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Modules for Computing Science

Kernmodule

inf900 - Group Project

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Verwendbarkeit des Moduls

- Master's Programme Business Informatics (Master) > Kernmodule
- Master's Programme Computing Science (Master) > Kernmodule
- Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering

Zuständige Personen

- Peter, Andreas (module responsibility)
- Marx Gómez, Jorge (module responsibility)
- Boll-Westermann, Susanne (module responsibility)
- Boles, Dietrich (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites

- Programming course
- Software Engineering
- Soft Skills

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.

### Literature recommendations

According to the assigned task

### Links

https://uol.de/informatik/studium-lehre/studiengaenge/master-studiengaenge/projektgruppen

### Languages of instruction

German, English

### Duration (semesters)

2 Semester

### Module frequency

semi-annual

### Module capacity

unlimited

### Reference text


### Teaching/Learning method

PG

### Examination

Prüfungszeiten

Type of examination

### Final exam of module

At the End of the semester term

Active involvement, presentation, final report, project assessment

### Form of instruction

Project group

### SWS

16

### Frequency

SoSe und WiSe

### Workload Präsenzzeit

112 h
Module label: Research Project I

Modulkürzel: inf903

Credit points: 12.0 KP

Workload: 360 h

Verwendbarkeit des Moduls:
- Master's Programme Business Informatics (Master) > Kernmodule
- Master's Programme Computing Science (Master) > Kernmodule
- Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering

Zuständige Personen:
- Marx Gómez, Jorge (module responsibility)
- Peter, Andreas (module responsibility)
- Boll-Westermann, Susanne (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites:
The “Research Project” modules (inf903 and inf904) can replace the project group for students who are spending a semester abroad.

Skills to be acquired in this module:
The Module practices the scientific competencies in preparation of the master thesis. It is intended to replace the project group with the two “Research Project” modules to ensure studibility and to enable students to perform research projects at foreign universities. Additionally, it is also intended to embed the student into the research activities of the supervisor in preparation of a potential doctoral work after finishing the program.

Module contents:
Definition of a research question, identifying the state of the art, development of a research plan, performing research tasks, scientific writing, presentation of results.

Professional competence
The students:
- will extend their competences in the required technologies of the research area

Methodological competence
The students:
- will extend their competences in scientific methodologies, methods, and tools regarding the research area

Social competence
The students:
- will be integrated in the working group of the supervisor of the work and have to present as well as discuss the results within the working group

Self-competence:
The students:
- 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 hypothesis to theories independently
- work in their field independently

Literatureempfehlungen
Will be announced by the supervisor according to the research topic.

Links

15 / 459
<table>
<thead>
<tr>
<th><strong>Languages of instruction</strong></th>
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<td>Prüfungszeiten</td>
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### inf904 - Research Project II

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- **Verwendbarkeit des Moduls**
  - Master's Programme Business Informatics (Master) > Kernmodule
  - Master's Programme Computing Science (Master) > Kernmodule

- **Zuständige Personen**
  - Marx Gómez, Jorge (module responsibility)
  - Peter, Andreas (module responsibility)
  - Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**

The “Research Project” modules (inf903 and inf904) can replace the project group for students who are spending a semester abroad.

**Skills to be acquired in this module**

The Module improves the scientific competencies in preparation of the master thesis. It is intended to replace the project group with the two “Research Project” modules to ensure studibility and to enable students to perform research projects at foreign universities. Additionally, it is also intended to embed the student into the research activities of the supervisor in preparation of a potential doctoral work after finishing the program.

**Professional competence**

The students:

- will improve their competences in the required technologies of the research area.

**Methodological competence**

The students:

- will improve their competences in scientific methodologies, methods, and tools regarding the research area.

**Social competence**

The students:

- will be integrated in the working group of the supervisor of the work and have to present as well as discuss the results within the working group.

**Self-competence:**

The students:

- know 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 hypothesis to theories independently
- work in their field independently

**Module contents**

Definition of a research question, identifying the state of the art, development of a research plan, performing research tasks, scientific writing, presentation of results

**Literaturempfehlungen**

Will be announced by the supervisor according to the research topic.

**Links**

- **Languages of instruction**
  - German, English
- **Duration (semesters)**
  - 1 Semester
| **Module frequency** | individually |
| **Module capacity** | unlimited |
| **Teaching/Learning method** | P |
| **Examination** | Prüfungszeiten |
| **Type of examination** | |
| **Final exam of module** | Project |
| **Form of instruction** | Project |
| | Project |
| **SWS** | 4 |
| **Frequency** | WiSe |
| **Workload Präsenzzeit** | 46 h |
Praktische Informatik

inf006 - Software Engineering II

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Verwendbarkeit des Moduls

- Bachelor's Programme Business Informatics (Bachelor) > Akzentsetzungsbereich Praktische Informatik und Angewandte Informatik
- Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsbereich - Wahlbereich Informatik
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Praktische Informatik)
- Master's Programme Business Informatics (Master) > Akzentsatzungsmodul der Informatik
- Master's Programme Computing Science (Master) > Praktische Informatik
- Master's Programme Environmental Modelling (Master) > Mastermodule

Zuständige Personen

- Winter, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites

Expected/useful experience

from inf005 - Software Engineering I

Professional competence

The students:
- recognize the phases in the software life cycle (requirements elicitation, design, implementation, quality assurance)
- name the tasks involved in each phase
- recognize and evaluate the arrangement of these activities in classic and agile approaches
- assess and select suitable process models for the realization of projects
- understand the advantages of the modelling process with UML
- develop and evaluate models in different UML notations and their combinations
- solve given problems with the help of UML notations

Methodological competence

The students:
- structure, evaluate, differentiate and use procedures of classic and agile project management
- structure, document and evaluate problems and solutions using the tools of object-oriented modeling
- apply methods and techniques of object-oriented modeling with UML in a targeted manner

Social competence

The students:
- create, present and discuss solutions to problems using modeling techniques
- describe and solve given modeling problems in teams

Self-competence

The students:
- reflect on their actions when describing problems and developing solutions

Skills to be acquired in this module
The aim of Software Engineering II is to deepen the topics covered in the Software Engineering. Using blended learning methods, students deepen their knowledge of software architecture. In the lecture part, the basics of software architecture and selected topics are presented. Students work together research-oriented to develop an overview of the current literature and the current state of research and practical application of methods and techniques in software architecture. In individual presentations, the students detail selected topics and document them in a joint script. This is supplemented by (invited) lectures on current architecture topics.

**Professional competence**

The students:

- deepen methods and techniques of software engineering
- apply methods and techniques of software engineering specifically to describe, analyze and evaluate software architectures
- differentiate between techniques for the development of software architectures
- implement functional and non-functional requirements in software architectures and independently evaluate and reflect on these solutions

**Methodological competence**

The Students:

- develop a current research map of software architecture
- identify current methods and techniques of software architecture
- identify and discuss cross-references between the topics of the lecture and the contributions of fellow students
- present current solution approaches

**Social competence**

The Students:

- explain and discuss software engineering solutions in their practical application
- accept criticism and understand it as assistance

**Self-competence**

The Students:

- reflect on their actions when identifying approaches to solve software architecture issues
- internalize the development methods presented and add them to their actions

**Module contents**

The following subjects are provided:

- software architecture terminology, software architect, necessity of software architectures
- architecture description, views and viewpoints, architecture patterns, reference viewpoints
- software architecture development procedures (Siemens, 4+1), formal and informal software specification
- model-driven architecture
- domain-specific languages
- software architecture migration

Topics developed and presented individually by students include (depending on the personal interests of the participants)

- quality of software architectures
- concrete architecture patterns, styles, viewpoints
- software deployment
- distributed architectures, service-oriented architectures, component-oriented architectures, software-defined vehicles, event-driven architecture, architecture of IoT systems/CPS, etc
- agile software architecture
- evolution of software architectures
- evaluation and simulation of software architectures

**Literatureempfehlungen**
• Slide script for the lecture
• and actual papers from IEEE Software, IEEE Transactions on Software-Engineering, Informatik-Spektrum und various conferences (ICSE, ICSME, SANER, ICPC, SLE, MODELS etc.)

Links
Language of instruction: German
Duration (semesters): 1 Semester
Module frequency: every summer term
Module capacity: unlimited
Teaching/Learning method: V+S
Examination: Prüfungszeiten
Type of examination: Final exam of module

Final exam of module
Accompanying lectures operation: Portfolio (30-45 minutes presentation, chapter (4-6 pages IEEE) in the common script.

Form of instruction
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Präsenzzeit Modul insgesamt: 56 h
inf040 - Introduction to Data Science

Module label: Introduction to Data Science

Modulkürzel: inf040

Credit points: 6.0 KP

Workload: 180 h

Verwendbarkeit des Moduls
- Bachelor's Programme Business Informatics (Bachelor) > Akzentsetzungsbereich Praktische Informatik und Angewandte Informatik
- Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsbereich - Wahlbereich Informatik
- Bachelor's Programme Sustainability Economics (Bachelor) > Wahlpflichtbereich
- Master Applied Economics and Data Science (Master) > Data Science
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Praktische Informatik)
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Theoretische Informatik)
- Master of Education Programme (Hauptschule and Realschule) Computing Science (Master of Education) > Mastermodule
- Master of Education Programme (Vocational and Business Education) Computing Science (Master of Education) > Akzentsetzungsbereich
- Master's Programme Computing Science (Master) > Praktische Informatik

Zuständige Personen
- Wingerath, Wolfram (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
- Basics of databases, Python programming and statistics

Skills to be acquired in this module

The module teaches fundamentals from the field of Data Science, covering purposes, challenges, and common best practices.

Professional competences
The students
- have knowledge of basic concepts, problems and solution approaches from the field of Data Science.
- are able to justify the choice of specific data analysis methods for a given problem
- include possible imponderables in the analysis when evaluating analysis results

Methodological competences
The students
- are able to translate questions from a specific domain into a feasible analysis
- work on Data Science tasks to expand their understanding of the different approaches and methods.

Social competences
The students
- discuss approaches and problems encountered in smaller and larger groups

Self competences
The students
- reflect on their actions when identifying possible solutions and critically question their own results

Module contents
Data Science is an interdisciplinary science at the intersection of statistics, machine learning, data visualization, and mathematical modeling. This course is designed to provide a practical introduction to the field of Data Science by teaching theoretical principles while also applying them practically. Topics covered range from data collection and preparation (data sources & formats, data cleaning, data bias), mathematical foundations (statistical distributions, correlation analysis, significance) and methods for visualization (tables & plots, histograms, best practices) to the development of models for classifying or predicting values (linear regression, classification, clustering).

<table>
<thead>
<tr>
<th>Literaturempfehlungen</th>
<th>See description of the assigned course</th>
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<table>
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<td>Prüfungszeiten</td>
</tr>
<tr>
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<td>Type of examination</td>
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| Final exam of module   | At the end of the lecture period or by arrangement with the instructor. |
|                        | Written or oral exam or portfolio or project or practical exercise    |

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<td></td>
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inf100 - Human Computer Interaction

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<tr>
<td>Workload</td>
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Verwendbarkeit des Moduls
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Praktische 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

Zuständige Personen
- Boll-Westermann, Susanne (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
Useful previous knowledge: Interactive Systems

Skills to be acquired in this module

With the help of suitable resources, the students can design, prototype, and evaluate a human-machine interface following the user-centered design process (HCD).

Professional competence
The students:
- can describe and explain the HCD process.
- can classify an unknown method into the HCD process when they are presented with a brief description.
- can select a suitable prototyping approach for a given application.
- can select a suitable prototyping method for a given application.
- can apply selected prototyping methods to create an interactive system.
- can name basic characteristics of human perception and motor skills and explain their importance for the development of interactive systems.
- can suggest and motivate improvement for a given user interface based on the gestalt laws.
- can explain the characteristics of human visual search and utilize it to improve given interfaces.
- can critically compare several variants of an interactive system's concept based on the "Multiple Resource Theory".

Methoden competence
The students:
- can critically compare and select methods for context of use and/or user requirements analysis.
- can apply methods for context of use and/or user requirements analysis to a real-world example.
- can retrospectively discuss and evaluate the use of a method for context of use and/or user requirements analysis.
- can plan, moderate and evaluate an ideation session.
- can formulate a precise research question based on a given problem description.
- can discuss the advantages and disadvantages of an experiment design.
- can select a suitable experiment design for a given research question.
- can define hypotheses and null hypotheses for a given experiment.

Social competence
The students:
- can work out solutions for a given design problem in group work.
- can present solutions to design problem in the plenum.
- can motivate their methodical approach to a design problem.
- can discuss their designs and results in an appropriate and professional manner with the plenum.
- can accept criticisms by their peer group as valuable contributions to their designs.
Self-competence:
The students:
- can accept and learn from mistakes made during the design process.

Module contents

The module covers research methods in the field of human-computer interaction. It discusses the core principles of human-computer interaction and the human-centered design process and its phases, context of use, requirements, and task analysis, prototyping and evaluation. Research methods used in the different phases of the process are introduced and discussed.

Available design options for human-machine interfaces are presented and discussed with regard to human perception capabilities and their limitations. The module discusses methods for user research, including surveys, diaries, case studies, interviews, and focus groups, as well as physiological measurements.

The module goes into further detail on evaluation methods, and introduces the foundations of experimental research in human-computer interaction, including types of research, research hypotheses, experimental design, and statistical analysis.

During the practical project, a concrete human-computer interface will be designed, developed and evaluated.

Literatureempfehlungen

- Literature in the reserve shelf in the university bibliography.
- Link list in Stud.IP.

Links

https://uol.de/en/media-informatics/teaching/courses

Languages of instruction

German, English

Duration (semesters)

1 Semester

Module frequency

every summer term

Module capacity

unlimited

Teaching/Learning method

V+Ü

Examination

Prüfungszeiten

Type of examination

Final exam of module

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. Details on the schedule can be found on the websites of the department and in Stud.IP.

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Portfolio
inf105 - Fault Tolerance in Distributed Systems

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**Verwendbarkeit des Moduls**
- Master's Programme Computing Science (Master) > Praktische Informatik

**Zuständige Personen**
- Theel, Oliver (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**
useful previous knowledge: Distributed operating systems

**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 - pessimistic vs. optimistic - semantic vs. syntactic - static vs. dynamic
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

**Literaturempfehlungen**

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| Teaching/Learning method                                           | V+S or V+Ü                                      |
|----------------------------------------------------------------------|
| Examination                                                         | Prüfungszeiten                                  |
| Type of examination                                                 | Written exam or oral exam or practical work     |

| Final exam of module                                                | End of lecture period                          |
|----------------------------------------------------------------------|
| Workload of compulsory attendance                                   | Written exam or oral exam or practical work     |

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| Präsenzzzeit Modul insgesamt                                       | 56 h                                           |
The objective of the module "Requirements Engineering and Management" is to convey the core concepts and technology of the requirements engineering and requirements management.

The lecture follows research oriented teaching methodologies by applying these methods and techniques practically to develop an exemplary requirements definition, starting in the second part of the semester.

**Professional competence**

The students:

- are aware of the necessity of requirements engineering and management
- integrate the process of requirements engineering in the software engineering process
- name methods and tools of requirements engineering and management
- differentiate classical and agile methods and techniques of requirements documentation and management
- select and apply methods and tools from requirements engineering and management to solve given problems appropriately
- illustrate the key tasks of the requirements engineering and management
- name essential concepts to develop and to structure ideas
- discuss methods of analyzing requirements and develop validation concepts

**Methodological competence**

The students:

- apply methods of elicitation, documentation, validation and confirmation of requirements
- create a comprehensive requirement document in group work
- follow problem oriented procedures
- abstract from concrete programming languages

**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
- contrast classical and agile requirements documents in groups

**Self-competence**

The students:

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

**Literaturempfehlungen**

- Slide script for the lecture (currently mixed bilingual)

**Links**

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Examination

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<th>Type of examination</th>
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<tr>
<td>Prüfungszeiten</td>
<td>Portfolio: joint report, individual self assessment report, and short oral exam</td>
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Final exam of module

- At the end of the lecture period

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**Präsenzzeit Modul insgesamt**

| 56 h |
## inf109 - Information Systems III

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<td>Master's Programme Computing Science (Master) &gt; Praktische Informatik</td>
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<tr>
<td>Zuständige Personen</td>
<td>Grawunder, Marco (module responsibility) , Lehrenden, Die im Modul (Prüfungsberechtigt)</td>
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<tr>
<td>Prerequisites</td>
<td>Professional competence</td>
</tr>
<tr>
<td>Skils to be acquired in this module</td>
<td>The students:</td>
</tr>
<tr>
<td></td>
<td>describe concepts, languages and architectures of database systems</td>
</tr>
<tr>
<td></td>
<td>discuss state-of-the-art database research topics</td>
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<tr>
<td></td>
<td>analyse information processing tasks and implement solutions appropriately</td>
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<td>Methodological competence</td>
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<tr>
<td></td>
<td>The students:</td>
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<tr>
<td></td>
<td>propose concrete processing requirements for special application classes</td>
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<tr>
<td></td>
<td>assess the consequences of techniques and approaches</td>
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<tr>
<td></td>
<td>perform supervised research in the field of information systems</td>
</tr>
<tr>
<td></td>
<td>analyse and reflect complex information system requirements</td>
</tr>
<tr>
<td></td>
<td>realize information demands and accordingly gather aim-oriented information</td>
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<td></td>
<td>Social Competencies</td>
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<tr>
<td></td>
<td>The students:</td>
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<tr>
<td></td>
<td>solve problems partially in small groups</td>
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<td></td>
<td>present solution proposals in front of the exercise group</td>
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<td>discuss their different solution proposals within the exercise group</td>
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<td>The students:</td>
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<tr>
<td></td>
<td>accept constructive criticism</td>
</tr>
<tr>
<td></td>
<td>reflect on their proposed solution considering the taught methods</td>
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<td>Module contents</td>
<td>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.</td>
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<tr>
<td>Literatureempfehlungen</td>
<td>Özsu, M. Tamer; Valduriez, Patrick, Principles of distributed database systems</td>
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<td></td>
<td>Rahm/Saake/Sattler: Verteiltes und Paralleles Datenmanagement, Springer</td>
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<td>Paper from SIGMOD, VLDB or ICDE</td>
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| Präsenzzeit Modul insgesamt | 56 h  |
inf11 - Advanced Database Practical

Module label | Advanced Database Practical
---|---
Modulkürzel | inf11
Credit points | 6.0 KP
Workload | 180 h

Verwendbarkeit des Moduls
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Praktische Informatik

Zuständige Personen
- Grawunder, Marco (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
Useful prior knowledge:
- Basics of database systems

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.

Literaturempfehlungen

Suggested reading:
- Held Andrea (2007), Oracle 10g Addison-Wesley.
- Oracle 10g, Das Programmierhandbuch, Galileo Computing
- Oracle Database 11g, DBA-Handbuch, Oracle Press-Hanser Verlag
- NoSQL (2011) Hanser Verlag

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As part of the exercises, the students incrementally develop a complex software application in teams of 2 or 3 students. For this purpose, new subtasks with reference to the respective lecture content have to be worked on weekly. In the oral examination, the students have to show that they know the taught programming technologies and can use them appropriate when developing their own applications.

Skills to be acquired in this module

The objective of the module is to provide the students with modern programming technologies. After the course, the students are able to use these technologies during the development and implementation of complex applications.

**Professional competence**

The students:

- name modern programming technologies
- appropriate use modern programming technologies to solve complex problems

**Methodological competence**

The students:

- search for solutions to specific problems in the internet independently

**Social competence**

The students:

- develop software in teams
- 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 module enhances the students' programming skills. It focuses on modern programming technologies. Among others, these are .NET-Framework, Java Server Technologies like Java EE or Spring, Android App development or the development of skills for digital voice assistants. The new technologies are presented in the lecture part. In the exercises, the students develop their own larger applications in groups of 2 or 3 students in reference to the lecture content.
Literaturempfehlungen

list of links in the learning management system

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Examination

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The presentation of developed solutions takes place weekly during the exercises. Final delivery of the final software application is one week after the end of the lecture period. The oral exam takes place in the second or third week after the end of the lecture period. Any re-examinations take place at the end of the semester break. The exact timetable can be found in the learning management system.

Form of instruction

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Präsenzzeit Modul insgesamt 56 h
inf113 - Operating Systems II

Module label: Operating Systems II
Modulkürzel: inf113
Credit points: 6.0 KP
Workload: 180 h

Verwendbarkeit des Moduls
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodul der Informatik
- Master's Programme Computing Science (Master) > Praktische Informatik

Zuständige Personen
- Theel, Oliver (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
- Betriebssysteme I

Skills to be acquired in this module

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 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

Literaturempfehlungen

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- Grundlagen moderner Betriebssysteme, dpunkt-verlag
inf131 - Advanced Topics in Human Computer Interaction

<table>
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**Verwendbarkeit des Moduls**
- 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

**Zuständige Personen**
- Boll-Westermann, Susanne (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**
Useful previous knowledge: Interactive Systems

**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.

**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 artifacts

**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
- 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:
- are comfortable tackling original research questions
- show aptitude in conceptualizing and running both qualitative and quantitative HCI experiments
- acquire the ability to summarize, analyze, and critique published peer-
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. 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.

Literaturempfehlungen


Links

https://uol.de/en/media-informatics/teaching/courses

<table>
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<td>Project and oral exam</td>
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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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Präsenzeit Modul insgesamt 56 h
inf170 - Special Topics in 'Information Systems’ I

Module label: Special Topics in 'Information Systems’ I

Modulkürzel: inf170

Credit points: 6.0 KP

Workload: 180 h

Verwendbarkeit des Moduls: Master's Programme Computing Science (Master) > Praktische Informatik

Zuständige Personen:
- Grawunder, Marco (module responsibility)
- Wingerath, Wolfram (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites: No participant 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

Literatureempfehlungen
As announced in course

Links

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inf171 - Special Topics in 'Information Systems' II

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Prerequisites

No participant 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

Literaturempfehlungen

As announced in course

Links

Languages of instruction

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</table>
**inf172 - Current Topics in 'Information Systems' I**

<table>
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<td>Modulkürzel</td>
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<td>Verwendbarkeit des Moduls</td>
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<tr>
<td>Zuständige Personen</td>
<td>• Grawunder, Marco (module responsibility)</td>
</tr>
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<td></td>
<td>• Wingerath, Wolfram (module responsibility)</td>
</tr>
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<td></td>
<td>• der Informatik, Lehrende (Prüfungsberechtigt)</td>
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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**

According to the assigned course

**Literaturempfehlungen**

As announced in course

**Links**

Languages of instruction: German, English
<table>
<thead>
<tr>
<th><strong>Duration (semesters)</strong></th>
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<td><strong>Examination</strong></td>
<td>Prüfungszeiten</td>
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<td>At the end of the lecture period</td>
</tr>
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<td>Written Exam or Portfolio or Presentation or oral exam</td>
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**inf173 - Current Topics in 'Information Systems' II**

<table>
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**Verwendbarkeit des Moduls**
- Master's Programme Computing Science (Master) > Praktische Informatik

**Zuständige Personen**
- Grawunder, Marco (module responsibility)
- Wingerath, Wolfram (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**
No participant 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

**Literaturempfehlungen**

As announced in course

**Links**

Languages of instruction: German, English
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</table>
inf174 - Special Topics in 'Media Informatics and Multimedia Systems' I

Module label: Special Topics in 'Media Informatics and Multimedia Systems' I

Modulkürzel: inf174

Credit points: 6.0 KP

Workload: 180 h

Verwendbarkeit des Moduls:
- Master's Programme Computing Science (Master) > Praktische Informatik
- Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction

Zuständige Personen:
- Boll-Westermann, Susanne (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites:
No participant requirements

Skills to be acquired in this module

The aim of the module is to integrate the latest developments in the field of "Media Informatics and Multimedia Systems" appropriately into a course of study.

Professional competences
The students:
- define and contrast special themes in computer science, and reflect on computer science practices in general.
- recognize and evaluate applied techniques and methods and their limits
- identify, structure and solve problems/tasks, in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- recognize 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 and utilize them appropriately
- combine new and original approaches and methods creatively
- reflect on problems/tasks, including new or developing subject areas in their discipline and apply computer science methods for investigation and resolution

Social competences
The students:
- integrate their skills in a team environment.

Self-competences
The students:
- pursue the further development of computer science in general and in this particular sub-field critically
- innovatively conduct professional activities effectively and independently

Module contents
According to the assigned course

Literatureempfehlungen
As announced in course

Links
<table>
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### Final exam of module

- **At the end of the lecture period**
- **Portfolio or Presentation or Oral Exam**

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**Präsenzzeit Modul insgesamt**

56 h
inf175 - Special Topics in 'Media Informatics and Multimedia Systems' II

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Prerequisite

No participant requirements

Skills to be acquired in this module

The aim of the module is to integrate the latest developments in the field of "Media Informatics and Multimedia Systems" appropriately into a course of study.

Professional competences

The students:

- define and contrast special themes in computer science, and reflect on computer science practices in general.
- recognize and evaluate applied techniques and methods and their limits
- identify, structure and solve problems/tasks, in new or developing subject areas
- apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- recognize 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 and utilize them appropriately
- combine new and original approaches and methods creatively
- reflect on problems/tasks, including new or developing subject areas in their discipline and apply computer science methods for investigation and resolution.

Social competence

The students:

- integrate their skills into team processes

Self-competences

The students:

- pursue the further development of computer science in general and in this particular sub-field critically.
- innovatively conduct professional activities effectively and independently.

Module contents

According to the assigned course

Literatureempfehlungen

Literature will be announced in the assigned course
<table>
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<th>Prüfungszeiten</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>Portfolio or presentation or oral exam</td>
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<th>VA-Auswahl</th>
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<td>Frequency</td>
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<tr>
<td>Workload Präsenzeit</td>
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inf176 - Current Topics in 'Media Informatics and Multimedia Systems' I

Module label: Current Topics in 'Media Informatics and Multimedia Systems' I
Modulkürzel: inf176
Credit points: 3.0 KP
Workload: 90 h

Verwendbarkeit des Moduls:
- Master's Programme Computing Science (Master) > Praktische Informatik

Zuständige Personen:
- Boll-Westermann, Susanne (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites:
No participant requirements

Skills to be acquired in this module

The aim of the module is to integrate the latest developments in the field of "Media Informatics and Multimedia Systems" appropriately into a course of study.

Professional competences
The students:
- define, differentiate, and contrast special themes in computer science, and reflect on computer science practices in general
- recognize and evaluate applied techniques and methods and their limits
- identify, structure and solve problems in new or emerging areas of their discipline
- apply appropriate and innovative methods to the state of the art in the investigation and resolution of problems, possibly with recourse to other disciplines
- recognize the limitations of existing knowledge and technology practices and contribute to the further scientific and technological development of computer science
- discuss current developments in computer science and assess their significance

Methodological competences
The students:
- investigate problems based on technical and scientific literature, compose an article according to scientific criteria, and present their results in a scientific lecture
- reflect on problems in new or emerging areas of their discipline and apply computer science methods for investigation and resolution
- do scheduling and planning of resources

Social competences
The students:
- communicate effectively verbally and in writing with users and experts

Self-competences
The students:
- critically pursue the further development of computer science in general and this particular sub-field
- develop and reflect on their own theories and independent hypotheses

Module contents
According to the assigned course

Literaturempfehlungen
As announced in course

Links
<table>
<thead>
<tr>
<th>Languages of Instruction</th>
<th>German, English</th>
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<td>At the end of the lecture period</td>
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inf177 - Current Topics in 'Media Informatics and Multimedia Systems' II

Module label Current Topics in 'Media Informatics and Multimedia Systems' II
Modulkürzel inf177
Credit points 3.0 KP
Workload 90 h

Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Praktische Informatik

Zuständige Personen
- Boll-Westermann, Susanne (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
No participant requirements

Skills to be acquired in this module

The aim of the module is to integrate the latest developments in the field of "Media Information and Multimedia Systems" into a course of study.

Professional competences
The students:
- define, differentiate, and contrast special themes in computer science, and reflect on computer science practices in general.
- recognize and evaluate applied techniques and methods and their limits
- identify, structure, and solve problems in new or emerging areas of their discipline
- apply appropriate and innovative methods to the state of the art in the investigation and resolution of problems, possibly with recourse to other disciplines
- recognize the limitations of existing knowledge and technology practices and contribute to the further scientific and technological development of computer science
- discuss current developments in computer science and assess their significance

Methodological competences
The students:
- investigate problems based on technical and scientific literature, compose an article according to scientific criteria, and present their results in a scientific lecture
- reflect on problems in new or emerging areas of their discipline and apply computer science methods for investigation and resolution
- do scheduling and planning of resources

Social competences
The students:
- communicate effectively verbally and in writing with users and experts

Self-competences
The students:
- critically pursue the further development of computer science in general and this particular sub-field
- develop and reflect on their own theories and independent hypotheses

Module contents
According to the assigned course

Literatureempfehlungen
As announced in course

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**inf178 - Special Topics in 'Software Engineering' I**

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**Verwendbarkeit des Moduls**
- Master's Programme Computing Science (Master) > Praktische Informatik

**Zuständige Personen**
- Winter, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**
No participant requirements

**Skills to be acquired in this module**

The module aims to integrate current developments in the specialization area of **software engineering** into the course of study in the appropriate course forms.

**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

**Literaturempfehlungen**
As announced in course

**Links**

**Language of instruction**
German
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<td><strong>Examination</strong></td>
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<td><strong>Type of examination</strong></td>
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inf179 - Special Topics in 'Software Engineering' II

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Verwendbarkeit des Moduls

- Master's Programme Computing Science (Master) > Praktische Informatik

Zuständige Personen

- Winter, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites

No participant requirements

Skills to be acquired in this module

The module aims to integrate current developments in the field of specialization "Software Engineering" into the course of study in the appropriate course forms.

**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

Literatureempfehlungen

As announced in course
<table>
<thead>
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inf180 - Current Topics in 'Software Engineering' I

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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:
- 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

Literaturempfehlungen
As announced in course

Links

Language of instruction
German
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inf181 - Current Topics in 'Software Engineering' I

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Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Praktische Informatik

Zuständige Personen
- Winter, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
No participant 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

Module contents
See assigned course description

Literatureempfehlungen
As announced in course

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Language of instruction: German
Duration (semesters): 1 Semester
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inf182 - Special Topics in 'System Software and Distributed Systems' I

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**Verwendbarkeit des Moduls**
- Master's Programme Computing Science (Master) > Praktische Informatik

**Zuständige Personen**
- Theel, Oliver (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**
- No participant 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“

**Literaturempfehlungen**
As announced in course

**Links**

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inf183 - Special Topics in 'System Software and Distributed Systems' II

Module label
Special Topics in 'System Software and Distributed Systems' II

Modulkürzel
inf183

Credit points
6.0 KP

Workload
180 h

Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Praktische Informatik

Zuständige Personen
- Theel, Oliver (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
No participant 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“

Literaturempfehlungen
As announced in course

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Language of instruction
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inf184 - Current Topics in 'System Software and Distributed Systems' I

Module label: Current Topics in 'System Software and Distributed Systems' I
Modulkürzel: inf184
Credit points: 3.0 KP
Workload: 90 h

Verwendbarkeit des Moduls: Master's Programme Computing Science (Master) > Praktische Informatik
Zuständige Personen: Theel, Oliver (module responsibility), Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites: No participant 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

Literaturempfehlungen
As announced in course

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inf185 - Current Topics in 'System Software and Distributed Systems' II

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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:

• 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

Literatureempfehlungen
As announced in course

Links

Language of instruction
German
<table>
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<td>Course or seminar</td>
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inf189 - Special Topics in Practical Computer Science I

Module label: Special Topics in Practical Computer Science I

Modulkürzel: inf189

Credit points: 6.0 KP

Workload: 180 h

Verwendbarkeit des Moduls:
- Master's Programme Computing Science (Master) > Praktische Informatik

Zuständige Personen:
- Peter, Andreas (module responsibility)
- Vogel-Sonnenschein, Ute (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites:
The required prerequisites are further specified in the details of the assigned course.

Skills to be acquired in this module

The module aims to integrate current developments in the field of Practical Informatics into the course of study in the appropriate course forms.

Professional competences
The students:
- differentiate and contrast a subarea of practical computer science in more detail
- recognize and assess the techniques and methods to be applied in the special field of the course and their limits
- identify, structure and solve problems also in new or emerging areas of their discipline
- recognize the limits of current knowledge and technology and contribute to the further scientific and technological development of computer science
- discuss current developments in practical computer science and assess their significance
- critically follow further developments in the special field discussed in the course.

Methodological competences
Students will:
- apply state-of-the-art and innovative methods in the reserarch and solution of problems, drawing on other disciplines where appropriate
- investigate problems on the basis of technical and scientific literature, write an article according to scientific criteria, and present their results in a scientific talk
- reflect on problems, including those in new or emerging areas of practical computer science, and apply computer science methods to investigate and solve them
- plan time schedules and other resources
- develop and reflect on their own theories on independently generated hypotheses

Social competences
Students will:
- communicate persuasively orally and in writing with users and professionals
- solve tasks goal-oriented in a team

Self competences
The students
- deepen their self-organization skills
- reflect self-critically on their actions and skills in the special field under consideration and assess them appropriately

Module contents
In this module, content and methods on current topics in practical computer science are taught.

