Modulhandbuch

Computing Science - Master of Education Programme (Gymnasium)

im Wintersemester 2022/2023

erstellt am 12/08/22
inf401 - Foundations of Theoretical Computer Science .............................................................. 4
inf701 - Computer Science Education II .............................................................. 6
inf704 - Computer Science Education III .............................................................. 8
inf712 - Current Topics in Computer Science Education I ............................................................. 10
inf851 - Computer Science and Society ............................................................. 12
inf806 - Special Topics in Computer Science IV ............................................................. 15
mam - Master Thesis and Colloquium ............................................................. 17
inf006 - Software Engineering II ............................................................. 19
inf008 - Information Systems II ............................................................. 21
inf009 - Database Practical ............................................................. 23
inf010 - Computer Networks ............................................................. 25
inf012 - Operating Systems I ............................................................. 27
inf015 - Distributed Operating Systems ............................................................. 29
inf016 - Internet Technologies ............................................................. 31
inf017 - Interactive Systems ............................................................. 33
inf018 - Media Processing ............................................................. 36
inf019 - Compiler Construction ............................................................. 39
inf020 - Machine-oriented Programming ............................................................. 41
inf201 - Computer Engineering II ............................................................. 43
inf202 - Computer Engineering Practical ............................................................. 45
inf203 - Embedded Systems I ............................................................. 47
inf204 - Embedded Systems II ............................................................. 49
inf205 - Formal Methods in Embedded System Design ............................................................. 51
inf207 - Electrical Engineering ............................................................. 53
inf208 - Microrobotics and Microsystems Technology ............................................................. 55
inf209 - Control Theory ............................................................. 57
inf210 - Signal and Image Processing ............................................................. 59
inf402 - Graph Transformation Systems ............................................................. 59
inf403 - Cryptology ............................................................. 61
inf404 - Petri Nets ............................................................. 63
inf405 - Algorithmic Graph Theory ............................................................. 65
inf407 - Program Verification ............................................................. 67
inf408 - Algorithms for Software Verification ............................................................. 69
inf409 - Formal Languages ............................................................. 71
inf410 - Formal Methods ............................................................. 73
inf521 - Medical Informatics ............................................................. 75
inf530 - Artificial Intelligence ............................................................. 77
inf600 - Business Informatics I ............................................................. 79
inf601 - Business Informatics II ............................................................. 81
inf603 - Planning and Simulation in Logistics ............................................................. 83
inf608 - eBusiness ............................................................. 85
## Pflichtmodule

### inf401 - Foundations of Theoretical Computer Science

<table>
<thead>
<tr>
<th>Module label</th>
<th>Foundations of Theoretical Computer Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module code</td>
<td>inf401</td>
</tr>
<tr>
<td>Credit points</td>
<td>6.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>180 h</td>
</tr>
</tbody>
</table>

### Applicability of the module
- Bachelor's Programme Computing Science (Bachelor) > Aufbaumodule
- Bachelor's Programme Mathematics (Bachelor) > Nebenfachmodule
- Dual-Subject Bachelor's Programme Computing Science (Bachelor) > Wahlpflicht Theoretische Informatik (30 KP)
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Pflichtmodule

### Responsible persons
- Olderog, Ernst-Rüdiger (Module responsibility)
- Lehrenden, Die im Modul (Authorized examiners)

### Prerequisites

### Skills to be acquired in this module

**Professional competence**
The students:
- Know different classes of languages (e.g. regular and context-free languages)
- Know automata models corresponding to the respective language classes (e.g. finite automata, pushdown automata, Turing machines)
- Construct automata, Turing machines, and grammars for given tasks
- Know equivalent formalisations of the concept of algorithm
- Classify functions as algorithmically computable and problems as algorithmically decidable
- Know and recognize undecidable problems
- Evaluate the complexity of algorithms
- Know problems that are solvable deterministically or nondeterministically in polynomial time

**Methodological competence**
The students:
- Learn about the power of abstract models of computation

**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 writing down solutions

### Module contents

In the first part of the course, different classes of languages are introduced (regular and context-free languages). For each class a matching automata model is presented (finite automata, pushdown automata). Various properties are proven for the introduced classes of languages and models of automata.

In the second part of the course, we examine which functions are computable and which problems are decidable. To this end, the concept of algorithm is formalised. Turing machines and grammars turn out as equivalent approaches. We show that there are problems that are undecidable. Many of these problems are of practical interest.

The third part of the course deals with the complexity of algorithms, i.e. how much time and space is required to solve a problem. In particular, we consider problems that are solvable in polynomial time, either deterministically or non-deterministically. These problems are classified as P and NP.
**Reader's advisory**
- essentiell: Skript "Grundbegriffe der Theoretischen Informatik", jeweils in aktueller Ausgabe
- Gute Sekundärliteratur: Hopcroft, Motwani, Ullman: "Einführung in die Automatentheorie, Formale Sprachen und Komplexitätstheorie", Pearson, 2002 (ein Klassiker...)

<table>
<thead>
<tr>
<th>Links</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language of instruction</td>
</tr>
<tr>
<td>Duration (semesters)</td>
</tr>
<tr>
<td>Module frequency</td>
</tr>
<tr>
<td>Module capacity</td>
</tr>
<tr>
<td>Modullevel / module level</td>
</tr>
<tr>
<td>Modulart / typ of module</td>
</tr>
<tr>
<td>Lehr-/Lernform / Teaching/Learning method</td>
</tr>
</tbody>
</table>

**Vorkenntnisse / Previous knowledge**

<table>
<thead>
<tr>
<th>Examination</th>
<th>Time of examination</th>
<th>Type of examination</th>
</tr>
</thead>
</table>

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

<table>
<thead>
<tr>
<th>Course type</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td>3</td>
<td>WiSe</td>
<td>42</td>
</tr>
<tr>
<td>Exercises</td>
<td></td>
<td>1</td>
<td>WiSe</td>
<td>14</td>
</tr>
</tbody>
</table>

**Total time of attendance for the module**
56 h
inf701 - Computer Science Education II

<table>
<thead>
<tr>
<th>Module label</th>
<th>Computer Science Education II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module code</td>
<td>inf701</td>
</tr>
<tr>
<td>Credit points</td>
<td>6.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>180 h</td>
</tr>
</tbody>
</table>

**Applicability of the module**
- 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

**Responsible persons**
- Diethelm, Ira (Module responsibility)
- Lehrenden, Die im Modul (Authorized examiners)

**Prerequisites**

**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

**Reader's advisory**

- Further literature will be announced in the lecture.

