreement protocols
4) Stable storage
5) Fail-stop processors
6) Atomic commit protocols
7) Classification of replication control schemes
8) Consistency notions
9) Quality criteria
10) Survey of replication control schemes
11) Design of replication control schemes
12) Unifying frameworks
13) Replication in practice

Reader's advisory

Links
Language of instruction: German
Duration (semesters): 1 Semester
Module frequency: jährlich
Module capacity: unlimited

Reference text
connectet with:
Betriebssysteme 1 und 2
Betriebssysteme-Praktikum
Verteilte Betriebssysteme

Modullevel: AS (Akzentsetzung / Accentuation)
Modulart: Wahlpflicht / Elective
Lern-/Lehrform / Type of program: V+S bzw V+Ü
Vorkenntnisse / Previous knowledge: Verteilte Betriebssysteme

Examination
Time of examination: written exam or oral exam or practical work
Type of examination: Final exam of module
End of lecture period: written exam or oral exam or practical work

Course type
Lecture
Seminar or exercise

SWS
2.00
2.00

Frequency
WiSe
WiSe

Workload attendance
28 h
28 h

Total time of attendance for the module: 56 h
inf108 - Requirements Engineering and Management

**Module label**
Requirements Engineering and Management

**Module code**
inf108

**Credit points**
6.0 KP

**Workload**
180 h

**Used in course of study**
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Praktische Informatik

**Contact person**

**Module responsibility**
- Andreas Winter
- Die im Modul Lehrende

**Authorized examiners**
- Andreas Winter
- Die im Modul Lehrende

**Entry requirements**

**Skills to be acquired in this module**
The objective of the module "Requirements Engineering and Management" is to convey the core concepts and technology of the requirements engineering and of the requirements management. In the second half of the semester these methods and techniques will be carried out practically to develop an exemplary requirements definition.

**Professional competence**
The students:

- integrate the process of requirements engineering in the software engineering process
- name the methods and tools of requirements engineering and management
- select methods and tools from requirements engineering and management to solve given problems appropriately
- illustrate the key tasks of the requirements engineering and management
- name the essential concepts to develop and to structure ideas
- discuss the methods of determination requirements and develop validation concepts
- differentiate the software development core activities in greater detail

**Methodological competence**
The students:

- apply the methods of determination, documentation, validation and confirmation of requirements and
- create a comprehensive requirement document in group work

**Social competence**
The students:

- communicate with all stakeholders dealing with software development
- design project visions in groups
- collect requirements in interviews
- design requirements for software systems collaboratively

**Self-competence**
The students:

- reflect their problem-solving behaviour by applying requirements engineering and management capabilities

**Module contents**
The module deals with requirements analysis core concepts as well as methods and techniques of requirements engineering and management. Topics of this module are:

- the necessity of requirements engineering and management
- the requirements engineering process in the software development process
- requirements engineering process (participants, documents, activities)
- understanding the application domains (vision development, system environment documentation, domain model development, use case identification)
- requirements collection (functional and non-functional requirements, requirements collection, requirements documentation, requirements validation, requirements needs)
- requirements management

**Reader's advisory**

- Chris Rupp: Requirements-Engineering und -Management: Professionelle, iterative
**Links**

<table>
<thead>
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<th>Language of instruction</th>
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<tbody>
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**Lern-/Lehrform / Type of program**

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**Course type**

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**Total time of attendance for the module**

56 h
### inf109 - Information Systems III

<table>
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<td>Credit points</td>
<td>6.0 KP</td>
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<tr>
<td>Workload</td>
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</table>
| Used in course of study | - Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik  
- Master's Programme Computing Science (Master) > Praktische Informatik |
| Contact person | Module responsibility  
- Marco Grawunder  
- Die im Modul Lehrenden |
|               | Authorized examiners  
- Marco Grawunder  
- Die im Modul Lehrenden |

#### Entry requirements

Skills to be acquired in this module

<table>
<thead>
<tr>
<th>Professional competence</th>
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</thead>
<tbody>
<tr>
<td>The students:</td>
</tr>
</tbody>
</table>
| - describe concepts, languages and architectures of database systems  
- discuss state-of-the-art database research topics  
- analyse information processing tasks and implement solutions appropriately |

Methodological competence

| The students:          |
| - propose concrete processing requirements for special application classes  
- assess the consequences of techniques and approaches  
- perform supervised research in the field of information systems  
- analyse and reflect complex information system requirements  
- realize information demands and accordingly gather aim-oriented information |

#### Module contents

This module is a continuation of the content of information systems I and of information systems II. It deepens and extends the contents of the preceding modules and focuses mainly on current research questions. A special focus lies on concept of distributed data management.

#### Reader's advisory

- Özsu, M. Tamer; Valduriez, Patrick. Principles of distributed database systems  
- Rahm/Saake/Sattler: Verteiltes und Paralleles Datenmanagement, Springer  
- Paper from SIGMOD, VLDB or ICDE

#### Links

[http://www.is.informatik.uni-oldenburg.de/lehre/lehre.html](http://www.is.informatik.uni-oldenburg.de/lehre/lehre.html)

#### Language of instruction

German

#### Duration (semesters)

1 Semester

#### Module frequency

jährlich

#### Module capacity

unlimited

#### Lern-/Lehrform / Type of program

je nach Studiengang Pflicht oder Wahlpflicht

#### Examination

<table>
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<th>Examination</th>
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<tbody>
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<td>Final exam of module</td>
<td>At the end of the lecture period</td>
<td>Written exam, oral exam or term paper</td>
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<th>Frequency</th>
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<td>WiSe</td>
<td>28 h</td>
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<td>Course type</td>
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inf111 - Advanced Database Practical

Module label: Advanced Database Practical
Module code: inf111
Credit points: 6.0 KP
Workload: 180 h

Used in course of study:
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Praktische Informatik

Contact person
Module responsibility:
- Marco Grawunder
- Die im Modul Lehrenden

Authorized examiners:
- Marco Grawunder
- Die im Modul Lehrenden

Entry requirements:
- Informationssysteme I

Skills to be acquired in this module
Objective of the module/skills:
The module enhances the previous knowledge of databases and information systems. In the context of a professional database system the students realize, implement, install and optimize the system. Theoretical and mathematical approaches are additional contents. Additionally the course provides the capability both to describe the differences between NoSQL Databases and (Object-)Relational Databases and how to use them.

Professional competence
The students:
- name realisation techniques, implementations und programming of database systems
- program and implement database oriented system routines
- administer a professional database system
- identify database system performance problems and solve them appropriately

Methodological competence*
The students:
- make optimisation decisions during the modelling phase
- construct optimisation strategies mathematically

Social competence
The students:
- develop appropriate implementations for given problems in a team

Self-competence
The students:
- acknowledge the limits of their ability to cope with pressure during the implementation of database specific solutions

Module contents
Content of the Module:
The module is a practical course. It is a continuation of the modules Information Systems I and Information Systems II. This module especially deals with the technical and theoretical concepts of database systems. Practical database implementation approaches and optimisation concepts are additional content of the module.

In detail the module provides: low-level database management programming, aspects of catalogue systems implementation, optimisation strategies based on different parallelisation and partitioning strategies, query concepts and modification.

Reader's advisory
Suggested reading:
- Held Andrea (2007), Oracle 10g Addison-Wesley.
- Feuerstein Steven, Pribyl Bill, Dawes Chip (2007), Oracle PL/SQL, 4. Auflage, O'Reillys Taschenbibliothek
- Oracle 10g, Das Programmierhandbuch, Galileo Computing
- Oracle Database 11g, DBA-Handbuch, Oracle Press-Hanser Verlag
- NoSQL (2011) Hanser Verlag

<table>
<thead>
<tr>
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<td>Duration (semesters)</td>
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<td>hands-on exercises and oral exam</td>
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<td>Workload attendance</td>
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## inf112 - Modern Programming Technologies Practical

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<tr>
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<td>Workload</td>
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</table>
| Used in course of study          | • Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik  
  • Master's Programme Computing Science (Master) > Praktische Informatik |
<p>| Contact person                   | Module responsibility                      |
|                                  | • Dietrich Boles                           |
|                                  | • Die im Modul Lehrenden                   |
|                                  | Authorized examiners                       |
|                                  | • Dietrich Boles                           |
|                                  | • Die im Modul Lehrenden                   |
| Entry requirements               | Skills to be acquired in this module       |
|                                  | The objective of the practical course is to provide the students with state-of-the-art programming techniques. After the course, the students are able to use these techniques during the implementation and development of applications. |
|                                  | Professional competence                    |
|                                  | The students:                              |
|                                  | • Name state-of-the-art programming techniques |
|                                  | Methodological competence                  |
|                                  | The students:                              |
|                                  | • Search for solutions on the internet     |
|                                  | Social competence                          |
|                                  | The students:                              |
|                                  | • Discuss own and someone else's solutions |
|                                  | Self-competence                            |
|                                  | The students:                              |
|                                  | • Reflect their problem-solving behaviour and take up new solutions, e.g. from the internet |
| Module contents                  | The practical course enhances the students' programming skills. It focuses on state-of-the-art programming techniques. Among others, these are .NET-Framework, OSGi, Java EE, Java ME, iOS Application development, Android Application development or Social Network API. |
| Reader's advisory                | Online-Documentation of the technologies and systems |
| Links                            | <a href="http://www-is.informatik.uni-oldenburg.de/~dibo/teaching/programmierpraktikum/">http://www-is.informatik.uni-oldenburg.de/~dibo/teaching/programmierpraktikum/</a> |
| Language of instruction          | German                                     |
| Duration (semesters)             | 1 Semester                                 |
| Module frequency                 | jährlich                                   |
| Module capacity                  | unlimited                                  |
| Modullevel                       | AS (Akzentsetzung / Accentuation)          |
| Modulart                         | je nach Studiengang Pflicht oder Wahlpflicht |
| Lern-/Lehrform / Type of program | Practical                                  |
| Vorkenntnisse / Previous knowledge | - gute Programmierkenntnisse               |
| Examination                      | Time of examination                        |
| Final exam of module             | At the end of the lecture period           |
|                                  | Exercises an oral exam, Programming tasks during the semester; short oral exam |
| Course type                      | Practical                                  |</p>
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<tbody>
<tr>
<td>Frequency</td>
<td>WiSe</td>
</tr>
<tr>
<td>Workload attendance</td>
<td>56 h</td>
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</table>
The aim of the module "Operating Systems 2" is to convey further knowledge and skills regarding the conception, implementation, and evaluation of operating systems.

**Professional competence:**
The Students:
- assess in detail what an operating system is able to do
- recognize the problems in the implementation of operating systems
- identify and evaluate implementations of further subproblems and apply them

**Methodological competence:**
The Students:
- transfer implementation concepts to other contexts
- critically question different solutions with regard to their properties

**Social competence:**
The Students:
- solve problems partly in small groups
- present own potential solutions to the exercise group
- discuss their different potential solutions within the exercise group

**Self-competence:**
The Students:
- accept criticism
- reflect their own potential solutions taking into account the methods taught

**Module contents**
The module conveys the following contents:
1) additional aspects of file systems
2) Input/output control
3) User representation
4) Advanced synchronization concepts
5) User interfaces
6) Job scheduling
7) Architectures of operating systems
8) Examples of operating systems

**Reader’s advisory**

**Links**
- Language of instruction: German
- Duration (semesters): 1 Semester
<table>
<thead>
<tr>
<th>Module frequency</th>
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<tr>
<td>Modulart</td>
<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
</tr>
<tr>
<td>Lern-/Lehrform / Type of program</td>
<td>V+Ü</td>
</tr>
<tr>
<td>Vorkenntnisse / Previous knowledge</td>
<td>- Betriebssysteme I</td>
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<td>Time of examination</td>
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<td>Final exam of module</td>
<td>written or oral exam</td>
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### inf131 - Advanced Topics in Human Computer Interaction

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<td><strong>Master's Programme Engineering of Socio-Technical Systems (Master) &gt; Human-Computer Interaction</strong></td>
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<td>Susanne Boll-Westermann</td>
<td></td>
</tr>
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<td><strong>Authorized examiners</strong></td>
<td></td>
</tr>
<tr>
<td>Die im Modul Lehrenden</td>
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</tbody>
</table>

### Entry requirements

**Skills to be acquired in this module**

This course aims to provide a sample of some of the most recent and significant advances in this exciting area. Topics may include: situational awareness, designing for attention, ambient/peripheral interaction, computer supported cooperative work and social computing (CSCW), ubiquitous and context-aware computing, haptic and gestural interaction, audio interaction, gaze-based interaction, biometric interfaces, and embedded, physical and tangible computing, mobile and wearable interfaces.

This course is explicitly not focused on the methods used in HCI practice (i.e., user-centered design cycle), but rather focuses on (recent) research.

Course prerequisite: Mensch-Maschine-Interaktion (Human Computer Interaction)

**Professional competences:**

The students:

- Demonstrate a systematic understanding of knowledge and critical awareness of a selection of the recent research advances in the area of HCI
- Evaluate and critique recent developments in the field of HCI on scientific and technological grounds
- Develop ability to conceptualize, design, implement, and evaluate user-centered systems and techniques.
- Plan and implement exploratory projects directed at envisioning and prototyping novel interactive artifact

**Methodological competences:**

The students:

- Analyze, review and critique research papers
- Carry out original research from start to finish
- Summarize and present research findings
- Work in a team to produce and evaluate prototypes of novel interactive artifact

**Social competences:**

The students:

- Work collaboratively in groups to analyze and review research papers
- Summarize and present research findings to rest of class
- Discuss how HCI concepts and methods can be applied in analysis, design, and evaluation of interactive technologies.
- Discuss social and ethical implications of interactive technologies

**Self-competences:**

The students:

- Be comfortable tackling original research questions
- Aptitude in conceptualizing and running both qualitative and quantitative HCI experiments
- Ability to summarize, analyze, and critique published (peer-review) research papers

### Module contents

HCI is a fast-growing field, where scientific research in this area crosses multiple disciplines. The body of theoretical and empirical knowledge that can inform the design of effective systems is rapidly developing, which underscores the importance of current research in the field.
This course aims to provide a sample of some of the most recent and significant advances in this exciting area. Topics may include: situational awareness, designing for attention, ambient/peripheral interaction, computer support cooperative work and social computing (CSCW), ubiquitous and context-aware computing, haptic and gestural interaction, audio interaction, gaze-based interaction, biometric interfaces, and embedded, physical and tangible computing, mobile and wearable interfaces.

Structure of the Module:

The course will consist of lectures and lab sessions. Lab sessions will cover assignments (writing paper reviews, presentations, and peer assessment). In addition to assignments and a final exam, a small part of the course includes a mini group-based HCI project.

Lectures: 2 hours per week
Lab: 2 hours per week

This lecture will be held in English. All assignment submissions and exams will be in English.

The primary audience for this class are Master students of Computer Science following the Human Computer Interaction track.

Reader’s advisory

Suggested reading:


Links

Language of instruction  English
Duration (semesters)  1 Semester
Module frequency  semi-annual
Module capacity  24
Modullevel  AS (Akzentsetzung / Accentuation)
Modulart  Pflicht o. Wahlpflicht / compulsory or optional
Lern-/Lehrform / Type of program  V+P
Vorkenntnisse / Previous knowledge  Interaktive Systeme

Examination

Time of examination  Type of examination
Final exam of module  At the end of the lecture period  Project and oral exams

Missing the exam
If you cannot attend the exam with valid reasons (medical reason, exam schedule conflicts), you need to inform us before the exam, and submit a scanned copy of the evidence (medical certificate, course registration, boarding passes) within 5 days after the exam.