For details on objectives and contents, please refer to the details of the assigned course or contact the lecturers directly.

**Literaturempfehlungen**

depending on the course assigned

**Links**

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**Final exam of module**

- Portfolio and presentation (Referat) : during the course
- Written or oral exam: At the end of the lecture period.
- More detailed information on the forms of examination will be given in the course.

**Form of instruction**

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**SWS**

| 4 |

**Frequency**

| siehe Angebotsrhythmus Modul |

**Workload Präsenzzeit**

| 56 h |
**Skills to be acquired in this module**

The module aims to integrate current developments in the field of Practical Informatics into the course of study in the appropriate course forms.

**Subject competences**

The students:

- differentiate and contrast a subarea of practical computer science in more detail
- recognize and assess the techniques and methods to be applied in the special field of the course and their limits
- identify, structure and solve problems also in new or emerging areas of their discipline
- recognize the limits of current knowledge and technology and contribute to the further scientific and technological development of computer science
- discuss current developments in practical computer science and assess their significance
- critically follow further developments in the special field discussed in the course.

**Methodological competencies**

The Students:

- apply state-of-the-art and innovative methods in the research and solution of problems, drawing on other disciplines where appropriate
- investigate problems on the basis of technical and scientific literature,
- write an article according to scientific criteria, and present their results in a scientific talk
- reflect on problems, including those in new or emerging areas of practical computer science, and apply computer science methods to investigate and solve them
- plan time schedules and other resources
- develop and reflect on their own theories on independently generated hypotheses

**Social Skills**

The Students:

- will communicate persuasively orally and in writing with users and professionals
- will solve tasks goal-oriented in a team

**Self-competencies**

The students:

- deepen their self-organization skills
- reflect self-critically on their actions and skills in the special field under consideration and assess them appropriately

**Module contents**

In this module, content and methods on current topics in practical computer science are taught.
For details on objectives and contents, please refer to the details of the assigned course or contact the lecturers directly.

**Literaturempfehlungen**

depending on the course assigned

**Links**

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**Form of instruction**

VA-Auswahl

**SWS**

2

**Frequency**

siehe Angebotsrhythmus Modul

**Workload Präsenzzeit**

56 h
inf334 - System Level Design

Module label: System Level Design

Modulkürzel: inf334

Credit points: 6.0 KP

Workload: 180 h

Verwendbarkeit des Moduls

- Master's Programme Computing Science (Master) > Praktische Informatik
- 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

Zuständige Personen

- Boll-Westermann, Susanne (module responsibility)
- Peter, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites

No participant 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.

Literaturempfehlungen

Suggested reading:
Main textbooks:


Optional books:


Links

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

Language of instruction
English

Duration (semesters)
1 Semester

Module frequency
annual

Module capacity
unlimited

Teaching/Learning method
V+Ü

Examination
Prüfungszeiten
Type of examination
Final exam of module
at the end of the lecture period
hands-on exercises and oral exam

Form of instruction
Comment
SWS
Frequency
Workload of compulsory attendance

Lecture
2
SoSe
28

Exercises
2
SoSe
28

Präsenzzzeit Modul insgesamt
56 h
inf420 - Introduction to IT-Security

Module label
Introduction to IT-Security

Modulkürzel
inf420

Credit points
6.0 KP

Workload
180 h

Verwendbarkeit des Moduls
- Bachelor's Programme Business Informatics (Bachelor) > Akzentsetzungsbereich Praktische Informatik und Angewandte Informatik
- Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsbereich - Wahlbereich Informatik
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Pflichtmodule
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Angewandte Informatik)
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Theoretische Informatik)
- Master of Education Programme (Hauptschule and Realschule) Computing Science (Master of Education) > Mastermodule
- Master of Education Programme (Vocational and Business Education) Computing Science (Master of Education) > Akzentsetzungsbereich
- Master's Programme Computing Science (Master) > Praktische Informatik

Zuständige Personen
- Peter, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites

Important useful background knowledge:

Fundamental knowledge on algorithms, discrete structures, and linear algebra as for instance covered in the following courses at the UOL:
- Inf030 Programmierung, Datenstrukturen und Algorithmen
- Mat950 Diskrete Strukturen
- Mat955 Lineare Algebra für Informatik

Further useful (but optional) additional knowledge:

Basics of computer networks as for instance covered in the UOL course:
- Inf010 Rechnernetze

Skills to be acquired in this module

Students understand the basic concepts, methods and protocols for protecting data and systems from manipulation and misuse on a basic, practice-oriented, scientific level (see "contents of the module"). The students can explain the causes of security problems in today’s systems, can reproduce the connections between protection mechanisms and the problems they address, and can apply them to case studies. They can identify vulnerabilities, analyze them and understand the attack mechanisms described. In addition, the students are able to discuss possible solutions and are able to protect systems accordingly.

Professional competence

The students

- understand the semantics of security and explain the properties of secure IT systems (see "contents of the module");
- discuss the importance of IT security, and
- carry out simple security analyses of systems.

Methodological competence

The students

- use concepts and techniques to increase security, in particular regarding which protection goals can be achieved with which techniques (see "contents of the module");
- apply mechanisms of IT security in simple scenarios, and
- question the properties and limits of security concepts and combine
different concepts in a meaningful way.

Social competence
The students
- solve problems partially in small groups and thus improve their willingness to cooperate and their communication skills,
- present solutions to IT security problems in front of the exercise group,
- discuss their different solutions within the exercise group, and
- improve their English language skills.

Self-competence
The students
- motivate themselves to work on questions and problems in the domain of IT security,
- justify their own actions with theoretical and methodical knowledge, and
- critically reflect on proposed solutions in relation to social expectations and consequences, taking into account the methods taught.

Module contents
The course provides a broad introduction to IT security, covering the following topics:
- basic terms, concepts, and principles in IT security,
- major cryptographic building blocks (encryption, signatures, ...),
- access control models and mechanisms,
- authentication and key exchange protocols,
- network security basics,
- anonymous communication (including TOR), and
- basics of privacy protection.

Literaturempfehlungen

Links
Language of instruction | English
Duration (semesters) | 1 Semester
Module frequency | Every winter semester
Module capacity | unlimited
Teaching/Learning method | V+Ü
Examination | Prüfungszeiten
Final exam of module

Written or oral exam
The concretely chosen form of examination will be announced in the first week of the course.

Form of instruction | Comment | SWS | Frequency | Workload of compulsory attendance
--- | --- | --- | --- | ---
Lecture | 2 | WiSe | 2
Exercises | 2 | WiSe | 2
Präsenzzeit Modul insgesamt | 4 h
inf1202 - Advanced Practical Course ‘Data Science’

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Verwendbarkeit des Moduls
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Praktische Informatik

Zuständige Personen
- Wingerath, Wolfram (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
Basics of Databases, Basics of Data Science

Skills to be acquired in this module
The goals of this module are to acquire practical knowledge of data science and to relate it to questions from a concrete application domain. Furthermore, the students gain a sustainable insight into the technical realization, implementation, and content classification of data analysis processes and their results.

Professional competences
The students
- have knowledge of technical implementation and programming of data analysis processes
- program and implement processes in the context of data analysis (such as for automation or data cleaning).

Methodological competences
The students
- propose concrete processing principles for specific questions
- reflect on certain technologies and procedures with regard to their effects on the results of data analyses

Social competences
The students
- generate approaches for data analysis in a team

Self competences
The students
- recognize their resilience in implementation and recognize errors
- reflect on their actions

Module contents
This module is primarily designed as a practical continuation of the module Data Science I. It deepens the content covered there through practical application in a concrete problem area. The module focuses on:
- design of analyses to answer concrete questions from the given problem area
- development (and cleaning) of relevant data sources
- selection and application of appropriate concepts and techniques in conducting analyses
- Interpretation and presentation of results

Literaturempfehlungen
See description of the assigned course
<table>
<thead>
<tr>
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<tbody>
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inf1204 - Special topics from the field of ‘Data Science’

Module label: Special topics from the field of ‘Data Science’

Modulkürzel: inf1204

Credit points: 6.0 KP

Workload: 180 h

Verwendbarkeit des Moduls:
- Master’s Programme Business Informatics (Master) > Akzentsetzungsmoduls der Informatik
- Master’s Programme Computing Science (Master) > Praktische Informatik

Zuständige Personen:
- Wingerath, Wolfram (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites:
No participant requirements

Skills to be acquired in this module

The module aims to integrate specific developments in the specialization area of "Data Science" into the course of study in the appropriate course forms.

Professional competences

The students
- differentiate and contrast in more detail a subfield of computer science in which they have specialized or reflect on computer science in general
- recognize and evaluate the techniques and methods to be used in their area of specialization and their limitations
- identify, structure, and solve problems also in new or emerging areas of their discipline
- apply state-of-the-art and innovative methods in investigating and solving problems, drawing on other disciplines as appropriate
- recognize the limits of current knowledge and technology and contribute to the further scientific and technological development of computer science
- discuss current developments in computer science and assess their significance

Methodological competences

The students
- investigate problems using technical and scientific literature write an article according to scientific principles and present their results in a scientific talk
- reflect on problems, including those in new or emerging areas of their discipline, and apply computer science methods to investigate and solve them
- plan time schedules and other resources

Social competences

The students
- communicate persuasively orally and in writing with users and professionals

Self competences

The students
- critically follow further developments in computer science in general and in their special field
- develop and reflect on their own theories in relation to independently formulated hypotheses

Module contents

See description of the assigned course
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inf1206 - Hot topics from the field of 'Data Science' I

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</table>

Skills to be acquired in this module

The module aims to integrate current developments in the specialization area of "Data Science" into the course of study in the appropriate course forms

Professional competences

The students

- differentiate and contrast in more detail a subfield of the field of data science in which they have specialized or reflect on computer science in general
- recognize and evaluate the techniques and methods to be used in their area of specialization and their limitations
- identify, structure, and solve problems also in new or emerging areas of their discipline
- apply state-of-the-art and innovative methods in investigating and solving problems, drawing on other disciplines as appropriate
- recognize the limits of current knowledge and technology and contribute to the further scientific and technological development of computer science
- discuss current developments in computer science and assess their significance

Methodological competences

The students

- investigate problems using technical and scientific literature write an article according to scientific principles and present their results in a scientific talk
- reflect on problems, including those in new or emerging areas of their discipline, and apply computer science methods to investigate and solve them
- plan time schedules and other resources

Social competences

The students

- communicate persuasively orally and in writing with users and professionals

Self competences

The students

- critically follow further developments in computer science in general and in their special field
- develop and reflect on their own theories in relation to independently formulated hypotheses

Module contents

See description of the assigned course
**Literaturempfehlungen**  
Will be announced in the course

### Links

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inf1210 - Practical multimodal-multisensor data analysis pipelines

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Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Praktische Informatik

Zuständige Personen
- Sonntag, Daniel (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
- Basic familiarity with Python and machine learning concepts

Skills to be acquired in this module
- review the current literature on multimodal-multisensor data analysis
- identify unexplored research topics
- recognize good practices and practical aspects of all steps in the data analysis process
- gain hands-on experience on multimodal-multisensor data analysis pipelines

Professional competence
The students:
- recognize the basic concepts of data analysis
- identify the basic steps of data analysis pipelines

Methodological competence
The students:
- clean data based on the principles of tidy data
- visualize data using different libraries and frameworks
- identify relevant data questions and implement machine learning models
- apply version control to data and models
- design and implement a User Interface to interact with the data and models

Social competence
The students:
- present their solutions to the group
- discuss with each other different solution approaches to a given problem
- review and discuss relevant research papers on data analysis

Self competence
The students:
- acknowledge the limits of their ability to cope with approaching assignment deadlines
- reflect on the limits of their ability to structure their project workload

Module contents
Multimodal-multisensor data is profoundly different from past data sources. It is extremely rich and dense data that typically involves multiple time-synchronized data streams, and it also can be analyzed at multiple levels such as signal, activity pattern, representational, transactional, etc. When multimodal-multisensor data are analysed at multiple levels, they constitute a vast multidimensional space for discovering important new phenomena with applied artificial intelligence methods.

This course focusses on Data Analysis Pipelines and covers good practices and practical aspects of all steps in the process: handling file input, organising a project’s code, transforming the data with spectral and machine learning methods, and generating models and visualisations that capture relevant
### Literature recommendations

### Links

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inf1212 - Designing Explainable Artificial Intelligence

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Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Praktische Informatik

Zuständige Personen
- Sonntag, Daniel (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
- Basic knowledge in Artificial Intelligence/Machine Learning
- Interest in the scientific development and evaluation of IT artifacts, which goes hand in hand with literature work
- Willingness to deal with qualitative and/or quantitative evaluation methods
- Interest in prototyping

Recommended prior knowledge:
- Basic knowledge of artificial intelligence and/or relevant programming skills (e.g., Python)
- Familiarity with software for the design of prototypical information systems (e.g., for user interfaces)

Skills to be acquired in this module
- Become acquainted with the research field of Explainable Artificial Intelligence (XAI)
- Become acquainted with different methods and techniques from the field of Explainable Artificial Intelligence (XAI) as well as their characteristics
- Hands-on experience creating XAI systems

Professional competence
The students:
- identify the basic concepts of Explainable Artificial Intelligence (XAI)

Methodological competence
The students:
- apply different methods and techniques from the field of Explainable Artificial Intelligence (XAI) and recognize their characteristics

Social competence
The students:
- present their solutions to the group
- discuss with each other different solution approaches to a given problem
- review and discuss relevant literature

Self competence
The students:
- acknowledge the limits of their ability to cope with approaching assignment deadlines
- reflect on the limits of their ability to structure their project workload

Module contents
This course combines theoretical foundations from the field of Explainable Artificial Intelligence (XAI) with practical implementations for real-world problems. This includes:
- communicating the status quo on the topic of Explainable Artificial Intelligence (XAI) and relevant use cases, stakeholders and research
opportunities
• instantiating possible solutions
• using qualitative and/or quantitative research methods for the
  evaluation of possible solutions
• working on (inter)disciplinary questions with high relevance for research
  and practice

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<thead>
<tr>
<th>Literatureempfehlungen</th>
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Technische Informatik

inf300 - Hybrid Systems

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<td>Credit points</td>
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<td>Workload</td>
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Verwendbarkeit des Moduls

- Master's Programme Computing Science (Master) > Technische Informatik
- 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

Zuständige Personen

- Fränzle, Martin Georg (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites

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.

Literatureempfehlungen


Links

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</tr>
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<tbody>
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<td>Prüfungszeiten</td>
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Final exam of module

- At the end of the lecture period
- Semester project including written work and final presentation

Form of instruction

<table>
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</table>
inf301 - Machine-oriented Systems Engineering

Module label | Machine-oriented Systems Engineering
---|---
Modulkürzel | inf301
Credit points | 6.0 KP
Workload | 180 h

Verwendbarkeit des Moduls
- 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

Zuständige Personen
- Fränzle, Martin Georg (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
- No participant requirements

Skills to be acquired in this module

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.

Literatureempfehlungen
Lecturers notes, hardware manuals and data sheets, and development tool manuals

Links

Languages of Instruction | German, English
Duration (semesters) | 1 Semester
<table>
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<td>Portfolio (Design, development and implementation of embedded systems, colloquium)</td>
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inf303 - Fuzzy Control and Artificial Neural Networks in Robotics and Automation

Module label | Fuzzy Control and Artificial Neural Networks in Robotics and Automation
---|---
Modulkürzel | inf303
Credit points | 6.0 KP
Workload | 180 h

Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Angewandte Informatik
- 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

Zuständige Personen
- Fatikow, Sergej (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
No participant 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
- 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

Literatureempfehlungen
Lecture notes will be provided, to prepare for oral examination

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Final exam of module
At the end of the lecture period until the beginning of the next semester
Hands-on-exercises and oral Exam

Form of instruction | Comment | SWS | Frequency | Workload of compulsory attendance |
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Präsenzzeit Modul insgesamt
56 h
inf305 - Medical Technology

Module label | Medical Technology
Modulkürzel | inf305
Credit points | 6.0 KP
Workload | 180 h

Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Interdisziplinäre Module
- 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

Zuständige Personen
- Hein, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
useful knowledge in
- Signal and Image Processing
- Control Engineering

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
Literaturempfehlungen

essential:
- Lecture slides
- recommended:

secondary literature:

Links

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| Präsenzzeit Modul insgesamt | 56 h |
inf307 - Robotics

Module label  Robotics
Modulkürzel  inf307
Credit points  6.0 KP
Workload  180 h

Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Interdisziplinäre Module
- 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

Zuständige Personen
- Hein, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
No participant 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- und 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

Literaturempfehlungen

essential:

- lecture nodes

recommended:


secondary literature:


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Final exam of module

- At the end of the lecture period
- Portfolio: Hands-on exercises, report, and written or oral exam

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Präsenzzeit Modul insgesamt

56 h
inf308 - Microrobotics II

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

Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Interdisziplinäre Module
- 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

Zuständige Personen
- Fatikow, Sergej (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
Participation in Microrobotics and Microsystems Engineering would be helpful

Skills to be acquired in this module

After having given an established introduction in the module “Microrobotics and Microsystems 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

Literaturempfehlungen

- Lecture notes (can be obtained in secretariate, A1-3-303)  
- Fatikow, Sergej (Ed.): Automated Nanohandling by Microrobots,  

Links

Languages of Instruction  
English, German

Duration (semesters)  
1 Semester

Module frequency  
annual

Module capacity  
unlimited

Teaching/Learning method  
V+Ü

Examination  
Prüfungszeiten  
Type of examination

Final exam of module  
After the end of the module until the beginning of  
the next lecture period  
Oral Exam and exercises

Form of instruction  
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Workload of compulsory attendance

Lecture  
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42

Exercises  
1  
SoSe  
14

Präsenzzeit Modul insgesamt  
56 h
inf311 - Low Energy System Design

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

Verwendbarkeit des Moduls
- 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

Zuständige Personen
- Rauh, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites

Skills to be acquired in this module

This module introduces the estimation of power dissipation and optimisation.

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.

Literatureempfehlungen
- Designing CMOS Circuits for Low Power – Dimitros Soudris, Christian Piguet, Costas Goutis
- 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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**Final exam of module**

- at the end of the lecture period
- hands-on exercises and oral exam

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**Präsenzzzeit Modul insgesamt** 56 h
inf331 - Automated and Connected Driving

**Module label**
Automated and Connected Driving

**Modulkürzel**
inf331

**Credit points**
6.0 KP

**Workload**
180 h

**Verwendbarkeit des Moduls**
- Master's Programme Computing Science (Master) > Technische Informatik
- Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction

**Zuständige Personen**
- Köster, Frank (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**
useful knowledge in
- Computer Engineering,
- Embedded Systems I,
- Embedded Systems II

**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

Literaturempfehlungen

Suggested reading:


Links

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<tr>
<td>Teaching/Learning method</td>
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Examination

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<tr>
<th>Prüfungszeiten</th>
<th>Type of examination</th>
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<tbody>
<tr>
<td>At the end of the lecture period</td>
<td>Praktical work or oral exam</td>
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Form of instruction

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<tr>
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<tr>
<td>Exercises</td>
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Präsenzzzeit Modul insgesamt

56 h
inf332 - Practice Robotics

<table>
<thead>
<tr>
<th>Module label</th>
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<tbody>
<tr>
<td>Modulkürzel</td>
<td>inf332</td>
</tr>
<tr>
<td>Credit points</td>
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<tr>
<td>Workload</td>
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</table>

Verwendbarkeit des Moduls

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

Zuständige Personen

- Hein, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites

No participant requirements

Skills to be acquired in this module

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.

Literaturempfehlungen

- John J. Craig, Introduction to Robotics: Mechanics and Control
- Patrick Goebel, ROS By Example

Links

Language of instruction

English
## Duration (semesters)
1 Semester

## Module frequency
annual

## Module capacity
unlimited

## Teaching/Learning method
V+Ü

## Examination
Prüfungszeiten

### Type of examination
Final exam of module

- At the end of the lecture period
- Demonstration and written documentation

### Form of instruction
<table>
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<tr>
<td>Exercises</td>
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### Präsentzeit Modul insgesamt
56 h
inf334 - System Level Design

<table>
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<tr>
<td>Workload</td>
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<td>Verwendbarkeit des Moduls</td>
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<tr>
<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; Systems Engineering</td>
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<tr>
<td>Zuständige Personen</td>
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</tr>
<tr>
<td>Boll-Westermann, Susanne (module responsibility)</td>
<td></td>
</tr>
<tr>
<td>Peter, Andreas (module responsibility)</td>
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<tr>
<td>Lehrenden, Die im Modul (Prüfungsberechtigt)</td>
<td></td>
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<tr>
<td>Prerequisites</td>
<td></td>
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<tr>
<td>No participant requirements</td>
<td></td>
</tr>
</tbody>
</table>

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.

Literaturempfehlungen

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 | annual
Module capacity | unlimited
Teaching/Learning method | V+Ü
Examination | Prüfungszeiten

Final exam of module
at the end of the lecture period
hands-on exercises and oral exam

Form of instruction | Comment | SWS | Frequency | Workload of compulsory attendance
--- | --- | --- | --- | ---
Lecture | 2 | SoSe | 28
Exercises | 2 | SoSe | 28

Präsenzzzeit Modul insgesamt | 56 h
inf336 - Application Area Automotive

<table>
<thead>
<tr>
<th>Module label</th>
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<tbody>
<tr>
<td>Modulkürzel</td>
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<tr>
<td>Workload</td>
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Verwendbarkeit des Moduls

- 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

Zuständige Personen

- Köster, Frank (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites

No participant requirements

Skills to be acquired in this module

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

Literaturempfehlungen


**Links**

<table>
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<tbody>
<tr>
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<tr>
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<td>Teaching/Learning method</td>
<td>V+Ü</td>
</tr>
<tr>
<td>Examination</td>
<td>Prüfungszeiten</td>
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**Final exam of module**

- At the end of the lecture period
- Practical work and oral exam

<table>
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<td>Exercises</td>
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<td>2</td>
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<td>28</td>
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**Präsenzzeit Modul insgesamt**

56 h
inf338 - Design of Autonomous Systems

Module label: Design of Autonomous Systems

Modulkürzel: inf338

Credit points: 6.0 KP

Workload: 180 h

Verwendbarkeit des Moduls
- 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

Zuständige Personen
- Fränzle, Martin Georg (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
No participant 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.
- Analyze existing architectures for autonomous systems with respect to their performance and safety.
- 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.
- 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.
- 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

Literaturempfehlungen

Links

Language of instruction: English
<table>
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<td>V+Ü</td>
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<td>Examination</td>
<td>Prüfungszeiten</td>
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<td>Final exam of module</td>
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<td>2</td>
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Präsenzzelt Modul insgesamt 56 h
inf339 - Industrie 4.0 Digitalization in Industrial Manufacturing

Module label: Industrie 4.0 Digitalization in Industrial Manufacturing

Modulekürzel: inf339

Credit points: 6.0 KP

Workload: 180 h

Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's Programme Computing Science (Master) > Technische Informatik
- Master's Programme Engineering of Socio-Technical Systems (Master) > Human-Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering

Zuständige Personen
- Fränzle, Martin Georg (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
No participant requirements

Skills to be acquired in this module

The module consists of a lecture part and a seminar part, in which special topics of the lecture are prepared and presented by the students on the basis of examples. This gives a clear insight into the different aspects and allows further discussion. The preparation and presenting a presentation with subsequent discussion on the respective topic area offers a deeper understanding.

**Professional competence**
The student:
- Recognize fundamental relationships of the digitization in industrial manufacturing
- Gain knowledge about key competences of the digitization in industrial manufacturing
- Develop practical knowledge about special topics of the digitization in industrial manufacturing
- Put concrete approaches for discussion

**Methodological competence**
The student:
- Capture needed information and analyze them
- Prepare the recorded information according to target group
- Form an understanding of the digitization in industrial manufacturing

**Social competence**
The student:
- Present and discuss their own work on a technical level

**Self-competence**
The student:
- Understand their own level of knowledge
- Learn how to prepare and present a specific topic

Module contents

The module conveys basic knowledge about the digitization of industrial production (Industrie 4.0). In addition to an overview of economic and technical aspects and opportunities of digitizing production, the module focuses on technologies for data acquisition, communication and control in production plants:
- Networked machine tools, Pproduction planning and control, organization, Quality and IT systems for planning and operation, The Gentelligent workpiece, Intelligent tools, Transfer systems, Assembly 4.0, Cyber Security, Convertible modular automation systems, Production transformation strategy, Business models
Literaturrempfehlungen

- Handbuch Industrie 4.0 – Geschäftsmodelle, Prozesse, Technik*, Gunther Reinhart, 2017
- Handbuch Industrie 4.0 Bd.1 – Produktion*, Birgit Vogel-Heuser, Thomas Bauernhansl, Micheal ten Hompel, 2017
- Handbuch Industrie 4.0 Bd.2 – Automatisierung*, Birgit Vogel-Heuser, Thomas Bauernhansl, Micheal ten Hompel, 2017
- Handbuch Industrie 4.0 Bd.3 – Logistik*, Birgit Vogel-Heuser, Thomas Bauernhansl, Micheal ten Hompel, 2017
- „Handbuch Industrie 4.0 Bd.4 – Allgemeine Grundlagen“, Birgit Vogel-Heuser, Thomas Bauernhansl, Micheal ten Hompel, 2017

Links

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<th>Languages of instruction</th>
<th>German, English</th>
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<td>Teaching/Learning method</td>
<td>V+S</td>
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<tr>
<td>Examination</td>
<td>Prüfungszeiten</td>
</tr>
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<tr>
<td>Final exam of module</td>
<td>At the end of the lecture term</td>
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<tr>
<td>Seminar</td>
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<td>56 h</td>
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inf340 - Uncertainty Modeling for Control in Digitalised Energy Systems

Module label | Uncertainty Modeling for Control in Digitalised Energy Systems
Modulkürzel | inf340
Credit points | 6.0 KP
Workload | 180 h

Verwendbarkeit des Moduls
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Technische Informatik
- Master's programme Digitalised Energy Systems (Master) > Digitalised Energy System Design and Assessment
- Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering

Zuständige Personen
- Rauh, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
Basic knowledge of the control of linear time-continuous and/or time-discrete systems and/or robust control

Skills to be acquired in this module

The students identify fundamentals of uncertainty modelling in control systems as well as problem-specific methods for the consideration of uncertainty during simulation and observer synthesis.

Professional competences
The students:
- identify fundamentals of uncertainty modeling in control systems
- characterize problem-specific solution techniques for systems with stochastic and set-based uncertainty
- are aware of software implementations in simulation, control, and state estimation.

Methodological competences
The students:
- students identify fundamentals of uncertainty modelling in control systems
- characterise problem-specific solution techniques for systems with stochastic and set-based uncertainty
- are aware of software implementations in simulation, control, and state estimation.

Social competences
The students:
- analyse problems of control-oriented uncertainty modelling
- analyse fundamental solution techniques on a theoretical basis as well as transfer and generalise them independently toward novel research-oriented application scenarios.

Self competences
The students:
- critically reflect the achieved results of their project work
- acknowledge limitations of various approaches for a control-oriented uncertainty modeling.

Module contents

1. Mathematical modeling of uncertainty in linear and nonlinear dynamic systems
2. Stochastic modeling approaches
3. Estimation of states, parameters and simulation of uncertain processes
   - Outlook: Markov models
   - Outlook: Bayesian networks

4. Set-based approaches
   - Set-based algorithms: Forward-backward contractor and bisection techniques
   - Interval methods for a verified solution of ordinary differential equations and for a stability proof of uncertain systems
   - Estimation of states and parameters as well as simulation of uncertain processes

5. Outlook: Synthesis of controllers and state observers under an explicit description of uncertainty

Literaturrempfehlungen

- Rauh, A. Folien/ Skript zur Vorlesung „Uncertainty Modelling for Control in DES“.

Links

Language of instruction English
Duration (semesters) 1 Semester Semester
Module frequency every winter term
Module capacity unlimited
Teaching/Learning method V+Ü+P
Examination
Final exam of module
   Following the event period
   Portfolio or written exam

Form of instruction Comment SWS Frequency Workload of compulsory attendance
Lecture 2 WiSe 2
Exercises 1 WiSe 1
Project 1 WiSe 1
Präsenzzeit Modul insgesamt 4 h
inf341 - Robust Control and State Estimation in Digitalised Energy Systems

Module label: Robust Control and State Estimation in Digitalised Energy Systems

Modulkürzel: inf341

Credit points: 6.0 KP

Workload: 180 h

Verwendbarkeit des Moduls
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Technische Informatik
- Master's programme Digitalised Energy Systems (Master) > Digitalised Energy System Automation, Control and Optimisation
- Master's Programme Engineering of Socio-Technical Systems (Master) > Embedded Brain Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering

Zuständige Personen
- Rauh, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites

Basic knowledge of the control of linear continuous-time and/or discrete-time systems or of robust control

Skills to be acquired in this module

The students identify fundamentals of robust control and state estimation as well as problem-specific solution techniques and their corresponding software implementation.

Professional competences

The students
- identify fundamentals of robust control and state estimation
- characterize problem-specific solution techniques for different classes of uncertainty
- are aware of reliable software implementations.

Methodological competences

The students
- analyze problems of robust control and state estimation for dynamic systems
- analyze fundamental solution techniques on a theoretical basis
- transfer as well as generalize those independently to new fields of applications.

Social competences

The students
- develop solution ideas for real-life control problems within an accompanying project in small teams
- explain the obtained results in short presentations.

Self competences

The students
- critically reflect the achieved results of their project work
- acknowledge limitations of various approaches for robust control and state estimation.

Module contents

1. Robustness of linear systems/ system analysis
   - Boundary crossing theorem of Frazer and Duncan
   - Mikhailov criterion
   - Khartonov criterion
   - Frequency response approaches
2. Selected control design techniques/ control synthesis
- Parameter-space approach of Ackermann and Kaesbauer
- Eigenvalue and eigenvalue domain assignment
- H-infinity control
- Frequency response approaches (Sensitivity function approaches in the frequency domain)

3. Robust LMI-based control techniques
- Lyapunov stability
- Polytopic uncertainty modeling
- Optimality of solutions

4. Duality between control and observer synthesis
- Robust state estimation
- Sliding mode observers

5. Interval methods: Solution of static and dynamic problems (Enclosing function values, Branch-and-bound techniques, Verification techniques for differential equations)

6. Fundamentals: Fault detection and fault-tolerant control

Literaturempfehlungen
- Ostertag, E. Mono- and Multivariable Control and Estimation, Springer-Verlag, 2011
- Rauh, A. Folien/ Skript zur Vorlesung „Robuste Regelung und Zustandsschätzung“
- Weinmann, A. Uncertain Models and Robust Control, Springer-Verlag, 1991

Links
Language of instruction | English
Duration (semesters) | 1 Semester Semester
Module frequency | every winter term
Module capacity | unlimited
Teaching/Learning method | V+Ü
Examination | Prüfungszeiten Type of examination
Final exam of module
Written exam: at the end of the lecture period Portfolio or written exam
Portfolio: during the semester
Form of instruction | Comment | SWS | Frequency | Workload of compulsory attendance
Lecture | 2 | WiSe | 28
Exercises | 2 | WiSe | 28
Präsenzzeit Modul insgesamt | | | 56 h
inf350 - Special Topics in 'Safety-Critical Systems' I

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

Modulkürzel
inf350

Credit points
6.0 KP

Workload
180 h

Verwendbarkeit des Moduls
• Master's Programme Computing Science (Master) > Technische Informatik

Zuständige Personen
• Fränzle, Martin Georg (module responsibility)
• Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
No participant 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“, ...

Literaturempfehlungen
As announced in course

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inf351 - Special Topics in ‘Safety-Critical Systems’ II

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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, e.g. „Sicherheitsanalysetechniken“, „Modellbasierter Systementwurf“, ...

Literaturempfehlungen

As announced in course

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inf352 - Current Topics in 'Safety-Critical Systems' I

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Prerequisites

No participant requirements

Skills to be acquired in this module

This module aims to integrate current developments in the specialization area "Safety Critical Systems" into the course of study in the appropriate course forms.