**Links**
http://elearning.uni-oldenburg.de

**Language of instruction**
German

**Duration (semesters)**
1 Semester
<table>
<thead>
<tr>
<th><strong>Module frequency</strong></th>
<th>jährlich</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module capacity</strong></td>
<td>unlimited</td>
</tr>
<tr>
<td><strong>Modullevel / module level</strong></td>
<td>AS (Akzentsetzung / Accentuation)</td>
</tr>
<tr>
<td><strong>Modulart / typ of module</strong></td>
<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
</tr>
<tr>
<td><strong>Lehr-/Lernform / Teaching/Learning method</strong></td>
<td>V+Ü</td>
</tr>
</tbody>
</table>

**Vorkenntnisse / Previous knowledge**

<table>
<thead>
<tr>
<th>Examination</th>
<th>Time of examination</th>
<th>Type of examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final exam of module</td>
<td>End of lecture period</td>
<td>Exercise and und 1 seminar paper or 1 oral exam</td>
</tr>
</tbody>
</table>

**Course type**

<table>
<thead>
<tr>
<th>Course type</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td>2</td>
<td>WiSe</td>
<td>28</td>
</tr>
<tr>
<td>Exercises</td>
<td></td>
<td>2</td>
<td>WiSe</td>
<td>28</td>
</tr>
</tbody>
</table>

**Total time of attendance for the module**

56 h
### Module contents

- forschungsmethodische Ansätze in der Informatikdidaktik
- Möglichkeiten der theoriegeleiteten Entwicklung von konkreten Unterrichtsszenarien
- Ansätze zur Evaluation informatischer Bildung bzw. informatikdidaktischer Konzepte

### Reader's advisory

- Further literature will be announced in the lecture.

### Links
<table>
<thead>
<tr>
<th><strong>Language of instruction</strong></th>
<th>German</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Duration (semesters)</strong></td>
<td>1 Semester</td>
</tr>
<tr>
<td><strong>Module frequency</strong></td>
<td>jährlich</td>
</tr>
<tr>
<td><strong>Module capacity</strong></td>
<td>unlimited</td>
</tr>
<tr>
<td><strong>Modullevel / module level</strong></td>
<td>MM (Mastermodul / Master module)</td>
</tr>
<tr>
<td><strong>Modulart / typ of module</strong></td>
<td>Pflicht / Mandatory</td>
</tr>
<tr>
<td><strong>Lehr-/Lernform / Teaching/Learning method</strong></td>
<td>S</td>
</tr>
<tr>
<td><strong>Vorkenntnisse / Previous knowledge</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Final exam of module</strong></td>
<td>Portfolio</td>
</tr>
<tr>
<td><strong>Course type</strong></td>
<td><strong>Comment</strong></td>
</tr>
<tr>
<td>Lecture</td>
<td></td>
</tr>
<tr>
<td>Seminar</td>
<td>2</td>
</tr>
</tbody>
</table>

**Total time of attendance for the module** 56 h
inf712 - Current Topics in Computer Science Education I

<table>
<thead>
<tr>
<th>Module label</th>
<th>Current Topics in Computer Science Education I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module code</td>
<td>inf712</td>
</tr>
<tr>
<td>Credit points</td>
<td>3.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>90 h</td>
</tr>
</tbody>
</table>

**Applicability of the module**
- 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

**Responsible persons**
- Diethelm, Ira (Module responsibility)
- Lehrenden, Die im Modul (Authorized examiners)

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

**Skills to be acquired in this module**

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

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

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

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

**Module contents**
See assigned course description

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

**Links**

**Language of instruction**
German

**Duration (semesters)**
1 Semester

**Module frequency**
unregelmäßig

**Module capacity**
unlimited

**Modullevel / module level**
AS (Akzentsetzung / Accentuation)

**Modulart / typ of module**
je nach Studiengang Pflicht oder Wahlpflicht

**Lehr-/Lernform / Teaching/Learning**
S oder V
### Method

<table>
<thead>
<tr>
<th>Vorkenntnisse / Previous knowledge</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Examination</td>
<td>Time of examination</td>
</tr>
<tr>
<td>Final exam of module</td>
<td>At the end of the lecture period</td>
</tr>
<tr>
<td>Course type</td>
<td>Course or seminar</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SWS</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>SuSe or WiSe</td>
</tr>
<tr>
<td>Workload attendance</td>
<td>28 h</td>
</tr>
</tbody>
</table>
### inf851 - Computer Science and Society

<table>
<thead>
<tr>
<th>Module label</th>
<th>Computer Science and Society</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module code</td>
<td>inf851</td>
</tr>
<tr>
<td>Credit points</td>
<td>6.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>180 h</td>
</tr>
</tbody>
</table>