• If the reason for missing the exam is valid, you will do your first try of the exam for the parts that you missed on the same date as the second chance exam.
• If the reason is not valid, you will not get any score from that exam. If your overall score passed the course, you will not have a chance to take the exam again.

Grading:
Your grade will be calculated as follows:

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<td>Final</td>
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<td>Assignments A01-03</td>
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Course type  Comment  SWS  Frequency  Workload attendance
Lecture  2.00  SuSe or WiSe  28 h
Practical  2.00  SuSe or WiSe  28 h
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inf170 - Special Topics in 'Information Systems' I

Module label Special Topics in 'Information Systems' I
Module code inf170
Credit points 6.0 KP
Workload 180 h
Used in course of study Master's Programme Computing Science (Master) > Praktische Informatik

Contact person
Module responsibility
  » Marco Grawunder
  » Die im Modul Lehrenden

Authorized examiners
  » Marco Grawunder
  » Die im Modul Lehrenden

Entry requirements

Skills to be acquired in this module
This module integrates current developments in the field in adequate study courses.

Professional competences
The students:

  » define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
  » recognise and evaluate applied techniques and methods of their subject and are aware of their limits
  » identify, structure and solve problems/tasks, also in new or developing subject areas
  » apply state of the art and innovative methods to solve problems, if necessary from other disciplines
  » are aware of the current limits and contribute to the development of computer science research and technology
  » discuss and evaluate recent computer science developments

Methodological competences
The students:

  » evaluate and apply tools, technology and methods sophisticatedly
  » combine new and original approaches and methods creatively
  » evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research

Social competences
The students:

  » support team process by their abilities

Self-competences
The students:

  » pursue the overall and special computer science development critically
  » implement innovative professional activities effectively and independently

Module contents According to the assigned course
Reader's advisory As announced in course
Links

Language of instruction German
Duration (semesters) 1 Semester
Module frequency unregelmäßig
Module capacity unlimited
Module level AS (Akzentsetzung / Accentuation)
Modulart je nach Studiengang Pflicht oder Wahlpflicht
Lern-Lehrform / Type of program 2 Veranstalt. aus V, S, Ü, P, PR (4 SWS)
Vorkenntnisse / Previous knowledge

203 / 308
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inf171 - Special Topics in 'Information Systems' I

**Module label**  
Special Topics in 'Information Systems' I

**Module code**  
inf171

**Credit points**  
6.0 KP

**Workload**  
180 h

**Used in course of study**  
- Master's Programme Computing Science (Master) > Praktische Informatik

**Contact person**

- Module responsibility
  - Marco Grawunder
  - Die im Modul Lehrenden

- Authorized examiners
  - Marco Grawunder
  - Die im Modul Lehrenden

**Entry requirements**

**Skills to be acquired in this module**

- This module integrates current developments in the field in adequate study courses.

**Professional competences**

The students:

- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

**Methodological competences**

The students:

- evaluate and apply tools, technology and methods sophisticatedly
- combine new and original approaches and methods creatively
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research

**Social competences**

The students:

- support team process by their abilities

**Self-competences**

The students:

- pursue the overall and special computer science development critically
- implement innovative professional activities effectively and independently

**Module contents**

According to the assigned course

**Reader's advisory**

As announced in course

**Links**

**Language of instruction**  
German

**Duration (semesters)**  
1 Semester

**Module frequency**  
unregelmäßig

**Module capacity**  
unlimited

**Modullevel**  
AS (Akzentsetzung / Accentuation)

**Modulart**  
je nach Studiengang Pflicht oder Wahlpflicht

**Lern-Lehrform / Type of program**  
2 Veran. aus V, S, Ü, P, PR (4SWS)

**Vorkenntnisse / Previous knowledge**


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<th>Type of examination</th>
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<td>SuSe or WiSe</td>
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inf172 - Special Topics in 'Information Systems' I

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<td>• Marco Grawunder</td>
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<tr>
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<td>• Lehrende der Informatik</td>
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</table>

**Entry requirements**

**Skills to be acquired in this module**

This module integrates current developments in the field in adequate study courses.

Professional competences

The students:

- Define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- Recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- Identify, structure and solve problems/tasks, also in new or developing subject areas
- Apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- Are aware of the current limits and contribute to the development of computer science research and technology
- Discuss and evaluate recent computer science developments

Methodological competences

The students:

- Examine tasks with technical and research literature, write an academic article and present their solutions academically
- Evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
- Schedule time processes and resources

Social competences

The students:

- Communicate with users and experts convincingly

Self-competences

The students:

- Pursue the overall and special computer science development critically
- Develop and reflect self-developed hypotheses to theories independently

**Module contents**

According to the assigned course

**Reader's advisory**

As announced in course

**Links**

Language of instruction: German

Duration (semesters): 1 Semester

Module frequency: unregelmäßig

Module capacity: unlimited

Modullevel: BC (Basiscurriculum / Base curriculum)

Modulart: je nach Studiengang Pflicht oder Wahlpflicht

Lern-/Lehrform / Type of program: 1 V oder 1 S

**Vorkenntnisse / Previous knowledge**

Examination

Time of examination

Type of examination

Final exam of module

At the end of the lecture period

Presentation or oral exam
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<tr>
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inf173 - Special Topics in 'Information Systems’ II

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<tr>
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**Contact person**

- Module responsibility
  - Marco Grawunder
  - Die im Modul Lehrenden

- Authorized examiners
  - Marco Grawunder
  - Die im Modul Lehrenden

**Entry requirements**

**Skills to be acquired in this module**

- This module integrates current developments in the field in adequate study courses.

**Professional competences**

The students:

- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

**Methodological competences**

The students:

- examine tasks with technical and research literature, write an academic article and present their solutions academically
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
- schedule time processes and resources

**Social competences**

The students:

- communicate with users and experts convincingly

**Self-competences**

The students:

- pursue the overall and special computer science development critically
- develop and reflect self-developed hypotheses to theories independently

**Module contents**

According to the assigned course

**Reader’s advisory**

As announced in course

**Links**

**Language of instruction**

German

**Duration (semesters)**

1 Semester

**Module frequency**

unregelmäßig

**Module capacity**

unlimited

**Modullevel**

AS (Akzentsetzung / Accentuation)

**Modulart**

je nach Studiengang Pflicht oder Wahlpflicht

**Lern-/Lehrform / Type of program**

V oder S

**Vorkenntnisse / Previous knowledge**
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**Course type**  
Seminar

**SWS**  
0.00

**Frequency**  
SuSe or WiSe

**Workload attendance**  
0 h
inf174 - Special Topics in 'Media Informatics and Multimedia Systems' II

Module label: Special Topics in 'Media Informatics and Multimedia Systems' II
Module code: inf174
Credit points: 6.0 KP
Workload: 180 h

Used in course of study:
- Master's Programme Computing Science (Master) > Praktische Informatik
- Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction

Contact person
Module responsibility:
- Susanne Boll-Westermann

Module counseling:
- Die im Modul Lehrenden

Entry requirements
Skills to be acquired in this module:
This module integrates current developments in the field in adequate study courses.

Professional competences:
The students:
- Define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- Recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- Identify, structure and solve problems/tasks, also in new or developing subject areas
- Apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- Are aware of the current limits and contribute to the development of computer science research and technology
- Discuss and evaluate recent computer science developments

Methodological competences:
The students:
- Evaluate and apply tools, technology and methods sophisticatedly
- Combine new and original approaches and methods creatively
- Evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research

Social competences:
The students:
- Support team process by their abilities

Self-competences:
The students:
- Pursue the overall and special computer science development critically
- Implement innovative professional activities effectively and independently

Module contents:
According to the assigned course

Reader's advisory:
As announced in course

Links
Languages of instruction: German, English
Duration (semesters): 1 Semester
Module frequency: irregularly
Module capacity: unlimited
Modullevel: AC (Aufbaucurriculum / Composition)
Modulart: je nach Studiengang Pflicht oder Wahlpflicht
Lern-Lehrform / Type of program: 2 Veranst. aus V, S, Ü P, PR
Vorkenntnisse / Previous knowledge
<table>
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<th>Time of examination</th>
<th>Type of examination</th>
</tr>
</thead>
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**Course type**  
VA-Auswahl

**SWS**  
2.00

**Frequency**  
SuSe or WiSe

**Workload attendance**  
28 h
## inf175 - Special Topics in 'Media Informatics and Multimedia Systems' II

<table>
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<tr>
<td>Module code</td>
<td>inf175</td>
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<tr>
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<td>6.0 KP</td>
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<tr>
<td>Workload</td>
<td>180 h</td>
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</table>

**Used in course of study**
- Master's Programme Computing Science (Master) > Praktische Informatik
- Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction

**Contact person**
- Module responsibility
  - Susanne Boll-Westermann
  - Die im Modul Lehrenden
- Authorized examiners
  - Susanne Boll-Westermann
  - Die im Modul Lehrenden

**Entry requirements**

**Skills to be acquired in this module**
- This module integrates current developments in the field in adequate study courses.

**Professional competences**
- The students:
  - Define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
  - Recognise and evaluate applied techniques and methods of their subject and are aware of their limits
  - Identify, structure and solve problems/tasks, also in new or developing subject areas
  - Apply state of the art and innovative methods to solve problems, if necessary from other disciplines
  - Are aware of the current limits and contribute to the development of computer science research and technology
  - Discuss and evaluate recent computer science developments

**Methodological competences**
- The students:
  - Evaluate and apply tools, technology and methods sophisticatedly
  - Combine new and original approaches and methods creatively
  - Evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research

**Social competences**
- The students:
  - Support team process by their abilities

**Self-competences**
- The students:
  - Pursue the overall and special computer science development critically
  - Implement innovative professional activities effectively and independently

**Module contents**
- According to the assigned course

**Reader's advisory**
- As announced in course

**Links**
- Language of instruction: German, English
- Duration (semesters): 1 Semester
- Module frequency: unregelmäßig
- Module capacity: unlimited
- Module level: AS (Akzentsetzung / Accentuation)
- Modulart: je nach Studiengang Pflicht oder Wahlpflicht
- Lern-/Lehrform / Type of program: 2 Veranst. aus V, S, Ü, P, PR (4 SWS)
### Vorkenntnisse / Previous knowledge

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<th>Examination</th>
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<th>Type of examination</th>
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<td>At the end of the lecture period</td>
<td>Exercises or presentation Semesterbegleitende or oral exam</td>
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<th>SWS</th>
<th>Frequency</th>
<th>Workload attendance</th>
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<tr>
<td></td>
<td>2.00</td>
<td>SuSe or WiSe</td>
<td>28 h</td>
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</table>
inf176 - Special Topics in 'Media Informatics and Multimedia Systems' I

Module label: Special Topics in 'Media Informatics and Multimedia Systems' I
Module code: inf176
Credit points: 3.0 KP
Workload: 90 h

Used in course of study:
- Master's Programme Computing Science (Master) > Praktische Informatik

Contact person:
Module responsibility
- Susanne Boll-Westermann
- Die im Modul Lehrenden

Authorized examiners:
- Susanne Boll-Westermann
- Die im Modul Lehrenden

Entry requirements:

Skills to be acquired in this module:
This module integrates current developments in the field in adequate study courses.

Professional competences
The students:
- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

Methodological competences
The students:
- examine tasks with technical and research literature, write an academic article and present their solutions academically
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
- schedule time processes and resources

Social competences
The students:
- communicate with users and experts convincingly

Self-competences
The students:
- pursue the overall and special computer science development critically
- develop and reflect self-developed hypotheses to theories independently

Module contents:
According to the assigned course

Reader's advisory:
As announced in course

Links:
Language of instruction: German
Duration (semesters): 1 Semester
Module frequency: unregelmäßig
Module capacity: unlimited
Modullevel: AS (Akzentsetzung / Accentuation)
Modulart: je nach Studiengang Pflicht oder Wahlpflicht
Lern-/Lehrform / Type of program: S oder V

Vorkenntnisse / Previous knowledge:
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<td>Workload attendance</td>
<td>28 h</td>
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</table>
inf177 - Special Topics in 'Media Informatics and Multimedia Systems' II

Module label
Special Topics in 'Media Informatics and Multimedia Systems' II

Module code
inf177

Credit points
3.0 KP

Workload
90 h

Used in course of study
- Master's Programme Computing Science (Master) > Praktische Informatik

Contact person
Module responsibility
- Susanne Boll-Westermann
- Lehrende der Informatik

Authorized examiners
- Susanne Boll-Westermann
- Die im Modul Lehrenden

Entry requirements

Skills to be acquired in this module
This module integrates current developments in the field in adequate study courses.

Professional competences
The students:
- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

Methodological competences
The students:
- examine tasks with technical and research literature, write an academic article and present their solutions academically
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
- schedule time processes and resources

Social competences
The students:
- communicate with users and experts convincingly

Self-competences
The students:
- pursue the overall and special computer science development critically
- develop and reflect self-developed hypotheses to theories independently

Module contents
As in the description of the assigned course

Reader's advisory
As announced in course

Links
Language of instruction
German

Duration (semesters)
1 Semester

Module frequency
unregelmäßig

Module capacity
unlimited

Modullevel
AS (Akkzentsetzung / Accentuation)

Modulart
je nach Studiengang Pflicht oder Wahlpflicht

Lern-/Lehrform / Type of program
S oder V

Vorkenntnisse / Previous knowledge
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inf178 - Special Topics in 'Software Engineering' I

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<tr>
<td>Credit points</td>
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</tr>
<tr>
<td>Contact person</td>
<td>Module responsibility</td>
</tr>
<tr>
<td></td>
<td>› Andreas Winter</td>
</tr>
<tr>
<td></td>
<td>› Die im Modul Lehrenden</td>
</tr>
<tr>
<td>Authorized examiners</td>
<td>› Andreas Winter</td>
</tr>
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<td>› Die im Modul Lehrenden</td>
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<tr>
<td>Entry requirements</td>
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<td>Skills to be acquired in this module</td>
<td>This module integrates current developments in the field in adequate study courses.</td>
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<tr>
<td>Professional competences</td>
<td>The students:</td>
</tr>
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<td></td>
<td>• define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general</td>
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<tr>
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<td>• recognise and evaluate applied techniques and methods of their subject and are aware of their limits</td>
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<td>• identify, structure and solve problems/tasks, also in new or developing subject areas</td>
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<td></td>
<td>• apply state of the art and innovative methods to solve problems, if necessary from other disciplines</td>
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<td>• are aware of the current limits and contribute to the development of computer science research and technology</td>
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<tr>
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<td>• discuss and evaluate recent computer science developments</td>
</tr>
<tr>
<td>Methodological competences</td>
<td>The students:</td>
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<tr>
<td></td>
<td>• evaluate and apply tools, technology and methods sophisticatedly</td>
</tr>
<tr>
<td></td>
<td>• combine new and original approaches and methods creatively</td>
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<td>• evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research</td>
</tr>
<tr>
<td>Social competences</td>
<td>The students:</td>
</tr>
<tr>
<td></td>
<td>• support team process by their abilities</td>
</tr>
<tr>
<td>Self-competences</td>
<td>The students:</td>
</tr>
<tr>
<td></td>
<td>• pursue the overall and special computer science development critically</td>
</tr>
<tr>
<td></td>
<td>• implement innovative professional activities effectively and independently</td>
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<p>| Module contents                   | See the assigned course description                         |
| Reader's advisory                 | As announced in course                                     |
| Language of instruction           | German                                                      |
| Duration (semesters)              | 1 Semester                                                 |
| Module frequency                  | unregelmäßig                                               |
| Module capacity                   | unlimited                                                   |
| Modullevel                        | BC (Base curriculum)                                       |
| Modulart                          | je nach Studiengang Pflicht oder Wahlpflicht                |
| Lern-Lehrform / Type of program   | 2 Veran. aus V, S, Ü, P, PR (4SWS)                         |
| Vorkenntnisse / Previous knowledge|                                                             |</p>
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<td>Workload attendance</td>
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inf179 - Special Topics in 'Software Engineering' II

Module label: Special Topics in 'Software Engineering' II
Module code: inf179
Credit points: 6.0 KP
Workload: 180 h

Used in course of study:
- Master's Programme Computing Science (Master) > Praktische Informatik

Contact person:
- Module responsibility
  - Andreas Winter
  - Die im Modul Lehrenden
- Authorized examiners
  - Andreas Winter
  - Die im Modul Lehrenden

Entry requirements:

Skills to be acquired in this module:
This module integrates current developments in the field in adequate study courses.