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

Literatureempfehlungen

As announced in course

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inf353 - CurrentTopics in 'Safety-Critical Systems' II

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                        | • Lehrenden, Die im Modul (Prüfungsberechtigt)  |
| Prerequisites         | No participant 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:

- 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

Literatureempfehlungen

As announced in course

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inf354 - Special Topics in 'Hybrid Systems' I

Module label
Special Topics in 'Hybrid Systems' I

Modulkürzel
inf354

Credit points
6.0 KP

Workload
180 h

Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Technische Informatik

Zuständige Personen
- Fränzle, Martin Georg (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
No participant 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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- 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. „Modellbasierter Systementwurf“, „Konstruktionsprinzipien ausgewählter Klassen von Fahrzeugfunktionen“

Literaturempfehlungen
As announced in course

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inf355 - Special Topics in 'Hybrid Systems' II

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**Verwendbarkeit des Moduls**
- Master's Programme Computing Science (Master) > Technische Informatik

**Zuständige Personen**
- Fränzle, Martin Georg (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**
No participant 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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- discuss and evaluate recent computer science developments

**Methodological competences**
The students:
- evaluate and apply tools, technology and methods sophisticatedly
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- 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

**Literaturempfehlungen**
As announced in course

**Links**

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**Final exam of module**
- At the end of the lecture period

**Form of instruction**
- VA-Auswahl

**SWS**
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**Frequency**
- siehe Angebotsrhythmus Modul

**Workload Präsenzzeit**
- 56 h
inf356 - CurrentTopics in 'Hybrid Systems' I

Module label: CurrentTopics in 'Hybrid Systems' I
Modulkürzel: inf356
Credit points: 3.0 KP
Workload: 90 h

Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Technische Informatik

Zuständige Personen
- Fränzle, Martin Georg (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
No participant 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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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

Literatureempfehlungen

As announced in course

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inf357 - Current Topics in 'Hybrid System' II

Module label: Current Topics in 'Hybrid System' II
Modulkürzel: inf357
Credit points: 3.0 KP
Workload: 90 h

Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Technische Informatik

Zuständige Personen
- Fränzle, Martin Georg (Prüfungsberechtigt)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
No participant 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
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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

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As announced in course

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inf358 - Special Topics in 'Hardware/Software Systems' I

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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, e.g. „Spezifikation und Modellierung Eingebetteter Systeme”

### Literatureempfehlungen

As announced in course

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inf359 - Special Topics in ‘Hardware/Software Systems’ II

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Prerequisites

No participant 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“

**Literaturempfehlungen**

As announced in course

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**Final exam of module**

- The exam period will be announced during the course
- Exercises or presentation or oral exam

**Form of instruction**

- VA-Auswahl

**SWS**

- 4

**Frequency**

- siehe Angebotsrhythmus Modul

**Workload Präsenzzeit**

- 56 h
inf360 - CurrentTopics in 'Hardware/Software Systems' I

Module label: CurrentTopics in 'Hardware/Software Systems' I

Modulkürzel: inf360

Credit points: 3.0 KP

Workload: 90 h

Verwendbarkeit des Moduls: Master's Programme Computing Science (Master) > Technische Informatik

Zuständige Personen: Fränzle, Martin Georg (module responsibility)
Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites: No participant 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, ...

Literatureempfehlungen

As announced in course

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Language of instruction: German
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### inf361 - Current Topics in 'Hardware/Software Systems' II

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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:

- 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“, ...

#### Literatureempfehlungen

As announced in course

#### Links

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**inf366 - Special Topics in 'Microrobotics and Control Engineering' I**

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**Skills to be acquired in this module**

This module addresses current developments in the field of microrobotics.

**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**

**Literaturempfehlungen**

will be announced in course

**Links**

**Languages of instruction**

- German, English

**Duration (semesters)**

- 1 Semester

**Module frequency**

- every semester

**Module capacity**

- unlimited

**Teaching/Learning method**

- events from V, S, Ü, P
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**Form of instruction**: VA-Auswahl

**SWS**: 4

**Frequency**: siehe Angebotsrhythmus Modul

**Workload Präsenzzeit**: 28 h
inf367 - Special Topics in 'Microrobotics and Control Engineering' II

Module label: Special Topics in 'Microrobotics and Control Engineering' II

Modulkürzel: inf367

Credit points: 6.0 KP

Workload: 180 h

Verwendbarkeit des Moduls: Master's Programme Computing Science (Master) > Technische Informatik

Zuständige Personen: Fatikow, Sergej (module responsibility) Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites: No participant 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

Literatureempfehlungen
As announced in course

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Language of instruction: German
Duration (semesters): 1 Semester
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inf368 - Current Topics in 'Microrobotics and Control Engineering' I

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

Modulkürzel
inf368

Credit points
3.0 KP

Workload
90 h

Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Technische Informatik

Zuständige Personen
- Fatikow, Sergej (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
Keine Teilnehmervoraussetzungen

Skills to be acquired in this module

This module addresses current developments in the field of microrobotics.

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

Literaturempfehlungen
will be announced in course

Links
Languages of instruction
German, English

Duration (semesters)
1 Semester

Module frequency
every semester

Module capacity
unlimited
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inf369 - Current Topics in 'Microrobotics and Control Engineering' II

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Verwendbarkeit des Moduls

- Master's Programme Computing Science (Master) > Technische Informatik

Zuständige Personen

- Fatikow, Sergej (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites

No participant requirements

Skills to be acquired in this module

This module addresses current developments in the field of microrobotics.

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

Literaturempfehlungen

As announced in course

Links

Languages of instruction | German, English
Duration (semesters)      | 1 Semester
Module frequency          | every semester
Module capacity           | unlimited
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inf374 - Special Topics in 'Automotive' I

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Verwendbarkeit des Moduls

- Master's Programme Computing Science (Master) > Technische Informatik

Zuständige Personen

- Fränzle, Martin Georg (module responsibility)
- Rauh, Andreas (module responsibility)
- Hein, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites

The required prerequisites are specified in the details of the assigned course.

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“

Literaturempfehlungen

As announced in course

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inf375 - Special Topics in 'Automotive' II

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Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Technische Informatik

Zuständige Personen
- Hein, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
No participant 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

Literaturempfehlungen

As announced in course

Links

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inf376 - Current Topics in 'Automotive' I

<table>
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Prerequisites

No participant 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

Literatureempfehlungen

As announced in course

Links

Language of instruction  German
Duration (semesters)     1 Semester
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inf377 - Current Topics in 'Automotive' II

### Module label
Current Topics in 'Automotive' II

### Module label
inf377

### Credit points
3.0 KP

### Workload
90 h

### Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Technische Informatik

### Zuständige Personen
- Lehrenden, Die im Modul (Prüfungsberechtigt)
- Hein, Andreas (module responsibility)

### Prerequisites
No participant 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

### Literatureempfehlungen
As announced in course

### Links

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- German, English

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- 1 Semester
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inf378 - Special Topics in Technical Computer Science I

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| Zuständige Personen                | • Fatikow, Sergej (module responsibility)  
  • Fränzle, Martin Georg (module responsibility)  
  • Peter, Andreas (module responsibility)  
  • Rauh, Andreas (module responsibility)  
  • Lehrenden, Die im Modul (Prüfungsberechtigt) |
| Prerequisites                      | Useful background knowledge is specified in the details of the assigned course. |
| Skills to be acquired in this module |                                              |
| Professional competences          | The students                                  |
|                                   | • know recent technical or scientific developments in computer science  
  • transfer computer science methods and procedure models to the requirements of IT application areas  
  • evaluate the possibilities and limitations of computer science methods and tools and use them appropriately  
  • use them appropriately |
| Methodological competences        | The students                                  |
|                                   | • evaluate problems, formulate them with the help of formal models and examine them adequately  
  • find and present (one or more) approaches to solving computer problems  
  • select and evaluate tools and methods appropriate to the task  
  • investigate problems |
| Social competences                | The students                                  |
|                                   | • cooperate in a team                         |
| Self-competences                  | The students                                  |
|                                   | • plan their independent approach to computer science |

Module contents

The module aims to integrate current developments in computer engineering into the degree program in appropriate course forms.

Literaturempfehlungen

Links

Languages of instruction | German, English |
Duration (semesters)     | 1 Semester    |
Module frequency         | irregular     |
Module capacity          | unlimited     |
Reference text           | If more than one course is assigned to the module, you should generally select courses with a total of 4 SWS, e.g. a lecture with an associated tutorial.
Further information can be found in the description (details) of the assigned courses.

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inf379 - Special Topics in Technical Computer Science II

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Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Technische Informatik

Zuständige Personen
- Fränzle, Martin Georg (module responsibility)
- Peter, Andreas (module responsibility)
- Rauh, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
Useful background knowledge is specified in the details of the assigned course.

Skills to be acquired in this module

Professional competences
The students
- know recent technical or scientific developments in computer science
- transfer computer science methods and procedure models to the requirements of IT application areas
- evaluate the possibilities and limitations of computer science methods and tools and use them appropriately
- use them appropriately

Methodological competences
The students
- evaluate problems, formulate them with the help of formal models and examine them adequately
- find and present (one or more) approaches to solving computer problems
- select and evaluate tools and methods appropriate to the task
- investigate problems

Social competences
The students
- cooperate in a team

Self-competences
The students
- plan their independent approach to computer science

Module contents
The module aims to integrate current developments in computer engineering into the degree program in appropriate course forms.

Literaturempfehlungen

Links
Languages of Instruction German, English
Duration (semesters) 1 Semester
Module frequency irregular
Module capacity unlimited
Reference text
If more than one course is assigned to the module, you should generally select courses with a total of 4 SWS, e.g. a lecture with an associated tutorial. Further information can be found in the description (details) of the assigned course.
Teaching/Learning method events from V, S, Ú, P
Examination Prüfungszeiten Type of examination
Final exam of module

- Written exam or portfolio or presentation or oral exam
- The concretely chosen form of examination will be announced in the respective assigned courses.

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<td>Workload Praenzzzeit</td>
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## Theoretische Informatik

### inf300 - Hybrid Systems

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### Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Technische Informatik
- 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

### Zuständige Personen
- Fränzle, Martin Georg (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

### Prerequisites

### Skills to be acquired in this module

**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.

**Literatureempfehlungen**


**Links**

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**Form of instruction**

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**Präsenzzeit Modul insgesamt**

56 h
**inf453 - Combination of Specification Techniques**

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**Verwendbarkeit des Moduls**
- Master's Programme Computing Science (Master) > Theoretische Informatik

**Zuständige Personen**
- Lehrenden, Die im Modul (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**

**Skills to be acquired in this module**

Introduction to the specification languages Z for data, CSP for processes, and their combination CSP-OZ for reactive systems with data and process parts.

**Professional competence**

The students:
- specify data and processes with Z, CSP and CSP-OZ formally
- check data refinement relations formally
- verify CSP-OZ specifications with FDR model checker

**Methodological competence**

The students:
- are able to integrate complementary specification methods

**Social competence**

The students:
- work together in small groups to solve problems
- present solutions to problems to groups of other students

**Self-competence**

The students:
- learn persistence in pursuing difficult tasks
- learn precision in specifying problems

**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

**Literaturempfehlungen**

**Essential:**
- M. Spivey. The Z Notation - A Reference Manual. Prentice Hall, 1989
  (see http://spivey.orient.ox.ac.uk/~mike/zrm/index.html).

Recommended:

**Links**

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**Final exam of module**

- At the end of the lecture period
- exercises and oral exam

**Form of instruction**

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<th>Frequency</th>
<th>Workload of compulsory attendance</th>
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Präsenzzeit Modul insgesamt: 56 h
inf454 - Communicating and Mobile Systems

**Module label**
Communicating and Mobile Systems

**Modulkürzel**
inf454

**Credit points**
6.0 KP

**Workload**
180 h

**Verwendbarkeit des Moduls**
- Master's Programme Computing Science (Master) > Theoretische Informatik
- Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering

**Zuständige Personen**
- Olderog, Ernst-Rüdiger (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**
No participant requirements

**Skills to be acquired in this module**

**Introduction to Milner’s Calculus of Communicating Systems (CCS) and the ?-calculus.**

**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 \( \pi \)-calculus
- proof of strong equivalence and observational equivalence of given processes
- specification of dynamic data structures in the \( \pi \)-calculus

Literaturempfehlungen

Links

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Final exam of module

At the end of the lecture period

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Präsenzzeit Modul insgesamt

56 h
inf455 - Model Checking

Module label
Model Checking

Modulkürzel
inf455

Credit points
6.0 KP

Workload
180 h

Verwendbarkeit des Moduls
Master's Programme Computing Science (Master) > Theoretische Informatik

Zuständige Personen
- Wehrheim, Heike (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
Useful prerequisites:
set theory, propositional and predicate logic, finite automata

Skills to be acquired in this module

Model checking is a technique for the automatic verification of hardware and software systems. In the course, the students develop knowledge and skills in requirements specification via temporal logic and the automatic algorithmic checking of systems with respect to requirements.

Professional competence
The students:
- name the operators in temporal logics and the differences between linear-time and branching-time logics.
- specify requirements in LTL and CTL
- translate LTL formulae to Büchi automata
- construct BDDs for boolean functions
- describe CTL formulae in fixpoint form
- apply model checking algorithms to Kripke structures
- know the expressivity of bisimulation

Methodological competence
The students:
- apply formal modelling techniques
- prove properties of temporal logics
- use model checking tools for the verification of systems

Social competence
The students:
- work on tasks in groups and discuss solutions
- develop system descriptions in groups and interpret results of tools

Self-competence
The students:
- organize their own work for the course

Module contents

- temporal logics LTL and CTL
- Büchi automata
- explicit model checking
- Binary decision diagrams
- Lattices, fixpoints, CTL as transformers
- Symbolic model checking
- bisimulation

Literaturempfehlungen

- Christel Baier, Joost-Pieter Katoen: Principles of Model Checking, MIT Press
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<td>Final exam of module</td>
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| Final exam of module                       | at the end of the term                       |

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**Präsenzzzeit Modul insgesamt**

56 h
### inf456 - Real-Time Systems

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#### Verwendbarkeit des Moduls
- 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

#### Zuständige Personen
- Olderog, Ernst-Rüdiger (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

#### Prerequisites

### 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

**Literatureempfehlungen**

**Essential:**

**Recommended:**

**Links**

**Languages of instruction**
- German, English

**Duration (semesters)**
- 1 Semester

**Module frequency**
- irregular

**Module capacity**
- unlimited

**Teaching/Learning method**
- V+Ü

**Examination Prüfungszeiten Type of examination**

**Final exam of module**
- At the end of the lecture period
- Exercises and written or oral exam

**Form of instruction Comment SWS Frequency Workload of compulsory attendance**

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**Präsenzzeit Modul insgesamt**
- 56 h
inf462 - Cryptography

Module label
Cryptography

Modulkürzel
inf462

Credit points
6.0 KP

Workload
180 h

Verwendbarkeit des Moduls
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Praktische Informatik)
- Master's Programme Computing Science (Master) > Theoretische Informatik

Zuständige Personen
- Peter, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
Fundamental knowledge on algorithms, discrete structures, and linear algebra as for instance covered in the following bachelor courses at the UOL:
- inf030 Programmierung, Datenstrukturen und Algorithmen
- mat950 Diskrete Strukturen
- mat955 Linear Algebra für Informatik

Skills to be acquired in this module
Students understand the foundations of modern cryptography. The students can explain the formal security definitions of the most essential cryptographic primitives and can apply proof techniques to show that a given cryptographic construction meets a given security definition. They can identify underlying cryptographic assumptions, analyze them and discuss them in context. In addition, the students are able to build cryptographic primitives that provably meet specific security goals.

Professional competences
The students
- understand definitions of security for different cryptographic primitives,
- discuss the importance of cryptography,
- formalize cryptographic assumptions, and
- carry out security proofs of cryptographic primitives.

Metological competence
The students
- use cryptographic concepts and techniques to increase security, in particular regarding which protection goals can be achieved with which cryptographic techniques,
- apply cryptographic mechanisms in simple scenarios, and
- question the properties and limits of cryptographic concepts and combine different concepts in a meaningful way.

Social competence
The students
- solve problems partially in small groups and thus improve their willingness to cooperate and their communication skills,
- present solutions to cryptographic problems in front of the exercise group,
- discuss their different solutions within the exercise group, and
- improve their English language skills.

Self-competence
The students
- motivate themselves to work on questions and problems in the domain of cryptography,
- justify their own actions with theoretical and methodical knowledge, and
- critically reflect on proposed solutions in relation to social expectations and consequences, taking into account the methods taught.
Module contents

The course provides a rigorous treatment of the basic paradigms and principles of modern cryptography. It puts an emphasis on formal definitions of security, precise assumptions, and rigorous proofs of security in well-defined models.

Concretely, the course deals with the formal and rigorous treatment of the following concepts and primitives:

- Private-Key Encryption
  - Definition of secure encryption and the concept of provable security
  - Pseudorandom number generators
  - Constructing secure encryption schemes based on pseudorandomness
  - Security under Chosen- Plaintext Attacks (CPA)
  - Pseudorandom functions and the construction of CPA-secure encryption
  - Pseudorandom permutations and block ciphers
  - Security against Chosen-Ciphertext Attacks (CCA)
- Message Authentication Codes (MACs) and hash functions
- Cryptographic assumptions
- Key management
- Public-key cryptography
  - Recap on RSA
  - Attacks on RSA and mitigations
  - The KEM/DEM paradigm
  - Homomorphic Encryption (particularly Paillier)
  - Secret Sharing and Threshold Encryption
- Advanced topics (varying per semester), e.g.:
  - Secure Multiparty Computation
  - Post-Quantum Cryptography
- Zero-Knowledge Proofs

While some of the above topics are typically covered on a very high level in an introductory course on IT security, it should be stressed that this course on cryptography differs substantially by a much more in-depth treatment of the topics with a focus on formal definitions, precise assumptions, and rigorous proofs.

Literaturempfehlungen

- D. Boneh and V. Shoup. A Graduate Course in Applied Cryptography. Version 0.6, 2023. Available at: http://toc.cryptobook.us/

Links

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The concretely chosen form of examination will be announced in the first week of the course.

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Präsenzzzeit Modul insgesamt 0 h
inf481 - Software Analysis

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Prerequisites

Useful prerequisites:

- set theory, propositional and predicate logic, programming in an imperative language

Skills to be acquired in this module

Software analyses extract facts about programs from source code. Such facts can be employed by compilers to optimize programs during compilation, but can also be used to verify correctness of programs. The students get to know different analysis methods, specify such techniques themselves and implement them.

**Professional competences**

The students:

- get to know data flow analysis and specify them
- name the components of data flow systems
- know when to apply widening operators in an analysis
- are able to develop abstract domains and operators for abstract interpretation
- know predicate abstraction and the principle of counterexample-guided abstraction refinement
- know when and how to apply SSA forms
- are able to judge the precision and scalability of points-to analyses

**Methodological competences**

The students:

- are able to formally define analyses
- are able to prove properties of analyses
- are able to implement analysis

**Social competences**

The students:

- work on tasks in groups and discuss solutions
- implement analyses in groups.

**Self-competences**

The students:

- organize their own work for the course

Module contents

- Data flow analyses
- Abstract interpretation
- Predicate abstraction, CEGAR
- SSA forms
- Slicing
- Points-to analysis
- Symbolic execution

Literaturempfehlungen

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inf484 - Special Topics in 'Correct Systems Design' I

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Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Theoretische Informatik

Zuständige Personen
- Olderog, Ernst-Rüdiger (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
No participant 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

Literaturempfehlungen
As announced in course

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**inf485 - Special Topics in 'Correct Systems Design' II**

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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

**Literatureempfehlungen**

As announced in course

**Links**

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inf486 - Current Topics in 'Correct Systems Design' I

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Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Theoretische Informatik

Zuständige Personen
- Olderog, Ernst-Rüdiger (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
No participant 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

Literatureempfehlungen
As announced in course

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inf487 - Current Topics in 'Correct Systems Design' II

Module label: Current Topics in 'Correct Systems Design' II
Modulkürzel: inf487
Credit points: 3.0 KP
Workload: 90 h

Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Theoretische Informatik

Zuständige Personen
- Olderog, Ernst-Rüdiger (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
No participant 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

Literatureempfehlungen
As announced in course

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Module label: Special Topics in 'Formal Methods'
Modulkürzel: inf489
Credit points: 6.0 KP
Workload: 180 h

Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Theoretische Informatik

Zuständige Personen
- Wehrheim, Heike (module responsibility)
- Lehrenden, Die im Modul (Module counselling)

Prerequisites
Helpful prerequisites: functions, relations etc., logic and automata theory

Skills to be acquired in this module
This module integrates current computer science developments into the informatics program, especially considering the selected focus area, by appropriate study courses

Professional competences
The students:
- know recent technological or scientific computer science developments
- transfer computer science methods and development models to IT application area requirements
- evaluate the possibilities and limitations of computer science methods and tools and
- apply them appropriately

Methodological competences
The students:
- review problems, formulate them with formal models and explore them appropriately
- identify and present (one or more) computer science problem solutions
- select and evaluate appropriate tools and methods
- examine problems with technical and scientific literature

Social competences
The students:
- cooperate in a team

Self-competences
The students:
- plan their informatical actions independently

Module contents
According to the assigned task

Literatureempfehlungen
will be announced in the course

Links
Languages of instruction: German, English
Duration (semesters): 1 Semester
Module frequency: irregular
Module capacity: unlimited
Teaching/Learning method: events from V, Ü, S, P
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<th>Type of examination</th>
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<td>At the end of the lecture period in consultation with the lecturer Portfolio or presentation or oral exam or written exam</td>
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inf490 - Current Topics in 'Formal Methods' I

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**Prerequisites**

No participant requirements

**Skills to be acquired in this module**

This module integrates current computer science developments into the informatics program, especially considering the selected focus area, by appropriate study courses

**Professional competence**

The students:

- know recent technological or scientific computer science developments
- transfer computer science methods and development models to IT application area requirements
- evaluate the possibilities and limitations of computer science methods and tools and
- apply them appropriately.

**Methological competence**

The students:

- review problems, formulate them with formal models and explore them appropriately
- identify and present (one or more) computer science problem solutions
- select and evaluate appropriate tools and methods
- examine problems with technical and scientific literature

**Social competence**

The students:

- cooperate in a team

**Self competence**

The students:

- plan their informatical actions independently

**Module contents**

According to the assigned task

**Literatureemphilehungen**

will be announced in the course

**Links**

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**Form of instruction**
- Course or seminar

**SWS**
- 2

**Frequency**
- siehe Angebotsrhythmus Modul

**Workload Präsenzzeit**
- 28 h
inf491 - Current Topics in Theoretical Computer Science

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Skills to be acquired in this module

This module integrates current developments in the field of Theoretical Computer Science into 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

Literatureempfehlungen

As announced in course

Links

Language of instruction English

Duration (semesters) 1 Semester
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inf492 - Special Topics in Theoretical Computer Science I

Module label: Special Topics in Theoretical Computer Science I

Modulkürzel: inf492

Credit points: 6.0 KP

Workload: 180 h

Verwendbarkeit des Moduls:

- Master's Programme Computing Science (Master) > Theoretische Informatik

Zuständige Personen:

- Wehrheim, Heike (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites:

The required prerequisites are specified in the details of the assigned course.

Skills to be acquired in this module:

The module aims to integrate current developments in the specialization area "Modeling and Analysis of Complex Systems" I into the course of study in the appropriate course forms.

**Professional competencies**

The students:

- differentiate and contrast a subarea of computer science in which they have specialized in more detail or reflect on computer science in general
- recognize and evaluate the techniques and methods to be applied in their special field and their limitations
- identify, structure and solve problems also in new or emerging areas of their discipline
- apply state-of-the-art and innovative methods in investigating and solving problems, drawing on other disciplines as appropriate
- recognize the limits of current knowledge and technology and contribute to the further scientific and technological development of computer science
- discuss current developments in computer science and assess their significance

**Methodological competencies**

The students:

- evaluate tools, technologies and methods and apply them in a differentiated manner
- creatively develop new and original approaches and methods
- reflect on problems also in new or emerging areas of their discipline and apply computer science methods for investigation and solution

**Social Competencies**

The students:

- integrate their skills into team processes

**Self-competencies**

The students:

- critically follow further developments in computer science in general and in their field of specialization
- carry out innovative activities in their professional field successfully and independently

Module contents:

depending on the assigned course

Literatureempfehlungen:

will be announced in the course
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inf493 - Special Topics in Theoretical Computer Science II

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</table>

Prerequisites

The required prerequisites are specified in the details of the assigned course.

Skills to be acquired in this module

The aim of the module is to integrate current developments in theoretical computer science into the degree program in appropriate course formats.

Professional skills

The students:

• differentiate and contrast a sub-area of computer science in which they have specialized in more detail or reflect on computer science in general
• recognize and assess the techniques and methods to be used in their special field and their limitations
• identify, structure and solve problems in new or emerging areas of their discipline
• apply state-of-the-art and innovative methods to investigate and solve problems, drawing on other disciplines where appropriate
• recognize the limits of today's knowledge and technology and contribute to the further scientific and technological development of computer science
• discuss current developments in computer science and assess their significance

Methodological skills

The students:

• evaluate tools, technologies and methods and apply them in a differentiated manner
• creatively develop new and original approaches and methods
• reflect on problems in new or emerging areas of their discipline and apply computer science methods to investigate and solve them

Social skills

The students:

• integrate their skills into team processes

Personal skills

The students:

• pursue the further developments in computer science in general and in their specialized field successfully and independently carry out innovative activities in their professional field

Module contents

Depending on the assigned course

Literatureempfehlungen

will be announced in the course
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| **Form of instruction** | VA-Auswahl |
| **SWS** | 2 |
| **Frequency** | siehe Angebotsrhythmus Modul |
| **Workload Präsenzzeit** | 28 h |
**inf494 - Current Topics in 'Modeling and Analysis of Complex Systems' I**

<table>
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<td><strong>Credit points</strong></td>
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**Verwendbarkeit des Moduls**

- Master's Programme Computing Science (Master) > Theoretische Informatik

**Zuständige Personen**

- Wehrheim, Heike (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**

No participant 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“

**Literatureempfehlungen**

As announced in course

**Links**

**Languages of instruction**

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inf495 - Current Topics in 'Modeling and Analysis of Complex Systems' II

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<td>Wehrheim, Heike (module responsibility)  Lehrenden, Die im Modul (Prüfungsberechtigt)</td>
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Prerequisites

No participant 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“

Literaturempfehlungen

As announced in course

Links

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<th>Languages of Instruction</th>
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inf496 - Current Topics in 'Formal Methods'

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Skills to be acquired in this module

This module integrates current computer science developments in formal methods into the informatics program by appropriate study courses.

**Professional competences**

The students

- know recent technological or scientific computer science developments
- transfer computer science methods and development models to IT application area requirements
- evaluate the possibilities and limitations of computer science methods and tools and
- apply them appropriately.

**Methological competences**

The students

- review problems, formulate them with formal models and explore them appropriately
- identify and present (one or more) computer science problem solutions
- select and evaluate appropriate tools and methods
- examine problems with technical and scientific literature

**Social competences**

The students

- cooperate in a team

**Self competences**

The students

- plan their informatical actions independently

Module contents

According to the assigned task

Literatureempfehlungen

will be announced in the course

Links

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<td>siehe Angebotsrhythmus Modul</td>
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<tr>
<td>Workload Präsenzzeit</td>
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inf131 - Advanced Topics in Human Computer Interaction

Module label: Advanced Topics in Human Computer Interaction

Modulkürzel: inf131

Credit points: 6.0 KP

Workload: 180 h

Verwendbarkeit des Moduls
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodul 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

Zuständige Personen
- Boll-Westermann, Susanne (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites

Useful previous knowledge: Interactive Systems

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.

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 artifacts

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:
Module contents

Human-Computer Interaction (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.

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.

Literatureempfehlungen


Links

http://uol.de/en/media-informatics/teaching/courses

Language of instruction: English
Duration (semesters): 1 Semester
Module frequency: every winter term
Module capacity: 24
Teaching/Learning method: V+Ü
Examination:
Type of examination:
Final exam of module:
At the end of the lecture period
Project and oral exam

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.
Examination
Prüfungszeiten
Type of examination

- 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>
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Form of instruction | Comment | SWS | Frequency | Workload of compulsory attendance |
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inf303 - Fuzzy Control and Artificial Neural Networks in Robotics and Automation

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**Verwendbarkeit des Moduls**
- Master's Programme Computing Science (Master) > Angewandte Informatik
- 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

**Zuständige Personen**
- Fatikow, Sergej (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**
- No participant 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

**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
- 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

Lecture notes will be provided, to prepare for oral examination

Language of instruction | German
Duration (semesters) | 1 Semester
Module frequency | annual
Module capacity | unlimited
Teaching/Learning method | V+Ü
Examination | Prüfungszeiten
Type of examination
Final exam of module
At the end of the lecture period until the beginning of the next semester
Hands-on-exercises and oral Exam

Form of instruction | Comment | SWS | Frequency | Workload of compulsory attendance
Lecture | | 3 | SoSe | 42
Exercises | | 1 | SoSe | 14
Präsenzzeit Modul insgesamt | | | | 56 h
Module contents

The module conveys basic knowledge about the digitization of industrial production (Industrie 4.0). In addition to an overview of economic and technical aspects and opportunities of digitizing production, the module focuses on technologies for data acquisition, communication, and control in production plants.

Networked machine tools, Production planning and control, organization, Quality and IT systems for planning and operation, The Intelligent workpiece, Intelligent tools, Transfer systems, Assembly 4.0, Cyber Security, Convertible modular automation systems, Production transformation strategy, Business models.
Literaturempfehlungen

- Handbuch Industrie 4.0 – Geschäftsmodelle, Prozesse, Technik", Gunther Reinhart, 2017
- Handbuch Industrie 4.0 Bd.1 – Produktion", Birgit Vogel-Heuser, Thomas Bauernhansl, Michael ten Hompel, 2017
- Handbuch Industrie 4.0 Bd.2 – Automatisierung", Birgit Vogel-Heuser, Thomas Bauernhansl, Michael ten Hompel, 2017
- Handbuch Industrie 4.0 Bd.3 – Logistik", Birgit Vogel-Heuser, Thomas Bauernhansl, Michael ten Hompel, 2017
- „Handbuch Industrie 4.0 Bd.4 – Allgemeine Grundlagen", Birgit Vogel-Heuser, Thomas Bauernhansl, Michael ten Hompel, 2017

Links

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<tr>
<th>Languages of instruction</th>
<th>German, English</th>
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<tr>
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Final exam of module

- At the end of the lecture term
- Oral exam

Form of instruction | Comment | SWS | Frequency | Workload of compulsory attendance |
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inf502 - Simulation

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Verwendbarkeit des Moduls

- Master's Programme Business Informatics (Master) > Akzentsetzungsmodul der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering

Zuständige Personen

- Hahn, Axel (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites

- Programming knowledge, primarily in Java, is mandatory

Skills to be acquired in this module

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 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
- understand the handling of time and problems of discretization.
- can solve problems with simulation after lecture. This includes modelling, use of simulation environment and evaluation of results.
- will be learned cause of practical use, the independent handling of research questions and the use of simulation as research method

**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

Literatureempfehlungen

Links
Languages of instruction | German, English
Duration (semesters) | 1 Semester
Module frequency | annual
Module capacity | unlimited
Teaching/Learning method | V+S+P
Examination | Prüfungszeiten
Type of examination
Final exam of module | Registration 2 weeks after the start of lectures
Seminar / Project report

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**inf510 - Energy Information Systems**

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<td>Workload</td>
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**Verwendbarkeit des Moduls**
- Master Applied Economics and Data Science (Master)  >  Specialization
- Master's Programme Business Informatics (Master)  >  Akzentsetzungsmodul der Informatik
- Master's Programme Computing Science (Master)  >  Angewandte Informatik
- Master's Programme Environmental Modelling (Master)  >  Mastermodule

**Zuständige Personen**
- Lehnhoff, Sebastian (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**
No participant 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

Literaturempfehlungen

- Crastan V.: “Elektrische Energieversorgung II”, Springer 2004

Links

<table>
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Examination

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<td>Student research project or presentation</td>
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Form of instruction

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Präsenzzeit Modul insgesamt 56 h
inf511 - Smart Grid Management

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Verwendbarkeit des Moduls

- 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
- Sustainable Renewable Energy Technologies (Master) > Mastermodule

Zuständige Personen

- Lehnhoff, Sebastian (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites

No participant 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 mathematical modelling and calculation methods to analyse conditions of electrical energy networks (in stationary conditions). These are:

- The organisation of the EU energy market (regulatory framework, responsibility in liberalisation 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

Literaturempfehlungen

Suggested reading:

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

Links

Language of instruction English
Duration (semesters) 1 Semester
Module frequency jährlich
Module capacity unlimited
Teaching/Learning method V+Ü
Examination Prüfungszeiten Type of examination
Final exam of module At the end of the semester written or oral exam

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inf513 - Energy Informatics Lab

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**Verwendbarkeit des Moduls**
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik

**Zuständige Personen**
- Lehrenden, Die im Modul (Prüfungsberechtigt)
- Lehnhoff, Sebastian (module responsibility)

**Prerequisites**
- Programming with Java
- Programming with Python

**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
Module contents

In this practical course students:

- model controllable, modulating electrical energy generators and consumers,
- put their hands on mosaik (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.

Literaturempfehlungen

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

annual

Module capacity

unlimited

Reference text

Elective module in the master specialization area (energy computer science).

Associated with the modules:

- Energieinformationssysteme
- Smart Grid Management
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**Form of instruction**  
Practical training

**SWS**  
4

**Frequency**  
SoSe

**Workload Präsenzzeit**  
56 h
inf514 - Simulation-based Smart Grid Engineering and Assessment

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Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's programme Digitalised Energy Systems (Master) > Computer Science and Energy Informatics

Zuständige Personen
- Lehnhoff, Sebastian (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
Basic programming in Java or Python

Skills to be acquired in this module
Goal of this module is to teach mathematical and methodological foundations of energy informatics and for conducting large-scale simulation studies

Professional competence
The students:
- know methods to analyze black-box objective functions
- recognize the relation between precision and reliability of expected results and the necessary surplus effort
- know methods to determine cause-effect relations between input parameters with small numbers of simulations (experiments)
- evaluate the significance of simulation results
- characterize (distributed) algorithms by their properties
- transfer proving techniques to distributed problems

Methodological competence
The students:
- choose suitable statistical methods to interpret simulation results
- apply methods from design of experiments
- apply significance tests to compare algorithms
- generate arbitrarily distributed input data
- present results from algorithm evaluation statistically sound

Social competence
The students:
- discuss the own algorithm choice
- present their results and discuss with other students

Self-competence
The students:
- reflect their own usage of the scarce resource energy
- reflect problems and uncertainties when using statistical methods
- recognize the limits of simulation studies and their responsibility for choosing correct statistical methods
- accept criticism and understand it as a suggestion for the further development of their own actions

Module contents
The goal of this module is to teach mathematical and methodological foundations of energy informatics and especially for conducting large-scale simulation studies.