#### Applicability of the module

- Bachelor's Programme Biology (Bachelor) > Säule "Überfachliche Professionalisierung"
- Bachelor's Programme Business Administration and Law (Bachelor) > Säule "Überfachliche Professionalisierung"
- Bachelor's Programme Business Informatics (Bachelor) > Säule "Überfachliche Professionalisierung"
- Bachelor's Programme Business Informatics (Bachelor) > Wahlbereich Informatik, Kultur und Gesellschaft
- Bachelor's Programme Chemistry (Bachelor) > Säule "Überfachliche Professionalisierung" more...
- Bachelor's Programme Comparative and European Law (Bachelor) > Säule "Überfachliche Professionalisierung"
- Bachelor's Programme Computing Science (Bachelor) > Säule "Überfachliche Professionalisierung"
- Bachelor's Programme Computing Science (Bachelor) > Wahlbereich Informatik, Kultur und Gesellschaft
- Bachelor's Programme Economics and Business Administration (Bachelor) > Säule "Überfachliche Professionalisierung"
- Bachelor's Programme Economics and Business Administration (Bachelor) > Studienrichtung Wirtschaftsinformatik
- Bachelor's Programme Education (Bachelor) > Säule "Überfachliche Professionalisierung"
- Bachelor's Programme Engineering Physics (Bachelor) > Säule "Überfachliche Professionalisierung"
- Bachelor's Programme Environmental Science (Bachelor) > Säule "Überfachliche Professionalisierung"
- Bachelor's Programme Intercultural Education and Counselling (Bachelor) > Säule "Überfachliche Professionalisierung"
- Bachelor's Programme Mathematics (Bachelor) > Säule "Überfachliche Professionalisierung"
- Bachelor's Programme Physics (Bachelor) > Säule "Überfachliche Professionalisierung"
- Bachelor's Programme Physics, Engineering and Medicine (Bachelor) > Säule "Überfachliche Professionalisierung"
- Bachelor's Programme Social Studies (Bachelor) > Säule "Überfachliche Professionalisierung"
- Bachelor's Programme Sustainability Economics (Bachelor) > Säule "Überfachliche Professionalisierung"
- Dual-Subject Bachelor's Programme Art and Media (Bachelor) > Säule "Überfachliche Professionalisierung"
- Dual-Subject Bachelor's Programme Biology (Bachelor) > Säule "Überfachliche Professionalisierung"
- Dual-Subject Bachelor's Programme Chemistry (Bachelor) > Säule "Überfachliche Professionalisierung"
- Dual-Subject Bachelor's Programme Computing Science (Bachelor) > Säule "Überfachliche Professionalisierung"
- Dual-Subject Bachelor's Programme Dutch Linguistics and Literary Studies (Bachelor) > Säule "Überfachliche Professionalisierung"
- Dual-Subject Bachelor's Programme Economic Education (Bachelor) > Säule "Überfachliche Professionalisierung"
- Dual-Subject Bachelor's Programme Economics and Business Administration (Bachelor) > Säule "Überfachliche Professionalisierung"
- Dual-Subject Bachelor's Programme Education (Bachelor) > Säule "Überfachliche Professionalisierung"
- Dual-Subject Bachelor's Programme English Studies (Bachelor) > Säule "Überfachliche Professionalisierung"
- Dual-Subject Bachelor's Programme Gender Studies (Bachelor) > Säule "Überfachliche Professionalisierung"
- Dual-Subject Bachelor's Programme General Education (Bachelor) > Säule "Überfachliche Professionalisierung"
- Dual-Subject Bachelor's Programme German Studies (Bachelor) > Säule "Überfachliche Professionalisierung"
- Dual-Subject Bachelor's Programme History (Bachelor) > Säule "Überfachliche Professionalisierung"
- Dual-Subject Bachelor's Programme Material Culture: Textiles (Bachelor) > Säule "Überfachliche Professionalisierung"
- Dual-Subject Bachelor's Programme Mathematics (Bachelor) > Säule "Überfachliche Professionalisierung"
- Dual-Subject Bachelor's Programme Music (Bachelor) > Säule "Überfachliche Professionalisierung"
- Dual-Subject Bachelor's Programme Philosophy / Values and Norms (Bachelor) > Säule "Überfachliche Professionalisierung"
- Dual-Subject Bachelor's Programme Philosophy / Values and Norms (Bachelor) > Säule "Überfachliche Professionalisierung"
- Dual-Subject Bachelor's Programme Politics-Economics (Bachelor) > Säule "Überfachliche Professionalisierung"
- Dual-Subject Bachelor's Programme Protestant Theology and Religious Education (Bachelor) > Säule "Überfachliche Professionalisierung"
"Überfachliche Professionalisierung"

- Dual-Subject Bachelor's Programme Slavic Studies (Bachelor) > Säule "Überfachliche Professionalisierung"
- Dual-Subject Bachelor's Programme Social Studies (Bachelor) > Säule "Überfachliche Professionalisierung"
- Dual-Subject Bachelor's Programme Special Needs Education (Bachelor) > Säule "Überfachliche Professionalisierung"
- Dual-Subject Bachelor's Programme Sport Science (Bachelor) > Säule "Überfachliche Professionalisierung"
- Dual-Subject Bachelor's Programme Technology (Bachelor) > Säule "Überfachliche Professionalisierung"
- Fach-Bachelor Pädagogisches Handeln in der Migrationsgesellschaft (Bachelor) > Säule "Überfachliche Professionalisierung"
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Pflichtmodule
- Master of Education Programme (Vocational and Business Education) Computing Science (Master of Education) > Recht und Gesellschaft

Responsible persons
Lehrenden, Die im Modul (Authorized examiners)
Lehrenden, Die im Modul (Module responsibility)

Prerequisites

Skills to be acquired in this module
Graduates of the module Informatik und Gesellschaft know the history of the development of Information technology and its impact on society and are familiar with issues of data protection.

They will be able, individually or in a team, to analyze the ethical and socio-political implications of different areas and applications of computer science and develop a reasoned own position on this, in particular concerning their professional responsibilities as computer scientists.

They have learned to present the results of their work convincingly and suitable for their target group using appropriate media and they are able to organize events such as workshops or small conferences for that purpose.

Professional competence
The students:
- reflect on the ethical and societal aspects of selected areas of computer science
- create and design websites
- create and manage documents in a team

Methodological competence
The students:
- explore methods of structured teamwork
- organize project work
- make presentations with different media

Social competence
The students:
- develop a subject area as a team
- teach a bigger audience to appreciate their knowledge
- discuss their observations and opinions with others

Self-competence
The students:
- reflect their role in a team
- reflect their role as computer scientists in society

Module contents
In brief, topics like the following are covered:

- Computer Crime
- Computer Games
- Data Protection
- Electronic Democracy
- Ethics in Computer Science
- History of Information Technology
- Use of information technology at school
- Internet - integration or division of society?
- Artificial Intelligence
- Manipulation by War Games
- Open Source Software
- Robots in Society
- Trustworthy Systems

**Reader's advisory**

- See reference books Informatik und Gesellschaft in BIS.
- H. Klaeren u.a., (Eds.), 1999: Tübinger Studientexte Informatik und Gesellschaft, Universität Tübingen.