Professional competences
The students:

- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

Methodological competences
The students:

- evaluate and apply tools, technology and methods sophisticatedly
- combine new and original approaches and methods creatively
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research

Social competences
The students:

- support team process by their abilities

Self-competences
The students:

- pursue the overall and special computer science development critically
- implement innovative professional activities effectively and independently

Module contents:
See the assigned course description

Reader's advisory:
As announced in course

Links:

Language of instruction: German
Duration (semesters): 1 Semester
Module frequency: unregelmäßig
Module capacity: unlimited
Modulelevel: AS (Akzentsetzung / Accentuation)
Modulart: je nach Studiengang Pflicht oder Wahlpflicht
Lern-/Lehrform / Type of program: 2 Veranst. aus V, S, Ü, P, PR (4SWS)
Vorkenntnisse / Previous knowledge:
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<tr>
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| Frequency                    | SuSe or WiSe         |

| Workload attendance          | 14 h                 |
inf180 - Current Topics in 'Software Engineering' I

Module label
Current Topics in 'Software Engineering' I

Module code
inf180

Credit points
3.0 KP

Workload
90 h

Used in course of study
- Master's Programme Computing Science (Master) > Praktische Informatik

Contact person
Module responsibility
- Andreas Winter
- Die im Modul Lehrenden

Authorized examiners
- Andreas Winter
- Die im Modul Lehrenden

Entry requirements

Skills to be acquired in this module
This module integrates current developments in the field in adequate study courses.

Professional competences
The students:
- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

Methodological competences
The students:
- examine tasks with technical and research literature, write an academic article and present their solutions academically
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
- schedule time processes and resources

Social competences
The students:
- communicate with users and experts convincingly

Self-competences
The students:
- pursue the overall and special computer science development critically
- develop and reflect self-developed hypotheses to theories independently

Module contents
See assigned course description

Reader's advisory
As announced in course

Links

Language of instruction
German

Duration (semesters)
1 Semester

Module frequency
unregelmäßig

Module capacity
unlimited

Modullevel
AS (Akzentsetzung / Accentuation)

Modulart
je nach Studiengang Pflicht oder Wahlpflicht

Lern-/Lehrform / Type of program
S oder V

Vorkenntnisse / Previous knowledge
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Inf181 - Current Topics in 'Software Engineering' I

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<td>• Andreas Winter</td>
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<td>• Die im Modul Lehrenden</td>
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<td>Authorized examiners</td>
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<td>• Andreas Winter</td>
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<td>• Die im Modul Lehrenden</td>
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**Entry requirements**

**Skills to be acquired in this module**

This module integrates current developments in the field in adequate study courses.

**Professional competences**

The students:

- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

**Methodological competences**

The students:

- examine tasks with technical and research literature, write an academic article and present their solutions academically
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
- schedule time processes and resources

**Social competences**

The students:

- communicate with users and experts convincingly

**Self-competences**

The students:

- pursue the overall and special computer science development critically
- develop and reflect self-developed hypotheses to theories independently

**Module contents**

See assigned course description

**Reader's advisory**

As announced in course

**Links**

<table>
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**Vorkenntnisse / Previous knowledge**
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Inf182 - Special Topics in 'System Software and Distributed Systems' I

Module label
- Special Topics in 'System Software and Distributed Systems' I

Module code
- inf182

Credit points
- 6.0 KP

Workload
- 180 h

Used in course of study
- Master's Programme Computing Science (Master) > Praktische Informatik

Contact person
- Module responsibility
  - Oliver Theel
  - Die im Modul Lehrenden
- Authorized examiners
  - Oliver Theel
  - Die im Modul Lehrenden

Entry requirements
- This module integrates current developments in the field in adequate study courses.

Skills to be acquired in this module

Professional competences
- The students:
  - define and contrast a computer science part, in which they are specialised, in detail or evaluate
    computer science in general
  - recognise and evaluate applied techniques and methods of their subject and are aware of their limits
  - identify, structure and solve problems/tasks, also in new or developing subject areas
  - apply state of the art and innovative methods to solve problems, if necessary from other disciplines
  - are aware of the current limits and contribute to the development of computer science research and
    technology
  - discuss and evaluate recent computer science developments

Methodological competences
- The students:
  - evaluate and apply tools, technology and methods sophisticatedly
  - combine new and original approaches and methods creatively
  - evaluate problems/tasks, including new or developing subject areas of their discipline and apply
    computer science methods for solutions and research

Social competences
- The students:
  - support team process by their abilities

Self-competences
- The students:
  - pursue the overall and special computer science development critically
  - implement innovative professional activities effectively and independently

Module contents
- According to the assigned course, e.g. „Verteilte Systeme“, „Realzeitbetriebssysteme“ or „Drahtlose
  Rechnernetze“

Reader's advisory
- As announced in course

Links

Language of instruction
- German

Duration (semesters)
- 1 Semester

Module frequency
- unregelmäßig

Module capacity
- unlimited

Modullevel
- AS (Akzentsetzung / Accentuation)

Modulart
- je nach Studiengang Pflicht oder Wahlpflicht

Lern-/Lehrform / Type of program
- 2 Veranst. aus V, S, Ü, P, PR (4SWS)

Vorkenntnisse / Previous knowledge
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<td>Course type</td>
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<td>SWS</td>
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<td>Frequency</td>
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<td>Workload attendance</td>
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</table>
inf183 - Special Topics in 'System Software and Distributed Systems' II

Module label: Special Topics in 'System Software and Distributed Systems' II
Module code: inf183
Credit points: 6.0 KP
Workload: 180 h

Used in course of study:
- Master's Programme Computing Science (Master) > Praktische Informatik

Contact person:
- Module responsibility:
  - Oliver Theel
  - Die im Modul Lehrenden
- Authorized examiners:
  - Oliver Theel
  - Die im Modul Lehrenden

Entry requirements:

Skills to be acquired in this module:
This module integrates current developments in the field in adequate study courses.

Professional competences:
The students:
- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

Methodological competences:
The students:
- evaluate and apply tools, technology and methods sophisticatedly
- combine new and original approaches and methods creatively
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research

Social competences:
The students:
- support team process by their abilities

Self-competences:
The students:
- pursue the overall and special computer science development critically
- implement innovative professional activities effectively and independently

Module contents:
According to the assigned course, e.g. “Verteilte Systeme”, “Realzeitbetriebssysteme” or “Drahtlose Rechnernetze”

Reader's advisory:
As announced in course

Links:
- Language of instruction: German
- Duration (semesters): 1 Semester
- Module frequency: unregelmäßig
- Module capacity: unlimited
- Modullevel: BC (Basiscurriculum / Base curriculum)
- Modulart: je nach Studiengang Pflicht oder Wahlpflicht
- Lern-/Lehrform / Type of program: V+Ü

Vorkenntnisse / Previous knowledge:

229 / 308
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<td>Frequency</td>
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<tr>
<td>Workload attendance</td>
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</table>
inf184 - Current Topics in 'System Software and Distributed Systems' I

Module label: Current Topics in 'System Software and Distributed Systems' I
Module code: inf184
Credit points: 3.0 KP
Workload: 90 h

Used in course of study:
- Master's Programme Computing Science (Master) > Praktische Informatik

Contact person:
Module responsibility
- Oliver Theel
- Die im Modul Lehrenden

Authorized examiners
- Oliver Theel
- Die im Modul Lehrenden

Entry requirements

Skills to be acquired in this module
This module integrates current developments in the field in adequate study courses.

Professional competences
The students:
- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

Methodological competences
The students:
- examine tasks with technical and research literature, write an academic article and present their solutions academically
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
- schedule time processes and resources

Social competences
The students:
- communicate with users and experts convincingly

Self-competences
The students:
- pursue the overall and special computer science development critically
- develop and reflect self-developed hypotheses to theories independently

Module contents
See assigned course description

Reader's advisory
As announced in course

Links
Language of instruction: German
Duration (semesters): 1 Semester
Module frequency: unregelmäßig
Module capacity: unlimited
Modullevel: BC (Basiscurriculum / Base curriculum)
Modulart: je nach Studiengang Pflicht oder Wahlpflicht
Lern-/Lehrform / Type of program: S oder V

Vorkenntnisse / Previous knowledge
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<td>Workload attendance</td>
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inf185 - Current Topics in 'System Software and Distributed Systems' II

Module label: Current Topics in 'System Software and Distributed Systems' II
Module code: inf185
Credit points: 3.0 KP
Workload: 90 h
Used in course of study:
- Master's Programme Computing Science (Master) > Praktische Informatik

Contact person:
Module responsibility:
- Oliver Theel
- Die im Modul Lehrenden

Authorized examiners:
- Oliver Theel
- Die im Modul Lehrenden

Entry requirements

Skills to be acquired in this module:
This module integrates current developments in the field in adequate study courses.

**Professional competences**
The students:

- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

**Methodological competences**
The students:

- examine tasks with technical and research literature, write an academic article and present their solutions academically
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
- schedule time processes and resources

**Social competences**
The students:

- communicate with users and experts convincingly

**Self-competences**
The students:

- pursue the overall and special computer science development critically
- develop and reflect self-developed hypotheses to theories independently

**Module contents**
See assigned course description

**Reader’s advisory**
As announced in course

**Links**

**Language of instruction**
German

**Duration (semesters)**
1 Semester

**Module frequency**
unregelmäßig

**Module capacity**
unlimited

**Modullevel**
AS (Akzentsetzung / Accentuation)

**Modulart**
je nach Studiengang Pflicht oder Wahlpflicht

**Lern-Lehrform / Type of program**
S oder V

**Vorkenntnisse / Previous knowledge**
<table>
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<tr>
<th>Examination</th>
<th>Time of examination</th>
<th>Type of examination</th>
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<td>Final exam of module</td>
<td>At the end of the lecture period</td>
<td>Presentation or oral exam</td>
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Theoretische Informatik

inf300 - Hybrid Systems

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<tr>
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<td>Workload</td>
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**Used in course of study**
- Master's Programme Computing Science (Master) > Technische Informatik
- Master's Programme Computing Science (Master) > Theoretische Informatik
- Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodule
- Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering

**Contact person**

- Module responsibility
  - Martin Georg Fränzle
- Authorized examiners
  - Martin Georg Fränzle
  - Die im Modul Lehrenden

**Entry requirements**


**Skills to be acquired in this module**

The module gives an introduction to hybrid discrete-continuous systems, as arising by embedding digital hardware into physical environments, and it elaborates on state of the art methods for the mathematical modelling and the analysis of such systems. It thus provides central competences for understanding and designing reliable cyber-physical systems.

**Professional competence**

The students:

- characterise formal models of cyber-physical systems: hybrid automata, hybrid state transition systems
- name domain-specific system requirements: safety, stability, robustness
- name analysis methods: symbolic state-space exploration, abstraction and abstraction refinement, generalized Lyapunov-Methods
- use state-of-the-art analysis tools
- select and apply adequate modelling and analysis methods for concrete application scenarios
- apply methods to reduce large state spaces and reduce infinite-state systems by abstraction
- know the de-facto industry standards for system modelling and are able to apply the corresponding modelling frameworks and tools

**Methodological competence**

The students:

- model heterogeneous dynamical systems with adequate modelling and design tools, in particular Simulink/Stateflow
- transfer modelling and analysis methods to other heterogeneous domains, e.g. socio-technical systems

**Social competence**

The students:

- work in teams
- solve complex modelling, design, and analysis tasks in teams

**Self-competence**

The students:

- reflect their actions and respect the scope of methods dedicated to hybrid systems

**Module contents**

Embedded computer systems continuously interact with their environment, which generally comprises state- and time-continuous components. The coupling of the embedded system to its environment thus induces complex interleavings between discrete computational and decision processes and continuous processes. The
resulting processes are neither amenable to the analytic techniques of continuous control nor of discrete mathematics. They instead require a broader, integrated theory: hybrid discrete-continuous systems. The lectures provide an in-depth introduction into a variety of analysis and design methods of these computer-based systems and their recent extensions to cyber-physical systems.

The accompanying hands-on-project enhances the lecture by developing and using design and verification tools.

Reader's advisory


Links

Languages of instruction: English, German

Duration (semesters): 1 Semester

Module frequency: once a year

Module capacity: unlimited

Modul level: AS (Accentuation)

Modulart: Pflicht o. Wahlpflicht / compulsory or optional

Lern-/Lehrform / Type of program: V+Ü

Vorkenntnisse / Previous knowledge: Bachelor in Computing Science oder Kenntnisse gewöhnlicher Differentialgleichungen

Exam: Semester project including written work and final presentation

Course type

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Total time of attendance for the module: 56 h
## Inf450 - Correctness of Graph Programs

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<tr>
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<td>Workload</td>
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| Used in course of study | - Master's Programme Computing Science (Master) > Theoretische Informatik
- Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodule |

### Contact person
- Module responsibility
  - Annegret Habel
  - Die im Modul Lehrenden
- Authorized examiners
  - Andreas Hein
  - Die im Modul Lehrenden

### Entry requirements
- **Skills to be acquired in this module**
  - The objectives of this module are modelling of systems, system changes and system properties. Introduction to graph programs. Introduction into system correctness. Methods for proving system correctness.
  - Professional competence
    - The students:
      - Describe the basics of graph programs and graph properties
      - Describe verification procedures of system correctness
  - Methodological competence
    - The students:
      - Model systems, system changes and system properties
      - Apply the formalism of graph programs
  - Social competence
    - The students:
      - Solve problems in a team
      - Present and discuss their proposed solutions
  - Self-competence
    - The students:
      - Reflect upon their actions with regard to term rewriting systems and the methods of those

### Module contents
- The module is an introduction to the modelling of systems, system changes and system properties by means of graphs, graph programs and graph conditions and presents a method for proving correctness of systems with respect to a pre- and a postcondition.
- The basic structures used in this lecture are graphs; they are used in practically all domains of computing science for the representation of complex structures. Graph programs are constructed from the core constructs of nondeterministic rule application, sequential composition and iteration and they can effect programmatic changes of a graph structure. One well-known method for determining the correctness of programs with respect to a pre- and a postcondition is based on the construction of a weakest precondition of the postcondition with respect to the program and the attempt to decide whether the given precondition implies the computed weakest precondition.