Literatureempfehlungen
Will be announced in the lecture
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| **Final exam of module**                                           |                                               |
| **At the end of the lecture term**                                 |                                               |

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inf515 - Intelligent Energy Systems

Module label: Intelligent Energy Systems
Modulkürzel: inf515
Credit points: 6.0 KP
Workload: 180 h

Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Angewandte Informatik

Zuständige Personen
- Bremer, Jörg (module responsibility)
- Lehnhoff, Sebastian (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
- Programming knowledge in Python

Skills to be acquired in this module


Fachkompetenzen

Die Studierenden
- kennen Methoden zur Modellierung der Flexibilität von Energieanlagen mittels maschinellem Lernen
- können Flexibilitätsmodelle implementieren
- kennen verschiedene Ansätze der Agenten-basierten Modellierung und Koordination im elektrischen Netz
- kennen Techniken des Adversarial Resilience Learning
- bewerten verschiedene Verfahren des Deep und Reinforcement Learning hinsichtlich ihrer Eigenschaften und Eignung in der verteilten Lastplanung
- charakterisieren Methoden maschinelles Lernens anhand ihrer Eigenschaften

Methodenkompetenz

Die Studierenden
- erzeugen systematisch zulässige Lösungen mittels Einsatz von Dekodertechnik
- wenden maschinelles Lernen in verteilten Algorithmen praktisch an

Sozialkompetenz

Die Studierenden
- wenden die Entwicklungsmethode des Pairprogrammings an
- diskutieren die getroffenen Design Entscheidungen
- präsentieren ihre Arbeitsergebnisse anderen Studierenden

Selbstkompetenz

Die Studierenden
- reflektieren den eigenen Umgang mit der begrenzten Ressource Energie
- nehmen Kritik an und verstehen sie als Vorschlag für die Weiterentwicklung des eigenen Handelns
- erkennen die gesellschaftspolitische Verantwortung beim Einsatz von Methoden der künstlichen Intelligenz

Module contents

In dieser Veranstaltung werden
• mathematische Grundlagen Supportvektor-basierter Modellierungstechniken vermittelt
• geometrische Untervektorraummodellierungen vermittelt und von den Studierenden angewendet
• Grundlagen verteilter Algorithmen in Energienetzen vermittelt
• das Design intelligenten Agenten mittels Reinforcement Learning und Q-Learning vermittelt und praktisch angewendet
• Grundlagen des Adversarial Resilience Learning vermittelt

Literaturempfehlungen

• Mehr wird in der Veranstaltung bekannt gegeben

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### inf516 - Distributed Operation in Digitalised Energy Systems

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| Verwendbarkeit des Moduls | - Master's Programme Computing Science (Master) > Angewandte Informatik  
- Master's programme Digitalised Energy Systems (Master) > Digitalised Energy System Automation, Control and Optimisation |
| Zuständige Personen | - Nieße, Astrid (module responsibility)  
- Lehrenden, Die im Modul (Prüfungs berechtigt) |
| Prerequisites | Fundamentals of Optimization, Fundamentals of Digitized Energy Systems |

#### Skills to be acquired in this module

After successful completion of this course, the students are able to analyze an application problem in cyber-physical energy systems to decide whether a distributed optimization approach could be usefully applied. Fundamentals of self-organizing systems are understood and can be transferred to specific applications. Furthermore, the basic concepts of distributed methods can be applied safely and transferred to an application case.

**Professional competence**

The students:

- will be familiar with the basic concepts of distributed optimization and agent systems mentioned above

**Methodological competence**

The students:

- will be able to present the fundamental concepts of distributed optimization and agent systems mentioned above and apply them to application problems in CPES

**Social competence**

The students:

- create solutions in small teams
- present and discuss their solutions
- reflect the solutions of others in a constructive manner

**Self competence**

The students:

- critically question the application of learned methods to a real-world problem

#### Module contents

In this course, fundamentals of agent-based control with applications in cyber-physical power systems are reviewed, discussed, and reinforced in the accompanying programming exercise.

These are:

1. Multi-agent systems
   - Foundations and definitions
   - MAS architectures
   - Agent communication
   - Cooperative and competitive agents MAS
   - Learning in MAS
2. Distributed Optimization
   - CASIMIR
   - Overview on distributed optimization
   - CSP and COP
   - Distributed SCP und COP
3. Self-organizing energy systems
4. Applications
   - Virtual Power Plants
   - QEMS and Microgrids
   - DSM and DR
   - Energy market applications
   - Swarms for storage management
   - Multi-purpose examples
5. Programming part
   - Agent framework mango
   - Co-simulation framework mosaik
   - Power grid simulation pandapower

Literatureempfehlungen


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<th>Language of instruction</th>
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<td>Portfolio or oral exam or written exam</td>
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Präsenzzeit Modul insgesamt

56 h
inf524 - Medical Basics

Module label
Medical Basics

Modulkürzel
inf524

Credit points
6.0 KP

Workload
180 h

Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's Programme Computing Science (Master) > Interdisziplinäre Module

Zuständige Personen
- Wulff, Antje (module responsibility)
- Klausen, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
No specific prior knowledge is required

Skills to be acquired in this module

The aim of the module is to provide students with a basic knowledge of human medicine. This should facilitate the understanding of the domain in case of a career choice or focus on medical informatics / medical technology and lead to basics for own questions and ideas for the application of methods of informatics in medicine.

Professional competence
The students
- learn the basics of medical terminology (Terminologia Anatomica) and the anatomy of the human body and can name the most important structure in technical language
- know the basics of the physiology of the human body and can describe the essential body functions
- gain insights into pathophysiological processes of the human body and the associated effects on the function of the human organism
- know the control circuits of the human body for maintaining important body functions and know that this control circuits can be used as a possibility to intervene in processes of the human body
- know reference values of important physiological parameters and can derive conclusions on body functions

Methodological competence
The students
- know the possible measurement procedures resulting from the physiological processes of the human body.
- apply measurement procedures to describe and evaluate human body functions. They can name examples of use and examples of interpretation
- know influencing variables that affect the interpretation of results from measurement procedures as well as the limits of measurement procedures
- learn how to carry out examinations according to protocols and how to document the results in a standardized way.

Social competence
The students
- experience an appreciative interaction with each other through regular role changes
- they take on the role of the test person as well as that of the experimenter
- an appreciative way of dealing with each other.
- describe in detail the data obtained in measurement procedures and consider them critically with other students
- integrate professional and factual criticism into their own courses of action
- use simulated examples from everyday clinical practice to learn the standardized procedures necessary to ensure patient safety

Self competence
The students
• deal with the function, the efficiency of the own body but also with its limits
• deal with the life cycle of conception, birth, adolescence, adulthood and aging

Module contents

See assigned course description

Literatureempfehlungen

As announced in course

Links

Languages of instruction: German, English
Duration (semesters): 1 Semester
Module frequency: every summer term
Module capacity: unlimited
Teaching/Learning method: V+Ü
Examination: Prüfungszeiten
Type of examination

Final exam of module

At the end of the lecture period
Written exam or oral exam
The chosen form of examination will be announced in the first week of the course

Form of instruction Comment SWS Frequency Workload of compulsory attendance

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**inf525 - Medical Informatics I**

**Module label**
Medical Informatics I

**Modulkürzel**
inf525

**Credit points**
6.0 KP

**Workload**
180 h

**Verwendbarkeit des Moduls**
- Master's Programme Computing Science (Master) > Angewandte Informatik

**Zuständige Personen**
- Wulff, Antje (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**
No specific prior knowledge is required

**Skills to be acquired in this module**

**Introduction to medical informatics**

**Professional competences**
The students
- know the application areas of medical informatics
- know the challenges of informatics in the field of health care
- know IT solutions and infrastructures in the field of health care
- know standards for data exchange and data-driven communication in health care

**Methological competences**
The students
- recognize and be able to apply the basic methods in the field of medical informatics, specifically
- learn how to analyze and model health care processes, information systems, and data
- understand medical information models and communication standards

**Social competences**
The students
- recognize the importance of interdisciplinary communication and collaboration in digitalisation in medicine
- develop, present and discuss the solutions from the exercises with others

**Self competences**
The students
- are aware of their heterogeneous tasks, responsibility and influence as a computer scientist in the health care sector
- reflect on problems and solutions, incorporating the methods they have learned

**Module contents**
The assigned lectures will provide an overview of the fields of medical informatics and the unique challenges of applying informatics methods and technologies to medicine and health care.
Literaturempfehlungen

Links

Languages of instruction  German, English
Duration (semesters)  1 Semester
Module frequency  annually in the winter term
Module capacity  unlimited
Teaching/Learning method  V+Ü
Examination  Prüfungszeiten

Final exam of module
at the end of the lecture period  written or oral exam
The chosen form of examination will be announced in the first week of the course

Form of instruction  Comment  SWS  Frequency  Workload of compulsory attendance
Lecture  2  WiSe  28
Exercises  2  WiSe  28

Präsenzzeit Modul insgesamt  56 h
inf526 - Medical Informatics II

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Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Angewandte Informatik

Zuständige Personen
- Wulff, Antje (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
- Basic programming skills

Skills to be acquired in this module

In-depth understanding about medical informatics.

Professional competences

The students
- know the application areas of medical informatics
- know the challenges of informatics in the field of health care
- know IT solutions and infrastructures in the field of health care
- know standards for data exchange and data-driven communication in health care and from the field of medical terminologies

Methodological competences

The students
- learn the in-depth application of more advanced, specialized methods in the field of medical informatics, specifically including
- Modeling and integration of medical information and data using current interoperability and communication standards.
- Analysis and simulation of processes and data-based communication paths as well as handling of healthcare information systems

Social competences

The students
- recognize the importance of interdisciplinary communication and collaboration in digitalisation in medicine
- develop, present and discuss the solutions from the exercises with others

Self competences

The students
- are aware of their heterogeneous tasks, responsibility and influence as a computer scientist in the health care sector
- reflect on problems and solutions, incorporating the methods they have learned

Module contents

In the assigned lectures, individual partial aspects from the subject area of medical informatics and the special challenges of the application of informatic methods and technologies in medicine and health care are to be deepened. In the lectures, topics from “Medical Informatics I” or “Introduction to Medical Informatics” (Bachelor) will be deepened.

Literaturempfehlungen

Tim Benson, Grahame Grieve – Principles of Health Interoperability. SNOMED
Further will be announced in the lecture

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inf527 - Big Data Analytics and Clinical Decision Support

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**Verwendbarkeit des Moduls**

- Master's Programme Computing Science (Master) > Angewandte Informatik

**Zuständige Personen**

- Wulff, Antje (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**

No specific prior knowledge is required

**Skills to be acquired in this module**

In-depth understanding about the processing of medical data sets in the context of Data Analytics, Big Data in medicine and the development and importance of (decision) support tools.

**Professional competences**

The students

- know the sources, characteristics and diversity of medical data and the significance of Big Data in medicine
- know methods for designing (decision) support applications, including the processing of relevant data and information, with regard to a medical issue
- know application classes and types of (decision) support applications and tools
- know professional, organizational and regulatory requirements and framework conditions for data analysis and application development in the healthcare sector

**Methodological competences**

The students

- can familiarize themselves with a medical, data-driven problem and solve it using familiar methods from the various areas of requirements elicitation, knowledge management, conception, implementation and evaluation
- can process given data in a targeted manner with regard to a medical-informational problem and discuss results critically
- can present and hand over results, e.g. decision support applications (especially for medical experts), in a way that adds value.

**Social competences**

The students

- learn the interdisciplinary exchange in this context and understand its importance and necessity
- develop, present and discuss the solutions from the exercises with others

**Self competences**

The students

- can assess their role and importance in the analysis of medical data and the development of medical support applications/tools
- recognize the limits of their (specialist) perspective and the added value of the domain knowledge of others
- critically reflect on problems and solutions, incorporating the methods they have learned

**Module contents**

Against the background of "Big Data in Medicine" and the increasing
digitalization of medicine in general, the assigned lectures aim to impart knowledge on the characteristics, analysis and handling of medical data for the development, application and evaluation of (decision) support applications/tools in healthcare.

Literaturempfehlungen

Papademetris X, Quraishi AN, Licholai GP. Introduction to Medical Software. Foundations for Digital Health, Devices and Diagnostics, 978-1316514993

Further will be announced in the course

Links

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Final exam of module

- at the end of the lecture period
- Portfolio, written exam, practical exercise or oral exam
- The chosen form of examination will be announced in the first week of the course

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Präsenzzeit Modul insgesamt

|                           | 56 h    |
inf535 - Computational Intelligence I

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**Verwendbarkeit des Moduls**

- Master Applied Economics and Data Science (Master) > Data Science
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodul 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
- Master's Programme Environmental Modelling (Master) > Mastermodule

**Zuständige Personen**

- Kramer, Oliver (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**

Basics of statistics

**Skills to be acquired in this module**

After successful completion of the course, students should have acquired the ability to master the presented methods in theory and practice. The students should be able to recognize and model corresponding optimization and data analysis problems themselves and to apply the methods unerringly.

**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

Literatureempfehlungen


Links

<table>
<thead>
<tr>
<th>Languages of Instruction</th>
<th>English, German</th>
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<tbody>
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<td>Teaching/Learning method</td>
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Examination

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<th>Prüfungszeiten</th>
<th>Type of examination</th>
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<td>Written or oral exam</td>
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Final exam of module

At the end of the lecture period

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<th>SWS</th>
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<th>Workload of compulsory attendance</th>
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<td>2</td>
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<td>28</td>
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Präsenzzeit Modul insgesamt

56 h
Module label: Computational Intelligence II

Modulkürzel: inf536

Credit points: 6.0 KP

Workload: 180 h

Verwendbarkeit des Moduls
- Master Applied Economics and Data Science (Master) > Data Science
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodul 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
- Master's Programme Environmental Modelling (Master) > Mastermodule

Zuständige Personen
- Kramer, Oliver (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
useful previous knowledge: Linear Algebra, Stochastics

Skills to be acquired in this module

In the lecture "Convolutional Neural Networks" you will learn the basics of Convolutional Neural Networks, from methodological understanding to implementation.

Professional competence
The Students:
- will learn Deep Learning expertise, which are essential qualifications as AI experts and Data Scientists.

Methodological competence
The Students:
- learn the methods mentioned as well as the implementation in Python, NymPy and Keras.

Social competence
The Students:
- are encouraged to discuss the taught content in groups and work together to implement the programming tasks in the exercises

Self-competence
The Students:
- are guided to conduct independent research on advanced methods as the teaching field changes dynamically

Module contents
Students learn the basics of machine learning and in particular the topics of dense layers, cross-entropy, backpropagation, SGD, momentum, Adam, batch normalization, regularization, convolution, pooling, ResNet, DenseNet, and convolutional SOMs

Literaturempfehlungen
- Deep Learning by Aaron C. Courville, Ian Goodfellow and Yoshua
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**Präsenzzeit Modul insgesamt** 56 h
inf537 - Intelligent Systems

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Verwendbarkeit des Moduls

- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule Bereich Wirtschaftsinformatik
- 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

Zuständige Personen

- Sauer, Jürgen (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites

- Production oriented business informatics

Skills to be acquired in this module

Professional competence
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

Methodological competence
The students:
- assign problem-solving methods to different problems

Social competence
The students:
- implement selected methods in small teams

Self-competence
The students:
- develop own solutions for given problems

Module contents

A lot of application areas use "intelligent" problem-solving methods. These are the main focus of this lecture. They will be illustrated by examples in order to enhance the students' problem-solving abilities. These include:

- A brief introduction into AI
- Agent systems and
- Solution methods of AI like heuristics, meta-heuristics, soft computing methods. To apply and foster the contents of the lecture, an intelligent planning system is implemented in practical exercises.

Literaturempfehlungen

Suggested reading:
- Ghallab/ Nau/Traverso: Automated Planning, Morgan Kaufman, 2004
### Links

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#### Final exam of module

- **At the end of the lecture period**
- **Practical exercises and oral exam or practical exercises and written exam or portfolio**

#### Form of instruction

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**Präsenzzeit Modul insgesamt**  
56 h
# inf538 - Management of IT-Services

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### Verwendbarkeit des Moduls
- Master's Programme Business Informatics (Master) > Akzentsetzungmodule Bereich Wirtschaftsinformatik
- Master's Programme Business Informatics (Master) > Akzentsetzungmodule der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik

### Zuständige Personen
- Sauer, Jürgen (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

### Prerequisites
No participant requirements

### Skills to be acquired in this module

**Professional competence**
The students:
- characterise 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, ...
- Virtualization
- IdM
- Portals
- Configuration management
- Accounting, performance calculation and evaluation, performance indicators
- SOA, EAI
- Controlling tools, Monitoring
- Solutions: SAP Adaptive Computing

Suggested reading:
- current company data
- current materials from internet
- Tiemeyer, Ernst: Handbuch IT-Management: Konzepte, Methoden, Lösungen und Arbeitshilfen für die Praxis, Hanser, 2006

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inf541 - Data Challenge

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<td>Verwendbarkeit des Moduls</td>
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<td>Bremer-Rapp, Barbara (module responsibility)</td>
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<td>Solsbach, Andreas (module responsibility)</td>
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<td>Barbara Bremer-Rapp</td>
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<td>Basics/knowledge of:</td>
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<tr>
<td></td>
<td>• Python programming and/or R programming</td>
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<td></td>
<td>• Statistics</td>
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<tr>
<td>Skills to be acquired in this module</td>
<td></td>
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<tr>
<td></td>
<td>After successful completion of the course, students should be able to answer specific, entrepreneurial questions with the help of data-driven methods. The handling of data should be mastered unerringly in the programming languages Python and/or R. Furthermore, competences in the field of algorithmics and data storytelling should be developed.</td>
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<tr>
<td></td>
<td>The module teaches basic skills in the field of data science and the application of various methods and algorithms. The cooperation with a practice partner ensures that the students work on a problem that is as real and practical as possible. By working independently on the problem and the final presentation of the results, further soft skills of the students will be trained.</td>
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<tr>
<td></td>
<td>Professional competence</td>
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<tr>
<td></td>
<td>The students:</td>
</tr>
<tr>
<td></td>
<td>• learn how to handle structured and unstructured data sources.</td>
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<td>• acquire practical knowledge about different methods of data science.</td>
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<td>• learn basic procedures in the implementation of data science projects.</td>
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<td>• follow and refine the implementation of the practical learning by means of a partly given model scenario, but also by self-initiatives.</td>
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<td></td>
<td>Methodological competence</td>
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<tr>
<td></td>
<td>The students:</td>
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<tr>
<td></td>
<td>• are able to explore and analyze data sets</td>
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<td>• recognize connections in large data sets</td>
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<td>• form a hypothesis for the solution of a business problem.</td>
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<td></td>
<td>Social competence</td>
</tr>
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<td></td>
<td>The students:</td>
</tr>
<tr>
<td></td>
<td>• work in groups, identify work packages and take on responsibility for the jobs assigned to them.</td>
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<td></td>
<td>• discuss and introduce the results on a functional level.</td>
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<td>Self-competence</td>
</tr>
<tr>
<td></td>
<td>The students:</td>
</tr>
<tr>
<td></td>
<td>• reflect their approach on the basis of self-defined goals.</td>
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<td></td>
<td>• collect and analyze required information.</td>
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<td></td>
<td>• prepare the collected information in a target group-oriented manner</td>
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</table>

Module contents
If methodological competence in the field of data science is to be learned and expanded, this is usually only possible with the help of open available, idealized data sets and exemplary tasks. Basic programming skills can be acquired in this way, but dealing with real business problems and solving them with the help of data science methods can only be learned through practice. In this module, a real problem of a practice partner is presented, this partner provides data and domain knowledge and then a data-centered solution for this problem must be designed and implemented independently.

Within the module, the following topics are dealt with:

- Exploration and analysis of data
- Methods of data science (e.g. deep learning)
- Dealing with programming languages and development frameworks (R, Python, Tensorflow)
- Hypothesis Formation and Data Storytelling

Literaturempfehlungen


Links

https://uol.de/vlba

Language of instruction: German
Duration (semesters): 1 Semester
Module frequency: annual
Module capacity: 30
Teaching/Learning method: Practical event
Examination: Prüfungszeiten
Type of examination: Practical event
Final exam of module: During the semester break, after the end of the lecture period

Form of instruction: Practical training
SWS: 4
Frequency: SoSe oder WiSe
Workload Präsenzzeit: 56 h
inf581 - Special Topics in 'Digitalised Energy Systems' II

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Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's programme Digitalised Energy Systems (Master) > Digitalised Energy System Automation, Control and Optimisation

Zuständige Personen
- Nieße, Astrid (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
No participant requirements

Skills to be acquired in this module

This module integrates current developments in the field of Digitalised Energy 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 tools, technologies and methods
- sophisticatedly combine new and original approaches and methods
- creatively evaluate problems/tasks, including new or developing subject areas of their discipline
- 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

Literatureempfehlungen
Will be announced in the course

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| Präsenzzelt Modul insgesamt | 56 h |
### Module label
Special Topics in 'Energy Informatics' I

### Modulkürzel
inf584

### Credit points
6.0 KP

### Workload
180 h

### Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's programme Digitalised Energy Systems (Master) > Digitalised Energy System Automation, Control and Optimisation

### Zuständige Personen
- Lehnhoff, Sebastian (Prüfungsberechtigt)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

### Prerequisites
No participant 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
- 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

### Literatureempfehlungen
As announced in course

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inf585 - Special Topics in 'Energy Informatics' II

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**Verwendbarkeit des Moduls**
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's programme Digitalised Energy Systems (Master) > Digitalised Energy System Automation, Control and Optimisation

**Zuständige Personen**
- Lehnhoff, Sebastian (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**
No participant 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

**Literaturempfehlungen**
As announced in course

**Links**

**Language of instruction**
German
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<td>events form V, S, Ü, P</td>
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<td>Prüfungszeiten</td>
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<td>At the end of the lecture period</td>
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<tr>
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<td>VA-Auswahl</td>
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inf586 - Current Topics in 'Energy Informatics' I

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<td>Modulkürzel</td>
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Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's programme Digitalised Energy Systems (Master) > Innovation Topics and Smart Grids

Zuständige Personen
- Lehnhoff, Sebastian (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
No participant 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

Literaturempfehlungen
Depending on the assigned course
<table>
<thead>
<tr>
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inf587 - Current Topics in 'Energy Informatics' II

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Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's programme Digitalised Energy Systems (Master) > Innovation Topics and Smart Grids

Zuständige Personen
- Lehnhoff, Sebastian (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
No participant 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

Literaturempfehlungen
Will be announced in the course
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inf588 - Special Topics in 'Medical Informatics' I

Module label: Special Topics in 'Medical Informatics' I

Modulkürzel: inf588

Credit points: 6.0 KP

Workload: 180 h

Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Angewandte Informatik

Zuständige Personen
- Hein, Andreas (module responsibility)
- Wulff, Antje (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
- No specific prior knowledge is required

Skills to be acquired in this module

The module aims to integrate current developments in the specialization area "Medical Informatics" into the course of study in the appropriate course forms.

Professional competences
- The students:
  - differentiate and contrast a subfield of computer science in which they specialize in more detail or reflect on computer science in general
  - recognize and evaluate the techniques and methods to be used in their area of specialization and their limitations
  - identify, structure and solve problems also in new or emerging areas of their discipline
  - apply state-of-the-art and innovative methods in investigating and solving problems, drawing on other disciplines as appropriate
  - recognize the limits of current knowledge and technology and contribute to the further scientific and technological development of computer science
  - discuss current developments in computer science and assess their significance

Methodological competences
- The students:
  - evaluate tools, technologies and methods and apply them in a differentiated manner
  - creatively develop new and original approaches and methods
  - reflect on problems also in new or emerging areas of their discipline and apply computer science methods to investigate and solve them

Social competences
- The students:
  - integrate their skills into team processes

Self-competences
- The students:
  - critically follow further developments in computer science in general and in their field of specialization
  - carry out innovative activities in their professional field successfully and independently

Module contents

See assigned course description

Literaturempfehlungen

As announced in course

Links
<table>
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inf589 - Special Topics in "Medical Informatics" II

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<td>- Wulff, Antje (module responsibility)</td>
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<td>- Lehrenden, Die im Modul (Prüfungsberechtigt)</td>
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Skills to be acquired in this module

The module aims to integrate current developments in the specialization area "Medical Informatics" into the course of study in the appropriate course forms.

**Professional competences**
The students:
- differentiate and contrast a subfield of computer science in which they specialize in more detail or reflect on computer science in general
- recognize and evaluate the techniques and methods to be used in their area of specialization and their limitations
- identify, structure and solve problems also in new or emerging areas of their discipline
- apply state-of-the-art and innovative methods in investigating and solving problems, drawing on other disciplines as appropriate
- recognize the limits of current knowledge and technology and contribute to the further scientific and technological development of computer science
- discuss current developments in computer science and assess their significance

**Methodological competences**
The students:
- evaluate tools, technologies and methods and apply them in a differentiated manner
- creatively develop new and original approaches and methods
- reflect on problems also in new or emerging areas of their discipline and apply computer science methods to investigate and solve them

**Social competences**
The students:
- integrate their skills into team processes

**Self-competences**
The students:
- critically follow further developments in computer science in general and in their field of specialization
- carry out innovative activities in their professional field successfully and independently

Module contents

See assigned course description

Literatureempfehlungen

As announced in the according course

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inf590 - Current Topics in 'Medical Informatics' I

Module label: Current Topics in 'Medical Informatics' I
Modulkürzel: inf590
Credit points: 3.0 KP
Workload: 90 h

Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Angewandte Informatik

Zuständige Personen
- Wulff, Antje (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
No specific prior knowledge is required.

Skills to be acquired in this module

The module aims to integrate current developments in the specialization area of "medical informatics" into the course of study in the appropriate course forms.

Professional competence
The students:
- differentiate and contrast a subfield of computer science in which they specialize in more detail or reflect on computer science in general
- recognize and evaluate the techniques and methods to be used in their area of specialization and their limitations
- identify, structure and solve problems also in new or emerging areas of their discipline
- apply state-of-the-art and innovative methods in investigating and solving problems, drawing on other disciplines as appropriate
- recognize the limits of current knowledge and technology and contribute to the further scientific and technological development of computer science
- discuss current developments in computer science and assess their significance

Methodological competences
The students:
- evaluate tools, technologies, methods and procedures and apply them in a differentiated manner
- investigate problems on the basis of technical and scientific literature, write an article according to scientific aspects and present their results in a scientific lecture
- reflect on problems also in new or emerging areas of their discipline and apply computer science methods to investigate and solve them

Social competences
The students:
- communicate convincingly orally and in writing

Self-competences
The students:
- critically follow further developments in computer science in general and in their field of specialization
- carry out innovative activities in their professional field successfully and independently
## Module contents

See assigned course description

## Literatureempfehlungen

As announced in course

## Links

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<td>V or S</td>
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<td>Presentation or oral exam</td>
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| Final exam of module | The chosen form of examination will be announced in the first week of the course |

## Form of instruction

Course or seminar

## SWS

2

## Frequency

siehe Angebotsrhythmus Modul

## Workload Präsenzzeit

28 h
inf591 - Current Topics in 'Digitalized Energy systems'

<table>
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**Verwendbarkeit des Moduls**
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's programme Digitalised Energy Systems (Master) > Innovation Topics and Smart Grids

**Zuständige Personen**
- Nieße, Astrid (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**
No participant requirement

**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

**Literaturempfehlungen**
Will be announced in the course
<table>
<thead>
<tr>
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inf592 - Special Topics in 'Applied Artificial Intelligence' II

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Skills to be acquired in this module

The module aims to integrate current developments in the specialization area 'Learning and Cognitive Systems II' into the appropriate course formats within the study program.

**Professional competences**
The students:
- differentiate and contrast a specific area of computer science in which they have specialized, in more detail, or reflect on computer science in general
- recognize and assess the techniques and methods applicable in their specialized field and their limitations
- identify, structure and solve problems also in new or emerging areas of their discipline
- apply state-of-the-art and innovative methods in investigating and solving problems, possibly drawing from other disciplines
- recognize the limits of current knowledge and technology and contribute to the further scientific and technological development of computer science
- discuss current developments in computer science and assess their significance

**Methodological competencies**
The students:
- valuate tools, technologies, and methods and apply them in a differentiated manner, creatively developing new and original approaches and methods
- reflect on problems, even in emerging areas of their discipline, and apply computer science methods to investigate and solve them

**Social Competencies**
The students:
- integrate their skills into team processes

**Self-competences**
The students:
- critically follow the further developments in computer science in general and in their specialized area
- successfully and independently carry out innovative activities in their professional field

Module contents

This module offers various classes in the field of Learning and Cognitive Systems. For details regarding objectives and content, please refer to the specific class or contact the instructor directly.

Literatureempfehlungen

depending on the area of specialization and the assigned course
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inf593 - Special Topics in 'Applied Artificial Intelligence' I

Module label: Special Topics in 'Applied Artificial Intelligence' I
Modulkürzel: inf593
Credit points: 6.0 KP
Workload: 180 h

Verwendbarkeit des Moduls:
- Master's Programme Computing Science (Master) > Angewandte Informatik

Zuständige Personen:
- Sonntag, Daniel (module responsibility)
- Lehrenden, Die im Modul (Module counselling)

Prerequisites:
No participant requirement

Skills to be acquired in this module

This module aims to integrate current developments in the specialization area "Learning and Cognitive Systems" I into the course of study in the appropriate course forms.

Professional competences
The students:
- differentiate and contrast a specific area of computer science in which they have specialized, in more detail, or reflect on computer science in general
- recognize and assess the techniques and methods applicable in their specialized field and their limitations
- identify, structure and solve problems also in new or emerging areas of their discipline
- apply state-of-the-art and innovative methods in investigating and solving problems, possibly drawing from other disciplines
- recognize the limits of current knowledge and technology and contribute to the further scientific and technological development of computer science
- discuss current developments in computer science and assess their significance

Methodological competencies
The students:
- valuate tools, technologies, and methods and apply them in a differentiated manner, creatively developing new and original approaches and methods
- reflect on problems, even in emerging areas of their discipline, and apply computer science methods to investigate and solve them

Social Competencies
The students:
- integrate their skills into team processes

Self-competences
The students:
- critically follow the further developments in computer science in general and in their specialized area
- successfully and independently carry out innovative activities in their professional field

Module contents

depending on the area of specialization and the assigned course

Literatureempfehlungen

depending on the area of specialization and the assigned course
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**inf596 - Special Topics in "Computational Intelligence" I**

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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:

- 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“

**Literaturempfehlungen**

As announced in the according course

**Links**

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inf597 - Special Topics in "Computational Intelligence" II

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Prerequisites

No participant requirement

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

Literaturrempfehlungen

As announced in course

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inf598 - Current Topics in 'Computational Intelligence' I

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Prerequisites

No participant requirement

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

Literatureempfehlungen

As announced in course

Links

Languages of Instruction | German, English
Duration (semesters)     | 1 Semester
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inf599 - Current Topics in 'Computational Intelligence' II

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Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Angewandte Informatik

Zuständige Personen
- Kramer, Oliver (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
No participant requirement

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“

Literaturempfehlungen
As announced in course

Links

Languages of instruction
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**inf604 - Business Intelligence I**

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**Verwendbarkeit des Moduls**
- Master Applied Economics and Data Science (Master) > Data Science
- Master of Education Programme (Vocational and Business Education) Computing Science (Master of Education) > Akzentsetzungsbereich
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodul Bereich Wirtschaftsinformatik
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodul 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

**Zuständige Personen**
- Marx Gómez, Jorge (Prüfungsberechtigt)
- Lehrenden, Die im Modul (Prüfungsberechtigt)
- Bremer-Rapp, Barbara (module responsibility)
- Solsbach, Andreas (module responsibility)

**Prerequisites**
No participant requirement

**Skills to be acquired in this module**

**Objective of the module/skills:**
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.

**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 past 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-MemoryComputing, etc.)
- Introduction to Data Mining.
- Case studies based practical exercises and assessments in order to impart practical knowledge.

Literaturempfehlungen


Links

http://www.wi-ol.de

Languages of instruction

German, English

Duration (semesters)

1 Semester

Module frequency

annual

Module capacity

unlimited

Teaching/Learning method

V+Ü

Examination

Prüfungszeiten

Type of examination

Final exam of module

At the end of the lecture period

Written exam max. 120 minutes

Form of instruction

Comment

SWS

Frequency

Workload of compulsory attendance

Lecture

2

WiSe

28

Exercises

2

WiSe

28

Präsenzzeit Modul insgesamt

56 h
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 past 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 analysist, and also being able to proceed deeper with respect to different approaches and methods
- gain a hams 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

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### Module contents

- Master Applied Economics and Data Science (Master) > Data Science
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodul der Informatik
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodulkern Wirtschaftsinformatik
- 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

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### Prerequisites

No participant requirement
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.