**Links**

http://www.informatik.uni-oldenburg.de/~iug

**Language of instruction**

German

**Duration (semesters)**

1 Semester

**Module frequency**

jährlich

**Module capacity**

unlimited

**Reference text**

The topics for the teams are assigned during the first week of the semester

**Modulart / typ of module**

Ergänzung/Professionalisierung

**Lehr-/Lernform / Teaching/Learning method**

S+P

**Vorkenntnisse / Previous knowledge**

Examination Time of examination Type of examination

<table>
<thead>
<tr>
<th>Final exam of module</th>
<th>During semester and at the end</th>
<th>Portfolio (5-6 partial performances)</th>
</tr>
</thead>
</table>

**Course type** Comment SWS Frequency Workload of compulsory attendance

| Seminar | 2 | WiSe | 28 |
| Practical training | 2 | WiSe | 28 |

**Total time of attendance for the module**

56 h
inf806 - Special Topics in Computer Science IV

<table>
<thead>
<tr>
<th>Module label</th>
<th>Special Topics in Computer Science IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module code</td>
<td>inf806</td>
</tr>
<tr>
<td>Credit points</td>
<td>6.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>180 h</td>
</tr>
</tbody>
</table>

**Applicability of the module**
- Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsbereich - Wahlbereich Informatik
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Pflichtmodule

**Responsible persons**
Lehrenden, Die im Modul (Authorized examiners)

**Prerequisites**
This module integrates current computer science developments within appropriate study courses.

**Skills to be acquired in this module**

**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

**Reader’s advisory**
According to the assigned task

**Languages of instruction**
German, English

**Duration (semesters)**
1 Semester

**Module frequency**
halbjährlich

**Module capacity**
unlimited

**Modulart / typ of module**
je nach Studiengang Pflicht oder Wahlpflicht

**Lehr-/Lernform / Teaching/Learning method**
2 Veranstaltungen aus V, Ü, S, P, PR

**Vorkenntnisse / Previous knowledge**

**Examination**
Time of examination
Type of examination
- Exercises or presentation or oral exam or written exam

**Course type**
Course selection

**SWS**
4
<table>
<thead>
<tr>
<th>Frequency</th>
<th>SuSe or WiSe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workload attendance</td>
<td>56 h</td>
</tr>
</tbody>
</table>
Abschlussmodul

mam - Master Thesis and Colloquium

<table>
<thead>
<tr>
<th>Module label</th>
<th>Master Thesis and Colloquium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module code</td>
<td>mam</td>
</tr>
<tr>
<td>Credit points</td>
<td>27.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>810 h</td>
</tr>
</tbody>
</table>

**Applicability of the module**

- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Abschlussmodul

**Responsible persons**

- Diethelm, Ira (Module responsibility)
- der Informatik, Lehrende (Module counselling)
- Lehrenden, Die im Modul (Module counselling)

**Prerequisites**

- unlimited

**Skills to be acquired in this module**

- The students prove that they are able to process and solve complex computer science tasks based on gained scientific knowledge and applied research methods. The students successfully implement a task especially by using their acquired professional and methodological knowledge and their professional and social competences.
- The accompanying seminar is used to discuss the master's thesis methodically and content-related. During the seminar the exchange of research and practical experience fosters the students' ability to discuss and evaluate their thesis with other students and experts. The master's thesis is finished by a colloquium.

**Professional competence**

- The students:
  - Recognise and evaluate applied techniques and methods of their subject and are aware of their limits
  - Design solutions for complex, possibly vaguely defined or unusual computer science tasks/problems and evaluate these with reference to state of the art computer science and technology
  - Identify, structure and solve problems/tasks, also in new or developing subject areas
  - Apply state of the art and innovative methods to solve problems, if necessary from other disciplines
  - Relate knowledge from different disciplines and apply this new knowledge in complex situations
  - Develop complex computer systems, processes and datamodels
  - Are aware of the current limits and contribute to the development of computer science research and technology
  - Discuss and evaluate recent computer science developments

**Methodological competence**

- The students:
  - Identify and develop one or more solutions
  - Evaluate and apply tools, technology and methods sophisticatedly
  - Examine tasks with technical and research literature, write an academic article and present their solutions academically
  - Schedule processes and resources
  - Apply project management techniques
  - Combine new and original approaches and methods creatively
  - Evaluate problems/tasks, including new or developing subject areas of their discipline and apply computer science methods for solutions and research

**Social competence**

- The students:
  - Communicate with users and experts convincingly
  - Take reasonable decisions

**Self-competence**

- The students:
  - Pursue the overall and special computer science development critically
  - Implement innovative professional activities effectively and independently
  - Recognise their abilities and extend them purposefully
  - Reflect their self-perception and actions with regard to professional, methodological and social aspects
  - Develop and reflect self-developed hypothesis to theories independently
• Work in their field independently