### Reader's advisory

### Links
<table>
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<tr>
<th>Language of instruction</th>
<th>German</th>
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<tr>
<td>Duration (semesters)</td>
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<tr>
<td>Module frequency</td>
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<td>AC (Aufbaucurriculum / Composition)</td>
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<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
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<td>Vorkenntnisse / Previous knowledge</td>
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<td>Exercises</td>
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<td>1.00</td>
<td>WiSe</td>
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| Total time of attendance for the module | 56 h |
inf451 - Complexity Theory

Module label: Complexity Theory
Module code: inf451
Credit points: 6.0 KP
Workload: 180 h

Used in course of study
- Master's Programme Computing Science (Master) > Theoretische Informatik

Contact person
- Module responsibility
  - Eike Best
  - Die im Modul Lehrenden
- Authorized examiners
  - Eike Best
  - Die im Modul Lehrenden

Entry requirements

Skills to be acquired in this module
This module covers the computational complexity of algorithms. Complexity considerations are concerned with the time, the memory, and the parallelism required or allowed, for solving an algorithmic problem. In particular, one is interested in lower and/or upper time and space bounds, and in approximative investigations providing information about entire classes of algorithms. For any concrete problem, complexity theory aims at being able to find out which class it belongs to, and thus estimating the cost of the most efficient methods of solving it. Methods taught in this module are general, not depending on any particular algorithmic model or chosen programming language.

Professional competence
The students:
- use Turing machines and variants thereof
- define time, memory, and processor requirements of algorithmic problems
- specify the most relevant complexity classes
- estimate the computational complexity of the most important problems

Methodological competence
The students:
- analyse the complexity of algorithms
- apply techniques of simulation, reduction, and diagonalisation
- compare new problems in terms of complexity

Social competence
The students:
- present proof sketches, proofs, and algorithmic solutions in front of an audience

Module contents
- Mathematical foundations
- Turing machines and register machines
- Space and time hierarchies, equivalence and hierarchy theorems
- Complexity classes: P, NP, NPC, PSPACE, and others
- Alternating automata and polynomial time hierarchy
- Circuit complexity

Reader's advisory
- Eike Best: Skript zur Vorlesung (2015)

Links
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<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
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<td>Vorkenntnisse / Previous knowledge</td>
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<td>exercises and oral exam</td>
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<td>SuSe</td>
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## inf453 - Combination of Specification Techniques

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<td>Module responsibility</td>
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<tr>
<td>• Andreas Hein</td>
<td></td>
</tr>
<tr>
<td>• Ernst-Rüdiger Olderog</td>
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<td>• Die im Modul Lehrenden</td>
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<td>• Andreas Hein</td>
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<td>inf400/inf401 Theoretische Informatik I and II</td>
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<tr>
<td>Skills to be acquired in this module</td>
<td>Introduction to the specification languages Z for data, CSP for processes, and their combination CSP-OZ for reactive systems with data and process parts.</td>
</tr>
<tr>
<td>Professional competence</td>
<td>The students:</td>
</tr>
<tr>
<td>• specify data and processes with Z, CSP and CSP-OZ formally</td>
<td></td>
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<tr>
<td>• check data refinement relations formally</td>
<td></td>
</tr>
<tr>
<td>• verify CSP-OZ specifications with FDR model checker</td>
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<tr>
<td>Methodological competence</td>
<td>The students:</td>
</tr>
<tr>
<td>• are able to integrate complementary specification methods</td>
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<tr>
<td>Social competence</td>
<td>The students:</td>
</tr>
<tr>
<td>• work together in small groups to solve problems</td>
<td></td>
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<tr>
<td>• present solutions to problems to groups of other students</td>
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<tr>
<td>Self-competence</td>
<td>The students:</td>
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<tr>
<td>• learn persistence in pursuing difficult tasks</td>
<td></td>
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<tr>
<td>• learn precision in specifying problems</td>
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### Module contents

The course addresses a research trend in formal methods, the combination and integration of different specification methods. It focuses on a concrete combination CSP-OZ of the specification techniques CSP (Communicating Sequential Processes) for processes and Z and Object-Z for data, respectively. Reactive systems are described by CSP-OZ.

As a preparation, the specification languages Z and CSP are described, followed by the combination CSP-OZ with its process-oriented semantics. The concepts of refinement and inheritance and the possibility of automatic verification of a sublanguage of CSP-OZ with the FDR model checker for CSP will be discussed. Finally, the course explains possibilities of extending CSP-OZ for the specification of time-critical systems.

**Topics:**

- specification of complex data and operations in Z, type definition and pattern calculations of Z, data refinement
- specifications of communicating processes in CSP, operational semantics of CSP, three abstract semantic models

for CSP: Trace semantics, failures semantics, failures-divergences semantics, process refinement in the above semantics, FDR model checker for CSP
• combined specification method CSP-OZ, transformational semantics as CSP-process, theorems of refinements,

object-oriented concepts of class and inheritance in CSP-OZ

Reader's advisory

Essential:


Recommended:


Links

Language of instruction German

Duration (semesters) 1 Semester

Module frequency unregelmäßig

Module capacity unlimited

Modullevel BC (Basiscurriculum / Base curriculum)

Modulart je nach Studiengang Pflicht oder Wahlpflicht

Lern-/Lehrform / Type of program

Vorkenntnisse / Previous knowledge

- in400 Theoretische Informatik I
- in401 Theoretische Informatik II

Examination

Time of examination At the end of the lecture period

Type of examination exercises and oral exam

Final exam of module

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<td>Lecture</td>
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<td>3.00</td>
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<td>1.00</td>
<td>WiSe</td>
<td>14 h</td>
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Total time of attendance for the module 56 h
Inf454 - Communicating and Mobile Systems

Module label: Communicating and Mobile Systems
Module code: inf454
Credit points: 6.0 KP
Workload: 180 h

Used in course of study:
- Master's Programme Computing Science (Master) > Theoretische Informatik
- Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodule
- Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering

Contact person:
Module responsibility:
- Ernst-Rüdiger Olderog
- Die im Modul Lehrenden

Authorized examiners:
- Die im Modul Lehrenden
- Ernst-Rüdiger Olderog

Entry requirements:

Skills to be acquired in this module

Professional competence
The students:

- Know the theory of the operational semantics of CCS and the ?-calculus
- Perform equivalence proofs using simulations and bisimulations
- Specify communicating and mobile systems with CCS and the ?-calculus

Methodological competence
The students:

- Learn about different views on mobility
- Recognize equivalences as formal means for system correctness

Social competence
The students:

- Work together in small groups to solve problems
- Present their solutions to groups of other students

Self-competence
The students:

- Learn persistence in pursuing difficult tasks
- Learn precision in specifying problems

Module contents

Communication is one of the basic concepts of computer science. It occurs between computers in a network as well as between components of a computer. The focus of the course is on Robin Milner's ?-calculus. It enables a new modelling of communication, taking the location of the communication into account.

The ?-calculus can describe the change of data in a computer as well as the sending of messages or even programs along networks like the internet. It is also possible to describe reconfigurable networks. This will be shown using the examples of mobile phones, schedulers, automatic vending machines, data structures, communication protocols, and objects in object-oriented programming. All these applications are backed by the theory of the ?-calculus, which is based on operational semantics and a concept of behavioural equivalence. The theory will be explained in a step-by-step manner.

Topics:

- different views on mobility
- transition systems with simulations and bisimulations
- Milner's Calculus of Communicating Systems (CCS) and Milner's ?-calculus for mobile systems, both with operational semantics, structural congruence, strong equivalence and observational equivalence, relationship between reactions and transitions, solvability of recursive equations
- formal specification of examples of communicating and mobile systems using CCS and the ?-calculus
- proof of strong equivalence and observational equivalence of given processes
• specification of dynamic data structures in the ?-calculus

Reader's advisory


Links
http://csd.informatik.uni-oldenburg.de/

Languages of instruction
German, English

Duration (semesters)
1 Semester

Module frequency
irregular

Module capacity
unlimited

Module level
AS (Akzentsetzung / Accentuation)

Module art
Pflicht o. Wahlpflicht / compulsory or optional

Lern-/Lehrform / Type of program
V+Ü

Previous knowledge
Theoretische Informatik II

Examination
Time of examination
Type of examination
Final exam of module
At the end of the lecture period
written exam or oral exam

Course type
Frequency
Workload attendance
Lecture
3.00
SuSe
42 h
Exercises
1.00
SuSe
14 h

Total time of attendance for the module
56 h
inf456 - Real-Time Systems

Module label: Real-Time Systems
Module code: inf456
Credit points: 6.0 KP
Workload: 180 h

Used in course of study:
- Master's Programme Computing Science (Master) > Theoretische Informatik
- Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodul
- Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering

Contact person:
Module responsibility:
- Ernst-Rüdiger Olderog
- Die im Modul Lehrenden

Authorized examiners:
- Die im Modul Lehrenden
- Ernst-Rüdiger Olderog

Entry requirements:

Skills to be acquired in this module:
- Introduction to formal methods of the specification and verification of time sensitive systems and their combinations.

Professional competence:
The students:
- Learn about different models of time and real-time properties
- Specify and verify real-time systems
- Model real-time systems using Timed Automata and PLC-Automata
- Apply the model checker UPPAAL for the verification of real-time properties
- Specify real-time systems using the Duration Calculus
- Learn about decidability and undecidability results for real-time systems

Methodological competence:
The students:
- Recognize logic and automata as adequate forms for describing real-time systems

Social competence:
The students:
- Work together in small groups to solve problems
- Present their solutions to groups of other students

Self-competence:
The students:
- Learn persistence in pursuing difficult tasks
- Learn precision in specifying problems

Module contents:
Examples of time-critical systems are railway control systems, robots, or even gas burners. It is essential for these systems to comply with certain timing conditions. For example, the control of a railway crossing must close the gates not later than 4 seconds after the sensors have reported an approaching train. If the gates are open, they should stay that way for at least 15 seconds to allow for a safe crossing of vehicles.

Different specification methods have been developed to describe such timing conditions. The Duration Calculus developed by Zhou Chaochen in 1991 is one attractive method. It is a logic combined with a calculus, in which the duration of states can be described. The course will introduce the Duration Calculus and will explain its application by means of examples. As further specification method Timed Automata introduced by Alur & Dill in 1994 will be presented. After the specification of real-time system requirements the verification of programs implementing these requirements will follow. The specification methods of the Duration Calculus and Timed Automata are used to describe the real-time behaviour of these programs. The correctness is then proven on the basis of these behavioral descriptions.

Topics:
• discrete and continuous model of time
• logics and automata models for the specification of real-time systems (predicate logic, Duration Calculus, Timed CTL, Timed Automata, PLC-Automata)
• decidability and undecidability results for real-time systems
• model checker UPPAAL for Timed Automata
• formal specification of real-time systems using Duration Calculus as well as Timed Automata and PLC-Automata
• verification of concrete Timed Automata using the model checker UPPAAL,
• transformation of Duration Calculus for discrete time into regular languages
• implementability of real-time systems on PLC-like hardware

Reader's advisory

essential:


recommended:


Links
Languages of instruction German, English
Duration (semesters) 1 Semester
Module frequency irregular
Module capacity unlimited
Module level AS (Akzentsetzung / Accentuation)
Modulart Pflicht o. Wahlpflicht / compulsory or optional
Lern-/Lehrform / Type of program V+Ü
Vorkenntnisse / Previous knowledge Theoretische Informatik I + II

Examination Time of examination Type of examination
Final exam of module At the end of the lecture period Exercises and written or oral exam

Course type Comment SWS Frequency Workload attendance
Lecture 3.00 SuSe or WiSe 42 h
Exercises 1.00 SuSe or WiSe 14 h

Total time of attendance for the module 56 h
inf458 - Term Rewriting Systems

Module label: Term Rewriting Systems

Module code: inf458

Credit points: 6.0 KP

Workload: 180 h

Used in course of study:
- Master's Programme Computing Science (Master) > Theoretische Informatik
- Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodul

Contact person:
- Module responsibility:
  - Annegret Habel
  - Die im Modul Lehrenden

Authorized examiners:
- Annegret Habel
- Die im Modul Lehrenden

Entry requirements:

Skills to be acquired in this module: The objectives of this module are an introduction to (term) rewriting systems, termination and confluence, the undecidable sets of termination and confluence problems, verification procedures of termination and confluence.

Professional competence:
The students:
- describe the basics of term rewriting systems
- characterise the undecidability of termination and confluence problems
- describe verification procedures of termination and confluence

Methodological competence:
The students:
- apply verification procedures of termination and confluence
- apply Huet's completion procedure

Social competence:
The students:
- solve problems in a team
- present and discuss their results

Self-competence:
The students:
- reflect their actions with regard to term rewriting systems and the methods of those

Module contents:
The module is an introduction to term rewriting systems and provides verification procedures for termination and confluence.

Term rewriting systems, termination and confluence are introduced, the undecidability of termination and confluence problems and the decidability for a set of special term rewriting systems are shown.

For this purpose reduction and simplification orders, critical pairs, orthogonality and Huet's completion procedure are introduced, examined and combined.

Reader's advisory:

Links:
- Language of instruction: German
- Duration (semesters): 1 Semester
- Module frequency: im 2-Jahres-Zyklus
- Module capacity: unlimited
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### Lern-/Lehrform / Type of program

| Vorkenntnisse / Previous knowledge | |
|-----------------------------------||
| Examination                      | |

### Final exam of module

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**Total time of attendance for the module**: 56 h
inf460 - Security

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**Used in course of study**
- Master's Programme Computing Science (Master) > Theoretische Informatik
- Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering

**Contact person**
- Module responsibility
  - Sibylle Fröschle
  - Die im Modul Lehrenden
- Authorized examiners
  - Die im Modul Lehrenden
  - Sibylle Fröschle

**Entry requirements**
- Basic knowledge in security

**Skills to be acquired in this module**
- The goal of this module is to provide a foundation in computer and network security.

**Professional competences:**
- The students: are aware of the threats posed by cyber attacks to computer and network systems
- understand the basic principles and mechanisms to protect a system against these threats
- are able to apply this knowledge to assess the risk of cyber attacks to a given system as well as to develop and evaluate countermeasures against them

**Methodological competences:**
- The students: carry out a threat and risk assessment - formulate security requirements for a given system - identify and apply standard security solutions to meet them (These are examples, the exact skills depend on the focus chosen by the student.)

**Social competences:**
- The students: are able to master a new topic by self-study and interaction with experts and peers
- are able to explain principles and applications of computer security to experts and non-experts
- are able to expertly discuss security risks and incidents

**Self-competences:**
- The students: follow up and critically assess current developments in computer security including security incidents
- are security aware in their own behaviour, in their assessment of the systems they work with, and those they develop

**Module contents**
- This module provides a broad and comprehensive knowledge in computer security. The topics cover threat analysis and attack trees, essential cryptographic tools, user authentication, access control, malware, intrusion detection and prevention, denial-of-service attacks and defences, software security and trusted systems, and network security. Students without prior knowledge in computer security focus on basic principles such as listed above. Students with prior knowledge in computer security can deepen their knowledge by studying real-world examples such as the SSL/TLS protocol. Typically, they will illustrate their topic by discussing a security incident reported in the public domain security news.