Literaturempfehlungen

- Jürgen Cleve und Uwe Lämmel - Data Mining; Berlin/München/Boston: Walter de Gruyter GmbH, 2020 (German)
- Max Bramer (2013): "Principles of data mining" (English)
- Ian Witten, Eibe Frank, Mark Hall (2011): "Data mining : practical machine learning tools and techniques" (English)
- Jure Leskovec, Anand Rajaraman, Jeffrey Ullman (2014): "Mining of massive datasets" (English)
- Sebastian Raschka und Vahid Mirjalili - Python machine learning : machine learning and deep learning with Python, scikit-learn, and TensorFlow; Birmingham Mumbai: Packt Publishing, September 2017 (English)
- Aurélien Géron - Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow : concepts, tools, and techniques to build intelligent systems; Beijing Boston Farnham Sebastopol Tokyo: O'Reilly, September 2019 (English)

Links

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

Languages of instruction

German, English

Duration (semesters)

1 Semester

Module frequency

Summer term

Module capacity

unlimited

Teaching/Learning method

V + Ü

Examination

Prüfungszeiten

Type of examination

Final exam of module

At the end of the block course

Written examination or oral examination or term paper or referat or portfolio or practical exercises and written examination or practical exercises and oral examination.

Form of instruction

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Präsenzzeit Modul insgesamt

56 h
inf650 - Transport Systems

Module label: Transport Systems

Modulkürzel: inf650

Credit points: 6.0 KP

Workload: 180 h

Verwendbarkeit des Moduls

- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule Bereich Wirtschaftsinformatik
- 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

Zuständige Personen

- Sauer, Jürgen (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites

Production-oriented business informatics

Skills to be acquired in this module

Objective of the module/skills:
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.

Professional competence
The students:

- name the basics of planning and controlling company logistics
- assess transport systems of companies
- name methods and approaches of computer aided transport systems and classify them
- characterise software to plan complex logistics

Methodological competence
The students:

- display topics and concepts of transport systems
- simulate transport and its systems with appropriate methods

Social competence
The students:

- work in groups
- discuss their results appropriately

Self-competence
The students:

- realise their limits while working on a project containing aspects of modelling and implementation
- question the presentation of their results

Module contents

- Transport and logistics concepts
- Data acquisition of company logistics
- Planning- and simulation software for complex logistics- and transport processes
- Energy- and resource efficient transport systems
- Resource oriented transport cost calculations (e.g. CO2, noise)
pollution

- Planning models for transport infrastructure

Literaturempfehlungen

Suggested reading:


Links

http://wi-ol.de

Languages of Instruction

German, English

Duration (semesters)

1 Semester

Module frequency

annual

Module capacity

unlimited

Teaching/Learning method

V+Ü

Examination

Prüfungszeiten

Type of examination

Final exam of module

At the end of the lecture period

Exercises and written exam

<table>
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Präsenzzeit Modul insgesamt

56 h
inf651 - Environmental Management Information Systems I

Module label
Environmental Management Information Systems I

Modulkürzel
inf651

Credit points
6.0 KP

Workload
180 h

Verwendbarkeit des Moduls
- Master's programme Business Administration: Management and Law (Master) > Schwerpunktmodule NM - interdisziplinär
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodul Marktplanung und IT
- 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) > Supplementary Modules

Zuständige Personen
- Marx Gómez, Jorge (module responsibility)
- Bremer-Rapp, Barbara (module responsibility)
- Solsbach, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
No participant requirement

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

Literaturempfehlungen


Links

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Form of instruction

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| Exercises | 2 | SoSe | 28 |
| Präsenzzzeit Modul insgesamt | | | 56 h |
inf652 - Production-oriented Business Informatics

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Verwendbarkeit des Moduls
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodul Bereich Wirtschaftsinformatik
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodul der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik

Zuständige Personen
- Sauer, Jürgen (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
No participant requirement

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 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.
Kurbel, Karl: Produktionsplanung und -steuerung im Enterprise Resource Planning und Supply Chain Management, Oldenbourg Verlag, 2005

Further literature will be announced in the lecture

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**Final exam of module**

At the end of the lecture period

Exercises and written exam

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**Präsenzzeit Modul insgesamt** 56 h
inf653 - ERP Technologies

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Verwendbarkeit des Moduls
- Master of Education Programme (Vocational and Business Education) Computing Science (Master of Education) > Akzentsetzungsbereich
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodul Bereich Wirtschaftsinformatik
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodul der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik

Zuständige Personen
- Marx Gómez, Jorge (module responsibility)
- Bremer-Rapp, Barbara (module responsibility)
- Solsbach, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
No participant requirement

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 limit 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 administration
- 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.

Literatureempfehlungen


Links

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| Präsenzzeit Modul insgesamt | 56 h |
**inf654 - Mobile Commerce**

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**Verwendbarkeit des Moduls**
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik

**Zuständige Personen**
- Marx Gómez, Jorge (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**
No participant requirement

**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

**Literatureempfehlungen**
- Also all materials provided within the lecture
Links

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Präsenzzeit Modul insgesamt 56 h
inf655 - IT-Controlling

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

Verwendbarkeit des Moduls
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodul der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik

Zuständige Personen
- Marx Gómez, Jorge (module responsibility)
- Solsbach, Andreas (module responsibility)
- Bremer-Rapp, Barbara (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
No participant requirement

Skills to be acquired in this module

This module emphazises 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.

Literatureempfehlungen
• Marx Gómez, Junker, Odebrecht: IT-Controlling: Strategien, Werkzeuge, Praxis. Erich Schmidt Verlag, 2009
• Gadatsch, A: IT-Controlling: Praxiswissen für IT-Controller und Chief-Information-Officer. Springer Verlag, 2012
• Krcmar, H: Informationsmanagement. 6. Auflage. Springer Verlag, 2015

Links
Language of instruction          German
Duration (semesters)             1 Semester
Module frequency                annual
Module capacity                  unlimited
Teaching/Learning method        V+Ü
Previous knowledge              none
Examination                     Prüfungszeiten
Final exam of module
At the end of the lecture period Practical work, papers or written examination. Announcement at the beginning of the lecture

Form of instruction            Comment      SWS    Frequency  Workload of compulsory attendance
Lecture                        2            WiSe  28
Exercises                      2            WiSe  28
Präsenzzeit Modul insgesamt    56 h
inf657 - Product Engineering

Module label: Product Engineering

Module label: Product Engineering

Credit points: 6.0 KP

Workload: 180 h

Verwendbarkeit des Moduls

- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule Bereich Wirtschaftsinformatik
- 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) > Human-Computer Interaction
- Master's Programme Engineering of Socio-Technical Systems (Master) > Systems Engineering

Zuständige Personen

- Sauer, Jürgen (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites

No participant requirement

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.

### Literatureempfehlungen
- Ehrlenspiel (2003): Integrierte Produktentwicklung

### Links

<table>
<thead>
<tr>
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### Teaching/Learning method

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### Form of instruction

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**Module label**
Environmental Management Information Systems II

**Modulkürzel**
inf659

**Credit points**
6.0 KP

**Workload**
180 h

**Verwendbarkeit des Moduls**
- Master's programme Business Administration: Management and Law (Master) > Schwerpunktmodule NM - interdisziplinär
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodul Bereich Wirtschaftsinformatik
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodul 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) > Supplementary Modules

**Zuständige Personen**
- Marx Gómez, Jorge (module responsibility)
- Bremer-Rapp, Barbara (module responsibility)
- Solsbach, Andreas (module responsibility)
- Lehrenden, die im Modul (Prüfungsberechtigt)

**Prerequisites**
No participant requirement

**Skills to be acquired in this module**

This course aims at examining emerging research questions in the field of corporate environmental management information systems (CEMIS). After finishing this course, the students will have extensive knowledge regarding Business Environmental Informatics. In addition, they will be aware of recent research topics and challenges as well as relevant software solutions and practical projects.

**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.

Literatureempfehlungen

- Marx Gómez, Jorge, Scholtz, Brenda (Hrsg.) (2016): Information Technology in Environmental Engineering. Springer International Publishing

Links

http://www.wi-ol.de

Languages of instruction German, English
Duration (semesters) 1 Semester
Module frequency annual
Module capacity unlimited
Reference text Type and language of program will be announced prior to the beginning of the course
Teaching/Learning method V+Ü
Examination Prüfungszeiten Type of examination
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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<td>Präsenzzeit Modul insgesamt</td>
<td></td>
<td>56 h</td>
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**inf660 - Sustainability Informatics**

<table>
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<td>Master's Programme Computing Science (Master) &gt; Angewandte Informatik</td>
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<td>Marx Gómez, Jorge (module responsibility)</td>
</tr>
<tr>
<td></td>
<td>Solsbach, Andreas (module responsibility)</td>
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<tr>
<td></td>
<td>Bremer-Rapp, Barbara (module responsibility)</td>
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<td>Lehrenden, Die im Modul (Prüfungsberechtigt)</td>
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<tr>
<td>Prerequisites</td>
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</table>

**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 organisation’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).

Literaturempfehlungen

• Rautenstrauch, C. (1999), Betriebliche Stoffstrominformationssysteme, Springer-Verlag, Berlin

Links

http://vba.wi-ol.de

Languages of instruction
German, English

Duration (semesters)
1 Semester

Module frequency
Winter term

Module capacity
unlimited

Teaching/Learning method
V+Ü or P

Examination
Prüfungszeiten
Type of examination

Final exam of module
At the end of the lecture period
Portfolio or project.

Form of instruction
Comment
SWS
Frequency
Workload of compulsory attendance

Lecture
2
SoSe
28

Übung oder Praktikum
2
SoSe
28

Präsenzzeit Modul insgesamt
56 h
**inf661 - Digital Transformation**

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**Verwendbarkeit des Moduls**
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodul Bereich Wirtschaftsinformatik
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodul der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik

**Zuständige Personen**
- Marx Gómez, Jorge (module responsibility)
- Bremer-Rapp, Barbara (module responsibility)
- Solsbach, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**
No participant 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
- devise different terms of digital transformation
- expose actual introduction projects
- compile practical knowledge by dividing goals of enabler and actors 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
- establish 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

Literaturempfehlungen


Links

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inf663 - Application Area Maritime

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Verwendbarkeit des Moduls
- 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

Zuständige Personen
- Hahn, Axel (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
No participant 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.
- understand the latter as a major contribution to organize navigation as a hierarchical team concept of a safety critical sociotechnical system.
- 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.
- learned to how systems can deal with harsh environmental conditions in a resilient way.

Social competences
The students:
- Maritime transportation is a major 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
The students:
- 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
Literaturempfehlungen

- Bernhard Berking, Werner Huth (Herausgeber), Handbuch Nautik 1: Navigatorische Schiffsführung, Seehafen Verlag, 2010

Links

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Final exam of module

At the end of the lecture period

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Präsenzzzeit Modul insgesamt 56 h
inf690 - Special Topics in 'Business Informatics' I

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Verwendbarkeit des Moduls

- Master's Programme Business Informatics (Master) > Akzentsetzungsmodul Bereich Wirtschaftsinformatik
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodul der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik

Zuständige Personen

- Marx Gómez, Jorge (module responsibility)
- Staudt, Philipp (module responsibility)
- Solsbach, Andreas (module responsibility)
- Bremer-Rapp, Barbara (module responsibility)
- Sauer, Jürgen (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites

No participant 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

Literatureempfehlungen

As announced in course
<table>
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**inf691 - Special Topics in 'Business Informatics' II**

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**Verwendbarkeit des Moduls**
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule Bereich Wirtschaftsinformatik
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik

**Zuständige Personen**
- Marx Gómez, Jorge (module responsibility)
- Sauer, Jürgen (module responsibility)
- Staudt, Philipp (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**
No participant 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

**Literatureempfehlungen**
As announced in course
<table>
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| **Form of instruction**                                               | VA-Auswahl                                                      |
| **SWS**                                                              | 4                                                              |
| **Frequency**                                                        | siehe Angebotsrhythmus Modul                                    |
| **Workload Präsenzzzeit**                                            | 56 h                                                            |
## inf692 - Special Topics in 'Business Informatics' III

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### Verwendbarkeit des Moduls
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule Bereich Wirtschaftsinformatik
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik

### Zuständige Personen
- Marx Gómez, Jorge (module responsibility)
- Sauer, Jürgen (module responsibility)
- Staudt, Philipp (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

### Prerequisites
No participant 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

### Literatureempfehlungen

As announced in course

### Links

### Language of instruction

German
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**Verwendbarkeit des Moduls**
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule Bereich Wirtschaftsinformatik
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik

**Zuständige Personen**
- Marx Gómez, Jorge (module responsibility)
- Sauer, Jürgen (module responsibility)
- Staudt, Philipp (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**
- No participant 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

**Literaturempfehlungen**
As announced in course
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inf694 - Current Topics in 'Business Informatics' I

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Verwendbarkeit des Moduls
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodul Bereich Wirtschaftsinformatik
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodul der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik

Zuständige Personen
- Marx Gómez, Jorge (module responsibility)
- Sauer, Jürgen (module responsibility)
- Staudt, Philipp (module responsibility)
- Solsbach, Andreas (module responsibility)
- Bremer-Rapp, Barbara (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
No participant 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

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inf695 - Current Topics in 'Business Informatics' II

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**Verwendbarkeit des Moduls**
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule Bereich Wirtschaftsinformatik
- Master's Programme Business Informatics (Master) > Akzentsetzungsmoduls der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik

**Zuständige Personen**
- Marx Gómez, Jorge (module responsibility)
- Sauer, Jürgen (module responsibility)
- Staudt, Philipp (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberichtig)

**Prerequisites**
- No participant 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

**Literaturempfehlungen**

As announced in course
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inf696 - Current Topics in 'Business Informatics' III

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Verwendbarkeit des Moduls
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodul Bereich Wirtschaftsinformatik
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodul der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik

Zuständige Personen
- Marx Gómez, Jorge (module responsibility)
- Sauer, Jürgen (module responsibility)
- Staudt, Philipp (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
No participant 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:
- 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

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inf697 - Current Topics in 'Business Informatics' IV

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Verwendbarkeit des Moduls

- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule Bereich Wirtschaftsinformatik
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik

Zuständige Personen

- Marx Gómez, Jorge (module responsibility)
- Sauer, Jürgen (module responsibility)
- Staudt, Philipp (module responsibility)

Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites

- No participant 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 convincing

**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

Literaturempfehlungen

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inf701 - Computer Science Education II

Module label: Computer Science Education II

Modulkürzel: inf701

Credit points: 6.0 KP

Workload: 180 h

Verwendbarkeit des Moduls

- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Pflichtmodule
- Master of Education Programme (Hauptschule and Realschule) Computing Science (Master of Education) > Mastermodule
- Master of Education Programme (Vocational and Business Education) Computing Science (Master of Education) > Pflichtbereich
- Master's Programme Computing Science (Master) > Angewandte Informatik

Zuständige Personen

- Diethelm, Ira (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites

No participant requirements

Skills to be acquired in this module

Professional competence
The students:
- (re-)construct the knowledge of computer science by the method of didactical reduction
- differentiate the development of computer science and evaluate this development with current trends for class
- select computer science education approaches for lesson planning, organisation and implementation

Methodological competence
The students:
- (re-)construct core concepts of lesson planning for computer science education requirements

Social competence
The students:
- present self-developed lesson plans and lesson materials
- discuss lesson plans regarding computer science education concepts
- accept opinions and criticism
- provide constructive feedback

Self-competence
The students:
- adapt computer science education concepts for lesson planning
- reflect on their self-perception with regard to the conception of computer science education

Module contents

The lecture will focus on the requirements and challenges of computer science education in grammar school (German: Gymnasium).

Main focus:
- Didactical (re-)construction of computer science knowledge, especially its didactical reduction
- Didactical categorisation of computer science and the development, importance and evaluation of computer science in school
- Scheduling, organisation and implementation of computer science in class

Literaturempfehlungen

- Humbert, Ludger: Didaktik der Informatik. Wiesbaden: B. G. Teubner,
Weitere Literatur wird in der Veranstaltung je nach thematischen Schwerpunkten bekannt gegeben

Links

http://elearning.uni-oldenburg.de

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**Final exam of module**

End of lecture period

Exercise and und 1 seminar paper or 1 oral exam

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inf705 - Practical in Computer Science Education

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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.

Literaturempfehlungen

As announced in course

Links

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**Form of instruction**
- Practical training

**SWS**
- 4

**Frequency**
- SoSe

**Workload Präsenzzeit**
- 56 h
inf710 - Special Topics in 'Computer Science Education' I

Module label: Special Topics in 'Computer Science Education' I

Modulkürzel: inf710

Credit points: 6.0 KP

Workload: 180 h

Verwendbarkeit des Moduls:
- Master's Programme Computing Science (Master) > Angewandte Informatik

Zuständige Personen:
- Diethelm, Ira (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites:
No participant 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

Literaturempfehlungen:
As announced in course

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- Duration (semesters): 1 Semester
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**Final exam of module**
- At the end of the lecture period

**Form of instruction**
- VA-Auswahl

**SWS**
- 4

**Frequency**
- siehe Angebotsrhythmus Modul

**Workload Präsenzzeit**
- 56 h
inf711 - Special Topics in 'Computer Science Education' II

Module label: Special Topics in 'Computer Science Education' II

Modulkürzel: inf711

Credit points: 6.0 KP

Workload: 180 h

Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Angewandte Informatik

Zuständige Personen
- Diethelm, Ira (module responsibility)
  - Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
No participant 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

Literaturempfehlungen
As announced in course

Links
Language of instruction: German
Duration (semesters): 1 Semester
| **Module frequency**                  | irregular                  |
| **Module capacity**                  | unlimited                  |
| **Teaching/Learning method**         | events from V, S, Ü, P      |
| **Examination**                      | Prüfungszeiten              |
| **Final exam of module**             | At the end of the lecture period |
| **Type of examination**              | Portfolio or presentation or oral exam |
| **Form of instruction**              | VA-Auswahl                  |
| **SWS**                              | 4                           |
| **Frequency**                        | siehe Angebotsrhythmus Modul |
| **Workload Präsenzzeit**             | 56 h                        |
inf712 - Current Topics in Computer Science Education I

Module label: Current Topics in Computer Science Education I

Modulkürzel: inf712

Credit points: 3.0 KP

Workload: 90 h

Verwendbarkeit des Moduls:
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Pflichtmodule
- Master of Education Programme (Vocational and Business Education) Computing Science (Master of Education) > Pflichtbereich
- Master’s Programme Computing Science (Master) > Angewandte Informatik

Zuständige Personen:
- Diethelm, Ira (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites:
No participant 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

Literatureempfehlungen

As announced in course
<table>
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| Form of instruction                       | Course or seminar                       |
| SWS                                       | 2                                       |
| Frequency                                 | siehe Angebotsrhythmus Modul            |
| Workload Präsenzzeit                      | 28 h                                    |
### inf713 - Current Topics in ‘Computer Science Education’ II

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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:

- 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

#### Literatureempfehlungen

As announced in course

#### Links

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inf810 - Special Topics in Computer Science I

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Verwendbarkeit des Moduls
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's Programme Computing Science (Master) > Informatik, allgemein
- Master's Programme Environmental Modelling (Master) > Mastermodule

Zuständige Personen
- Peter, Andreas (module responsibility)
- Marx Gómez, Jorge (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
- The expected previous knowledge is specified in the details of the assigned course.

Skills to be acquired in this module
This module integrates current computer science developments into the business informatics program by appropriate study courses.

Professional competence
The students:
- know recent technological or scientific computer science developments
- transfer computer science methods and development models to IT application area requirements
- evaluate the possibilities and limitations of computer science methods and tools and apply them appropriately

Methodological competence
The students:
- review problems, formulate them with formal models and explore them appropriately
- identify and present (one or more) computer science problem solutions
- select and evaluate appropriate tools and methods
- examine problems with technical and scientific literature

Social competence
The students:
- work in a team

Self-competence:
The Students:
- plan their informatical actions independently

Module contents
According to the assigned course

Literatureempfehlungen
According to the assigned course
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inf811 - Special Topics in Computer Science II

Module label: Special Topics in Computer Science II

Modulkürzel: inf811

Credit points: 6.0 KP

Workload: 180 h

Verwendbarkeit des Moduls
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's Programme Computing Science (Master) > Informatik, allgemein
- Master's Programme Environmental Modelling (Master) > Mastermodule

Zuständige Personen
- Marx Gómez, Jorge (module responsibility)
- Peter, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
Useful background knowledge is specified in the details of the assigned course.

Skill to be acquired in this module

This module integrates current computer science developments into the business informatics program, especially considering the selected focus area, by appropriate study courses.

Professional competence

The students:
- know recent technological or scientific computer science developments
- transfer computer science methods and development models to IT application area requirement
- evaluate the possibilities and limitations of computer science methods and tools and apply them appropriately

Methodological competence

The students:
- review problems, formulate them with formal models and explore them appropriately
- identify and present (one or more) computer science problem solutions
- select and evaluate appropriate tools and methods
- examine problems with technical and scientific literatur

Social competence

The students:
- work in a team

Self-competence:

The Students:
- lan their informatical actions independently

Module contents

According to the assigned course

Literaturempfehlungen

According to the assigned course

Links

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inf812 - Current Topics in Computer Science I

Module label: Current Topics in Computer Science I

Modulkürzel: inf812

Credit points: 3.0 KP

Workload: 90 h

Verwendbarkeit des Moduls
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodul der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's Programme Computing Science (Master) > Informatik, allgemein
- Master's Programme Environmental Modelling (Master) > Mastermodule

Zuständige Personen
- Fränzle, Martin Georg (module responsibility)
- Marx Gómez, Jorge (module responsibility)
- Peter, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
Useful background knowledge is specified in the details of the assigned course.

Skills to be acquired in this module

This module integrates current computer science developments into the business informatics program by appropriate study courses.

Professional competence
The students:
- know recent technological or scientific computer science developments
- transfer computer science methods and development models to IT application area requirements
- evaluate the possibilities and limitations of computer science methods and tools and apply them appropriately

Methodological competence
The students
- review problems, formulate them with formal models and explore them appropriately
- identify and present (one or more) computer science problem solutions
- examine problems with technical and scientific literature

Social competence
The students:
- work in a team

Self-competence:
The Students:
- plan their informatical actions independently

Module contents
According to the assigned task

Literatureempfehlungen
According to the assigned task

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inf813 - Current Topics in Computer Science II

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**Verwendbarkeit des Moduls**
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodul der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's Programme Computing Science (Master) > Informatik, allgemein
- Master's Programme Environmental Modelling (Master) > Mastermodule

**Zuständige Personen**
- Marx Gómez, Jorge (module responsibility)
- Fränzle, Martin Georg (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**
No participant requirements

**Skills to be acquired in this module**

This module integrates current computer science developments into the business informatics program, especially considering the selected focus area, by appropriate study courses.

**Professional competence**

The students:
- know recent technological or scientific computer science developments
- transfer computer science methods and development models to IT application area requirements
- evaluate the possibilities and limitations of computer science methods and tools and apply them appropriately

**Methodological competence**

The students:
- review problems, formulate them with formal models and explore them appropriately
- identify and present (one or more) computer science problem solutions
- select and evaluate appropriate tools and methods
- examine problems with technical and scientific literature

**Social competence**

The students:
- work in a team

**Self-competence**:

The Students:
- plan their informatical actions independently

**Module contents**

According to the assigned task

**Literatureempfehlungen**

According to the assigned task

**Links**

- Language of instruction: German
- Duration (semesters): 1 Semester
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### Module contents

According to the assigned course/task

### Literatureempfehlungen

Will be announced in the course

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### inf815 - Aktuelle Themen aus dem Gebiet "Safety-Security-Interaction" II

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| Verwendbarkeit des Moduls | [Master's Programme Computing Science (Master) > Angewandte Informatik](#)  
[Master's Programme Computing Science (Master) > Informatik, allgemein](#) |
| Zuständige Personen | Peter, Andreas (module responsibility)  
Lehrenden, Die im Modul (Prüfungsberechtigt) |

**Prerequisites**

Useful background knowledge is specified in the details of the assigned course.

**Skills to be acquired in this module**

This module integrates current computer science developments into the computer science Master program, especially considering the selected Master specialization, by appropriate study courses

**Professional competence**

The students:

- know recent technological or scientific computer science developments
- transfer computer science methods and development models to IT application area requirements
- evaluate the possibilities and limitations of computer science methods and tools and apply them appropriately

**Methodological competenc**

The students:

- analyze the technical merits of specific developments within the field of "Safety-Security-Interaction"
- substantiate their analyses using existing and scientific documented knowledge
- clearly write up those analyses in a concise scientific report
- present their results in a scientific talk

**Social competence**

The students:

- communicate persuasively orally and in writing
- further develop an attitude in which being able to clearly explain matters is geared to optimize the quality of feedback

**Self-competence**

The students:

- critically follow further developments in computer science in general and in their special field
- develop and reflect on their own theories in relation to independently formulated hypotheses

**Module contents**

According to the assigned course/task

**Literaturempfehlungen**

Will be announced in the course

**Links**

Language of instruction: English
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inf5100 - Digital Technology on Energy Markets

Module label: Digital Technology on Energy Markets

Modulkürzel: inf5100

Credit points: 6.0 KP

Workload: 180 h

Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's programme Digitalised Energy Systems (Master) > Automation and Electrical Engineering

Zuständige Personen
- Staudt, Philipp (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
- No participant requirements

Skills to be acquired in this module

This module integrates current computer science developments into the informatics program, especially considering the selected focus area, by appropriate study courses

Professional competence
- The students:
  - will be able to follow scientific work in the application area of digitalised energy markets, and thus be able to reflect on the current state of research in this area

Methodological competence
- The students:
  - are able to classify energy markets and judge new technological developments based on this classification

Social competence
- The students:
  - create solutions in small teams
  - present and discuss their solutions
  - reflect the solutions of others in a constructive manner

Self competence
- The students:
  - evaluate new technologies regarding their relevance for current energy-economic topics.

Module contents

In this module, theoretical concepts for understanding energy markets are presented and reflected with respect to the questions, how digitalisation of cyber-physical energy systems (CPES) is impacting the development of these markets.

Fundamental concepts are discussed using easy-to-follow examples. These are:

- Overview on Energy Markets
- Consecutive markets and different time horizons
- Smart Grids and energy markets
- Push-effect of digital technologies on energy market development
- Digitalised processes on energy markets
- Market integration of renewable energy resources

Language of instruction: English
**Duration (semesters)**
1 Semester

**Module frequency**
annual

**Module capacity**
unlimited

**Teaching/Learning method**
V+Ü

**Examination**
Prüfungszeiten

**Final exam of module**
Following the event period

**Type of examination**
written exam or oral exam or

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**Präsenzzeit Modul insgesamt**
56 h
inf5104 - Fundamentals of Game Theory in Energy Systems

Module label
Fundamentals of Game Theory in Energy Systems

Modulkürzel
inf5104

Credit points
6.0 KP

Workload
180 h

Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's programme Digitalised Energy Systems (Master) > Computer Science and Energy Informatics

Zuständige Personen
- Nieße, Astrid (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
Useful prior knowledge: Fundamentals of optimization

Skills to be acquired in this module

Upon successful completion of the course, students can understand fundamental concepts of game theory, and the relevance of these concepts to applications in energy informatics research.

Professional competence
The students:
- will be able to follow game-theoretic work in the application area of energy systems, and thus be able to reflect on the current state of research in this area

Methodological competence
The students:
- can classify and formalise games and apply solution concepts for the presented types of games. Application examples can be examined for game types and the necessary simplifications can be evaluated.

Social competence
The students:
- create solutions in small teams
- present and discuss their solutions
- reflect the solutions of others in a constructive manner

Self competence
The students:
- derive connections between everyday situations and their game theory conceptualization.

Module contents

In this module, theoretical concepts from game theory are prepared and presented with connections to the application in cyber-physical energy systems (CPES).

Fundamental concepts are discussed using easy-to-follow examples.

These are:
- Game theory and decision theory
- Interdependencies
- Cooperative and non-cooperative game theory
- Utility, discrete and continuous strategy, dominant strategy
- Axioms of game theory
- Theorems of game theory
- Solution concepts for games, e.g. iterated elimination, backward induction
- Multi-step and repeated games
- Partial game perfection
- Discont factor
Mechanisms design, markets and auctions

In CPES-application examples, references are made to distributed artificial intelligence and multi-agent systems, strategy learning, and operating in markets in energy applications.

Literaturempfehlungen

- Fudenberg, Tirole: Game Theory. MIT Press, 1991

Links

<table>
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<th>Language of instruction</th>
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Final exam of module

- Prüfungszeiten
- Type of examination
- Written exam

Form of instruction

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Präsenzzzeit Modul insgesamt

- 56 h
inf5106 - Optimal and Model-Predictive Control

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<td>- Lehrenden, Die im Modul (Prüfungsberechtigt)</td>
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**Prerequisites**

Useful previous knowledge: Basic knowledge of control of linear continuous-time and/or discrete-time systems or robust control.

**Skills to be acquired in this module**

The students identify fundamentals of the optimisation of control systems

**Professional competence**

The students:

- identify fundamentals of the optimisation of control systems
- characterise static and dynamic optimisation problems
- are aware of software implementations for selected test rigs

**Methodological competence**

The students:

- analyse problems of optimal control
- generalise them independently toward novel research-oriented application scenarios

**Social competence**

The students:

- develop solution ideas for real control engineering tasks in small groups in a project/practical course accompanying the lecture
- communicate their results in short presentations

**Self competence**

The students:

- critically reflect the achieved results of their project work
- acknowledge limitations of various approaches for optimal control design

**Module contents**

1. Parameter optimization
   - Unconstrained optimisation
   - Optimisation under equality/inequality constraints
2. Dynamic optimisation (structural optimisation)
   - Bellman’s optimality principle
   - Maximum principle of Pontryagin
   - Special optimisation problems: Minimum time problems, minimum energy, LQR
3. Linear model-predictive control
4. Nonlinear model-predictive control
5. Receding horizon state estimation

**Literaturempfehlungen**

- Föllinger, O.: Optimierung dynamischer Systeme. - Eine Einführung für Ingenieure.
### Links

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#### Final exam of module

- at the end of the lecture period
- Portfolio or written exam

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### Präsenzzeit Modul insgesamt

- 56 h
**inf5112 - Digitalised Energy System Modeling and Control**

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**Verwendbarkeit des Moduls**
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's programme Digitalised Energy Systems (Master) > Digitalised Energy System Automation, Control and Optimisation

**Zuständige Personen**
- Lehnhoff, Sebastian (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**
No participant 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 the limited resource power

**Module contents**
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 net management are introduced. This module deals with the technical and economical framework for a permissible electrical network as well as mathematical modelling and calculation methods to analyse conditions of electrical energy networks (in stationary conditions).

These are:

- the organisation of the EU energy market (regulatory framework, responsibility in liberalisation 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

Literaturempfehlungen

- Konstantin, P.; Praxisbuch Energiewirtschaft, Springer 2006
- Schwab, A.; Elektroenergiesysteme, Springer 2009
- Kirtley, J.L.; Electric Power Principles, John Wiley & Sons, 2010
- Gremmel, H.; ABB Schaltanlagen-handbuch, Cornelsen 2007
- Leinhoff, S.; Dezentrales vernetztes Energiemanagement, 2010

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inf5114 - Digitalised Energy System Requirements Engineering

Module label | Digitalised Energy System Requirements Engineering
Modulkürzel | inf5114
Credit points | 6.0 KP
Workload | 180 h

Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's programme Digitalised Energy Systems (Master) > Digitalised Energy System Automation, Control and Optimisation

Zuständige Personen
- Lehnhoff, Sebastian (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
No participant requirements

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

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

Methodological competence
The students:
- name problems for the 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 the energy management together
- develop use cases in teams
- present self-developed solutions

Self competence
The students:
- reflect their actions with regard to structure and decompose systems
- reflect their own use of the limited resource power

Module contents
This module provides the computer science basics for the 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 plants communication, the load management in particular
• Methods for modelling and simulation of power supply system dynamics

Literaturempfehlungen

• Crastan V.: "Elektrische Energieversorgung II", Springer 2004
• Konstantin, P.: "Praxisbuch Energiewirtschaft", Springer 2006
• Schwab, A.: "Elektroenergiesysteme, Springer 2009

Links

Language of instruction English
Duration (semesters) 1 Semester
Module frequency every winter term
Module capacity unlimited
Teaching/Learning method V+Ü
Examination Prüfungszeiten Type of examination

Final exam of module

At the end of the course term paper

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inf5118 - Decentralised Nonlinear Model-Based Control in Digitalised Energy Systems

Module label: Decentralised Nonlinear Model-Based Control in Digitalised Energy Systems

Modulkürzel: inf5118

Credit points: 6.0 KP

Workload: 180 h

Verwendbarkeit des Moduls:
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's programme Digitalised Energy Systems (Master) > Digitalised Energy System Automation, Control and Optimisation

Zuständige Personen:
- Rauh, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites:
Basic knowledge of the control of linear continuous-time and/or discrete-time systems or of robust control

Skills to be acquired in this module:

The students identify fundamentals of control and state estimation for nonlinear systems.