<table>
<thead>
<tr>
<th>Module contents</th>
<th>The content of this module is an independent topic research. The research findings will be presented and discussed in a master's thesis colloquium.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reader's advisory</td>
<td>Wird entsprechend des konkreten Themas spezifiziert</td>
</tr>
<tr>
<td>Links</td>
<td></td>
</tr>
<tr>
<td>Languages of instruction</td>
<td>German, English</td>
</tr>
<tr>
<td>Duration (semesters)</td>
<td>1 Semester</td>
</tr>
<tr>
<td>Module frequency</td>
<td>halbjährlich</td>
</tr>
<tr>
<td>Module capacity</td>
<td>unlimited</td>
</tr>
<tr>
<td>Modullevel / module level</td>
<td>Abschlussmodul (Abschlussmodul)</td>
</tr>
<tr>
<td>Modulart / typ of module</td>
<td>Pflicht</td>
</tr>
<tr>
<td>Lehr-/Lernform / Teaching/Learning method</td>
<td></td>
</tr>
<tr>
<td>Vorkenntnisse / Previous knowledge</td>
<td></td>
</tr>
<tr>
<td>Examination</td>
<td>Time of examination</td>
</tr>
<tr>
<td>Final exam of module</td>
<td>Masterthesis, presentation and discussion</td>
</tr>
<tr>
<td>Course type</td>
<td>Seminar</td>
</tr>
<tr>
<td>SWS</td>
<td>2</td>
</tr>
<tr>
<td>Frequency</td>
<td>SuSe and WiSe</td>
</tr>
<tr>
<td>Workload attendance</td>
<td>28 h</td>
</tr>
</tbody>
</table>
Wahlpflichtmodule (Praktische Informatik)

inf006 - Software Engineering II

<table>
<thead>
<tr>
<th>Module label</th>
<th>Software Engineering II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module code</td>
<td>inf006</td>
</tr>
<tr>
<td>Credit points</td>
<td>6.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>180 h</td>
</tr>
</tbody>
</table>

Applicability of the module

- 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) > Akzentsetzungsmodul der Informatik
- Master's Programme Computing Science (Master) > Praktische Informatik
- Master's Programme Environmental Modelling (Master) > Mastermodule

Responsible persons

- Winter, Andreas (Module responsibility)
- Lehrenden, Die im Modul (Authorized examiners)

Prerequisites

Skills to be acquired in this module

The objective of the module inf006 Software Engineering II is to deepen the subjects and skills of the module Software Engineering I. Special software engineering topics will be presented, deepened and discussed. The lecture deals with different software engineering methods and technology which will be discussed in the seminar. The discussions are contextualised by scientific research projects, practical projects and latest research findings. Professional competence The students: - Deepen software engineering methods and techniques - Use specific software engineering methods and techniques - Differentiate developmental techniques of software systems - Discuss software engineering topics - Design software systems by using appropriate methods - Solve software engineering problems independently - Reflect self-designed software engineering solutions critically and present them appropriately Methodological competence The Students: - Structure problems with modelling techniques - Develop actual methods of software engineering - Present software engineering solutions - Write scientific papers independently Social competence The Students: - Explain and discuss software development solutions in their practical use - Accept criticism and see it as an asset Self-competence The Students: - Reflect their problem-solving behaviour with regard to the possibilities of software technology - Internalize the presented developmental methods and integrate them in their own actions

Module contents

- Concept of systems
- Iterative and agile process models of software development
- System development and cost estimation
- Methods, techniques and tools to collect requirements
- Techniques to develop and describe software architecture
- Measurement and evaluation of software systems
- Extended techniques of modelling, meta-modelling, domain specific languages
- Model based development
- Methods and techniques of software evolution

Reader's advisory

- Helmut Balzert: Lehrbuch der Software-Technik, Spektrum Akademischer Verlag, 3. Auflage 2009
- and actual papers from IEEE Software, IEEE Transactions on Software-Engineering, Informatik-Spektrum and conferences (z.B. ICSE, ICSM, WCRE, CSMR, ICPC, SLE, u.a.)

Links

Language of instruction

- German

Duration (semesters)

- 1 Semester

Module frequency

- jährlich

Module capacity

- unlimited

Modullevel / module level

- AS (Akzentsetzung / Accentuation)
<table>
<thead>
<tr>
<th>Modulart / typ of module</th>
<th>je nach Studiengang Pflicht oder Wahlpflicht</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lehr-/Lernform / Teaching/Learning method</td>
<td>V+S</td>
</tr>
<tr>
<td>Vorkenntnisse / Previous knowledge</td>
<td>Softwaretechnik I</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examination</th>
<th>Time of examination</th>
<th>Type of examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final exam of module</td>
<td>At the end of the lecture period</td>
<td>Portfolio (30-minute presentation, 1 paper (4 pages, IEEE) and oral exam)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course type</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td>2</td>
<td>SuSe</td>
<td>28</td>
</tr>
<tr>
<td>Seminar</td>
<td></td>
<td>2</td>
<td>SuSe</td>
<td>28</td>
</tr>
</tbody>
</table>

**Total time of attendance for the module** 56 h
inf008 - Information Systems II

<table>
<thead>
<tr>
<th>Module label</th>
<th>Information Systems II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module code</td>
<td>inf008</td>
</tr>
<tr>
<td>Credit points</td>
<td>6.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>180 h</td>
</tr>
</tbody>
</table>

**Applicability of the module**
- Bachelor's Programme Business Informatics (Bachelor) > Aufbaucurriculum-Wahlbereich Praktische Informatik
- Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsbereich - Wahlbereich Informatik
- Bachelor's Programme Economics and Business Administration (Bachelor) > Studienrichtung Wirtschaftsinformatik
- Master Applied Economics and Data Science (Master) > Specialization
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Praktische Informatik)
- Master's Programme Business Informatics (Master) > Akzentsetzungsmodule der Informatik

**Responsible persons**
- Grawunder, Marco (Module responsibility)
- Lehrenden, Die im Modul (Authorized examiners)

**Prerequisites**

**Skills to be acquired in this module**

The Module “Information Systems II” enhances the knowledge and the concepts of “Information Systems I”.