**Reader's advisory**

**Links**
- access from http://vhome.offis.de/sibylief

**Language of instruction**
- English

**Duration (semesters)**
- 1 Semester

**Module frequency**
- once a year

**Module capacity**
- unlimited

**Reference text**
- Associated with the module(s): Security of Cyber-Physical Systems

**Module level**
- AS (Akzentsetzung / Accentuation)

**Modulart**
- MM (Mastermodul / Master module)

**Lern-Lehrform / Type of program**
- S or V

**Vorkenntnisse / Previous knowledge**
- Basic knowledge in security
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**Used in course of study**
- Master's Programme Computing Science (Master) > Theoretische Informatik
- Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering

**Contact person**
- Module responsibility
  - Sibylle Fröschle
  - Die im Modul Lehrenden
- Authorized examiners
  - Die im Modul Lehrenden
  - Sibylle Fröschle

**Entry requirements**

**Skills to be acquired in this module**

**Professional competences:** The students:
- are aware of the threats posed by cyber attacks to cyber-physical systems
- understand security solutions specific to CPS
- know examples of security architectures of CPS
- are able to apply this knowledge to assess the risk of cyber attacks to a given CPS as well as to develop a conceptual systems security architecture for it

**Methodological competences:** The students:
- carry out a threat and risk assessment for a given CPS
- formulate security requirements for a given CPS
- develop a systems security architecture for a given CPS to meet them

**Social competences:** The students:
- are able to master a new topic by self-study and interaction with experts and peers
- are able to explain the significance and facets of security for CPS to experts and non-experts
- are able to expertly discuss security risks and incidents of CPS

**Self-competences:** The students:
- follow up and critically assess current developments in the security of CPS including relevant security incidents
- are security aware and foster a security culture with respect to CPS and the resulting critical infrastructures

**Module contents**

Embedded systems in the energy, transportation, and health domains are currently undergoing a technological transition towards highly networked automated cyber-physical systems (CPS). Such systems are potentially vulnerable to cyber attacks, and these can have physical impact. This includes targeted sabotage of a plant (e.g. Stuxnet), large-scale sabotage of infrastructure to cause economic damage (e.g. attacks against energy grids), and indiscriminate attacks to cause civilian casualties (e.g. by compromise of transportation systems). In this module we investigate and discuss security principles, solutions, and architectures for CPS as well as real-life security incidents. The topics include distance bounding protocols, location tracking and counter-measures, safety and security engineering of CPS, security in the automotive and maritime domain including car hacking and vehicle-2-x communication, hacking in the medical domain, attacks against energy grids, Stuxnet, CPS and society: benefits, risks, acceptance.

**Reader's advisory**

Recent scientific papers and reports in the public domain news.

**Language of instruction**

English

**Duration (semesters)**

1 Semester

**Module frequency**

once a year

**Module capacity**

unlimited

**Modullevel**

AS (Akzentsetzung / Accentuation)

**Modullevel**

MM (Mastermodul / Master module)

**Modulart**

Pflicht o. Wahlpflicht / compulsory or optional

**Modulart**

je nach Studiengang Pflicht oder Wahlpflicht

**Lern-/Lehrform / Type of program**

S or V

**Lern-/Lehrform / Type of program**

S or V

**Vorkenntnisse / Previous knowledge**


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**Course type**

Course or seminar

**SWS**

2.00

**Frequency**

SuSe or WiSe
Workload attendance  28 h
inf480 - Special Topics in 'Parallel Systems' I

Module label: Special Topics in 'Parallel Systems' I
Module code: inf480
Credit points: 6.0 KP
Workload: 180 h
Used in course of study: Master's Programme Computing Science (Master) > Theoretische Informatik

Contact person:
Module responsibility:
- Eike Best
- Die im Modul Lehrenden

Authorized examiners:
- Eike Best
- Die im Modul Lehrenden

Entry requirements:
This module integrates current developments in the field in adequate study courses.

Skills to be acquired in this module:

Professional competences:
The students:
- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

Methodological competences:
The students:
- evaluate and apply tools, technology and methods sophisticatedly
- combine new and original approaches and methods creatively
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research

Social competences:
The students:
- support team process by their abilities

Self-competences:
The students:
- pursue the overall and special computer science development critically
- implement innovative professional activities effectively and independently

Module contents:
See assigned course description, e.g. „Automatentheorie und Logik“, „Modelchecking“, „Effiziente Algorithmen“ und „Theorie und Spiele“.

Reader’s advisory:
As announced in course

Links:
Language of instruction: German
Duration (semesters): 1 Semester
Module frequency: unregelmäßig
Module capacity: unlimited
Modullevel: AC (Aufbaucurriculum / Composition)
Modulart: je nach Studiengang Pflicht oder Wahlpflicht
Lern-/Lehrform / Type of program: 2 Veranst. aus V, Ü, S, P, PR (4SWS)
Vorkenntnisse / Previous knowledge:

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**inf481 - Special Topics in 'Parallel Systems' II**

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**Contact person**

- Module responsibility
  - Eike Best
  - Die im Modul Lehrenden
- Authorized examiners
  - Eike Best
  - Die im Modul Lehrenden

**Entry requirements**

**Skills to be acquired in this module**

This module integrates current developments in the field in adequate study courses.

**Professional competences**

The students:

- Define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- Recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- Identify, structure and solve problems/tasks, also in new or developing subject areas
- Apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- Are aware of the current limits and contribute to the development of computer science research and technology
- Discuss and evaluate recent computer science developments

**Methodological competences**

The students:

- Evaluate and apply tools, technology and methods sophisticatedly
- Combine new and original approaches and methods creatively
- Evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research

**Social competences**

The students:

- Support team process by their abilities

**Self-competences**

The students:

- Pursue the overall and special computer science development critically
- Implement innovative professional activities effectively and independently

**Module contents**

See assigned course description, e.g. „Automatentheorie und Logik“, „Modelchecking“, „Effiziente Algorithmen“ und „Theorie und Spiele“.

**Reader's advisory**

As announced in course

**Links**

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**Vorkenntnisse / Previous knowledge**

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inf482 - Current Topics in 'Parallel Systems' I

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<td>• Eike Best</td>
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<td>• Die im Modul Lehrenden</td>
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<td>• Eike Best</td>
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<td>• Die im Modul Lehrenden</td>
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Entry requirements

- This module integrates current developments in the field in adequate study courses.

Professional competences

The students:

- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

Methodological competences

The students:

- examine tasks with technical and research literature, write an academic article and present their solutions academically
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
- schedule time processes and resources

Social competences

The students:

- communicate with users and experts convincingly

Self-competences

The students:

- pursue the overall and special computer science development critically
- develop and reflect self-developed hypotheses to theories independently

Module contents

See assigned course description

Reader's advisory

As announced in course

Links

<table>
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Vorkenntnisse / Previous knowledge
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**Course type**
- Course or seminar

**SWS**
- 2.00

**Frequency**
- SuSe or WiSe

**Workload attendance**
- 28 h
### inf483 - Current Topics in 'Parallel Systems' II

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</table>

**Entry requirements**

**Skills to be acquired in this module**

This module integrates current developments in the field in adequate study courses.

**Professional competences**

The students:

- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

**Methodological competences**

The students:

- examine tasks with technical and research literature, write an academic article and present their solutions academically
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
- schedule time processes and resources

*Social competences*

The students:

- communicate with users and experts convincingly

**Self-competences**

The students:

- pursue the overall and special computer science development critically
- develop and reflect self-developed hypotheses to theories independently

**Module contents**

See assigned course description

**Reader's advisory**

As announced in course

**Links**

<table>
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**inf484 - Special Topics in 'Correct Systems Design' I**

**Module label**
Special Topics in 'Correct Systems Design' I

**Module code**
inf484

**Credit points**
6.0 KP

**Workload**
180 h

**Used in course of study**
- Master's Programme Computing Science (Master) > Theoretische Informatik

**Contact person**

Module responsibility
- Ernst-Rüdiger Olderog
- Die im Modul Lehrenden

Authorized examiners
- Ernst-Rüdiger Olderog
- Die im Modul Lehrenden

**Entry requirements**

**Skills to be acquired in this module**

This module integrates current developments in the field in adequate study courses.

**Professional competences**
The students:

- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

**Methodological competences**
The students:

- evaluate and apply tools, technology and methods sophisticatedly
- combine new and original approaches and methods creatively
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research

**Social competences**
The students:

- support team process by their abilities

**Self-competences**
The students:

- pursue the overall and special computer science development critically
- implement innovative professional activities effectively and independently

**Module contents**
See assigned course description

**Reader's advisory**
As announced in course

**Links**

**Language of instruction**
German

**Duration (semesters)**
1 Semester

**Module frequency**
halbjährlich

**Module capacity**
unlimited

**Modullevel**
AS (Akzentsetzung / Accentuation)

**Modularität**
je nach Studiengang Pflicht oder Wahlpflicht

**Lern-/Lehrform / Type of program**
2 Veran. aus V, Ü, S, P, PR

**Vorkenntnisse / Previous knowledge**

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inf485 - Special Topics in 'Correct Systems Design' II

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Entry requirements

Skills to be acquired in this module

This module integrates current developments in the field in adequate study courses.

Professional competences

The students:

- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

Methodological competences

The students:

- evaluate and apply tools, technology and methods sophisticatedly
- combine new and original approaches and methods creatively
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research

Social competences

The students:

- support team process by their abilities

Self-competences

The students:

- pursue the overall and special computer science development critically
- implement innovative professional activities effectively and independently

Module contents

See assigned course description

Reader's advisory

As announced in course

Links

Language of instruction

German

Duration (semesters)

1 Semester

Module frequency

unregelmäßig

Module capacity

unlimited

Modullevel

AS (Akzentsetzung / Accentuation)

Modulart

je nach Studiengang Pflicht oder Wahlpflicht

Lern-Lehrform / Type of program

2 Veranst. aus V, Ü, S, P, PR

Vorkenntnisse / Previous knowledge
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**inf486 - Current Topics in 'Correct Systems Design' I**

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**Entry requirements**

**Skills to be acquired in this module**

This module integrates current developments in the field in adequate study courses.

**Professional competences**

The students:

- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

**Methodological competences**

The students:

- examine tasks with technical and research literature, write an academic article and present their solutions academically
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
- schedule time processes and resources

**Social competences**

The students:

- communicate with users and experts convincingly

**Self-competences**

The students:

- pursue the overall and special computer science development critically
- develop and reflect self-developed hypotheses to theories independently

**Module contents**

See assigned course description

**Reader's advisory**

As announced in course

**Language of instruction**

German

**Duration (semesters)**

1 Semester

**Module frequency**

unregelmäßig

**Module capacity**

unlimited

**Modullevel**

AS (Akzentsetzung / Accentuation)

**Modulart**

je nach Studiengang Pflicht oder Wahlpflicht

**Lern-Lehrform / Type of program**

S oder V (2 SWS)

**Vorkenntnisse / Previous knowledge**
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inf487 - CurrentTopics in 'Correct Systems Design' II

Module label: CurrentTopics in 'Correct Systems Design' II
Module code: inf487
Credit points: 3.0 KP
Workload: 90 h

Used in course of study:
- Master's Programme Computing Science (Master) > Theoretische Informatik

Contact person:
Module responsibility:
- Ernst-Rüdiger Olderog
- Die im Modul Lehrenden

Authorized examiners:
- Ernst-Rüdiger Olderog
- Die im Modul Lehrenden

Entry requirements:
Skills to be acquired in this module:
This module integrates current developments in the field in adequate study courses.

Professional competences:
The students:
- Define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- Recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- Identify, structure and solve problems/tasks, also in new or developing subject areas
- Apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- Are aware of the current limits and contribute to the development of computer science research and technology
- Discuss and evaluate recent computer science developments

Methodological competences:
The students:
- Examine tasks with technical and research literature, write an academic article and present their solutions academically
- Evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
- Schedule time processes and resources

Social competences:
The students:
- Communicate with users and experts convincingly

Self-competences:
The students:
- Pursue the overall and special computer science development critically
- Develop and reflect self-developed hypotheses to theories independently

Module contents:
See assigned course description

Reader's advisory:
As announced in course

Links:
Language of instruction: German
Duration (semesters): 1 Semester
Module frequency: unregelmäßig
Module capacity: unlimited
Module level: AS (Akzentsetzung / Accentuation)
Modulart: je nach Studiengang Pflicht oder Wahlpflicht
Lern-/Lehrform / Type of program: S oder V (2SWS)
Vorkenntnisse / Previous knowledge:

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**inf488 - Special Topics in 'Formal Languages' I**

**Module label**
Special Topics in 'Formal Languages' I

**Module code**
inf488

**Credit points**
6.0 KP

**Workload**
180 h

**Used in course of study**
- Master's Programme Computing Science (Master) > Theoretische Informatik

**Contact person**
Module responsibility
- Annegret Habel
- Die im Modul Lehrenden

Authorized examiners
- Annegret Habel
- Die im Modul Lehrenden

**Entry requirements**

**Skills to be acquired in this module**
This module integrates current developments in the field in adequate study courses.

**Professional competences**
The students:

- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

**Methodological competences**
The students:

- evaluate and apply tools, technology and methods sophisticatedly
- combine new and original approaches and methods creatively
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research

**Social competences**
The students:

- support team process by their abilities

**Self-competences**
The students:

- pursue the overall and special computer science development critically
- implement innovative professional activities effectively and independently

**Module contents**
See assigned course description

**Reader's advisory**
As announced in course

**Links**

**Language of instruction**
German

**Duration (semesters)**
1 Semester

**Module frequency**
unregelmäßig

**Module capacity**
unlimited

**Modullevel**
AS (Akzentsetzung / Accentuation)

**Modulart**
je nach Studiengang Pflicht oder Wahlpflicht

**Lern-Lehrform / Type of program**
2 Veranst. aus V, S, Ü, P, PR

**Vorkenntnisse / Previous knowledge**

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inf489 - Special Topics in 'Formal Languages' II

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**Contact person**
- Module responsibility
  - Michael Sonnenschein
  - Annegret Habel
- Module counseling
  - Die im Modul Lehrenden

**Entry requirements**
- This module integrates current developments in the field in adequate study courses.

**Skills to be acquired in this module**

**Professional competences**
The students:
- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

**Methodological competences**
The students:
- evaluate and apply tools, technology and methods sophisticatedly
- combine new and original approaches and methods creatively
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research

**Social competences**
The students:
- support team process by their abilities

**Self-competences**
The students:
- pursue the overall and special computer science development critically
- implement innovative professional activities effectively and independently

**Module contents**
See assigned course description

**Reader's advisory**
As announced in course

**Links**

**Language of instruction**
German

**Duration (semesters)**
1 Semester

**Module frequency**
unregelmäßig

**Module capacity**
unlimited

**Modullevel**
AS (Akzentsetzung / Accentuation)

**Modulart**
je nach Studiengang Pflicht oder Wahlpflicht

**Lern-/Lehrform / Type of program**
2 Veranst. aus V, Ü, S, P, PR

**Vorkenntnisse / Previous knowledge**

**Examination**

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inf490 - Current Topics in 'Formal Languages' I

**Module label**
Current Topics in 'Formal Languages' I

**Module code**
inf490

**Credit points**
3.0 KP

**Workload**
90 h

**Used in course of study**
- Master's Programme Computing Science (Master) > Theoretische Informatik

**Contact person**

Module responsibility
- Annegret Habel
- Die im Modul Lehrenden

Authorized examiners
- Annegret Habel
- Die im Modul Lehrenden

**Entry requirements**

**Skills to be acquired in this module**
This module integrates current developments in the field in adequate study courses.