Professional competence:
The students:
- identify fundamentals of control and state estimation for nonlinear systems
- characterise problem-specific solution techniques
- are aware of software implementations for selected test rigs

Methodological competence:
The students:
- analyse problems of nonlinear control and state estimation and generalise them independently toward novel research-oriented applications scenarios

Social competence:
The students:
- develop solution ideas for real-life control problems within an accompanying project/lab course in small teams
- explain the obtained results in short presentations

Self competence:
The students:
- critically reflect the achieved results of their project work
- acknowledge limitations of various approaches for nonlinear control design.

Module contents:

1. Fundamentals of control-oriented modelling
2. Special properties of nonlinear control systems
   - Finite escape time
   - Chaos
   - Limit cycles
   - Equilibria
3. Stability properties/ Stability analysis
   - Local vs. global Stability
   - Lyapunov methods
   - Stability of limit cycles
   - Criteria for the proof of instability
4. Nonlinear control design
   - Control Lyapunov functions
   - Backstepping control
   - Feedback linearization
   - Flatness-based control
5. Nonlinear observer synthesis
Literaturempfehlungen

- Rauh, A. Folien/ Skript zur Vorlesung „Decentralised Nonlinear Model-Based Control in DES“.

| Links |
|------------------------|------------------------|
| Language of instruction | English |
| Duration (semesters) | 1 Semester |
| Module frequency | every summer term |
| Module capacity | unlimited |
| Teaching/Learning method | V+Ü |
| Examination | Prüfungszeiten |
| Type of examination | |
| Final exam of module | At the end of the lecture period |
| portfolio or written exam | |

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Präsenzzeit Modul insgesamt 56 h
**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 by evaluating them. In order to manage the integration of control algorithms, students are taught the principles of cosimulation using the example of the "mosaik" smart grid cosimulation framework. Students are put into the position to understand and apply distributed, agent-based control schemes to decentralised 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 practically apply the foundations for planning and conducting simulation based experiments as well as the interpretation of the results. Attention is especially paid to a tradeoff between precision and robustness of the results and the necessary efforts (design of experiments) in order to gain as much insight into interdependencies with as few experiments.

**Profesional competence**

The student:

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

**Methodological competence**

The student:

- 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 decentralised energy generators and/or consumers
- evaluate simulation results
- search information and look into methods to implement models
- propose hypothesis and check their validity with simulation experiments

**Social competence**

The student:

- apply the development technique pair programming
- discuss design decisions
- identify work packages and take responsibility for it

**Self-competence**

The student:
• reflect on their own use of the limited resource power
• accept and use criticism to develop their own behaviour

Module contents

In this practical course students:

• mathematically model controllable, modulating electrical energy generators and consumers and translate them to executable simulation models,
• put hands on mosaik (installation, description and configuration of scenarios, conduction of simulations),
• learn the principles of co-simulation of energy systems,
• learn about the challenges of implementing coordination mechanisms (multi-criticality, convergency, quality) on the training,
• apply foundations of design of experiments to practical simulation based experiments.

Literatureempfehlungen

Smart Grids:


Multiagentensysteme

• Sutton, R. S.; Barto, A. G.: “Reinforcement Learning”, MIT Press, 1998-
• Ferber J.; Kim, S.: “Multiagentensysteme: eine Einführung in die Verteilte Künstliche Intelligenz”, Addison-Wesley, 2001

Co-Simulation


Versuchsplanung

• Klein, B.: “Versuchsplanung - DoE”, Oldenbourg, 2011

Links

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inf5122 - Learning-Based Control in Digitalised Energy Systems

Module label
Learning-Based Control in Digitalised Energy Systems

Modulkürzel
inf5122

Credit points
6.0 KP

Workload
180 h

Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's programme Digitalised Energy Systems (Master) > Digitalised Energy System Design and Assessment
- 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

Zuständige Personen
- Rauh, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
Basic knowledge of control of linear continuous-time and/or discrete-time systems and/or robust control

Skills to be acquired in this module

The students identify fundamentals of learning-based control for dynamic systems.

Professional competences
The students:
- identify fundamentals of learning-based control for dynamic systems
- characterise problem-specific learning techniques
- are aware of software implementations for selected test rigs.

Methodological competences
The students:
- analyse problems of learning-based control
- generalise them independently toward novel research-oriented application scenarios.

Social competences
The students:
- develop solution ideas for real-life control problems within an accompanying project/lab course in small teams
- explain the obtained results in short presentations.

Self competences
The students:
- critically reflect the achieved results of their project work
- acknowledge limitations of various approaches for learning-based control design.

Module contents
1. Iterative learning control (ILC)
   - Grundlegende 2D-Systemstrukturen
   - Stability criteria
   - Ausgewählte Optimierungsansätze
2. Data-driven neural network modelling vs. first-principle modelling
   - Static function approximations
   - NARX-modelling
3. Design of neural network-based controllers
4. Stability of neural network-based controllers
Literaturempfehlungen

- Jian Xin Xu; Ying Tan. Linear and Nonlinear Iterative Learning Control. Springer-Verlag. 2003
- Rauh, A. Folien/Skript zur Vorlesung „Learning-Based Control in DES“

Links

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Final exam of module

At the end of the course

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inf5126 - Digitalised Energy System Cyber-Resilience

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<td>• Master’s programme Digitalised Energy Systems (Master) &gt; Innovation Topics and Smart Grids</td>
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<td>• Lehnhoff, Sebastian (module responsibility)</td>
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<tr>
<td></td>
<td>This module integrates current developments in cyber resilience and its application to energy systems.</td>
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<td></td>
<td><strong>Professional competences</strong></td>
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<tr>
<td></td>
<td>The students</td>
</tr>
<tr>
<td></td>
<td>• recognise the entailed problems and challenges of new digitalization trends such as billion devices on the internet connected to our power grid (televisions, baby monitors, alexa, etc.), smart services, cloud services, outsourcing, Artificial Intelligence, Big Data etc.</td>
</tr>
<tr>
<td></td>
<td>• evaluate fraud/ intrusion detection methods</td>
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<td></td>
<td>• identify security flaws and vulnerabilities of the energy system</td>
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<td></td>
<td><strong>Methodological competences</strong></td>
</tr>
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<td></td>
<td>The students</td>
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<tr>
<td></td>
<td>• examine tasks with technical and research literature, write an academic article and present their solutions academically</td>
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<td>• evaluate problems of cyber resilience in energy systems</td>
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<td>• schedule time processes and resources.</td>
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<td></td>
<td><strong>Social competences</strong></td>
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<td>The students</td>
</tr>
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<td></td>
<td>• communicate with colleagues and experts convincingly.</td>
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<td><strong>Self competences</strong></td>
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<tr>
<td></td>
<td>The students</td>
</tr>
<tr>
<td></td>
<td>• reflect the problems of cyber resilience of energy systems critically and pursue different possible solution strategies.</td>
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<td></td>
<td>• reflect self-developed hypotheses and theories independently.</td>
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<tr>
<td>Module contents</td>
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</tr>
<tr>
<td></td>
<td>• Energy system as critical infrastructure (KRITIS)</td>
</tr>
<tr>
<td></td>
<td>• Propagation of phenomena and their dynamics</td>
</tr>
<tr>
<td></td>
<td>• Omnipresent conflicts of objectives</td>
</tr>
<tr>
<td></td>
<td>• Susceptibility of the energy system to new effects, such as the occurrence of “classic” IT challenges (errors, update management, interactions, ...) and to sophisticated cyber-attacks</td>
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<tr>
<td>Literatureempfehlungen</td>
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<td>V or S</td>
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#### Examination

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#### Form of instruction

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Präsenzzeit Modul insgesamt 28 h
inf5128 - AI in Energy Systems

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**Verwendbarkeit des Moduls**
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's programme Digitalised Energy Systems (Master) > Innovation Topics and Smart Grids

**Zuständige Personen**
- Bremer, Jörg (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**
No participant requirements

**Skills to be acquired in this module**

The students learn to understand the energy system as self-organizing, self-optimizing and self-healing cyber physical system and how equip the components with of a cyber physical energy system with intelligence and autonomy.

**Professional competences**

The students
- contrast different methods of AI
- define modern use cases of AI applications in energy systems
- identify appropriate AI methods to achieve a given control goal in the energy system
- evaluate risks and drawbacks of AI in energy systems
- apply AI to selected problems

**Methodological competences**

The students
- examine tasks with technical and research literature, write an academic article and present their solutions academically
- evaluate problems of AI in energy systems
- schedule time processes and resources

**Social competences**

The students
- communicate with colleagues and experts convincingly

**Self competences**

The students
- pursue and reflect the integration of AI into energy systems critically
- reflect self-developed hypotheses to theories independently

**Module contents**

This module integrates current developments in artificial intelligence (AI) and its application to energy systems

**Literaturempfehlungen**

**Links**

**Language of instruction**
- English

**Duration (semesters)**
- 1 Semester

**Module frequency**
- irregular

**Module capacity**
- unlimited
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<td>Workload Präsenzzzeit</td>
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inf5130 - Socio-technical Energy Systems

**Module label**  
Socio-technical Energy Systems

**Modulkürzel**  
inf5130

**Credit points**  
3.0 KP

**Workload**  
90 h

**Verwendbarkeit des Moduls**
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's programme Digitalised Energy Systems (Master) > Innovation Topics and Smart Grids

**Zuständige Personen**
- Lehnhoff, Sebastian (module responsibility)
- Bremer, Jörg (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**
No participant requirements

**Skills to be acquired in this module**

The students learn to consider human needs right from the beginning in the design process of Human Cyber Physical Energy Systems. A human-centered design is at the core as an approach to interactive systems development that aims to make systems usable and useful by focusing on the users; and to develop systems that are aware of (NOT rationally acting) humans when making decisions.

**Professional competences**

The students
- recognise the energy system as a human cyber physical system with a steadily growing degree of autonomy
- identify the potential for conflict that arises when humans interact with cyber physical systems
- model human-system-interaction
- recognise, evaluate and contrast approaches to self-explaining AI

**Methodological competences**

The students
- examine tasks with technical and research literature, write an academic article and present their solutions academically
- evaluate problems of socio-technical energy system
- schedule time processes and resources

**Social competences**

The students
- communicate with colleagues and experts convincingly

**Self competences**

The students
- pursue the integration of humans and human behaviour into cyber physical energy systems critically
- develop and reflect self-developed hypotheses to theories independently

**Module contents**

- Simulation (and prediction) of human behaviour and decisions
- Modeling user behaviour in human cyber physical systems
- Self-explaining and justifying AI

**Literaturempfehlungen**

Will be announced in the course
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<tbody>
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<tr>
<td>Type of examination</td>
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| Form of instruction            | Course or seminar                    |
| SWS                            | 2                                    |
| Frequency                      | WiSe                                 |
| Workload Präsenzzeit           | 28 h                                 |
inf5400 - Advanced Topics in Applied Deep Learning

Module label  Advanced Topics in Applied Deep Learning
Modulkürzel  inf5400
Credit points  6.0 KP
Workload  180 h

Verwendbarkeit des Moduls
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodul der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik

Zuständige Personen
- Strodthoff, Nils (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
This module is intended for an advanced audience and requires a solid understanding of the fundamentals of Machine Learning. Experience in training deep neural networks is essential in this context.

Skills to be acquired in this module

Professional competence
The students
- have in-depth knowledge of selected application areas of deep learning. They are familiar with various solutions for problems in these areas, know their advantages and disadvantages, and can practically implement them and adapt them to their own issues.

Methodological competence
The students
- independently develop theoretical and practical concepts with the help of in-person events, provided materials, and specialized literature.

Social competence
The students
- can present solution approaches for problems in this area to the plenary and defend them in discussions.

Self-competence
The students
- are able to assess their own subject-specific and methodological competence. They take responsibility for their competence development and learning progress and reflect on these independently. In addition, they independently work on learning content and can critically reflect on the content.

Module contents
This lecture builds upon the module "Applied Deep Learning in PyTorch" and addresses current research topics at an advanced level of depth. As in the first part, there is a strong emphasis on imparting practical knowledge, which will be learned and reinforced through practical exercises.

The thematic areas to be covered in various instantiations of the module include deep learning methods for time series analysis, self-supervised learning methods, and modern generative models.

Literatureempfehlungen

Links

Language of instruction  English
Duration (semesters)  1 Semester
<table>
<thead>
<tr>
<th><strong>Module frequency</strong></th>
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<tr>
<td><strong>Examination</strong></td>
<td>Prüfungszeiten</td>
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| **Final exam of module** | At the end of the lecture period | Written exam / oral exam / project work |

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<th><strong>Form of instruction</strong></th>
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<th><strong>Frequency</strong></th>
<th><strong>Workload of compulsory attendance</strong></th>
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<td>Exercises</td>
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<td>2</td>
<td>WiSe</td>
<td>28</td>
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| **Präsenzzeit Modul insgesamt** | 56 h |
inf5402 - Trustworthy Machine Learning

Module label | Trustworthy Machine Learning
Modulkürzel | inf5402
Credit points | 6.0 KP
Workload | 180 h

Verwendbarkeit des Moduls
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodul der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik

Zuständige Personen
- Strodthoff, Nils (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
Content requirements are basic theoretical knowledge in machine learning, practical programming knowledge in Python basic knowledge in deep neural network training.

Skills to be acquired in this module

Professional competence
The students
- have an overview of the various aspects that determine the quality of machine learning algorithms.
- are familiar with methods to measure different quality aspects and, if necessary, methods to enhance them, and they can implement and apply these methods.

Methodological competence
The students
- independently develop theoretical and practical concepts with the help of in-person events, provided materials, and specialized literature.

Social competence
The students
- can present solution approaches for problems in this area to the plenary and defend them in discussions.

Self-competence
The students
- are able to assess their own subject-specific and methodological competence. They take responsibility for their competence development and learning progress and reflect on these independently. In addition, they independently work on learning content and can critically reflect on the content.

Module contents
Machine learning algorithms are increasingly being applied in a wide range of areas, particularly in safety-critical domains. However, the quality of these algorithms is rarely systematically examined. The focus of this event is on various quality dimensions for machine learning algorithms, especially deep neural networks. This ranges from performance measurement to interpretability/explainability (XAI), robustness (adversarial robustness, non-adversarial robustness, distribution shifts, OOD-detection), uncertainty quantification, fairness/bias, and privacy. The methods will be introduced theoretically in the lecture and practically implemented and applied in the exercises.

Literatureempfehlungen

Links

Language of instruction | English
Duration (semesters) | 1 Semester
<table>
<thead>
<tr>
<th>Module frequency</th>
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<td>28</td>
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<td><strong>56 h</strong></td>
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inf5406 - Medical Data Analysis with Deep Learning

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Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Angewandte Informatik

Zuständige Personen
- Strodthoff, Nils (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
A basic theoretical understanding in machine learning, practical programming skills in Phyton, and basic knowledge in deep neural networks.

Skills to be acquired in this module

Professional competence
The students
- have an overview of the application areas of machine learning methods for analyzing medical data and can contextualize the issues within both the methodological and (bio)medical problem contexts. They are familiar with suitable algorithms and can apply them in practice.

Methodological competence
The students
- independently develop theoretical and practical concepts with the help of in-person events, provided materials, and specialized literature.

Social competence
The students
- can present solution approaches for problems in this area to the plenary and defend them in discussions.

Self-competence
The students
- are able to assess their own subject-specific and methodological competence. They take responsibility for their competence development and learning progress and reflect on these independently. In addition, they independently work on learning content and can critically reflect on the content.

Module contents
This lecture provides an insight into current methods of deep learning for analyzing medical data. A wide spectrum of data modalities and application areas is covered, ranging from medical imaging (X-ray/histopathology/CT/MRI) to medical time series (EKG/EEG/audio), and extending to electronic health records, medical text data, and finally, the multimodal integration of various data sources. These topics are complemented by methodological focal points that are particularly relevant for medical data analysis, such as interpretability, imbalanced or sparsely labeled data.

Literatureempfehlungen

Links

Language of instruction          English
Duration (semesters)             1 Semester
Module frequency                 irregular in summer term
Module capacity                  unlimited
Teaching/Learning method         V+Ü
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**Präsenzzzeit Modul insgesamt** 56 h
inf5408 - Applied Deep Learning in PyTorch

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<td>Workload</td>
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Verwendbarkeit des Moduls
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodul 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
- Master's Programme Environmental Modelling (Master) > Mastermodule

Zuständige Personen
- Strodthoff, Nils (module responsibility)
- Lehrende, Die im Modul (Prüfungsberechtigt)

Prerequisites
- knowledge of fundamental theoretical understanding in the field of machine learning and practical programming skills in Python.

Skills to be acquired in this module

Professional competence
The students
- have an overview of the components of deep learning frameworks
- are familiar with application areas of deep learning methods across various data modalities, and common solution strategies and model architectures
- can appropriately adapt deep learning methods to new problems in the respective domains and apply them independently.

Methodological competence
The students
- independently develop theoretical and practical concepts with the help of in-person events, provided materials, and specialized literature.

Social competence
The students
- can present solution approaches for problems in this area to the plenary and defend them in discussions.

Self-competence
The students
- are able to assess their own subject-specific and methodological competence
- take responsibility for their competence development and learning progress and reflect on these independently
- independently work on learning content and can critically reflect on the content.

Module contents

This lecture provides a comprehensive introduction to contemporary Deep Learning methods, with a specific emphasis on their practical application. Concurrently, it serves as a primer for the widely-used PyTorch Deep Learning framework, assuming only a basic familiarity with Python. The course encompasses a wide range of prevalent machine learning tasks across various data types, including tabular, image, text, audio, and graph data. Throughout the course, we delve into the most crucial and up-to-date model architectures within these domains.

This encompasses convolutional neural networks, recurrent neural networks,
and transformer models. The lecture is complemented by hands-on exercise sessions, where students will gain practical proficiency with PyTorch. Simultaneously, they will acquire practical insights to effectively apply contemporary deep learning methods within their specific fields of interest.

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<td>Exercises</td>
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inf5450 - Current topics in applied deep learning

Module label: Current topics in applied deep learning

Modulkürzel: inf5450

Credit points: 3.0 KP

Workload: 90 h

Verwendbarkeit des Moduls:
- Master's Programme Business Informatics (Master) > Akzentsetzungsmoduls der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik

Zuständige Personen:
- Strodthoff, Nils (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites:
The seminar requires attending a foundational lecture in the field of Machine Learning and Deep Learning.

Skills to be acquired in this module:

Professional competence
The students
- have an overview of selected current challenges in the field of applied deep learning, along with exemplary solution approaches, and can contextualize the latter within the broader methodological context.

Methodological competence
The students
- can independently explore topics using current research literature and critically reflect upon them.

Social competence
The students
- can present solution approaches for problems in this area to the plenary and defend them in discussions.

Self-competence
The students
- are able to assess their own subject-specific and methodological competence. They take responsibility for their competence development and learning progress and reflect on these independently. In addition, they independently work on learning content and can critically reflect on the content.

Module contents:
This seminar provides insights into selected methodological challenges in the field of applied deep learning. Depending on the instantiation of the module, different emphases will be placed, such as the modeling of long-range interactions or methods for improving the label efficiency of machine learning algorithms, e.g. through self-supervised learning.

Literatureempfehlungen

Links

Language of instruction: English

Duration (semesters): 1 Semester

Module frequency: every winter term

Module capacity: unlimited

Teaching/Learning method: S

Examination Prüfungszeiten Type of examination

Final exam of module
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inf5452 - Current Topics in Trustworthy Machine Learning

**Module label**
Current Topics in Trustworthy Machine Learning

**Modulkürzel**
inf5452

**Credit points**
3.0 KP

**Workload**
90 h

**Verwendbarkeit des Moduls**
- 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

**Zuständige Personen**
- Strodthoff, Nils (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**
The seminar requires attending a foundational lecture in the field of Machine Learning and/or Deep Learning.

**Skills to be acquired in this module**

**Professional competence**
The students
- gain an exemplary overview of challenges and existing solution approaches in their respective problem domains and can contextualize these within the broader methodological context.

**Methodological competence**
The students
- can independently explore topics using current research literature and critically reflect upon them.

**Social competence**
The students
- can present solution approaches for problems in this area to the plenary and defend them in discussions.

**Self-competence**
The students
- are able to assess their own subject-specific and methodological competence. They take responsibility for their competence development and learning progress and reflect on these independently. In addition, they independently work on learning content and can critically reflect on the content.

**Module contents**
This seminar provides insights into various aspects of trustworthy Machine Learning. Depending on the instantiation of the module, different focuses should be set, such as interpretability/explainability, uncertainty quantification, or robustness.

**Literaturempfehlungen**

**Links**

- **Language of instruction**
  English

- **Duration (semesters)**
  1 Semester

- **Module frequency**
  every winter term

- **Module capacity**
  unlimited
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inf5454 - Current Topics of Machine Learning in (bio-)medicine

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Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Angewandte Informatik

Zuständige Personen
- Strodthoff, Nils (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Skills to be acquired in this module

Professional competence
The students gain an exemplary overview of application areas of machine learning in biomedicine and can contextualize the discussed topics within broader methodological and application contexts.

Methodological competence
The students can independently explore topics using current research literature and critically reflect upon them.

Social competence
The students can present solution approaches for problems in this area to the plenary and defend them in discussions.

Self-competence
The students are able to assess their own subject-specific and methodological competence. They take responsibility for their competence development and learning progress and reflect on these independently. In addition, they independently work on learning content and can critically reflect on the content.

Module contents
This seminar provides insights into various application contexts of machine learning methods, especially deep learning, in the (bio)medical field. Depending on the instantiation of the module, different emphases will be placed, such as current examples of machine learning methods for diagnostic support, analysis of multimodal data, and even the analysis of protein data.

Literatureempfehlungen

Links

Language of instruction | English
Duration (semesters)    | 1 Semester
Module frequency        | every summer term
Module capacity          | unlimited
Teaching/Learning method| S
Examination Prüfungszeiten | Type of examination
Final exam of module
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inf5456 - Applied AI - Multimodal-Multisensor Interfaces I: Foundations, User Modeling, and Common Modality Combination

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| Zuständige Personen | Sonntag, Daniel (module responsibility)  
| | Lehrenden, Die im Modul (Prüfungsberechtigt) |

Prerequisites

basic concepts of Artificial Intelligence, Human-Computer Interfaces

Skills to be acquired in this module

Learning methods of multimodal interaction, learning Human-Computer Interaction concepts.

Professional competences

The students

- work their way into the topic of multimodality (competence: basic concepts of multimodality)
- develop an intuition for multimodal approaches, multimodal fusion techniques

Methodological competences

The students

- prepare a term paper on a special topic in the field of multimodality (competence: quick comprehension; structured literature review, precise expression)

Social competences

The students

- choose a topic and interact with each other and the supervising person (competence: communication skills, enthusiasm, initiative)

Self competences

The students

- work independently in a supervised setting (competencies: Personal responsibility, analytical thinking, organization, time management)

Module contents

We look at relevant theory and neuroscience foundations for guiding the development of high-performance systems. We discuss approaches to user modeling, interface design that supports user choice, synergistic combination of modalities with sensors, and blending of multimodal input and output. We also highlight an in-depth look at the most common multimodal-multisensor combinations—such as touch and pen input, haptic and non-speech audio output, and speech co-processed with visible lip movements, gaze, gestures, or pen input. A common theme throughout is support for mobility and individual differences among users—including the world's rapidly growing population of seniors.

Literaturempfehlungen

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</table>
Inf5458 - Applied AI - Multimodal-Multisensor Interfaces II: Signal Processing, Architectures, and Detection of Emotion and Cognition


Modulkürzel: inf5458

Credit points: 3.0 KP

Workload: 90 h

Verwendbarkeit des Moduls:
- Master's Programme Computing Science (Master) > Angewandte Informatik

Zuständige Personen:
- Sonntag, Daniel (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites:
- basic concepts of Artificial Intelligence, Human-Computer Interfaces

Skills to be acquired in this module:
- Learning methods of multimodal interaction, learning Human-Computer Interaction concepts.

Professional competences:
The students work their way into the topic of multimodality (competence: basic concepts of multimodality, develop an intuition for multimodal approaches, multimodal fusion techniques).

Methodological competences:
The students prepare a term paper on a special topic in the field of multimodality (competence: quick comprehension, structured literature review, precise expression).

Social competences:
The students choose a topic and interact with each other and the supervising person (competence: communication skills, enthusiasm, initiative).

Self competences:
The students work independently in a supervised setting (competencies: Personal responsibility, analytical thinking, organization, time management).

Module contents:
We begin with multimodal signal processing, architectures, and machine learning. It includes recent deep-learning approaches for processing multisensorial and multimodal user data and interaction, as well as context-sensitivity. A further highlight is processing of information about users' states and traits, an exciting emerging capability in next-generation user interfaces. We discuss real-time multimodal analysis of emotion and social signals from various modalities and perception of affective expression by users. Then we discuss multimodal processing of cognitive state using behavioral and physiological signals to detect cognitive load, domain expertise, deception, and depression. This collection of chapters provides walk-through examples of system design and processing, information on tools and practical resources for developing and evaluating new systems, and terminology, and tutorial support for mastering this rapidly expanding field. Finally, we look at experts' exchange views on the timely and controversial challenge topic of multimodal deep learning. The discussion focuses on how multimodal-multisensor interfaces are most likely to advance human performance during the next decade.

Literatureempfehlungen:
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inf5460 - Applied AI - Multimodal-Multisensor Interfaces III: Language Processing, Software, Commercialization, and Emerging Directions

Module label
inf5460 - Applied AI - Multimodal-Multisensor Interfaces III: Language Processing, Software, Commercialization, and Emerging Directions

Modulkürzel
inf5460

Credit points
3.0 KP

Workload
90 h

Verwendbarkeit des Moduls

- Master's Programme Computing Science (Master) > Angewandte Informatik

Zuständige Personen

- Sonntag, Daniel (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites

- basic concepts of Artificial Intelligence, Human-Computer Interfaces

Skills to be acquired in this module

Learning methods of multimodal interaction, learning Human-Computer Interaction concepts.

Professional competences

The students

work their way into the topic of multimodality (competence: basic concepts of multimodality, develop an intuition for multimodal approaches, multimodal fusion techniques)

Methodological competences

The students

- prepare a term paper on a special topic in the field of multimodality (competence: quick comprehension, structured literature review, precise expression).

Social competences

The students

- choose a topic and interact with each other and the supervising person (competence: communication skills, enthusiasm, initiative)

Self competences

The students

- work independently in a supervised setting (competencies: Personal responsibility, analytical thinking, organization, time management)

Module contents

This third seminar takes the contents of the first two seminars—namely, the motivations, foundational concepts, basic modality combinations, component analyses, and recognition and fusion techniques—to the next level. MMI 3 discusses how to design and build functioning multimodal-multisensor systems that can sustain real-world use. This seminar is most appropriate for graduate students and of primary interest to students studying computer science and information technology, human-computer interfaces, mobile and ubiquitous interfaces, affective and behavioral computing, machine learning, and related multidisciplinary majors. It is very useful if you want to work on practical applications, transfer of AI technology to application domains such as medicine and healthcare, and industrial prototypes. Afterward, students might engage in a hands-on project in which they design, build, and evaluate the performance of a multimodal system in our project group MMI II (https://elearning.uni-oldenburg.de/dispatch.php/course/details?sem_id=098bd500a53e723551364c7ff2175b5&again=yes).
**Literaturempfehlungen**


**Links**

https://uol.de/aai/lehre

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inf6602 - Sustainable Information Systems

Module label: Sustainable Information Systems

Modulkürzel: inf6602

Credit points: 6.0 KP

Workload: 180 h

Verwendbarkeit des Moduls
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodul Bereich Wirtschaftsinformatik
- Master's Programme Computing Science (Master) > Angewandte Informatik

Zuständige Personen
- Staudt, Philipp (module responsibility)
- Lehrenden, die im Modul (Prüfungsberechtigt)

Prerequisites
- Programming experience is an advantage but not necessary

Skills to be acquired in this module
- Understanding of Green Information Systems concepts and related theories
- Overview of sustainability topics in information systems research
- Understanding of the basics of decision support systems and ability to develop decision support systems in an environmental context
- Research methods in IS research in Green IS

Professional competences
The students
- know about the role of information systems research insustainability questions
- know how to use information systems to control sustainability in companies
- have an overview of the use cases for decision support tools in sustainability questions

Methodological competences
The students
- are able to build decision support tools for sustainability purposes
- know how to apply Design Science Research techniques
- are able to build online experiments using otree
- are able to generate research results based on case studies or surveys

Social competences
The students
- improve their teamwork competencies in group exercises
- improve their presentation skills through exercise

Self competences
The students
- improve their time management through submission deadlines
- learn about the role and importance of energy markets for society

Module contents

Literaturempfehlungen
- Watson, R. T., Boudreau, M. C., & Chen, A. J. (2010). Information systems and environmentally sustainable development: energy informatics and new directions for the IS community. MIS quarterly,
## Links

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### Final exam of module

- Two exams spread over the semester break
- Written or oral exam (depending on participant number)

### Form of instruction

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Preisemzeit Modul insgesamt 0 h
**inf704 - Computer Science Education III**

**Module label**  
Computer Science Education III

**Modulkürzel**  
inf704

**Credit points**  
3.0 KP

**Workload**  
90 h

**Verwendbarkeit des Moduls**  
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Pflichtmodule
- Master's Programme Computing Science (Master) > Angewandte Informatik

**Zuständige Personen**  
- Diethelm, Ira (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**  
no participant requirements

**Skills to be acquired in this module**

The students should know research methodical approaches of computer science didactics and be able to apply them exemplarily. They should be able to examine and further develop subject-specific didactic approaches in a well-founded manner and describe the corresponding effects on content, methods and tools of teaching.

**Professional competences**

The students:

- characterize research methodological approaches in computer science didactics
- investigate an exemplary research question, with the help of research methods of computer science didactics
- differentiate approaches of computer science didactics and their impact on content, methods and tools of teaching

**Methodological competences**

The students:

- transfer the presented research methods to new questions and adapt them appropriately to develop theories,
- formulate hypotheses for research in the classroom and test them

**Social competences**

The students:

- discuss in groups the research methods presented
- present research methods they have used and accept criticism or give professional critique

**Self-competences**

The students:

- incorporate the research methods presented into their actions in order to test their hypotheses
- reflect on their self-image as a researcher in the field of subject didactics

**Module contents**

The course will address:

- research methodological approaches in computer science didactics
- possibilities of theory-based development of concrete teaching scenarios
- approaches to the evaluation of computer science education and computer science didactics concepts

**Literaturempfehlungen**

- Humbert, Ludger: Didaktik der Informatik. Wiesbaden: B. G. Teubner,
Further literature will be announced in the lecture.

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Informatik, allgemein

inf810 - Special Topics in Computer Science I

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Verwendbarkeit des Moduls

- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's Programme Computing Science (Master) > Informatik, allgemein
- Master's Programme Environmental Modelling (Master) > Mastermodule

Zuständige Personen

- Peter, Andreas (module responsibility)
- Marx Gómez, Jorge (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites

The expected previous knowledge is specified in the details of the assigned course.

Skills to be acquired in this module

This module integrates current computer science developments into the business informatics program by appropriate study courses.

Professional competence

The students:

- know recent technological or scientific computer science developments
- transfer computer science methods and development models to IT application area requirements
- evaluate the possibilities and limitations of computer science methods and tools and apply them appropriately

Methodological competence

The students:

- review problems, formulate them with formal models and explore them appropriately
- identify and present (one or more) computer science problem solutions
- select and evaluate appropriate tools and methods
- examine problems with technical and scientific literature

Social competence

The students:

- work in a team

Self-competence:

The Students:

- plan their informatical actions independently

Module contents

According to the assigned course
## Literaturempfehlungen

According to the assigned course

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<td>Workload Präsenzzzeit</td>
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inf811 - Special Topics in Computer Science II

<table>
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<tr>
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Verwendbarkeit des Moduls

- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's Programme Computing Science (Master) > Informatik, allgemein
- Master's Programme Environmental Modelling (Master) > Mastermodule

Zuständige Personen

- Marx Gómez, Jorge (module responsibility)
- Peter, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites

Useful background knowledge is specified in the details of the assigned course.

Skills to be acquired in this module

This module integrates current computer science developments into the business informatics program, especially considering the selected focus area, by appropriate study courses.

Professional competence

The students:

- know recent technological or scientific computer science developments
- transfer computer science methods and development models to IT application area requirement
- evaluate the possibilities and limitations of computer science methods and tools and apply them appropriately

Methodological competence

The students:

- review problems, formulate them with formal models and explore them appropriately
- identify and present (one or more) computer science problem solutions
- select and evaluate appropriate tools and methods
- examine problems with technical and scientific literatur

Social competence

The students:

- work in a team

Self-competence:

The Students:

- lan their informatical actions independently

Module contents

According to the assigned course

Literaturempfehlungen

According to the assigned course

Links
<table>
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<td>Prüfungszeiten</td>
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<td>Final exam of module</td>
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inf812 - Current Topics in Computer Science I

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**Verwendbarkeit des Moduls**
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's Programme Computing Science (Master) > Informatik, allgemein
- Master's Programme Environmental Modelling (Master) > Mastermodule

**Zuständige Personen**
- Fränzie, Martin Georg (module responsibility)
- Marx Gómez, Jorge (module responsibility)
- Peter, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**
Useful background knowledge is specified in the details of the assigned course.

**Skills to be acquired in this module**
This module integrates current computer science developments into the business informatics program by appropriate study courses.