**Professional competence**

The students:
- Know further concepts, languages and architectures of databases
- Analyse advanced information processing tasks
- Analyse complex requirements of information systems appropriately
- Realize information requirements and gather relevant information

**Methodological competence**

The students:
- Propose concrete processing principles for special application classes
- Reflect specific technologies’ consequences and proceedings

**Social competence**

The students:

**Self-competence**

The students:
- Reflect their problem-solving behaviour with regard to extended information processing concepts

**Module contents**

- Implementation of databases (architecture, index structures, query processing and optimization)
- Data integration and data analysis (data integration, data warehouses, data mining)
- Information retrieval
- Parallel databases

**Reader’s advisory**

Suggested reading:
- Härder, T., Rahm, E.: Datenbanksysteme - Konzepte und Techniken der Implementierung, Morgan Kaufmann
- U. Leser, F. Naumann. Informationsintegration: Architekturen und Methoden zur Integration verteilter und heterogener Datenquellen, dpunkt
- Bauer/Günzel. Data-Warehouse-Systeme, dpunkt
- Han/Kamber/Pel. Data Mining: Concepts and Techniques, Morgan Kaufmann
**Language of instruction**: German  
**Duration (semesters)**: 1 Semester  
**Module frequency**: jährlich  
**Module capacity**: unlimited  
**Modullevel / module level**: AS (Akzentsetzung / Accentuation)  
**Modulart / typ of module**: Wahlmodul / Opportunity  
**Lehr-/Lernform / Teaching/Learning method**: V+Ü  

### Vorkenntnisse / Previous knowledge

<table>
<thead>
<tr>
<th>Examination</th>
<th>Time of examination</th>
<th>Type of examination</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Final exam of module</strong></td>
<td>At the end of the lecture period</td>
<td>written or oral Exam</td>
</tr>
</tbody>
</table>

### Course type

<table>
<thead>
<tr>
<th>Course type</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td>3</td>
<td>SuSe</td>
<td>42</td>
</tr>
<tr>
<td>Exercises</td>
<td></td>
<td>1</td>
<td>SuSe</td>
<td>14</td>
</tr>
</tbody>
</table>

**Total time of attendance for the module**: 56 h
inf009 - Database Practical

<table>
<thead>
<tr>
<th>Module label</th>
<th>Database Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module code</td>
<td>inf009</td>
</tr>
<tr>
<td>Credit points</td>
<td>6.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>180 h</td>
</tr>
<tr>
<td>Applicability of the module</td>
<td></td>
</tr>
<tr>
<td>Bachelor's Programme Business Informatics (Bachelor) &gt; Akzentsetzungsbereich Praktische Informatik und Angewandte Informatik</td>
<td></td>
</tr>
<tr>
<td>Bachelor's Programme Computing Science (Bachelor) &gt; Akzentsetzungsbereich - Wahlbereich Informatik</td>
<td></td>
</tr>
<tr>
<td>Dual-Subject Bachelor's Programme Computing Science (Bachelor) &gt; Praktische Vertiefung (60 KP)</td>
<td></td>
</tr>
<tr>
<td>Master of Education Programme (Gymnasium) Computing Science (Master of Education) &gt; Wahlpflichtmodule (Praktische Informatik)</td>
<td></td>
</tr>
<tr>
<td>Master of Education Programme (Vocational and Business Education) Computing Science (Master of Education) &gt; Praktische Vertiefung der Informatik</td>
<td></td>
</tr>
</tbody>
</table>

Responsible persons
Grawunder, Marco (Module responsibility)
Lehrenden, Die im Modul (Authorized examiners)

Prerequisites

Skills to be acquired in this module
The objective of this module is to gather practical experience on databases and information systems. The students get an overview of the technical realisation, implementation and optimisation of a professional database management system.

Professional competence
The students:
- Realise, implement and program database systems
- Program and implement database-oriented system routines
- Implement optimisation goals in the modelling phase
- Administer professional database systems (installation, maintenance and adjustment)
- Recognise database systems’ performance problems and are able to fix them with according methods
- Organise and control processes of database systems

Social competence
The students:
- Solve database system problems in a team

Self-competence
The students:
- Acknowledge the limits of their ability to cope with pressure during the implementation and are aware of failures
- Reflect their self-perception

Module contents
The module “Practical Course Databases” is a related practical course of the module “Information Systems I”. The objectives of this module are special technical concepts of a database system and practical solutions in database programming and optimisation.

Contents of this module are:
- System-oriented database management programming,
- Implementation of catalogue systems,
- Optimisation strategies based on parallelisation and partitioning requirements

Reader's advisory
Held Andrea (2005). Oracle 10g Hochverfügbarkeit Addison-Wesley.
Feuerstein Steven, Pribyl Bill, Dawes Chip (2007).
Oracle PL/SQL. 4. Auflage, O'Reillys Taschenbibliothek

Links
http://www-is.informatik.uni-oldenburg.de/227/

Language of instruction
German
<table>
<thead>
<tr>
<th>Duration (semesters)</th>
<th>1 Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module frequency</td>
<td>jährlich</td>
</tr>
<tr>
<td>Module capacity</td>
<td>unlimited</td>
</tr>
<tr>
<td>Modullevel / module level</td>
<td>AS (Akzentsetzung / Accentuation)</td>
</tr>
<tr>
<td>Modulart / typ of module</td>
<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
</tr>
<tr>
<td>Lehr-/Lernform / Teaching/Learning method</td>
<td>P</td>
</tr>
<tr>
<td>Vorkenntnisse / Previous knowledge</td>
<td>Informationsysteme I Betriebssystemkenntnisse</td>
</tr>
<tr>
<td>Examination</td>
<td>Time of examination</td>
</tr>
<tr>
<td>Final exam of module</td>
<td>At the end of the lecture period</td>
</tr>
<tr>
<td>Course type</td>
<td>Practical training</td>
</tr>
<tr>
<td>SWS</td>
<td>4</td>
</tr>
<tr>
<td>Frequency</td>
<td>WiSe</td>
</tr>
<tr>
<td>Workload attendance</td>
<td>56 h</td>
</tr>
</tbody>
</table>
**inf010 - Computer Networks**

**Module label**  
Computer Networks

**Module code**  
inf010

**Credit points**  
6.0 KP

**Workload**  
180 h

**Applicability of the module**
- Bachelor's Programme Business Informatics (Bachelor) > Aufbaucurriculum-Wahlbereich Praktische Informatik
- Bachelor's Programme Computing Science (Bachelor) > Wahlpflichtbereich Praktische Informatik
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Praktische Informatik)
- Master of Education Programme (Vocational and Business Education) Computing Science (Master of Education) > Akzentsetzungsbereich