**Professional competences**
The students:
- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

**Methodological competences**
The students:
- examine tasks with technical and research literature, write an academic article and present their solutions academically
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
- schedule time processes and resources

**Social competences**
The students:
- communicate with users and experts convincingly

**Self-competences**
The students:
- pursue the overall and special computer science development critically
- develop and reflect self-developed hypotheses to theories independently

**Module contents**
See assigned course description

**Reader's advisory**
As announced in course

**Links**

**Language of instruction**
German

**Duration (semesters)**
1 Semester

**Module frequency**
halbjährlich

**Module capacity**
unlimited

**Modullevel**
AS (Akzentsetzung / Accentuation)

**Modulart**
je nach Studiengang Pflicht oder Wahlpflicht

**Lern-/Lehrform / Type of program**
S oder V (2 SWS)

**Vorkenntnisse / Previous knowledge**


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**Course type**
- Course or seminar

**SWS**
- 2.00

**Frequency**
- SuSe or WiSe

**Workload attendance**
- 28 h
inf491 - Current Topics in 'Formal Languages' II

Module label | Current Topics in 'Formal Languages' II
---|---
Module code | inf491
Credit points | 3.0 KP
Workload | 90 h

Used in course of study
- Master's Programme Computing Science (Master) > Theoretische Informatik

Contact person
- Module responsibility
  - Annegret Habel
  - Die im Modul Lehrenden
- Authorized examiners
  - Annegret Habel
  - Die im Modul Lehrenden

Entry requirements

Skills to be acquired in this module
This module integrates current developments in the field in adequate study courses.

Professional competences
The students:
- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

Methodological competences
The students:
- examine tasks with technical and research literature, write an academic article and present their solutions academically
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
- schedule time processes and resources

Social competences
The students:
- communicate with users and experts convincingly

Self-competences
The students:
- pursue the overall and special computer science development critically
- develop and reflect self-developed hypotheses to theories independently

Module contents
See assigned course description

Reader's advisory
As announced in course

Links

Language of instruction | German
Duration (semesters) | 1 Semester
Module frequency | unregelmäßig
Module capacity | unlimited
Modullevel | AS (Akzentsetzung / Accentuation)
Modulart | je nach Studiengang Pflicht oder Wahlpflicht
Lern-/Lehrform / Type of program | S oder V
Vorkenntnisse / Previous knowledge
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inf494 - Current Topics in 'Modeling and Analysis of Complex Systems' I

Module label
Current Topics in 'Modeling and Analysis of Complex Systems' I

Module code
inf494

Credit points
3.0 KP

Workload
90 h

Used in course of study
- Master's Programme Computing Science (Master) > Theoretische Informatik

Contact person
Module responsibility
- Sibylle Fröschle
- Die im Modul Lehrenden

Authorized examiners
- Sibylle Fröschle
- Die im Modul Lehrenden

Entry requirements

Skills to be acquired in this module
This module integrates current developments in the field in adequate study courses.

Professional competences
The students:
- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

Methodological competences
The students:
- examine tasks with technical and research literature, write an academic article and present their solutions academically
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
- schedule time processes and resources

Social competences
The students:
- communicate with users and experts convincingly

Self-competences
The students:
- pursue the overall and special computer science development critically
- develop and reflect self-developed hypotheses to theories independently

Module contents
See assigned course description, e.g. „Security: Grundlagen“ oder „Security for Cyberphysical Systems“

Reader's advisory
As announced in course

Links

Language of instruction
German

Duration (semesters)
1 Semester

Module frequency
unregelmäßig

Module capacity
unlimited

Modullevel
AS (Akzentsetzung / Accentuation)

Modulart
je nach Studiengang Pflicht oder Wahlpflicht

Lern-Lehrform / Type of program
S oder V (2 SWS)

Vorkenntnisse / Previous knowledge
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### Module label
Current Topics in 'Modeling and Analysis of Complex Systems' II

### Module code
inf495

### Credit points
3.0 KP

### Workload
90 h

### Used in course of study
- Master's Programme Computing Science (Master) > Theoretische Informatik

### Contact person
Module responsibility
- Sibylle Fröschele
- Die im Modul Lehrenden

### Authorized examiners
Die im Modul Lehrenden

### Entry requirements

### Skills to be acquired in this module
This module integrates current developments in the field in adequate study courses.

#### Professional competences
The students:
- define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general
- recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- identify, structure and solve problems/tasks, also in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- are aware of the current limits and contribute to the development of computer science research and technology
- discuss and evaluate recent computer science developments

#### Methodological competences
The students:
- examine tasks with technical and research literature, write an academic article and present their solutions academically
- evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research
- schedule time processes and resources

#### Social competences
The students:
- communicate with users and experts convincingly

#### Self-competences
The students:
- pursue the overall and special computer science development critically
- develop and reflect self-developed hypotheses to theories independently

### Module contents
See assigned course description, e.g. „Security: Grundlagen“ oder „Security for Cyberphysical Systems“

### Reader's advisory
As announced in course

### Links

### Language of instruction
German

### Duration (semesters)
1 Semester

### Module frequency
unregelmäßig

### Module capacity
unlimited

### Modullevel
AS (Akzentsetzung / Accentuation)

### Modulart
je nach Studiengang Pflicht oder Wahlpflicht

### Lern-Lehrform / Type of program
S oder V (2 SWS)

### Vorkenntnisse / Previous knowledge
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Nicht Informatik

inf207 - Electrical Engineering

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**Used in course of study**
- Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsmodule
- Dual-Subject Bachelor's Programme Computing Science (Bachelor) > Wahlpflicht Technische Informatik (30 KP)
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Mastermodule
- Master's Programme Computing Science (Master) > Nicht Informatik

**Contact person**
- Module responsibility
  - Andreas Hein
- Authorized examiners
  - Andreas Hein
  - Die im Modul Lehrenden

**Entry requirements**

**Skills to be acquired in this module**

**Professional competence:**
The students:
- Analyse linear electrical networks (direct current and alternating current)
- Name basic concepts to calculate and to use electrical and magnetic fields
- List the characteristics of simple electrical elements (two terminal networks)
- Calculate the parameters of simple electrical networks/wirings
- Apply computer based analysing tools
- Design and implement simple networks/wirings

**Methodological competence:**
The students:
- Transfer calculation methods onto complex dynamic systems
- Implement electrical system models

**Social competence:**
The students:
- Present solutions for specific questions

**Self-competence:**
The students:
- Reflect their solutions by using methods learned in this course

**Module contents**

- Basic concepts (electric dimensions and units)
- Network elements
- Calculation of linear direct current networks (Ohms law, Kirchhoff's circuit law, superposition principle)
- Characteristics, calculations and representations of electric and magnetic fields
- Construction elements (capacitor and coil)
- Extensions of periodical dimensions dependent on time, pointer representation, calculations with complex root-mean-square value pointers

**Reader's advisory**

- slides
recommended:


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| Total time of attendance for the module | 56 h |

282 / 308
inf208 - Microrobotics and Microsystems Technology

Module label: Microrobotics and Microsystems Technology
Module code: inf208
Credit points: 6.0 KP
Workload: 180 h

Used in course of study:
- Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsmodule
- Dual-Subject Bachelor's Programme Computing Science (Bachelor) > Wahlpflicht Technische Informatik (30 KP)
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Mastermodule
- Master's Programme Computing Science (Master) > Nicht Informatik

Contact person
Module responsibility:
- Sergej Fatikow

Authorized examiners:
- Sergej Fatikow
- Die im Modul Lehrenden

Entry requirements

Skills to be acquired in this module
Within the last few years, microrobotics and microsystem technology (MST) have become a focus of interest to industry and evolved into an important field with great application potential. It plays a decisive role for industry to be competitive in many areas such as medicine, production engineering, biotechnology, environmental technology, automotive products, etc. Despite of the growing interest in this new technology, there is hardly any book or lecture course that treats microrobotics and MST in a coherent and comprehensive way. This course is an attempt of the Microrobotics and Control Engineering Division (AMiR) to give students a systematic introduction to microrobotics and MST. It discusses all important aspects of this rapidly expanding technology, its diversity of products and fields of application. The course contains an overview of numerous ideas of new devices and the problems of manufacturing them.

Professional competence:
The students:
- name the ideas, challenges and activities of microrobotics and microsystem technology
- describe the microrobotics and MST applications
- characterise MST methods
- name microsensor functionality
- characterise microsensor examples
- discuss MST terms of information technology
- classify microrobotics

Methodological competence
The students:
- discover interdisciplinary connections and links between scientific and technical fields of research and development
- learn technical abstraction of complex contexts

Social competence
The students:
- solving problems partially as group
- present their solutions and approaches to the group

Self-competence
The students:
- reflect their knowledge of technical computer science
- learn to expand on their professional competence independently

Module contents
Ideas and problems of microrobotics and MST; applications; techniques of MST; silicon-based micromechanics; LIGA technology; microactuators: principles and examples (electrostatic, piezoelectric, magnetostrictive, electromagnetic, SMA-based, thermomechanical, electrorheological and other actuators); microsensors: principles and examples (force and pressure, position and speed, acceleration, biological and chemical, temperature and other sensors); MST and information processing; microsystem design and simulation; classification of microrobots; coarse positioning of a microrobot; fine positioning of a microrobot; handling of...
microparts: problems and solutions; micro grasp techniques; microassembly; process automation by microrobots; desktop robot cell in SEM

Reader's advisory

Essential:

- Lecture notes

Recommended:


Secondary Literature (only available for some subareas):

- Elbel, Th.: Mikrosensorik, Vieweg, Wiesbaden, 1996
- Völklein, F. und Zetterer, Th.: Einführung in die Mikrosystemtechnik, Vieweg, Wiesbaden, 2000

Links

Language of instruction: German
Duration (semesters): 1 Semester
Module frequency: jährlich
Module capacity: unlimited
Reference text: Associated with the modules: Embedded Systems and Microrobotics
Modullevel: AS (Akzentsetzung / Accentuation)
Modulart: je nach Studiengang Pflicht oder Wahlpflicht
Lern-/Lehrform / Type of program: V+Ü
Vorkenntnisse / Previous knowledge: Analysis II oder Numerik
Examination: Time of examination: At the end of the semester
Type of examination: Oral exam in German
Final exam of module: At the end of the semester

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Total time of attendance for the module: 56 h
inf209 - Control Theory

Module label | Control Theory
Module code | inf209
Credit points | 6.0 KP
Workload | 180 h

Used in course of study
- Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsmodul
- Dual-Subject Bachelor's Programme Computing Science (Bachelor) > Wahlpflicht Technische Informatik (30 KP)
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Mastermodule
- Master's Programme Computing Science (Master) > Nicht Informatik

Contact person
Module responsibility
- Sergej Fatikow
- Andreas Hein

Authorized examiners
- Sergej Fatikow
- Andreas Hein
- Die im Modul Lehrenden

Entry requirements
- Module Differential Equations
- Module Basics Electrical Engineering

Skills to be acquired in this module

Professional competence
The students:
- Describe the core principles of steering and control of technical systems
- Discuss the modelling core concepts of systems and their controllers
- Name methods to determine the quality of controlled systems
- Model technical systems with differential equations and their transfer functions
- Develop control structures, evaluate their stability and determine their optimal control parameters

Methodological competence
The students:
- Are aware of the technical challenges and solve them by including the implementations of other disciplines and methods

Social competence
The students:
- Present solutions for specific questions

Self-competence
The students:
- Get used to the specific challenges of the development of controlled systems

Module contents
Basics; analog transfer elements: linear time invariant (LTI-) systems; simulation and modeling; step response; frequency response; frequency response locus; differential equations and transfer function; control loop stability; types of controlled systems; types of linear controllers; linear control loops: reference and disturbance reaction of the controlled system; rules for control loop optimization; methods of analysis and synthesis, implementation; computer based control MATLAB/Simulink

Reader's advisory
- Unbehauen, H.: Regelungstechnik I, Klassische Verfahren zur Analyse und Synthese linearer kontinuierlicher Regelsysteme
- Lutz, H. und Wendt, W.: Taschenbuch der Regelungstechnik
- further reading will be announced at lecture
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inf210 - Signal and Image Processing

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Contact person

Module responsibility

- Martin Georg Fränzle
- Andreas Hein

Authorized examiners

- Martin Georg Fränzle
- Andreas Hein
- Die im Modul Lehrenden

Entry requirements

Skills to be acquired in this module

Professional competence

The students:

- Name the concepts of signal and image processing in technical systems
- Name the methods/algorithms of preprocessing, filtering, classification, interpretation and visualisation of signals and pictures
- Select algorithms appropriately
- Evaluate the effectiveness of algorithms
- Design algorithms and processing chains and evaluate their quality

Methodological competence

The students:

- Get used to specific subjects of signal and image processing

Social competence

The students:

- Present solutions for specific questions in signal and image processing

Self-competence

The students:

- Reflect their solutions by using methods learned in this course

Module contents

- Basic Concepts
- Signal Processing
- Signal Spaces and Signal Processing Systems
- Discrete and Constant Signals
- Labelling of Signal Transmitters with Test Signals
- Representations Areas and Transformations
- Time-Discrete Systems and Scanning
- Estimation and Filtering
- Construction with MATLAB
- Image Processing
- Introduction / Range of Applications
- Functional Transformation
- Image Enhancement/Filtering
- Segmentation
- 3D Reconstruction an Visualization
### Reader's advisory

**essential:**
- Slides

**recommended:**
- Meyer, M.; Signalverarbeitung: Analoge und digitale Signale, Systeme und Filter
- Grüningen, D. C. v.; Digitale Signalverarbeitung: mit einer Einführung in die kontinuierlichen Signale und Systeme
- Tönnies, K.; Grundlagen der Bildverarbeitung; Pearson Studium 2005
- Lehmann, Th.; Oberschelp, W.; Pehlak, E.; Pepges, R.; Bildverarbeitung in der Medizin; Springer Verlag 1997
- Handels, H.; Medizinische Bildverarbeitung; Teubner Verlag, Stuttgart - Leipzig 2000

### Links

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### Examination

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**Total time of attendance for the module**: 56 h
inf305 - Medical Technology

Module label: Medical Technology
Module code: inf305
Credit points: 6.0 KP
Workload: 180 h

Used in course of study:
- Master's Programme Computing Science (Master) > Nicht Informatik
- Master's Programme Computing Science (Master) > Technische Informatik
- Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodul
- Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering

Contact person:
Module responsibility:
- Andreas Hein

Authorized examiners:
- Andreas Hein
- Die im Modul Lehrenden

Entry requirements:

Skills to be acquired in this module:

Professional competence:
The students:
- Describe medical diagnosis and therapy methods
- Understand the core concepts of computer-assisted medical interventions
- Are aware of the basic concepts and legal conditions of the development of medical devices
- Define the character of medical devices' software parts and implement them
- Assess the complex interaction of medical products and patients
- Get familiar with the development of medical products within a short period of time

Methodological competence:
The students:
- Recognise the interdisciplinary challenges and accordingly exchange information with other disciplines

Social competence:
The students:
- Present solutions for specific questions

Self-competence:
The students:
- reflect their solutions by using methods learned in this course

Module contents:

- Medical areas and areas of application
- Basic requirements for medical systems (hygiene, MPG, technical security, materials)
- Medical systems:
  - Functional diagnostics (ECG, EMG, EEG)
  - Imaging systems (CT, MRI, ultrasound, PET, SPECT) - Therapy equipment (Laser, RF, Microtherapy)
- Signal processing / monitoring (cardiovascular, hemodynamic, respiratory, metabolic, cerebral)
- Medical Informatics (HIS, DICOM, Telemedicine, VR, image processing).