**Professional competence**
The students:
- know recent technological or scientific computer science developments
- transfer computer science methods and development models to IT application area requirements
- evaluate the possibilities and limitations of computer science methods and tools and apply them appropriately

**Methodological competence**
The students:
- review problems, formulate them with formal models and explore them appropriately
- identify and present (one or more) computer science problem solutions
- examine problems with technical and scientific literature

**Social competence**
The students:
- work in a team

**Self-competence**
The Students:
- plan their informational actions independently

**Module contents**
According to the assigned task

**Literaturempfehlungen**
According to the assigned task

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inf813 - Current Topics in Computer Science II

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**Verwendbarkeit des Moduls**
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's Programme Computing Science (Master) > Informatik, allgemein
- Master's Programme Environmental Modelling (Master) > Mastermodule

**Zuständige Personen**
- Marx Gómez, Jorge (module responsibility)
- Fränzle, Martin Georg (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**
No participant requirements

**Skills to be acquired in this module**
This module integrates current computer science developments into the business informatics program, especially considering the selected focus area, by appropriate study courses.

**Professional competence**
The students:
- know recent technological or scientific computer science developments
- transfer computer science methods and development models to IT application area requirements
- evaluate the possibilities and limitations of computer science methods and tools and apply them appropriately

**Methodological competenc**
The students:
- review problems, formulate them with formal models and explore them appropriately
- identify and present (one or more) computer science problem solutions
- select and evaluate appropriate tools and methods
- examine problems with technical and scientific literature

**Social competence**
The students:
- work in a team

**Self-competence:**
The Students:
- plan their informatical actions independently

**Module contents**
According to the assigned task

**Literatureempfehlungen**
According to the assigned task

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inf814 - Aktuelle Themen aus dem Gebiet "Safety-Security-Interaction" I

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**Verwendbarkeit des Moduls**
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's Programme Computing Science (Master) > Informatik, allgemein

**Zuständige Personen**
- Peter, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**
Useful background knowledge is specified in the details of the assigned course.

**Skills to be acquired in this module**

This module integrates current computer science developments into the computer science Master program, especially considering the selected Master specialization, by appropriate study courses.

**Professional competence**
The students:
- know recent technological or scientific computer science developments
- transfer computer science methods and development models to IT application area requirements
- evaluate the possibilities and limitations of computer science methods and tools and apply them appropriately

**Methodological competencies**
The students:
- analyze the technical merits of specific developments within the field of "Safety-Security-Interaction"
- substantiate their analyses using existing and scientific documented knowledge
- clearly write up those analyses in a concise scientific report
- present their results in a scientific talk

**Social competence**
The students:
- communicate persuasively orally and in writing
- further develop an attitude in which being able to clearly explain matters is geared to optimize the quality of feedback

**Self-competence**
The students:
- critically follow further developments in computer science in general and in their special field
- develop and reflect on their own theories in relation to independently formulated hypotheses

**Module contents**
According to the assigned course/task

**Literaturempfehlungen**
Will be announced in the course

**Links**

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### inf815 - Aktuelle Themen aus dem Gebiet "Safety-Security-Interaction" II

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#### Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's Programme Computing Science (Master) > Informatik, allgemein

#### Zuständige Personen
- Peter, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

#### Prerequisites

Useful background knowledge is specified in the details of the assigned course.

### Skills to be acquired in this module

This module integrates current computer science developments into the computer science Master program, especially considering the selected Master specialization, by appropriate study courses

#### Professional competence
The students:
- know recent technological or scientific computer science developments
- transfer computer science methods and development models to IT application area requirements
- evaluate the possibilities and limitations of computer science methods and tools and apply them appropriately

#### Methodological competency
The students:
- analyze the technical merits of specific developments within the field of "Safety-Security-Interaction"
- substantiate their analyses using existing and scientific documented knowledge
- clearly write up those analyses in a concise scientific report
- present their results in a scientific talk

#### Social competence
The students:
- communicate persuasively orally and in writing
- further develop an attitude in which being able to clearly explain matters is geared to optimize the quality of feedback

#### Self-competence
The students:
- critically follow further developments in computer science in general and in their special field
- develop and reflect on their own theories in relation to independently formulated hypotheses

### Module contents

According to the assigned course/task

### Literatureempfehlungen

Will be announced in the course

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<td>Final exam of module</td>
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inf862 - Study Abroad I

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**Verwendbarkeit des Moduls**
- Master's Programme Business Informatics (Master) > Kernmodule
- Master's Programme Computing Science (Master) > Informatik, allgemein
- Master's Programme Computing Science (Master) > Interdisziplinäre Module

**Zuständige Personen**
- Vogel-Sonnenschein, Ute (module responsibility)
- Sauer, Jürgen (module responsibility)
- Marx Gómez, Jorge (Module counselling)
- Fränzle, Martin Georg (Module counselling)

**Further responsible persons**
- Studiengangsverantwortliche der Master-Studiengänge Informatik und Wirtschaftsinformatik

**Prerequisites**
According to the requirements of the selected courses at the international host university

**Skills to be acquired in this module**

**Professional competence**
- depending on the chosen course at the host university

**Methodological competence**
- depending on the chosen course at the host university

The students
- organize themselves independently in the culture of the host country
- use time and other resources efficiently and in a goal-oriented manner

**Social competence**

The students
- have intercultural competence: they interact successfully and appropriately with individuals and groups from other cultures,
- communicate with people from other cultures in a targeted and respectful manner,
- have in-depth empathic skills. They empathize with other people on a cognitive and emotional level, listen carefully and attentively, and understand the opinions of others.

**Self-competence**

The students
- have generally deepened their skills in a foreign language for subject-related discourse,
- express themselves fluently in the language of their host country,
- adapt to changing living and learning environments,
- deal tolerantly with ambiguities,
- approach other people openly,
- assess their own strengths and weaknesses appropriately,
- make appropriate decisions even in difficult situations,
- work on challenges in a solution- and goal-oriented manner,
- face up to new tasks, challenges and experiences.

**Module contents**
The ongoing process of globalization requires preparation for professional activities that are increasingly internationally oriented. This requires not only foreign language skills, but also intercultural skills in
particular.
These skills are intensively promoted during a semester abroad.
As courses at the host university can also relate to areas of knowledge that are
not included in the Computer Science curriculum or are outside of Computer
Science, such coursework completed in the host country can be credited via
this module.
The choice of courses at the host university is agreed in advance of the stay as
part of a learning agreement with the student advisor or, depending on the
requirements of the place of study and the study financing, with the
international representatives of the Department of Computer Science.

**Literaturempfehlungen**

Specification of the foreign university

**Links**

- International Student Office of CvO Universität
- Web-Site of the Computer Science Department (in German)

<table>
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**Form of instruction**

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| Frequency | -- |
| Workload Präsenzzzeit | 56 h |
inf863 - Study Abroad II

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Verwendbarkeit des Moduls
- Master's Programme Business Informatics (Master) > Kernmodule
- Master's Programme Computing Science (Master) > Informatik, allgemein
- Master's Programme Computing Science (Master) > Interdisziplinäre Module

Zuständige Personen
- Vogel-Sonnenschein, Ute (module responsibility)
- Sauer, Jürgen (module responsibility)
- Fränzle, Martin Georg (Module counselling)
- Marx Gómez, Jorge (Module counselling)

Further responsible persons
Studiengangsverantwortliche der Master-Studiengänge Informatik und Wirtschaftsinformatik

Prerequisites
According to the requirements of the selected courses at the international host university

Skills to be acquired in this module

Professional competence
- depending on the chosen course at the host university

Methodological competence
- depending on the chosen course at the host university

The students
- organize themselves independently in the culture of the host country
- use time and other resources efficiently and in a goal-oriented manner

Social competence
The students
- have intercultural competence: they interact successfully and appropriately with individuals and groups from other cultures,
- communicate with people from other cultures in a targeted and respectful manner,
- have in-depth empathic skills. They empathize with other people on a cognitive and emotional level, listen carefully and attentively, and understand the opinions of others.

Self-competence
The students
- have generally deepened their skills in a foreign language for subject-related discourse,
- express themselves fluently in the language of their host country,
- adapt to changing living and learning environments,
- deal tolerantly with ambiguities,
- approach other people openly,
- assess their own strengths and weaknesses appropriately,
- make appropriate decisions even in difficult situations,
- work on challenges in a solution- and goal-oriented manner,
- face up to new tasks, challenges and experiences.

Module contents
The ongoing process of globalization requires preparation for professional activities that are increasingly internationally oriented. This requires not only foreign language skills, but also intercultural skills in
particular. These skills are intensively promoted during a semester abroad. As courses at the host university can also relate to areas of knowledge that are not included in the Computer Science curriculum or are outside of Computer Science, such coursework completed in the host country can be credited via this module. The choice of courses at the host university is agreed in advance of the stay as part of a learning agreement with the student advisor or, depending on the requirements of the place of study and the study financing, with the international representatives of the Department of Computer Science.

Literatureempfehlungen

Specification of the foreign university

Links

- International Student Office of CvO Universität
- Web-Site of the Computer Science Department (in German)

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Form of instruction VA-Auswahl

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Interdisziplinäre Module

inf207 - Electrical Engineering

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Verwendbarkeit des Moduls

- Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsbereich - Wahlbereich Informatik
- Dual-Subject Bachelor's Programme Computing Science (Bachelor) > Wahlpflicht Technische Informatik (30 KP)
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Technische Informatik)
- Master of Education Programme (Hauptschule and Realschule) Computing Science (Master of Education) > Mastermodule
- Master's Programme Computing Science (Master) > Interdisziplinäre Module

Zuständige Personen

- Hein, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites

Module Analysis II or Numerics

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
Literaturrempfehlungen

essential:
- slides

recommended:

Links

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Präsenzzeit Modul insgesamt 56 h
inf208 - Microrobotics and Microsystems Technology

Module label: Microrobotics and Microsystems Technology

Modulkürzel: inf208

Credit points: 6.0 KP

Workload: 180 h

Verwendbarkeit des Moduls

- Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsbereich - Wahlbereich Informatik
- Dual-Subject Bachelor's Programme Computing Science (Bachelor) > Wahlpflicht Technische Informatik (30 KP)
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Technische Informatik)
- Master's Programme Computing Science (Master) > Interdisziplinäre Module

Zuständige Personen

- Fatikow, Sergej (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites

No participant 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

---

**Literatureempfehlungen**

**Essential:**
- Vorlesungsskrift in Buchform

**Recommended:**

**Secondary Literature:**
- Elbel, Th.: Mikrosensorik, Vieweg, Wiesbaden, 1996
- Völklein, F. und Zetterer, Th.: Einführung in die Mikrosystemtechnik, Vieweg, Wiesbaden, 2000

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inf209 - Control Theory

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Verwendbarkeit des Moduls
- Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsbereich - Wahlbereich Informatik
- Dual-Subject Bachelor's Programme Computing Science (Bachelor) > Wahlpflicht Technische Informatik (30 KP)
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Technische Informatik)
- Master's Programme Computing Science (Master) > Interdisziplinäre Module

Zuständige Personen
- Fatikow, Sergej (module responsibility)
- Hein, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
- Differential Equations
- Analysis II
- Fundamentals of electrical engineering

Skills to be acquired in this module

Instruction on theoretical and mathematical basics of control engineering

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

Literature recommendations
- Unbehauen, H.: Regelungstechnik I, Klassische Verfahren zur Analyse und Synthese linearer kontinuierlicher Regel- systeme
- Lutz, H. und Wendt, W.: Taschenbuch der Regelungstechnik
- further reading will be announced at lecture

Links
- Language of instruction: German
- Duration (semesters): 1 Semester
- Module frequency: annual
- Module capacity: unlimited
- Teaching/Learning method: V+Ü
- Examination: Prüfungszeiten

Final exam of module
- At the end of the lecture period
- Hands-on exercises and written or oral exam

Form of instruction | Comment | SWS | Frequency | Workload of compulsory attendance
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Lecture | 3 | WiSe | 42
Exercises | 1 | WiSe | 14
Präsenzzeit Modul insgesamt | | | 56 h
inf210 - Signal and Image Processing

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  - Dual-Subject Bachelor’s Programme Computing Science (Bachelor) > Wahlpflicht Technische Informatik (30 KP)  
  - Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Technische Informatik)  
  - Master's Programme Computing Science (Master) > Interdisziplinäre Module  |
| Zuständige Personen    |  
  - Hein, Andreas (module responsibility)  
  - Fränzle, Martin Georg (module responsibility)  
  - Lehrenden, Die im Modul (Prüfungsberechtigt)  |
| Prerequisites          | Module math040 Analysis II b: Differential calculus of several variables  |

**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
Literaturempfehlungen

Essential:
- Foliensammlung zur Vorlesung

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.; Pelinak, E.; Pepges, R.; Bildverarbeitung in der Medizin; Springer Verlag 1997
- Handels, H.; Medizinische Bildverarbeitung; Teubner Verlag, Stuttgart
- Leipzig 2000 weiterführende Literatur wird in der Vorlesung bekannt gegeben

Links

Language of instruction  German
Duration (semesters)  1 Semester
Module frequency  annual
Module capacity  unlimited
Teaching/Learning method  V+Ü

Examination  Prüfungszeiten  Type of examination

Final exam of module

At the end of the semester  Hands-on exercises and written or oral exam

Form of instruction  Comment  SWS  Frequency  Workload of compulsory attendance

Lecture  2  WiSe  28
Exercises  2  WiSe  28

Präsenzzeit Modul insgesamt  56 h
inf305 - Medical Technology

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

Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Interdisziplinäre Module
- 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

Zuständige Personen
- Hein, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
Useful knowledge in:
- Signal and Image Processing
- Control Engineering

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
Literaturempfehlungen

essential:
- Lecture slides
- recommended:

secondary literature:

Links

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Examination

Final exam of module
- At the end of the lecture periode
- Portfolio: Hands-on exercises, report, and written or oral exam

Form of instruction

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Präsenzzeit Modul insgesamt
- 56 h
inf307 - Robotics

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Verwendbarkeit des Moduls

- Master's Programme Computing Science (Master) > Interdisziplinäre Module
- 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

Zuständige Personen

- Hein, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites

No participant 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- und 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

**Literatureempfehlungen**

**essential:**

- lecture nodes

**recommended:**


**secondary literature:**


**Links**

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inf308 - Microrobotics II

**Module label**
Microrobotics II

**Modulkürzel**
inf308

**Credit points**
6.0 KP

**Workload**
180 h

**Verwendbarkeit des Moduls**
- Master's Programme Computing Science (Master) > Interdisziplinäre Module
- 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

**Zuständige Personen**
- Fatikow, Sergej (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**
Participation in Microrobotics and Microsystems Engineering would be helpful

**Skills to be acquired in this module**

After having given an established introduction in the module “Microrobotics and Microsystems 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

**Literature recommendations**

- Lecture notes (can be obtained in secretariat, A1-3-303)

**Links**

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inf524 - Medical Basics

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Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Angewandte Informatik
- Master's Programme Computing Science (Master) > Interdisziplinäre Module

Zuständige Personen
- Wulff, Antje (module responsibility)
- Klausen, Andreas (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
No specific prior knowledge is required

Skills to be acquired in this module

The aim of the module is to provide students with a basic knowledge of human medicine. This should facilitate the understanding of the domain in case of a career choice or focus on medical informatics / medical technology and lead to basics for own questions and ideas for the application of methods of informatics in medicine.

Professional competence
The students
- learn the basics of medical terminology (Terminologia Anatomica) and the anatomy of the human body and can name the most important structure in technical language
- know the basics of the physiology of the human body and can describe the essential body functions
- gain insights into pathophysiological processes of the human body and the associated effects on the function of the human organism
- know the control circuits of the human body for maintaining important body functions and know that this control circuits can be used as a possibility to intervene in processes of the human body
- know reference values of important physiological parameters and can derive conclusions on body functions

Methodological competence
The students
- know the possible measurement procedures resulting from the physiological processes of the human body.
- apply measurement procedures to describe and evaluate human body functions. They can name examples of use and examples of interpretation
- know influencing variables that affect the interpretation of results from measurement procedures as well as the limits of measurement procedures
- learn how to carry out examinations according to protocols and how to document the results in a standardized way.

Social competence
The students
- experience an appreciative interaction with each other through regular role changes
- they take on the role of the test person as well as that of the experimenter
- an appreciative way of dealing with each other.
- describe in detail the data obtained in measurement procedures and consider them critically with other students
- integrate professional and factual criticism into their own courses of action
- use simulated examples from everyday clinical practice to learn the standardized procedures necessary to ensure patient safety

Self competence
The students
• deal with the function, the efficiency of the own body but also with its limits
• deal with the life cycle of conception, birth, adolescence, adulthood and aging

Module contents

See assigned course description

Literaturempfehlungen

As announced in course

Links

Languages of instruction German, English
Duration (semesters) 1 Semester
Module frequency every summer term
Module capacity unlimited
Teaching/Learning method V+Ü
Examination Prüfungszeiten Type of examination
Final exam of module
At the end of the lecture period Written exam or oral exam
The chosen form of examination will be announced in the first week of the course

<table>
<thead>
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<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
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inf951 - Interdisciplinary Module II

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<td>Credit points</td>
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<td>Verwendbarkeit des Moduls</td>
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<td>Master's Programme Computing Science (Master) &gt; Interdisziplinäre Module</td>
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<tr>
<td>Zuständige Personen</td>
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<tr>
<td>Vogel-Sonnenschein, Ute (module responsibility)</td>
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<td>Lehrenden, Die im Modul (Prüfungsberechtigt)</td>
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<tr>
<td>Vogel-Sonnenschein, Ute (Module counselling)</td>
<td></td>
</tr>
<tr>
<td>Further responsible persons</td>
<td>Studiengangsverantwortliche der Master-Studiengänge Informatik und Wirtschaftsinformatik</td>
</tr>
<tr>
<td>Prerequisites</td>
<td></td>
</tr>
<tr>
<td>Depending on the allocated course</td>
<td></td>
</tr>
</tbody>
</table>

Skills to be acquired in this module

The graduates know the basics and the application-relevant application-relevant background of the selected discipline.

Professional competencies

The students:
- identify the fundamentals and methods of the chosen field
- use the technical language of the field of application competently

Methodological competencies

The students:
- characterize the context of use and requirements of IT in the chosen field
- apply the disciplinary methods and techniques of the application area and contrast them with the methods and techniques
- known from methods and techniques
- known from computer science
- investigate problems of an application area with the methods and techniques typical for the discipline methods

Social competencies

The students:
- can appreciate the diversity of subject cultures and
- respect other disciplines and their way of working
- prepare themselves for application scenarios for IT systems

Self-competences

The students:
- reflect on their self-image and actions against the background of a other subject discipline

Module contents

The module is instantiated with modules from other disciplines or modules from the Department of Computer Science, which provide an interdisciplinary insight into another scientific discipline. The types of courses and examination modalities depend on the module selected.

Literaturempfehlungen

Language of instruction

English, German

Duration (semesters)

1 Semester

Module frequency

Irregular
<table>
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<td>Prüfungszeiten</td>
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<tr>
<td>Final exam of module</td>
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<tr>
<td>Form of instruction</td>
<td>VA-Auswahl</td>
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<tr>
<td>SWS</td>
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<tr>
<td>Frequency</td>
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<td>Workload Präsenzeit</td>
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inf862 - Study Abroad I

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<td>Modulkürzel</td>
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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>

**Verwendbarkeit des Moduls**
- Master's Programme Business Informatics (Master) > Kernmodule
- Master's Programme Computing Science (Master) > Informatik, allgemein
- Master's Programme Computing Science (Master) > Interdisziplinäre Module

**Zuständige Personen**
- Vogel-Sonnenschein, Ute (module responsibility)
- Sauer, Jürgen (module responsibility)
- Marx Gómez, Jorge (Module counselling)
- Fränzle, Martin Georg (Module counselling)

**Further responsible persons**
Studiengangsverantwortliche der Master-Studiengänge Informatik und Wirtschaftsinformatik

**Prerequisites**
According to the requirements of the selected courses at the international host university

**Skills to be acquired in this module**

**Professional competence**
- depending on the chosen course at the host university

**Methodological competence**
- depending on the chosen course at the host university

The students
- organize themselves independently in the culture of the host country
- use time and other resources efficiently and in a goal-oriented manner

**Social competence**

The students
- have intercultural competence: they interact successfully and appropriately with individuals and groups from other cultures,
- communicate with people from other cultures in a targeted and respectful manner,
- have in-depth empathic skills. They empathize with other people on a cognitive and emotional level, listen carefully and attentively, and understand the opinions of others.

**Self-competence**

The students
- have generally deepened their skills in a foreign language for subject-related discourse,
- express themselves fluently in the language of their host country,
- adapt to changing living and learning environments,
- deal tolerantly with ambiguities,
- approach other people openly,
- assess their own strengths and weaknesses appropriately,
- make appropriate decisions even in difficult situations,
- work on challenges in a solution- and goal-oriented manner,
- face up to new tasks, challenges and experiences.

**Module contents**
The ongoing process of globalization requires preparation for professional activities that are increasingly internationally oriented. This requires not only foreign language skills, but also intercultural skills in
These skills are intensively promoted during a semester abroad. As courses at the host university can also relate to areas of knowledge that are not included in the Computer Science curriculum or are outside of Computer Science, such coursework completed in the host country can be credited via this module. The choice of courses at the host university is agreed in advance of the stay as part of a learning agreement with the student advisor or, depending on the requirements of the place of study and the study financing, with the international representatives of the Department of Computer Science.

Literaturempfehlungen

Specification of the foreign university

Links

- International Student Office of CvO Universität
- Web-Site of the Computer Science Department (in German)

<table>
<thead>
<tr>
<th>Languages of instruction</th>
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<td>Examination</td>
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</table>

Transcripts of records from courses attended at the foreign university must be submitted in German or English translation.
### inf852 - IT Project Management

<table>
<thead>
<tr>
<th>Modulbezeichnung</th>
<th>IT Project Management</th>
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<tbody>
<tr>
<td>Modulkürzel</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>
</tr>
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</table>

### Verwendbarkeit des Moduls

- 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) > Praxismodule für Studierende mit außerschulischem Berufsziel
- Bachelor's Programme Economics and Business Administration (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 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 Education (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) >
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. They 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.

Literatureempfehlungen


Links

www.wi-ol.de

Language of instruction German
Duration (semesters) 1 Semester
Module frequency annual
Module capacity unlimited
Teaching/Learning method V+Ü

Examination Prüfungszeiten Type of examination

Final exam of module

At the end of the lecture period Written or oral exam

Form of instruction Comment SWS Frequency Workload of compulsory attendance

<table>
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<tr>
<th>Lecture</th>
<th>2</th>
<th>SoSe</th>
<th>28</th>
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</thead>
<tbody>
<tr>
<td>Exercises</td>
<td>2</td>
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Präsenzzzeit Modul insgesamt 56 h
inf863 - Study Abroad II

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<td>Workload</td>
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**Verwendbarkeit des Moduls**
- Master's Programme Business Informatics (Master) > Kernmodule
- Master's Programme Computing Science (Master) > Informatik, allgemein
- Master's Programme Computing Science (Master) > Interdisziplinäre Module

**Zuständige Personen**
- Vogel-Sonnenschein, Ute (module responsibility)
- Sauer, Jürgen (module responsibility)
- Fränzle, Martin Georg (Module counselling)
- Marx Gómez, Jorge (Module counselling)

**Further responsible persons**
Studiengangsverantwortliche der Master-Studiengänge Informatik und Wirtschaftsinformatik

**Prerequisites**
According to the requirements of the selected courses at the international host university

**Skills to be acquired in this module**

**Professional competence**
- depending on the chosen course at the host university

**Methodological competence**
- depending on the chosen course at the host university

The students
- organize themselves independently in the culture of the host country
- use time and other resources efficiently and in a goal-oriented manner

**Social competence**
The students
- have intercultural competence: they interact successfully and appropriately with individuals and groups from other cultures,
- communicate with people from other cultures in a targeted and respectful manner,
- have in-depth empathic skills. They empathize with other people on a cognitive and emotional level, listen carefully and attentively, and understand the opinions of others.

**Self-competence**
The students
- have generally deepened their skills in a foreign language for subject-related discourse,
- express themselves fluently in the language of their host country,
- adapt to changing living and learning environments,
- deal toleranty with ambiguities,
- approach other people openly,
- assess their own strengths and weaknesses appropriately,
- make appropriate decisions even in difficult situations,
- work on challenges in a solution- and goal-oriented manner,
- face up to new tasks, challenges and experiences.

**Module contents**
The ongoing process of globalization requires preparation for professional activities that are increasingly internationally oriented. This requires not only foreign language skills, but also intercultural skills in
These skills are intensively promoted during a semester abroad. As courses at the host university can also relate to areas of knowledge that are not included in the Computer Science curriculum or are outside of Computer Science, such coursework completed in the host country can be credited via this module. The choice of courses at the host university is agreed in advance of the stay as part of a learning agreement with the student advisor or, depending on the requirements of the place of study and the study financing, with the international representatives of the Department of Computer Science.

### Literature Empfehlungen

Specification of the foreign university

### Links

- International Student Office of CvO Universität
- Web-Site of the Computer Science Department (in German)

### Languages of instruction

| English, French, German |

### Duration (semesters)

| 1 Semester |

### Module frequency

| individual |

### Module capacity

| unlimited |

### Teaching/Learning method

| Requirement of the foreign university |

### Examination

| Prüfungszeiten |

### Final exam of module

| Specification of the foreign university |

### Recognition must be applied for at the Academic Examinations Office. |

### Transcripts of records from courses attended at the foreign university must be submitted in German or English translation. |

### Form of instruction

| VA-Auswahl |

### SWS

| 0 |

### Frequency

| -- |

### Workload Präsenzzeit

| 56 h |
inf950 - Interdisciplinary Module I

Module label | Interdisciplinary Module I
---|---
Modulkürzel | inf950
Credit points | 6.0 KP
Workload | 180 h

Verwendbarkeit des Moduls
- Master's Programme Computing Science (Master) > Interdisciplinäre Module

Zuständige Personen
- Lehrenden, Die im Modul (Prüfungsberechtigt)
- Vogel-Sonnenschein, Ute (module responsibility)
- Vogel-Sonnenschein, Ute (Module counselling)

Further responsible persons
- Studiengangsverantwortliche der Master-Studiengänge Informatik und Wirtschaftsinformatik

Prerequisites
Depending on the allocated course

Skills to be acquired in this module

The graduates know the basics and the application-relevant application-relevant background of the selected discipline.

Professional competencies
The students:
- identify the fundamentals and methods of the chosen field
- use the technical language of the field of application competently

Methodological competencies
The students:
- characterize the context of use and requirements of IT in the chosen field
- apply the disciplinary methods and techniques of the application area and contrast them with the methods and techniques
- known from methods and techniques
- known from computer science
- investigate problems of an application area with the methods and techniques typical for the discipline methods

Social competencies
The students:
- can appreciate the diversity of subject cultures and
- respect other disciplines and their way of working
- prepare themselves for application scenarios for IT systems

Self-competences
The students:
- reflect on their self-image and actions against the background of a other subject discipline

Module contents

The module is instantiated with specialist modules from other disciplines or modules from the Department of Computer Science, which provide an interdisciplinary insight into another scientific discipline. The types of courses and examination modalities depend on the module selected.

Literatureempfehlungen
Depending on the allocated course

Links
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<td>Module capacity</td>
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<td>events from V, S, Ü, P</td>
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<td>Examination</td>
<td>Prüfungszeiten</td>
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<td>Final exam of module</td>
<td>Prüfungszeiten</td>
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<td>SWS</td>
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<td>Frequency</td>
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Module aus anderen Studiengängen

mat996 - Introduction to Numerical Analysis

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<tr>
<td>Verwendbarkeit des Moduls</td>
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<tr>
<td></td>
<td>- Bachelor's Programme Business Informatics (Bachelor) &gt; Aufbaucurriculum-Wahlbereich Mathematik</td>
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<tr>
<td></td>
<td>- Bachelor's Programme Computing Science (Bachelor) &gt; Wahlpflichtbereich Mathematik</td>
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<td></td>
<td>- Master's Programme Computing Science (Master) &gt; Module aus anderen Studiengängen</td>
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<tr>
<td>Zuständige Personen</td>
<td>- Chernov, Alexey (module responsibility)</td>
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<td>- Schöpfer, Frank (module responsibility)</td>
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<tr>
<td>Prerequisites</td>
<td>Analysis I, Lineare Algebra</td>
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<tr>
<td>Skills to be acquired in this module</td>
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<tr>
<td></td>
<td>The students learn and analyze the basic numerical methods. The students learn to implement the basic numerical methods in a computer program.</td>
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<tr>
<td></td>
<td>Professional competence</td>
</tr>
<tr>
<td></td>
<td>The students:</td>
</tr>
<tr>
<td></td>
<td>- learn basic numerical methods and algorithms</td>
</tr>
<tr>
<td></td>
<td>- analyze properties of the numerical methods using rigorous mathematical tools</td>
</tr>
<tr>
<td></td>
<td>- implement the basic numerical methods in a computer program</td>
</tr>
<tr>
<td></td>
<td>- interpret results of computer simulations</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>- analyze algorithms with mathematical tools</td>
</tr>
<tr>
<td></td>
<td>- implement numerical algorithms for concrete problems</td>
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<tr>
<td></td>
<td>Social competence</td>
</tr>
<tr>
<td></td>
<td>The students:</td>
</tr>
<tr>
<td></td>
<td>- develop solutions to given problems in groups</td>
</tr>
<tr>
<td></td>
<td>- accept constructive criticism</td>
</tr>
<tr>
<td></td>
<td>Personal competence</td>
</tr>
<tr>
<td></td>
<td>The students:</td>
</tr>
<tr>
<td></td>
<td>- reflect their solution strategies</td>
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<tr>
<td></td>
<td>- deepen their understanding of the presented mathematical and algorithmical concepts with exercises and adopt the solution methods</td>
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<td>Module contents</td>
<td>- Numerical methods for linear systems: LU-, Cholesky decompositions, iterative methods</td>
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<td>- Numerical methods for nonlinear equations: fix-point iterations, Newton's Method</td>
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<tr>
<td></td>
<td>- Numerical integration: Newton-Cotes, Gauss quadrature rules, adaptive quadrature and extrapolation methods</td>
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<tr>
<td></td>
<td>- Stability and conditioning of algorithms and problems</td>
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<td>Language of instruction</td>
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<td>Als 6 KP Modul werden Vorlesung und Übungen nur in den ersten 2/3 des Semesters besucht.</td>
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<tr>
<td>Examination</td>
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</tr>
<tr>
<td>Prüfungszeiten</td>
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<tr>
<td>Examination</td>
<td>Prüfungszeiten</td>
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<tr>
<td>------------------------------</td>
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<tr>
<td><strong>Final exam of module</strong></td>
<td>At the end of the lecture period written exam</td>
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### mat997 - Introduction to Probability and Statistics

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<td>mat997</td>
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**Verwendbarkeit des Moduls**
- Bachelor's Programme Computing Science (Bachelor) > Wahlpflichtbereich Mathematik
- Master's Programme Computing Science (Master) > Module aus anderen Studiengängen

**Zuständige Personen**
- Christiansen, Marcus (module responsibility)
- Ruckdeschel, Peter (module responsibility)
- May, Angelika (module responsibility)

**Prerequisites**
- Exemplarisches Kennenlernen weiterer mathematischer Gebiete und damit Erweiterung des eigenen mathematischen Wissens
- Kennenlernen von schulrelevanten Anwendungen
- Vertiefung, auch exemplarisch, der im Grundlagenbereich erworbenen Kenntnisse
- Vernetzung des eigenen mathematischen Wissens durch Herstellung von Beziehungen 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 Linear 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

**Literaturempfehlungen**
- 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

**Examination**

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**Form of instruction**

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**Präsenzzeit Modul insgesamt**
- 56 h
wir021 - Double Entry Bookkeeping & Financial Statements under German Law (HGB)

**Module label**: Double Entry Bookkeeping & Financial Statements under German Law (HGB)

**Modulkürzel**: wir021

**Credit points**: 6.0 KP

**Workload**: 180 h

**Verwendbarkeit des Moduls**
- Bachelor's Programme Business Administration and Law (Bachelor) > Basiscurriculum Wirtschaftswissenschaften
- Bachelor's Programme Business Informatics (Bachelor) > Aufbaucurriculum - Pflichtbereich
- Bachelor's Programme Comparative and European Law (Bachelor) > Module
- Bachelor's Programme Economics and Business Administration (Bachelor) > Basismodule
- Bachelor's Programme Mathematics (Bachelor) > Nebenfachmodule
- Bachelor's Programme Sustainability Economics (Bachelor) > Wahlpflichtbereich
- Dual-Subject Bachelor's Programme Economics and Business Administration (Bachelor) > Basismodule
- Master's Programme Computing Science (Master) > Module aus anderen Studiengängen

**Zuständige Personen**
- Sextroh, Christoph (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**: none

**Skills to be acquired in this module**
1. understand financial accounting as the basis of corporate data and bookkeeping
2. gain comprehensive knowledge of main accounting areas such as procurement, sales, HR, inventory, tax, provisions etc.
3. obtain basic knowledge about annual report process of single entities.