**Responsible persons**
Kramer, Oliver (Module responsibility)
Lehrenden, Die im Modul (Authorized examiners)

**Prerequisites**

**Skills to be acquired in this module**

**Professional competence:** The students:
- Identify the layers of the ISO/OSI model
- Recognise the main concepts and algorithms of each IOS/OSI layer
- Assign technical processes to the layers
- Classify new technologies to the main concepts of the ISO/OSI model - Compare different methods and approaches of a layer (i.e. TCP and UDP)
- Characterise safety-critical aspects of each layer

**Methodological competence:** The students:
- Administer small networks
- Characterise safety-critical aspects of networks

**Social competence:** The students:
- work on exercises in small teams

**Self-competence:** The students:
- accept criticism
- reflect on their proposed solutions, taking into account the methods taught

**Module contents**

Contents of this lecture (cf. suggested reading Tanenbaum and Wetherall):
- Introduction to networks and the internet
- Physical Layer
- Data Link Layer - MAC Sub-Layer
- Network Layer
- Transport Layer
- Session Layer
- Presentation Layer
- Application Layer - Technologies (Cable and Co)
- Nyquist Shannon and Transmissions - CDMA
- Hamming & CRC - Stop & wait, go back n, selective repeat
- Aloha & CSMA
- Ethernet technologies
- WiFi
- Paket switchen & Dijkstra
- IP Adressing & Header
- TCP - UDP
- Buckets & TCP-Reno
- DNS
- Flask
- RSA & PGP
- Firewalls

**Reader's advisory**

**Links**
http://einstein.informatik.uni-oldenburg.de/20902.html

**Language of instruction**
German

**Duration (semesters)**
1 Semester

**Module frequency**
jährlich

**Module capacity**
unlimited

**Module level / module level**
AM (Aufbaumodul / Composition)
<table>
<thead>
<tr>
<th>Modulart / typ of module</th>
<th>je nach Studiengang Pflicht oder Wahlpflicht</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lehr-/Lernform / Teaching/Learning method</td>
<td>V+Ü</td>
</tr>
<tr>
<td>Vorkenntnisse / Previous knowledge</td>
<td></td>
</tr>
<tr>
<td>Examination</td>
<td>Time of examination</td>
</tr>
<tr>
<td>Final exam of module</td>
<td>At the end of the lecture period</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course type</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td>3</td>
<td>SuSe</td>
<td>42</td>
</tr>
<tr>
<td>Exercises</td>
<td></td>
<td>1</td>
<td>SuSe</td>
<td>14</td>
</tr>
</tbody>
</table>

Total time of attendance for the module 56 h
inf012 - Operating Systems I

Module label: Operating Systems I
Module code: inf012
Credit points: 6.0 KP
Workload: 180 h

Applicability of the module:
- Bachelor's Programme Business Informatics (Bachelor) > Aufbaucurriculum-Wahlbereich Praktische Informatik
- Bachelor's Programme Computing Science (Bachelor) > Wahlpflichtbereich Praktische Informatik
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Praktische Informatik)

Responsible persons:
Theel, Oliver (Module responsibility)
Lehrenden, Die im Modul (Authorized examiners)

Prerequisites:

Skills to be acquired in this module:
To gain knowledge of and capabilities in the design, the implementation, and the evaluation of operating systems.

Professional competence:
The students:
- Develop an understanding of operating systems regarding terminology, structure, functionality, conception, central challenges and solutions
- Evaluate the performance of operating systems
- Are aware of the implementation problems of operating systems
- Realise and evaluate solutions of subproblems
- Comprehend and evaluate the functional connections between application systems and hardware
- Understand operating systems as a link between technical and applied computer science

Methodological competence:
The students:
- Transfer concepts of implementations to other contexts
- Question different solutions wrt. properties

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 initial solutions in the light of newly learned methods

Module contents:
The contents of this module are:
1. "Operating systems" definition and structure
2. Requirements of operation systems
3. Technical characteristics of related hardware
4. The need and implementation options of parallel processes
5. Cooperation of processes: communication and synchronisation (semaphores)
6. Memory management: virtual and non-virtual memory management
7. File management

Reader's advisory:
A. Tanenbaum (2009), Modern Operating Systems. 3rd edition, Prentice Hall

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

- Betriebssysteme II (als mögliche Anschlussveranstaltung)
- Verteilte Betriebssysteme (als mögliche Spezialisierung)
- Betriebssysteme-Praktikum

<table>
<thead>
<tr>
<th>Modullevel / module level</th>
<th>AC (Aufbaucurriculum / Composition)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typ / type of module</td>
<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
</tr>
<tr>
<td>Lehr-/Lernform / Teaching/Learning method</td>
<td>V+Ü</td>
</tr>
</tbody>
</table>

Nützliche Vorkenntnisse:
Studieninhalte des ersten Studienjahres des Fach-Bachelors Informatik oder Wirtschaftsinformatik

<table>
<thead>
<tr>
<th>Examination</th>
<th>Time of examination</th>
<th>Type of examination</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Final exam of module</th>
<th>End of the lecture period</th>
<th>Written or oral exam</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Course type</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td>2</td>
<td>SuSe</td>
<td>28</td>
</tr>
<tr>
<td>Exercises</td>
<td></td>
<td>2</td>
<td>SuSe</td>
<td>28</td>
</tr>
</tbody>
</table>

Total time of attendance for the module: 56 h
inf015 - Distributed Operating Systems

Module label  Distributed Operating Systems
Module code  inf015
Credit points  6.0 KP
Workload  180 h

Applicability of the module
- Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsbereich - Wahlbereich Informatik
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Praktische Informatik)

Responsible persons
Theel, Oliver (Module responsibility)
Lehrenden, Die im Modul (Authorized examiners)

Prerequisites
This module deals with the fundamentals of distributed operating systems. It gives an understanding of the terminology, structures, functions, conceptions, key problems and implementation concepts of distributed operating systems.