Reader's advisory:

essential:
- Lecture slides

recommended:

**secondary literature:**


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inf307 - Robotics

Module label  Robotics
Module code  inf307
Credit points  6.0 KP
Workload  180 h

Used in course of study
- Master's Programme Computing Science (Master) > Nicht Informatik
- Master's Programme Computing Science (Master) > Technische Informatik
- Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodule
- Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering

Contact person
Module responsibility
- Andreas Hein
- Die im Modul Lehrenden

Authorized examiners
- Die im Modul Lehrenden
- Andreas Hein

Entry requirements

Skills to be acquired in this module
Professional competence
The students:
- Name and know the functions and applications of robot systems
- Characterise the basic concepts to program robot systems
- Differentiate between the interaction of mechanical, electrical and software components

Methodological competence
The students:
- Define characteristics and components of robot systems for a specific application
- Design and implement robot system sub-components
- Design and parameterise simple control structures
- Plan the application of robot systems and derive the requirements
- Model electrical and mechanical systems
- Develop and realise simple robot systems

Social competence
The students:
- Solve robot systems problems in team work

Self-competence
The students:
- Reflect their solutions in reference to robot system methods

Module contents
- Integration in production plants / aims / subsystems
- Architectures / classifications (classification of robots)
- Robot components « Computer systems for programming
  - PA-10
  - Lego Mindstorms
- Basics of kinematics
  - Coordinate transformation, homogeneous coordinates, Coordinate transitions
  - Kinematic equation systems, transformation of vectors
- Kinematic
  - Joint types (manipulators) / Wheels, TCP
  - Denavit-Hartenberg-Transformation
  - Forward calculation
  - Backward calculation
- Sensors
- General properties of sensors, parameter
- Simple optical position sensors
- Inductive-, capacitive- and ultrasonic-sensors
- Distance sensors (laser scanner, triangulation sensors)
- Force sensors
- Sensor data preparation

- Planing / Regulation
  - Overall regulation approach, terms, process- and control functions, PID-controller
  - Planning concepts and approaches (On-Line, Off-Line), planning processes, construction and path planning

- Actuators

Reader's advisory

**essential:**
- lecture nodes

**recommended:**

**secondary literature:**

**Links**

- **Languages of instruction**
  - German, English

- **Duration (semesters)**
  - 1 Semester

- **Module frequency**
  - once a year

- **Module capacity**
  - unlimited

- **Modullevel**
  - AS (Akzentsetzung / Accentuation)

- **Modulart**
  - Pflicht o. Wahlpflicht / compulsory or optional

- **Lern-/Lehrform / Type of program**
  - V+Ü

- **Vorkenntnisse / Previous knowledge**

- **Examination**
  - Time of examination
  - Type of examination

- **Final exam of module**
  - At the end of the lecture period

- **Course type**
- **Comment**
- **SWS**
- **Frequency**
- **Workload attendance**

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**Total time of attendance for the module**

- 56 h
**inf308 - Microrobotics II**

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<tr>
<td></td>
<td>Master's Programme Computing Science (Master) &gt; Nicht Informatik</td>
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<td>Master's Programme Computing Science (Master) &gt; Technische Informatik</td>
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<td>Master's Programme Embedded Systems and Microrobotics (Master) &gt; Akzentsetzungsmodule</td>
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<td></td>
<td>Master's Programme Engineering of Socio-Technical Systems (Master) &gt; Embedded Brain Computer Interaction</td>
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<td>Master's Programme Engineering of Socio-Technical Systems (Master) &gt; Human-Computer Interaction</td>
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<td>Master's Programme Engineering of Socio-Technical Systems (Master) &gt; Systems Engineering</td>
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<td>Master's Programme Engineering Physics (Master) &gt; Schwerpunkt: Laser and Optics</td>
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<tr>
<td>Contact person</td>
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</tr>
<tr>
<td></td>
<td>▶ Sergei Fatikow</td>
</tr>
<tr>
<td></td>
<td>▶ Die im Modul Lehrenenden</td>
</tr>
<tr>
<td>Authorized examiners</td>
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<td>▶ Sergei Fatikow</td>
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<td>▶ Die im Modul Lehrenenden</td>
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<tr>
<td>Entry requirements</td>
<td></td>
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<tr>
<td>Skills to be acquired in this module</td>
<td>After having given an established introduction in the module “Microrobotics and Microsystem Technology” this lecture offers a further specialisation in microrobotics. Within the course, all relevant areas (among others the research topics of the division “Microrobotics and Control Engineering (AMiR)” will be presented and analysed. The student will be provided with an insight into current research projects of AMiR and of other research institutes of microrobotics worldwide; here mainly the requirements of industry to microrobots will be discussed. The lecture will be enhanced by practical courses in the research laboratories of AMiR.</td>
</tr>
<tr>
<td>Professional competence</td>
<td>The students:</td>
</tr>
<tr>
<td></td>
<td>▶ name and recognise the basic concepts of nanotechnology, in particular, micro- and nanorobotics approaches</td>
</tr>
<tr>
<td></td>
<td>▶ differentiate the development, control and application of micro- and nanorobotics systems</td>
</tr>
<tr>
<td></td>
<td>▶ implement and design application-specific micro- and nanorobotics systems</td>
</tr>
<tr>
<td>Methodological competence</td>
<td>The students:</td>
</tr>
<tr>
<td></td>
<td>▶ transfer their control engineering and image processing abilities on interdisciplinary problems</td>
</tr>
<tr>
<td></td>
<td>▶ transfer their hands-on experience to develop controls and applications of microrobotic systems on new tasks</td>
</tr>
<tr>
<td>Social competence</td>
<td>The students:</td>
</tr>
<tr>
<td></td>
<td>▶ work in a team</td>
</tr>
<tr>
<td>Self-competence</td>
<td>The students:</td>
</tr>
<tr>
<td></td>
<td>▶ reflect their problem-solving behaviour and use hands-on experience to develop, control and application of microrobotics</td>
</tr>
<tr>
<td>Module contents</td>
<td>Smart and versatile microrobots; microactuators (piezo-, ferrofluid- and SMA-actuators) for microrobots; real-time image processing in the micro world (SEM, optical microscopy); micro force sensors and tactile sensors for microrobots; microbot control systems, e.g. neural networks and fuzzy logic; haptic interface for the control of microrobots; neural speech interface for the control of microrobots; robot-based micro- and nanohandling (SEM, optical microscopy); applications: microassembly, nano-testing, cell handling; Micro Air Vehicles (MAVs); multi-robot systems: team behavior, communication, control issues</td>
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<td>Reader's advisory</td>
<td>Lecture notes (can be obtained in secretariate, A1-3-303)</td>
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<td>Link</td>
<td>Value</td>
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<td>Duration (semesters)</td>
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<tr>
<td>Module type</td>
<td>Pflicht o. Wahlpflicht / compulsory or optional</td>
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<td>Lern-Lehrform / Type of program</td>
<td>V+Ü</td>
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<td>Previous knowledge</td>
<td>Mikrorobotik und Mikrosystemtechnik</td>
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<td>Time of examination</td>
<td>At the end of the lecture period</td>
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<td>Type of examination</td>
<td>Oral Exam and exercises</td>
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<td>Frequency</td>
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**inf524 - Introduction to Medicine for Computer Science Students**

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<th>Module label</th>
<th>Introduction to Medicine for Computer Science Students</th>
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<tr>
<td>Module code</td>
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<tr>
<td>Credit points</td>
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<tr>
<td>Workload</td>
<td>180 h</td>
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| Used in course of study           | Master's Programme Computing Science (Master) > Angewandte Informatik  
                                | Master's Programme Computing Science (Master) > Nicht Informatik |
| Contact person                    |                                                        |
| Module responsibility             |                                                        |
| ❖ Rainer Röhrig                   |                                                        |
| ❖ Die im Modul Lehrenden          |                                                        |
| Authorized examiners              |                                                        |
| ❖ Rainer Röhrig                   |                                                        |
| ❖ Die im Modul Lehrenden          |                                                        |
| Entry requirements                |                                                        |

<table>
<thead>
<tr>
<th>Skills to be acquired in this module</th>
<th>Ziele des Moduls:</th>
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<tr>
<td>- Fachkompetenzen</td>
<td>Das Ziel des Moduls ist den Studierenden ein Basiswissen aus der Humanmedizin zu vermitteln. Dies soll bei einer Berufswahl oder Schwerpunkten der Medizinischen Informatik / Medizintechnik das Verständnis der Domäne erleichtern und Grundlagen für eigene Fragestellungen und Ideen zur Anwendung von Methoden der Informatik in der Medizin führen.</td>
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<tr>
<td>- Methodenkompetenzen</td>
<td>Die Studierenden:</td>
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<tr>
<td>- Sozialkompetenzen</td>
<td>Die Studierenden:</td>
</tr>
<tr>
<td>- Selbstkompetenzen</td>
<td>Die Studierenden:</td>
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</table>

**Fachkompetenzen**
Die Studierenden:

- lernen die Grundlagen der medizinischen Terminologie (Terminologia Anatomica) und Anatomie des menschlichen Körpers kennen und können die wichtigsten Strukturen in der Fachsprache benennen
- kennenlernen die Grundlagen der Physiologie des menschlichen Körpers und können die wesentlichen Körper- funktionen beschreiben
- erhalten Einblicke in pathophysiologische Vorgänge des menschlichen Körpers und die damit verbundenen Auswirkungen auf die Funktion des menschlichen Organismus
- kennenlernen Regelkreise des menschlichen Körpers zur Aufrechterhaltung wichtiger körperlicher Funktionen und wissen, dass diese Regelkreise als Möglichkeit in Vorgänge des menschlichen Körpers einzugreifen genutzt werden können
- kennenlernen Referenzwerte wichtiger physiologischer Parameter und können Schlussfolgerungen auf Körperfunktionen ableiten

**Methodenkompetenzen**
Die Studierenden:

- kennenlernen die sich aus den physiologischen Vorgängen des menschlichen Körpers ergebenen möglichen Messverfahren
- wenden Messverfahren an, um Körperfunktionen des Menschen zu beschreiben und zu bewerten. Sie können Anwendungsbeispiele und Beispiele der Interpretation benennen
- kennenlernen Einflussgrößen, die die Interpretation von Ergebnissen aus Messverfahren beeinflussen sowie Grenzen von Messverfahren
- lernen die protokollgeführte Durchführung von Untersuchungen und die standardisierte Dokumentation dieser Ergebnisse

**Sozialkompetenzen**
Die Studierenden:

- erfahren durch regelhafte Rollenwechsel - sie übernehmen sowohl die Rolle des Probanden wie auch die der Versuchsleitung - einen wertschätzenden Umgang miteinander.
- lernen Anhand von Grenzsituationen in der Medizin die Auseinandersetzung mit ethischen Fragestellungen kennen.
- beschreiben die bei Messverfahren gewonnenen Daten detailliert und betrachten diese kritisch mit anderen Studierenden
- integrieren fachliche und sachliche Kritiken in ihre eigenen Handlungsabläufe
- lernen an simulierten Beispielen aus dem klinischen Alltag die zur Gewährleistung einer Patientensicherheit notwendigen standardisierten Abläufe

**Selbstkompetenzen**
Die Studierenden:

- setzen sich mit der Funktion, der Leistungsfähigkeit des eigenen Körpers auseinander aber auch mit dessen Grenzen
setzen sich mit dem Lebenszyklus von Zeugung, Geburt, Adoleszenz, Erwachsenenalter und Altern auseinander

Module contents

Vorlesungen:

- Einführung, Terminologia Anatomica, Räumliche Orientierung (am Skelett)
- Herz-Kreislauf-System
- Atmung
- Nervensystem
- Bewegungsapparat
- Verdauungssystem / Stoffwechsel
- Harnsystem
- Gynäkologie
- Das Organ Blut / Labormedizin
- Fallbeispiel aus der Medizin: Anästhesie / Intensivmedizin
- Pharmakologie
- Bildgebende Verfahren

Zu den Vorlesungen gibt es jeweils Übungsaufgaben zur Vertiefung, bzw. zum Lernen des Stoffes und 2-4 stündige Praktika mit Untersuchungen.

Übungen und Praktika:

- Räumliche Orientierung (am Skelett)
- Schreiben muskulärer Bewegungsabläufe
- EKG ableiten und auswerten
- Spirometrie
- Ultraschalluntersuchungen
- Histologie / Mikroskopie
- Labormedizin
- Gynäkologie
- Standardisierte Einleitung einer Narkose am Phantom

Reader's advisory

- Speckmann / Wittkowski, Handbuch Anatomie, h.f. ulmmanp publishing GmbH 2015, ISBN 978-3-8480-0878-0

Links

https://www.uni-oldenburg.de/versorgungsforschung/abteilungen/medizininformatik/lehre/

Language of instruction

German

Duration (semesters)

1 Semester

Module frequency

jährlich

Module capacity

unlimited

Reference text

Die Durchführung der Veranstaltung erfolgt in Kooperation mit verschiedenen Professuren der Departments. Für Humanmedizin, sowie der Anatomie der Fakultät VI.

Modullevel

AS (Akzentsetzung / Accentuation)

Modulart

je nach Studiengang Pflicht oder Wahlpflicht

Lern-/Lehrform / Type of program

Vorkenntnisse / Previous knowledge

Examination

Time of examination

Type of examination

Final exam of module

Am Ende der Vorlesungszeit / Anfang des Folgesemesters

KL

Course type

Comment

SWS

Frequency

Workload attendance

Lecture

2.00

WiSe

28 h

Exercises

2.00

WiSe

28 h

Total time of attendance for the module

56 h

296 / 308
inf852 - IT Project Management

Module label: IT Project Management
Module code: inf852
Credit points: 6.0 KP
Workload: 180 h

Used in course of study:
- Bachelor's Programme Biology (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Bachelor's Programme Business Administration and Law (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Bachelor's Programme Business Informatics (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Bachelor's Programme Chemistry (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Bachelor's Programme Comparative and European Law (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsmodul
- Bachelor's Programme Computing Science (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Bachelor's Programme Economics and Business Administration (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Bachelor's Programme Economics and Business Administration (Bachelor) > Studienrichtung Wirtschaftsinformatik
- Bachelor's Programme Education (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Bachelor's Programme Engineering Physics (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Bachelor's Programme Environmental Science (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Bachelor's Programme Intercultural Education and Counselling (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Bachelor's Programme Mathematics (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Bachelor's Programme Physics (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Bachelor's Programme Physics, Engineering and Medicine (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Bachelor's Programme Social Studies (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Bachelor's Programme Sustainability Economics (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Art and Media (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Biology (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Chemistry (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Computing Science (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Dutch Linguistics and Literary Studies (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Economics and Business Administration (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Elementary Mathematics (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme English Studies (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Gender Studies (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme General Education (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme German Studies (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme History (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Mathematics (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Material Culture: Textiles (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Natural Sciences (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Material Culture: Textiles (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Mathematics (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
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- Dual-Subject Bachelor's Programme Mathematics (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Mathematics (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Music (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Philosophy / Values and Norms (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Physics (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Politics-Economics (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Protestant Theology and Religious Education (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Slavic Studies (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Social Studies (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Special Needs Education (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Dual-Subject Bachelor's Programme Sport Science (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Fach-Bachelor Pädagogisches Handeln in der Migrationsgesellschaft (Bachelor) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Master's Programme Computing Science (Master) > Nicht Informatik

Contact person
Module responsibility
- Jürgen Sauer

Authorized examiners
- Jürgen Sauer
- Die im Modul Lehrenden

Entry requirements
Skills to be acquired in this module
The participants of this course are aware of problems, activities and tools of data processing project management (DP-Project-Management). They are able to identify and select the corresponding tools in different project stages and are familiar with those tools. They are able to describe the business informatics fields of actions. The are competent to work in a team and organise and implement projects.