**Module contents**
The main objective of this module is to give the students an overview of the double entry bookkeeping as well as the link between financial accounting, balance sheet and income statement. The acquisition of basis knowledge of the corporate accountancy stands in the foreground, for example, how organizations manage the bookkeeping, legal basis of the annual accounts, creating an inventory, content of accounting and income statement.

**Literaturempfehlungen**
An additional script is provided.

**Links**
http://www.uni-oldenburg.de/accounting/

**Language of instruction**: German

**Duration (semesters)**
1 Semester

**Module frequency**: jährlich

**Module capacity**: unlimited

**Examination**
Prüfungszeiten: final exam

**Final exam of module**
at the end of the semester

**Form of instruction**

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| Tutorial | SWS | WiSe | 28   |

**Präsenzzeit Modul insgesamt**: 56 h
wir082 - Corporate Finance

Module label: Corporate Finance
Modulkürzel: wir082
Credit points: 6.0 KP
Workload: 180 h

Verwendbarkeit des Moduls
- Bachelor's Programme Business Administration and Law (Bachelor) > Aufbaubereich Wirtschaftswissenschaften
- Bachelor's Programme Business Informatics (Bachelor) > Akzentsetzungsbereich Wirtschaftswissenschaften
- Bachelor's Programme Economics and Business Administration (Bachelor) > Akzentsetzungsmodule
- Bachelor's Programme Sustainability Economics (Bachelor) > Wahlpflichtbereich more
- Dual-Subject Bachelor's Programme Economics and Business Administration (Bachelor) > Schwerpunkt Management und Ökonomie
- Master of Education Programme (Vocational and Business Education) Economics and Business Administration (Master) > Mastermodule
- Master's Programme Business Informatics (Master) > Module aus Wirtschafts- und Rechtswissenschaften (Master)
- Master's Programme Computing Science (Master) > Module aus anderen Studiengängen

Zuständige Personen
- Prokop, Jörg (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites
Skills to be acquired in this module
- Students
  - understand the role corporate finance plays in today’s business environment,
  - are able to make consistent investment decisions based on established financial models both under certainty and under uncertainty,
  - are able to place these models in within the broader context of economic theory, including both neoclassical theory and principal-agent theory,
  - are able to assess the limitations of these models,
  - analyze firm’s main sources of (long-term) financing.

Module contents
Course outline:
1. Introduction
2. Valuation and Capital Budgeting
3. Risk and Return
4. Long-Term Financing

This course is an introduction to corporate finance. It covers typical tools and techniques used in making investment and financing decisions, and it provides insights into their theoretical foundations. The concept of time value of money and net present value is discussed in detail, first under certainty, and then in the presence of uncertainty. We will examine the relationship between an investment’s risk and its return, and discuss ways to derive risk-adjusted cost of equity capital. In addition, the course provides insights into firms’ main sources of (long-term) financing.

The topics covered in this course are relevant for financial decision-making in various areas of business management, including operations management, marketing, and in particular corporate strategy.

Literatur
Main textbook:

Supplementary readings:
- Berk & DeMarzo, Corporate Finance, current edition, Boston (Mass.),
- Brealey, Myers & Allen, Principles of Corporate Finance, current edition, Boston (Mass.),

Links
http://www.uni-oldenburg.de/fiwi_bbl/

Language of instruction: English
Duration (semesters): 1 Semester
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<td>Lecture</td>
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<td>2</td>
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<tr>
<td>Präsenzzeit Modul insgesamt</td>
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</table>
### Skills to be acquired in this module

The module introduces the basics of Entrepreneurship. Upon completion of the module, students will be able to:
- understand the challenges of launching an enterprise,
- strategically analyse the structure of market
- understand how employees are able to behave like an entrepreneur in established enterprises
- develop innovative business ideas
- shape the key factors for realizing a business idea
- demonstrate a knowledge of the entrepreneurial process
- demonstrate a knowledge of cost accounting (especially break-even analysis, etc.) and will be able to calculate costs by themselves
- analyse and evaluate business models

### Module contents

The module combines the lecture "Strategie und Entrepreneurship" with a tutorial. It investigates the challenges of launching enterprises and entrepreneurial behaviour in large companies as well. The content of the module follows the process of an entrepreneur. It starts with business ideas, their perception, and evaluation. In addition, it deals with the most important questions of development and management of new business models. The contents of the courses include the following topics:
- historical, institutional, and theoretical context
- development, evaluation, and pitching ideas
- business models
- building entrepreneurial teams
- entrepreneurship in large enterprises
- resources and finance
- management of growth

### Literatureempfehlungen

<table>
<thead>
<tr>
<th>Links</th>
<th><a href="http://www.uni-oldenburg.de/wire/entrepreneurship/lehrangebot/veranstaltungen/lehrangebot-wise-20162017/">http://www.uni-oldenburg.de/wire/entrepreneurship/lehrangebot/veranstaltungen/lehrangebot-wise-20162017/</a></th>
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<tr>
<td>Frequency</td>
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<td>Workload of compulsory attendance</td>
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wir210 - Corporate Environmental Management

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**Verwendbarkeit des Moduls**

- Bachelor's Programme Business Administration and Law (Bachelor) > Aufbaubereich Wirtschaftswissenschaften
- Bachelor's Programme Business Informatics (Bachelor) > Akzentsetzungsbereich Wirtschaftswissenschaften
- Bachelor's Programme Business Informatics (Bachelor) > Wahlbereich Informatik, Kultur und Gesellschaft
- Bachelor's Programme Computing Science (Bachelor) > Wahlbereich Informatik, Kultur und Gesellschaft
- Bachelor's Programme Economics and Business Administration (Bachelor) > Studienrichtung Betriebswirtschaftslehre
- Bachelor's Programme Economics and Business Administration (Bachelor) > Studienrichtung Ökologie und Nachhaltigkeit
- Bachelor's Programme Sustainability Economics (Bachelor) > Wahlpflichtbereich
- Master of Education Programme (Vocational and Business Education) Economics and Business Administration (Master of Education) > Mastermodule
- Master's Programme Business Informatics (Master) > Module der Wirtschafts- und Rechtswissenschaften (Master)
- Master's Programme Computing Science (Master) > Module aus anderen Studiengängen

**Zuständige Personen**

- Siebenhüner, Bernd (module responsibility)
- Lehrenden, Die im Modul (Module counselling)

**Prerequisites**

The students:

- understand the goals and concepts of sustainable development;
- discuss the importance of sustainability for companies;
- know basic strategies and instruments that enable companies to achieve sustainable development;
- acquire conceptual and practical skills using case studies, in particular about which instruments can be used to prepare companies for the challenges of sustainable development.

**Module contents**

The module consists of a lecture and a seminar. While the lecture presents and explains concepts, instruments and strategies for sustainable development, the seminar focuses on the practical relevance of the various instruments, concepts and strategies and discusses these based on case studies.

- Concepts and goals of sustainable development
- Introduction to the current discussion on sustainable development
- Current sustainability instruments and strategies for companies
- Case studies

**Literaturempfehlungen**


**Links**

https://www.uni-oldenburg.de/wire/

**Language of instruction**

German

**Duration (semesters)**

1 Semester

**Module frequency**

jährlich

**Module capacity**

unlimited
Examination  Prüfungszeiten  Type of examination
Final exam of module  usually around Mid of March  HA

Form of instruction  Comment  SWS  Frequency  Workload of compulsory attendance
Lecture  2  28
Seminar  2  28

Präsenzzeit Modul insgesamt  56 h
wir270 - Resource and Energy Economics

Module label | Resource and Energy Economics
Modulkürzel | wir270
Credit points | 6.0 KP
Workload | 180 h

Verwendbarkeit des Moduls
- Bachelor's Programme Economics and Business Administration (Bachelor) > Studienrichtung Ökologie und Nachhaltigkeit
- Bachelor's Programme Economics and Business Administration (Bachelor) > Studienrichtung Volkswirtschaftslehre
- Bachelor's Programme Sustainability Economics (Bachelor) > Vertiefungsmodul
- Master's Programme Computing Science (Master) > Module aus anderen Studiengängen

Zuständige Personen
- Böhringer, Christoph (module responsibility)
- Asane-Otoo, Emmanuel (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)
- Asane-Otoo, Emmanuel (Module counselling)

Prerequisites
Keine

Skills to be acquired in this module
Die Studierenden sind in der Lage:
- Ressourcen- und energieökonomische Standardmodelle nachzu vollziehen,
- Standardmodelle in Hinblick auf weitergehende Fragestellungen anzupassen bzw. zu erweitern,
- die Funktionsweise von Ressourcen- und Energiemärkten zu verstehen,
- reale Vorgänge auf Ressourcen- und Energiemärkten anhand der Kriterien Effizienz, Verteilung und Nachhaltigkeit zu bewerten,
- die institutionell-regulatorischen Rahmenbedingungen von Ressourcen- und Energiemärkten anhand der Kriterien Effizienz, Verteilung und Nachhaltigkeit zu bewerten.

Module contents
Behandelt werden die Themenlinien nicht regenerierbare Ressourcen (effiziente Nutzung, intertemporale Gerechtigkeit, intertemporales Marktgleichgewicht); regenerierbare Ressourcen (effiziente Nutzung im steady state, Marktgleichgewicht); Nachhaltigkeit; Grundlagen der Energiewirtschaft; Energienachfrage; Energie und Umwelt; Energieresourcen; Märkte für Primärenergieträger; Strommarkt und Regulierung. Dabei stehen die volkswirtschaftlichen Aspekte im Zentrum, wobei notwendigerweise auch grundlegende technische und betriebswirtschaftliche Aspekte vermittelt werden.

Literaturempfehlungen

Links
https://www.uni-oldenburg.de/wire/

Language of instruction
German

Duration (semesters)
1 Semester

Module frequency
jährlich

Module capacity
unlimited

Examination
Prüfungszeiten
Type of examination
Final exam of module
Zum Ende der Vorlesungszeit
KL

Form of instruction
Lecture

SWS
4

Frequency

Workload Präsenzzzeit
56 h
wir360 - Environmental and Sustainability Policies

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<td>• Bachelor's Programme Economics and Business Administration (Bachelor) &gt; Studienrichtung Ökologie und Nachhaltigkeit</td>
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<td>• Bachelor's Programme Sustainability Economics (Bachelor) &gt; Vertiefungsmodule</td>
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<td>• Master's Programme Computing Science (Master) &gt; Module aus anderen Studiengängen</td>
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<td>• Lehrenden, Die im Modul (Prüfungsberechtigt)</td>
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<tr>
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<td>• Siebenhüner, Bernd (Module counselling)</td>
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<td>• Siebenhüner, Bernd (module responsibility)</td>
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<td>students:</td>
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<tr>
<td></td>
<td>• have basic information about national and European environmental and sustainability governance</td>
</tr>
<tr>
<td></td>
<td>• describe the history of national and European environmental and sustainability governance</td>
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<tr>
<td></td>
<td>• reflect upon central principles, instruments, players and strategies in environmental and sustainability governance</td>
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<tr>
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<td>Development directions of German and European environmental and sustainability governance;</td>
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<td>Analysis of selected topics like energy, agriculture, chemical industry etc.;</td>
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<td>Principles of environmental and sustainability governance;</td>
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<td>Instruments of environmental and sustainability governance compared on international level;</td>
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<td>New mechanisms in governance;</td>
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<td>Relevant actors of environmental and sustainability governance (administration, industry, media, science, NGOs etc.);</td>
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<td></td>
<td>International environmental and sustainability governance</td>
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<tr>
<td>Literatureempfehlungen</td>
<td>Aden, Hartmut (2012): Umweltpolitik, Wiesbaden: VS-Verlag</td>
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<tr>
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<td><a href="https://www.uni-oldenburg.de/wire/">https://www.uni-oldenburg.de/wire/</a></td>
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### wir806 - Information Technology Law

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<tr>
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<td>180 h</td>
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### Verwendbarkeit des Moduls

- Bachelor's Programme Business Informatics (Bachelor) > Wahlbereich Informatik, Kultur und Gesellschaft
- Bachelor's Programme Computing Science (Bachelor) > Wahlbereich Informatik, Kultur und Gesellschaft
- Master Applied Economics and Data Science (Master) > Specialization
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Pflichtmodule
- Master of Education Programme (Hauptschule and Realschule) Computing Science (Master of Education) > Mastermodule
- Master of Education Programme (Vocational and Business Education) Computing Science (Master of Education) > Recht und Gesellschaft
- Master's programme Business Administration: Management and Law (Master) > Basismodule
- Master's programme Business Administration: Management and Law (Master) > Schwerpunktmodule RdW - Recht
- Master's Programme Business Informatics (Master) > Module der Wirtschafts- und Rechtswissenschaften (Master)
- Master's Programme Computing Science (Master) > Module aus anderen Studiengängen

### Zuständige Personen

- Rott, Peter (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)
- Rott, Peter (Module counselling)

### Prerequisites

Not applicable

### Skills to be acquired in this module

The students are familiar with the effects of digitalisation with its chances and risks in European and German private law and, in particular, consumer law. They obtain knowledge of specific areas of digitalised private law and consumer law with particular relevance for their future professional practice, are able to solve consumer law cases in a goal-oriented way, are able to find approaches for legal problems as well as recognise liability risks and how to deal with them, and are, in contract negotiations, able to recognise the requirements for regulation and to evaluate its consequences.

### Module contents

This module conveys how new technologies impact on private law and, in particular, on consumer law. It focuses on the (modified) interpretation of existing laws but even more on the reactions of the EU and national legislators and of the judiciary to new technological developments. The module discusses, among others, distance selling law, digitalised sales law and product liability law, the law of digital content and digital services, unfair commercial practices on internet and the law of the platform economy. Finally, the module looks at enforcement.

### Literaturempfehlungen

To be announced in the first lecture

### Links

- German

### Duration (semesters)

1 Semester

### Module frequency

Jährlich

### Module capacity

Unlimited

### Type of module

Wahlpflicht / Elective

### Module level

MM (Mastermodul / Master module)

### Teaching/Learning method

Lecture and Seminar

### Previous knowledge

Basic knowledge of civil law is helpful.

### Examination

To be taken from the examination regulations

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<tr>
<td><strong>Präsenzzeit Modul insgesamt</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>56 h</strong></td>
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### wir808 - Multivariate Statistics

<table>
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<tr>
<th>Module label</th>
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<tbody>
<tr>
<td>Modulkürzel</td>
<td>wir808</td>
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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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#### Verwendbarkeit des Moduls
- Master's programme Business Administration: Management and Law (Master) > Basismodule
- Master's Programme Business Informatics (Master) > Module der Wirtschafts- und Rechtswissenschaften (Master)
- Master's Programme Computing Science (Master) > Module aus anderen Studiengängen
- Master's Programme Environmental Modelling (Master) > Mastermodule
- Master's Programme Sustainability Economics and Management (Master) > Basic Modules

#### Zuständige Personen
- Stecking, Ralf Werner (module responsibility)
- Lehrende, Die im Modul (Prüfungsberechtigt)

#### Prerequisites

Skills to be acquired in this module

- With successful completion of the course, students shall:
  - be aware of and be able to evaluate advanced methods of multivariate data analysis.
  - be able to select adequate methods in relevant fields of application, like prediction, classification, and segmentation analysis.
  - be able to run computer-aided analyses and to interpret the results properly.

#### Module contents

Various methods of quantitative data analysis such as:

- Linear Regression
- Logistic Regression
- Linear Discriminant Analysis
- Principal Component Analysis
- Feature selection and evaluation methods

#### Literaturempfehlungen


#### Links

<table>
<thead>
<tr>
<th>Language of instruction</th>
<th>German</th>
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<tbody>
<tr>
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</tr>
<tr>
<td>Module capacity</td>
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#### Examination

- Prüfungszeiten: at the end of the semester
- Type of examination: written exam or oral exam

#### Final exam of module

<table>
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<th>Form of instruction</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
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<tr>
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Präsenzzeit Modul insgesamt: 56 h
**Module: Environmental Law**

**Module label**: Environmental Law

**Modulkürzel**: wir812

**Credit points**: 6.0 KP

**Workload**: 180 h

**Verwendbarkeit des Moduls**
- Master's programme Business Administration: Management and Law
  (Master) > Basismodule
- Master's programme Business Administration: Management and Law
  (Master) > Schwerpunktmodule NM-Recht
- Master's programme Business Administration: Management and Law
  (Master) > Schwerpunktmodule RdW - Recht
- Master's Programme Business Informatics (Master) > Module der
  Wirtschafts- und Rechtswissenschaften (Master)
- Master's Programme Computing Science (Master) > Module aus
  anderen Studiengängen
- Master's Programme Sustainability Economics and Management
  (Master) > Basic Modules

**Zuständige Personen**
- Meyerholt, Ulrich (Module counselling)
- Godt, Christine (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**

**Skills to be acquired in this module**
Building on the existing knowledge of the participants, the course will deepen
knowledge of European and international law, whereby emphasis will be laid
on those areas in which the dividing line between state intervention (public law)
and market rights (private law) has become blurred.
Students will be able to analyze contemporary regulatory techniques inherent
in the multilevel system of governance and to assess them from an
interdisciplinary (economic and legal) perspective.

**Module contents**
The module comprises two courses, one of which will be taught by PD Dr.
Meyerholt, and the other together with Prof. Godt.
The first course deals with selected issues in environmental law. With the
general structure of environmental law as a point of departure, the course
content will be taught in a holistic manner that will also incorporate the leading
decisions of the higher courts.
The second course takes into consideration intra-disciplinary environmental
law as situated between public and private economic law, whereby special
focus will be laid on the European and international dimensions.

**Literaturempfehlungen**
Epiney, A. (2013), Umweltrecht der Europäischen Union, Nomos, Baden-
Baden.
Publishing, Groningen.

**Links**

**Language of instruction**: German

**Duration (semesters)**: 1 Semester

**Module frequency**: jährlich

**Module capacity**: unlimited

**Examination**
- **Prüfungszeiten**: jährlich
- **Type of examination**: Final exam of module
during term
oral presentation and written script

**Form of instruction**: Lecture

**SWS**: 4

**Frequency**: SoSe oder WiSe

**Workload Präsenzzeit**: 56 h
## Module Contents

The course offers an overview of advanced concepts and frameworks in the field of Strategic Management. At the beginning, the course will provide a brief introduction into the historical development, goals, and research streams of the field. In this context, important terms, methods, and philosophical approaches of (management) research will be clarified. Subsequently, students form groups to analyze selected scientific articles with regard to their theoretical relevance and practical implications. Theoretical topics that will be covered in depth are:

1. Top Management Teams, Upper Echelons and Corporate Governance
2. Resource- and Capability-based Approaches
4. Institutional Theory, Institutional Work/Entrepreneurship and Social Movements
5. Organizational Cognition, Identity, and Framing
6. Organizational Learning and Ambidexterity
7. Organizational networks and ecosystems

The results of the analysis will be summarized in a seminar thesis, presented in class, and discussed with the other students. The main goal of the course is to equip students with advanced concepts, which allow them to understand organizational dynamics, question established practices in firms, and develop new solutions that go beyond the application of standard instruments.

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### Literature


Links

<table>
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Examination

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Final exam of module

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Präsenzzeit Modul insgesamt

56 h
**wir857 - Law of Media and Telecommunication**

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<tr>
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**Verwendbarkeit des Moduls**
- Master's programme Business Administration: Management and Law (Master) > Schwerpunktmodule RdW - Recht
- Master's programme Business Administration: Management and Law (Master) > Schwerpunktmodule UF - Recht
- Master's Programme Business Informatics (Master) > Module der Wirtschafts- und Rechtswissenschaften (Master)
- Master's Programme Computing Science (Master) > Module aus anderen Studiengängen

**Zuständige Personen**
- Boehme-Neßler, Volker (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

**Prerequisites**
The students:
- have in-depth insights into the economic conditions of media production, distribution and exploitation.
- know the legal basis and framework conditions of media production, media presentation and mediation (e.g. copyrights, performance rights, distribution of media).
- bring together economic and legal dimensions of media work.
- know the economic and legal framework conditions of media institutions (e.g. television, radio, media mediation).

**Module contents**
This module is about making a connection of the theoretical and practical acquired aesthetic competences with the economic and legal framework conditions. In the sense of professionalisation, prospective media producers and mediators should learn to assess their own future activities under economic and legal conditions.

**Literaturempfehlungen**
- Current case law and:
  + Fechner, Medienrecht, 19.Aufl. 2018
  + Petersen, Medienrecht, 2010.

**Links**
- http://www.integrated-media.de/

**Language of instruction**
- German

**Duration (semesters)**
- 1 Semester

**Module frequency**
- jährlich

**Module capacity**
- unlimited

**Examination**
**Prüfungszeiten**
- At the end of the term

**Type of examination**
- Presentation with term paper

**Form of instruction**
- Lecture

**SWS**
- 4

**Frequency**
- SoSe

**Workload Präsenzzeit**
- 56 h
### wir860 - Data Protection Law

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<td>Zuständige Personen</td>
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<td>Lehrenden, Die im Modul (Prüfungsberechtigt)</td>
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<td>Rott, Peter (module responsibility)</td>
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<tr>
<td>Prerequisites</td>
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<tr>
<td>Skills to be acquired in this module</td>
<td>Upon completion of the module, students will be able to:</td>
</tr>
<tr>
<td>recognize simple data protection incidents.</td>
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<tr>
<td>apply existing protection mechanisms.</td>
<td></td>
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<tr>
<td>implement projects in accordance with the law.</td>
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<tr>
<td>discuss and defend their plans in front of others.</td>
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<tr>
<td>Module contents</td>
<td></td>
</tr>
<tr>
<td>The module gives an overview on data protection laws. Basic knowledge of data protection regulations (DSGVO; BDSG) and existing protection mechanisms is imparted. Within the framework of the seminar, the discussed topics will be deepened with the help of seminar papers and individual aspects will be discussed in more detail. The event will highlight the new informational structures in modern society and their effects on data protection and data security. Questions concerning general personal rights, freedom of information, IT security and relevant criminal law regulations will be discussed on the basis of examples and legally provided protection mechanisms as well as the tasks of supervisory authorities will be discussed. In particular, the most important decisions on data protection will be covered in detail during the seminar. At the seminar, students will have the opportunity to prepare in-depth seminar papers on the various topics, which will then be discussed with all participants.</td>
<td></td>
</tr>
<tr>
<td>Literatureempfehlungen</td>
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<td>Further literature references will be given in the lecture.</td>
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<td><a href="http://www.wto.org/">http://www.wto.org/</a></td>
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<td>Examination</td>
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<td>Type of examination</td>
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<td>Final exam of module</td>
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<td>Seminar paper and presentation or Term paper or Oral exam</td>
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<td>Form of instruction</td>
<td>Comment</td>
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<tr>
<td>SWS</td>
<td>Frequency</td>
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<td>Workload of compulsory attendance</td>
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<td>Präsenzzeit Modul insgesamt</td>
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wir875 - Forecasting Methods

Module label: Forecasting Methods

Modulkürzel: wir875

Credit points: 6.0 KP

Workload: 180 h

Verwendbarkeit des Moduls:
- Master Applied Economics and Data Science (Master) > Empirical Methods
- Master's programme Business Administration: Management and Law (Master) > Schwerpunktmodule UF - VWL
- Master's Programme Business Informatics (Master) > Module der Wirtschafts- und Rechtswissenschaften (Master)
- Master's Programme Computing Science (Master) > Module aus anderen Studiengängen

Zuständige Personen:
- Stecking, Ralf Werner (module responsibility)
- Lehrenden, Die im Modul (Prüfungsberechtigt)

Prerequisites:
With successful completion of the course, students shall:
- be aware of and be able to evaluate quantitative forecasting methods,
- be able to select adequate methods in relevant fields of application, like time series and classification analysis,
- be able to run computer-aided analyses and to interpret the results properly.

Module contents:
Various aspects of quantitative forecasting methods such as:
- Time series components,
- Trend and seasonal methods,
- Stationarity,
- Multivariate forecasting methods,
- Autoregressive and moving average processes,
- Box-Jenkins method.

Literatureempfehlungen:

Links:
- Language of instruction: English
- Duration (semesters): 1 Semester
- Module frequency: halbjährlich
- Module capacity: unlimited
- Examination: Prüfungszeiten

Type of examination:

450 / 459
<table>
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<th>Prüfungszeiten</th>
<th>Type of examination</th>
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<td>Final exam of module</td>
<td>end of semester</td>
<td>written exam or oral exam or term paper or seminar paper and presentation</td>
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Präsenzzeit Modul insgesamt 56 h
**wir901 - Environmental Economics**

<table>
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<td>(Lecture: 3 SWS (42h)</td>
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<td>Exercise: 1 SWS (14h)</td>
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**Verwendbarkeit des Moduls**

- Master Applied Economics and Data Science (Master) > Economics
- Master’s programme Business Administration: Management and Law (Master) > Schwerpunktmodule NM-VWL
- Master’s Programme Computing Science (Master) > Module aus anderen Studiengängen
- Master’s Programme Environmental Modelling (Master) > Mastermodule
- Master’s Programme Sustainability Economics and Management (Master) > Basic Modules

**Zuständige Personen**

- Helm, Carsten (Module counselling)
- Lehrenden, Die im Modul (Module counselling)
- Lehrenden, Die im Modul (Prüfungsberechtigt)
- Helm, Carsten (module responsibility)

**Prerequisites**

Keine

**Skills to be acquired in this module**

Know and be able to apply fundamental concepts and figures of thought in environmental economics; be able to analyse and evaluate environmental problems and solution approaches; practice scientific methods and the ability to discuss; be able to classify environmental economics in the context of interdisciplinary sustainability research.

**Module contents**

Economic analysis of environmental impacts (property rights, external effects, market failure); ethical aspects of environmental economics, instruments of environmental policy (tradable permits, taxes, subsidies, liability law); innovation and adaptation of new technologies; international environmental problems.

**Literaturempfehlungen**


**Links**

**Language of instruction**

English

**Duration (semesters)**

1 Semester

**Module frequency**

Annually

**Module capacity**

unlimited

**Type of module**

Pflicht o. Wahlpflicht / compulsory or optional

**Teaching/Learning method**

Lecture and exercise

**Examination**

<table>
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<td>Written exam; bonus through solution of exercises</td>
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**Form of instruction**

<table>
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<th>SWS</th>
<th>Frequency</th>
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<td>Lecture</td>
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<tr>
<td>Exercises</td>
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**Präsenzzeit Modul insgesamt**

56 h
**Module: Environmental and Sustainability Policies**

<table>
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<th>Module label</th>
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| Verwendbarkeit des Moduls     | • Master's Programme Business Informatics (Master) > Module der Wirtschafts- und Rechtswissenschaften (Master)  
• Master's Programme Computing Science (Master) > Module aus anderen Studiengängen  
• Master's programme Social Sciences (Master) > Wahlpflichtmodule anderer Institute und Departments  
• Master's Programme Sustainability Economics and Management (Master) > Basic Modules |
| Zuständige Personen           | • Lehrenden, Die im Modul (Prüfungsberechtigt)  
• Siebenhüner, Bernd (Module counselling)  
• Wegner, Alkje (Module counselling)  
• Müller, Werner Joachim (Module counselling)  
• Siebenhüner, Bernd (module responsibility) |
| Prerequisites                 | students:  
• have basic information about national and european environmental and sustainability governance  
• describe the history of national and european environmental and sustainability governance  
• reflect upon central principles, instruments, players and strategies in environmental and sustainability governance  
• analyze selected topics of environmental and sustainability governance based upon central principles, instruments, players and strategies |
| Module contents               | • Introduction to environmental politics - Politics, Political Science, Policy Analysis  
• Environment – Terms and Concepts - Historical Foundations of Environmental Politics  
• Actors, institutions and governance structures; Actors in Environmental Policy  
• Socio-ecological systems framework  
• Environmental Policy in Germany  
• Environmental Policy in the European Union  
• Steering and principles in environmental policy  
• Instruments in environmental policy  
• Policy process and environmental policy  
• Multilevel and reflexive governance - Multilevel governance  
• International environmental governance  
• Science-Policy Interface |
| Literatureempfehlungen        | Aden, Hartmut (2012): Umweltpolitik, Wiesbaden: VS-Verlag  
<p>| Links                         | <a href="https://www.uni-oldenburg.de/wire/">https://www.uni-oldenburg.de/wire/</a> |
| Languages of instruction      | German, English |
| Duration (semesters)          | 1 Semester |
| Module frequency              | halbjährlich |
| Module capacity               | unlimited |
| Examination                   | Prüfungszeiten |
| Type of examination           | 453 / 459 |</p>
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<td><strong>Form of instruction</strong></td>
<td>Vorlesung und Seminar</td>
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<tr>
<td><strong>SWS</strong></td>
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<td><strong>Workload Präsenzzzeit</strong></td>
<td>56 h</td>
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**wir905 - Environmental Sciences**

<table>
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</tr>
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<td>Workload</td>
<td>180 h</td>
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**Verwendbarkeit des Moduls**
- Master's Programme Computing Science (Master) > Module aus anderen Studiengängen
- Master's Programme Sustainability Economics and Management (Master) > Basic Modules
- Master's Programme Water and Coastal Management (Master) > Science

**Zuständige Personen**
- Freund, Holger (Module counselling)
- Köster, Jürgen (Module counselling)
- Dozent, Gast (Module counselling)
- Klenke, Thomas (Prüfungsberechtigt)
- Freund, Holger (Prüfungsberechtigt)
- Köster, Jürgen (Prüfungsberechtigt)
- Klenke, Thomas (module responsibility)

**Prerequisites**
- The Introduction to processes and systems of the dynamic Earth constituting the foundation for sustainable management is presented to produce:
  - Knowledge about processes and systems relevant for sustainable management using knowledge and methodologies from all science disciplines in an integrated way.
  - Skills in elaborating on complex tasks of environmental management using an interdisciplinary science based approach and to present related findings to non-expert audiences.
  - Lecture room presentations and discussions based on slides and black/white board usage.

**Module contents**

**Lecture:**
Understanding the Bioplanet Earth (2 contact hours/week) (Vorlesung, 2 LVs: Aufbau und Entwicklungsgeschichte der Erde; Dynamik der Erde; Kreisläufe und Evolutionsprozesse; Lebensraum Boden; Wasser; Klima; Biodiversität; Lagerstätten und Ressourcenerschließung; Ökosysteme der Erde.)

**Seminar:**
Cases in Understanding the Bioplanet Earth (2 contact hours/week)

Introduction to key processes and to systems dynamics of the Earth representing a planet being alive driven by external and internal forces interacting with biological activities. Topics of the lecture comprise introductions to the evolution of the universe and solar systems, the differentiation and sub-systems of the Earth’s interior, minerals and rock cycle, soils, ocean and climate, evolution and biodiversity, organisms and physiology, water and element cycling plus insights into ecosystems under different climate conditions. The cases are selected in order to (i) highlight certain principles and theories in geo- and biosciences and (ii) exemplify critical objects and phenomena in modern practice of resource and environmental management. This module consists of topical programmes of the Master Cluster Environment and Sustainability.

**Literaturempfehlungen**
A 'foundation material pool' will be made available online for students and lecturers providing paper books, reports and media covering the topics of the lecture and the cases.

**Links**

**Language of instruction**
- English

**Duration (semesters)**
- 1 Semester

**Module frequency**
- jährlich (yearly)

**Module capacity**
- unlimited

**Examination**

<table>
<thead>
<tr>
<th>Form of instruction</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final exam of module</td>
<td>By the end of the lecture period.</td>
<td></td>
<td></td>
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</table>

**Prüfungszeiten**

- Presentation/discussion and written report on a case;
- Scientific quality of presentation (40 %)
- Clarity of presentation and discussion (20 %)
- Scientific quality of report (60 %)
<table>
<thead>
<tr>
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<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
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</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td>2</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Seminar</td>
<td></td>
<td>2</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td><strong>Präsenzzeit Modul insgesamt</strong></td>
<td></td>
<td></td>
<td></td>
<td>56 h</td>
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Abschlussmodul

mam - Master Thesis Module Computer Science

<table>
<thead>
<tr>
<th>Modulkürzel</th>
<th>Credit points</th>
<th>Workload</th>
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<tbody>
<tr>
<td>mam</td>
<td>30.0 KP</td>
<td>900 h</td>
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</tbody>
</table>

Verwendbarkeit des Moduls

- Master’s Programme Computing Science (Master) > Abschlussmodul

Zuständige Personen

- Peter, Andreas (module responsibility)
- Lehrenden, Die im Modul (Module counselling)

Prerequisites

no participant 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 masters 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 masters 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

Module contents

Independently researched scientific work. The research findings will be
presented and discussed in a masters thesis colloquium.

Literatureempfehlungen

ist entsprechend des konkreten Themas selbst zu recherchieren

Links

<table>
<thead>
<tr>
<th>Languages of instruction</th>
<th>German, English</th>
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<tbody>
<tr>
<td>Duration (semesters)</td>
<td>1 Semester</td>
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<td>Module frequency</td>
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<td>Module capacity</td>
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<tr>
<td>Teaching/Learning method</td>
<td>S+MA</td>
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<tr>
<td>Examination</td>
<td>Prüfungszeiten</td>
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<tr>
<td>Type of examination</td>
<td></td>
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</table>

Final exam of module

Individually in consultation with the reviewers and
supervisors

Masters thesis, presentation and discussion.

Form of instruction

Seminar

SWS

2

Frequency

SoSe und WiSe

Workload Präsenzzzeit

28 h