Professional competence
The students:
- Characterise problems, activities and tools of the data processing project management.
- Are able to identify the corresponding tools in different project stages
- Use specific DP-Project-Management tools
- Differentiate the business informatics field of actions

Methodological competence
The students:
- Perform projects with the tools of each phase

Social competence
The students:
- Work in small project-teams
- Make design decisions cooperatively
- Present solutions

Self-competence
The students:
- Acquire DP-Project-Management methods and use them
- Recognise and are responsible for working packages

Module contents
It is important to know different IT project management types and forms as well as corresponding methods and tools. This course provides basic data-processing problems, activities and methods. The course is based on M. Burghardt’s book. After an introduction, the course is divided as follows:
- Project management (Requirements Engineering, Profitability Analysis, Organisational Structure)
- Project Planning (Project Structure, Network Analysis, Project Plans)
- Project Control (Cost Evaluation, Quality Control)
- Project Completion

The participants get familiar with project management tools. Presentations drawn from practice are intended.

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<tr>
<td>Modulart</td>
<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
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<td>Lern-/Lehrform / Type of program</td>
<td>V+Ü</td>
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<td>Vorkenntnisse / Previous knowledge</td>
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inf950 - Interdisciplinary Module I

Module label: Interdisciplinary Module I
Module code: inf950
Credit points: 6.0 KP
Workload: 180 h

Used in course of study:
- Master's Programme Computing Science (Master) > Nicht Informatik
- Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodule

Contact person:
Module responsibility
- Die im Modul Lehrenden

Authorized examiners
- Die im Modul Lehrenden

Entry requirements:
Skills to be acquired in this module:

Ziele des Moduls/Kompetenzen:
Die Absolventinnen und Absolventen kennen die Grundlagen und anwendungsrelevanten Hintergründe der ausgewählten Disziplin.

Fachkompetenzen
Die Studierenden:
- benennen die Grundlagen und Methoden des gewählten Gebietes
- wenden die Fachsprache des Anwendungsgebietes kompetent an

Methodenkompetenzen
Die Studierenden:
- charakterisieren Nutzungskontext und Anforderungen von IT im gewählten Gebiet
- wenden die disziplinären Methoden und Techniken des Anwendungsgebietes an und kontrastieren diese mit den aus der Informatik bekannten Methoden und Techniken
- untersuchen Probleme eines Anwendungsgebietes mit den disziplin-typischen Methoden

Sozialkompetenzen
Die Studierenden:
- können die Verschiedenheit von Fachkulturen einschätzen und respektieren andere Fachgebiete und deren Arbeitsweise
- bereiten sich auf Anwendungsszenarien für IT-Systeme vor

Selbstkompetenzen
Die Studierenden:
- reflektieren ihr Selbstbild und Handeln vor dem Hintergrund einer anderen Fachdisziplin

Module contents:
Das Modul wird mit Fachmodulen aus anderen Disziplinen oder Modulen des Departments für Informatik instanziert, die als Nicht Informatik-Modul gekennzeichnet sind. Die Veranstaltungsformen und Prüfungsmodalitäten orientieren sich an dem jeweils gewählten Modul.

Reader's advisory:

Links:

Languages of instruction:

Duration (semesters): 1 Semester

Module frequency:
unlimited

Modullevel: AS (Akzentsetzung / Accentuation)

Modulart: je nach Studiengang Pflicht oder Wahlpflicht

Lern-/Lehrform / Type of program:

Vorkenntnisse / Previous knowledge:

Examination:
Time of examination:
Type of examination:

Final exam of module:
M
<table>
<thead>
<tr>
<th>Course type</th>
<th>VA-Auswahl</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWS</td>
<td>2.00</td>
</tr>
<tr>
<td>Frequency</td>
<td>WiSe</td>
</tr>
<tr>
<td>Workload attendance</td>
<td>28 h</td>
</tr>
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</table>
**inf951 - Interdisciplinary Module II**

<table>
<thead>
<tr>
<th><strong>Module label</strong></th>
<th>Interdisciplinary Module II</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module code</strong></td>
<td>inf951</td>
</tr>
<tr>
<td><strong>Credit points</strong></td>
<td>6.0 KP</td>
</tr>
<tr>
<td><strong>Workload</strong></td>
<td>180 h</td>
</tr>
</tbody>
</table>
| **Used in course of study** | Master's Programme Computing Science (Master) > Nicht Informatik  
                         | Master's Programme Embedded Systems and Microrobotics (Master) > Akzentsetzungsmodul |
| **Contact person**     |                                              |
| **Entry requirements** |                                              |
| **Skills to be acquired in this module** |                                              |
| **Module contents**    |                                              |
| **Reader's advisory**  |                                              |
| **Links**              |                                              |
| **Languages of instruction** |                                              |
| **Duration (semesters)** | 1 Semester                                  |
| **Module frequency**   |                                              |
| **Module capacity**    | unlimited                                    |
| **Modulelevel**        | BC (Basiscurriculum / Base curriculum)       |
| **Modulart**           | je nach Studiengang Pflicht oder Wahlpflicht |
| **Lern-/Lehrform / Type of program** |                                              |
| **Vorkenntnisse / Previous knowledge** |                                              |
| **Examination**        | Time of examination                          |
| **Final exam of module** | Type of examination                          |
| **Course type**        | VA-Auswahl                                   |
| **SWS**                | 2.00                                         |
| **Frequency**          | WiSe                                         |
| **Workload attendance** | 28 h                                        |
mat996 - Introduction to Numerical Analysis

Module label
Introduction to Numerical Analysis

Module code
mat996

Credit points
6.0 KP

Workload
180 h

Used in course of study
- Bachelor's Programme Business Informatics (Bachelor) > Aufbaumodule
- Bachelor's Programme Computing Science (Bachelor) > Wahlpflichtbereich Mathematik
- Master's Programme Computing Science (Master) > Nicht Informatik

Contact person
Module responsibility
- Alexey Chernov
- Frank Schöpfer

Entry requirements
Analysis I, Lineare Algebra

Skills to be acquired in this module
The students learn and analyze the basic numerical methods. The students learn to implement the basic numerical methods in a computer program.

Professional competence
The students:
- learn basic numerical methods and algorithms
- analyze properties of the numerical methods using rigorous mathematical tools
- implement the basic numerical methods in a computer program
- interpret results of computer simulations

Methodological competence
The students:
- analyze algorithms with mathematical tools
- implement numerical algorithms for concrete problems

Social competence
The students:
- develop solutions to given problems in groups
- accept constructive criticism

Personal competence
The students:
- reflect their solution strategies
- deepen their understanding of the presented mathematical and algorithmical concepts with exercises and adopt the solution methods

Module contents
- Numerical methods for linear systems: LU-, Cholesky decompositions, iterative methods
- Numerical methods for nonlinear equations: fix-point iterations, Newton's Method
- Polynomials, spline and trigonometric interpolation
- Numerical integration: Newton-Cotes, Gauss quadrature rules, adaptive quadrature and extrapolation methods
- Stability and conditioning of algorithms and problems

Reader's advisory

Links
Language of instruction
German

Duration (semesters)
1 Semester

Module frequency
every year

Module capacity
unlimited

Reference text
Als 6 KP Modul werden Vorlesung und Übungen nur in den ersten 2/3 des Semesters besucht.

Modullevel
AC (Aufbaucurriculum / Composition)

Modulart
Wahlpflicht / Elective

Lern-/Lehrform / Type of program
Previous knowledge

Examination
Time of examination
Type of examination
Final exam of module
At the end of the lecture period written exam
Final exam of module
<table>
<thead>
<tr>
<th>Course type</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td>2.67</td>
<td>WiSe</td>
<td>37.38 h</td>
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<tr>
<td>Exercises</td>
<td></td>
<td>1.33</td>
<td>WiSe</td>
<td>18.62 h</td>
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</table>

**Total time of attendance for the module**

56 h
mat997 - Introduction to Probability and Statistics

<table>
<thead>
<tr>
<th>Module label</th>
<th>Introduction to Probability and Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module code</td>
<td>mat997</td>
</tr>
<tr>
<td>Credit points</td>
<td>6.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>180 h</td>
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<td>Used in course of study</td>
<td>Bachelor's Programme Computing Science (Bachelor) &gt; Wahlpflichtbereich Mathematik</td>
</tr>
<tr>
<td></td>
<td>Master's Programme Computing Science (Master) &gt; Nicht Informatik</td>
</tr>
<tr>
<td>Contact person</td>
<td>Peter Krug, Marcus Christiansen, Angelika May, Peter Ruckdeschel</td>
</tr>
</tbody>
</table>

**Entry requirements**

Skills to be acquired in this module

- Exemplarisches Kennenlernen weiterer mathematischer Gebiete und damit Erweiterung des eigenen mathematischen Wissens
- Kennenlernen von schulrelevanter Anwendungen
- Vertiefung, auch exemplarisch, der im Grundlagenbereich erworbenen Kenntnisse
- Vernetzung des eigenen mathematischen Wissens durch Herstellung von Bezügen zwischen verschiedenen mathematischen Bereichen
- Aufbau von Grundkenntnissen in Wahrscheinlichkeitstheorie und Statistik
- Vertiefung und Erweiterung der im Grundlagenbereich erworbenen Kenntnisse aus Analysis und Linearer Algebra
- Kennenlernen von schulrelevanten Anwendungen im Bereich diskreter Wahrscheinlichkeitsräume und statistischer Hypothesen
- Kennenlernen von mathematischen Grundlagen der Wahrscheinlichkeitstheorie und Einblicke in die Statistik
- Vernetzung des eigenen mathematischen Wissens durch Verknüpfung wahrscheinlichkeitstheoretischer Konzepte mit Inhalten aus Analysis I und II sowie der Linearen Algebra

**Module contents**

Grundzüge der Maß- und Integrationstheorie, Wahrscheinlichkeitsräume, Zufallsvariablen/-vektoren und ihre Verteilung, Dichte und Verteilungsfunktion, stochastische Unabhängigkeit, Erwartungswert, Varianz und Kovarianz, bedingte Wahrscheinlichkeiten/Erwartungen, multivariate Normalverteilung, Grenzwertsätze: Gesetz der großen Zahlen und Zentraler Grenzwertsatz

**Reader's advisory**

Andreas Büchter, Hans-Wolfgang Henn: Elementare Stochastik, Springer
Herold Dehling, Beate Haupt: Einführung in die Wahrscheinlichkeitstheorie und Statistik, Springer

**Links**

Language of instruction: German

**Duration (semesters)**

1 Semester

**Module frequency**

jährlich

**Module capacity**

unlimited

**Reference text**

Als 6 KP Modul werden Vorlesung und Übungen nur in den ersten 2/3 des Semesters besucht.

**Modullevel**

AC (Aufbaucurriculum / Composition)

**Modulart**

Wahlpflicht / Elective

**Lern-/Lehrform / Type of program**

Vorkenntnisse / Previous knowledge

<table>
<thead>
<tr>
<th>Examination</th>
<th>Time of examination</th>
<th>Type of examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final exam of module</td>
<td>Klausur am Ende des Semesters</td>
<td>KL</td>
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</table>

<table>
<thead>
<tr>
<th>Course type</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td>2.00</td>
<td>SuSe</td>
<td>28 h</td>
</tr>
<tr>
<td>Exercises</td>
<td></td>
<td>2.00</td>
<td>SuSe</td>
<td>28 h</td>
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</tbody>
</table>

**Total time of attendance for the module**

56 h
Abschlussmodul

mam - Master Thesis and Colloquium

<table>
<thead>
<tr>
<th>Module label</th>
<th>Master Thesis and Colloquium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module code</td>
<td>mam</td>
</tr>
<tr>
<td>Credit points</td>
<td>30.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>900 h</td>
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<tr>
<td>Used in course of study</td>
<td>Master's Programme Computing Science (Master) &gt; Abschlussmodul</td>
</tr>
</tbody>
</table>

Contact person

- Michael Sonnenschein
- Andreas Hein
- Die im Modul Lehrenden

Entry requirements

Skills to be acquired in this module

- The students prove that they are able to process and solve complex computer science tasks based on gained scientific knowledge and applied research methods. The students successfully implement a task especially by using their acquired professional and methodological knowledge and their professional and social competences.
- The accompanying seminar is used to discuss the master’s thesis methodically and content-related. During the seminar the exchange of research and practical experience fosters the students’ ability to discuss and evaluate their thesis with other students and experts.
- The master’s thesis is finished by a colloquium.

Professional competence

- The students:
  - Recognise and evaluate applied techniques and methods of their subject and are aware of their limits
  - Design solutions for complex, possibly vaguely defined or unusual computer science tasks/problems and evaluate these with reference to state of the art computer science and technology
  - Identify, structure and solve problems/tasks, also in new or developing subject areas
  - Apply state of the art and innovative methods to solve problems, if necessary from other disciplines
  - Relate knowledge from different disciplines and apply this new knowledge in complex situations
  - Develop complex computer systems, processes and datamodels
  - Are aware of the current limits and contribute to the development of computer science research and technology
  - Discuss and evaluate recent computer science developments

Methodological competence

- The students:
  - Identify and develop one or more solutions
  - Evaluate and apply tools, technology and methods sophisticatedly
  - Examine tasks with technical and research literature, write an academic article and present their solutions academically
  - Schedule processes and resources
  - Apply project management techniques
  - Combine new and original approaches and methods creatively
  - Evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research

Social competence

- The students:
  - Communicate with users and experts convincingly
  - Take reasonable decisions

Self-competence

- The students:
  - Pursue the overall and special computer science development critically
  - Implement innovative professional activities effectively and independently
- Recognise their abilities and extend them purposefully
- Reflect their self-perception and actions with regard to professional, methodological and social aspects
- Develop and reflect self-developed hypotheses to theories independently
- Work in their field independently

<table>
<thead>
<tr>
<th>Module contents</th>
<th>Independently researched scientific work. The research findings will be presented and discussed in a master’s thesis colloquium.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reader’s advisory</td>
<td>Ist entsprechend des konkreten Themas selbst zu recherchieren</td>
</tr>
<tr>
<td>Links</td>
<td></td>
</tr>
<tr>
<td>Languages of instruction</td>
<td>German, English</td>
</tr>
<tr>
<td>Duration (semesters)</td>
<td>1 Semester</td>
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<tr>
<td>Module frequency</td>
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<tr>
<td>Module capacity</td>
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<tr>
<td>Module level</td>
<td>Abschlussmodul (Abschlussmodul)</td>
</tr>
<tr>
<td>Modulart</td>
<td>Pflicht</td>
</tr>
</tbody>
</table>
| Lern-/Lehrform / Type of program | S (2 SWS)  
MA+S                                                                 |
| Vorkenntnisse / Previous knowledge |                                                                                                                            |
| Examination | Time of examination                                                                                                        |
| Final exam of module | Individuell in Absprache mit den GutachterInnen und BetreuerInnen
Master’s thesis, presentation and discussion. |
| Course type | Seminar                                                                                                                     |
| SWS | 2.00                                                                                                                        |
| Frequency | SuSe and WiSe                                                                                                              |
| Workload attendance | 28 h                                                                                                                       |