Professional competence
The students:
- Evaluate the performance and functionality of distributed operating systems
- Are aware of the realisation problems of distributed operating systems
- Know and evaluate standard methods of solving problems in the context of distributed operating systems
- Use standard methods to solve problems in the context of distributed operating systems

Methodological competence
The students:
- Use standard methods of the distributed operating system domain to solve problems in other contexts
- Analyse and rank different solutions in the problem domain wrt. relevant properties

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 initial solutions in the light of newly learned methods

Module contents
The contents of this module are:
1) The historical development towards distributed operating systems
2) Models of distributed computer systems
3) Models of distributed operating systems
4) Design criteria of distributed operating systems
5) Interprocess communication (Computer Networks, Message Passing, Remote Procedure Call)
6) Memory management
   - DSM
7) Process management
   - Task allocation
   - Load balancing
   - Load distribution
   - Process migration
8) Synchronisation
• Clocks
• Ordering of events
• Distributed mutual exclusion
• Distributed leader election
• Deadlocks

9) Naming and localisation of objects
10) Distributed file systems
11) Fault tolerance concepts

Reader's advisory

• Chow and Johnson (1998) Distributed Operating Systems and Algorithms, Addison-Wesley

Links
Language of instruction  German
Duration (semesters)  1 Semester
Module frequency  jährlich
Module capacity  unlimited
Reference text  Associated with the modules:

• Betriebssysteme I & II
• Betriebssysteme-Praktikum
• Fehlertoleranz in verteilten Systemen (as a possible differentiation)

Modullevel / module level  AS (Akzentsetzung / Accentuation)
Modulart / typ of module  je nach Studiengang Pflicht oder Wahlpflicht
Lehr-/Lernform / Teaching/Learning method  V+Ü
Vorkenntnisse / Previous knowledge  Betriebssysteme I
Examination  Time of examination
Final exam of module  End of the lecture period
Course type  Comment  SWS  Frequency  Workload of compulsory attendance
Lecture  2  SuSe  28
Exercises  2  SuSe  28
Total time of attendance for the module  56 h
inf016 - Internet Technologies

<table>
<thead>
<tr>
<th>Module label</th>
<th>Internet Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module code</td>
<td>inf016</td>
</tr>
<tr>
<td>Credit points</td>
<td>6.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>180 h</td>
</tr>
</tbody>
</table>
| Applicability of the module | • Bachelor's Programme Business Informatics (Bachelor) > Aufbaucurriculum-Wahlbereich Praktische Informatik  
                        | • Bachelor's Programme Computing Science (Bachelor) > Wahlpflichtbereich Praktische Informatik  
                        | • Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Praktische Informatik)  
                        | • Master of Education Programme (Vocational and Business Education) Computing Science (Master of Education) > Akzentsetzungsbereich |

**Responsible persons**

Boles, Dietrich (Module responsibility)
Lehrenden, Die im Modul (Authorized examiners)

**Prerequisites**

Skills to be acquired in this module

The graduates of the module know the basic concepts and technologies of Internet and web applications. They can evaluate the capability of the concepts and technologies to design Internet-based applications. The students will apply these concepts and techniques in a project.

**Professional competence**
The students:
- Know basic concepts and technologies of the Internet and the web

**Methodological competence**
The students:
- Are able to use the techniques in projects

**Social competence**
The students:
- Implement web-based projects in a team

**Self-competence**
The students:
- Reflect their own capabilities to develop Internet-based applications

**Module contents**
The module deals with the basic development concepts of Internet-based applications. It covers relevant client technologies of web applications (HTML, CSS, JavaScript), server technologies (forms, servlets, PHP, databases) and technologies for client server communication (AJAX, WebSockets, Web services, Social-Media-APIs). Additional topics are web design, Internet law, security and web search. The practical exercises of this module consist of the design, implementation and presentation of a comprehensive web application. The topics of the lecture will be applied and deepened in practice.

**Reader's advisory**
list of links in the learning management system

**Links**

**Language of instruction**
German

**Duration (semesters)**
1 Semester

**Module frequency**
every summer semester

**Module capacity**
unlimited

**Reference text**
Useful previous knowledge: object-oriented programming

**Modulelevel / module level**
AS (Akzentsetzung / Accentuation)

**Modular / typ of module**
je nach Studiengang Pflicht oder Wahlpflicht

**Lehr-/Lernform / Teaching/Learning method**
V+Ü

**Vorkenntnisse / Previous knowledge**
- Objektorientierte Programmierung

**Examination**

<table>
<thead>
<tr>
<th>Time of examination</th>
<th>Type of examination</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Examination | Time of examination | Type of examination
--- | --- | ---
**Final exam of module** | The presentation of partial results of the practical project takes place weekly during the exercises. Final delivery of the final project is one week after the end of the lecture period. The written exam or oral exam take place in the last week of the lecture period or the first 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. | project and written exam or project and oral exam

<table>
<thead>
<tr>
<th>Course type</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td>2</td>
<td>SuSe</td>
<td>28</td>
</tr>
<tr>
<td>Exercises</td>
<td></td>
<td>2</td>
<td>SuSe</td>
<td>28</td>
</tr>
</tbody>
</table>

**Total time of attendance for the module** 56 h
inf017 - Interactive Systems

Module label | Interactive Systems
Module code | inf017
Credit points | 6.0 KP
Workload | 180 h

Applicability of the module

- Bachelor's Programme Biology (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Bachelor's Programme Business Administration and Law (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Bachelor's Programme Business Informatics (Bachelor) > Akzentsetzungsbereich Praktische Informatik und Angewandte Informatik
- Bachelor's Programme Business Informatics (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Bachelor's Programme Chemistry (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer" more...
- Bachelor's Programme Comparative and European Law (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsbereich - Wählbereich Informatik
- Bachelor's Programme Computing Science (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Bachelor's Programme Economics and Business Administration (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Bachelor's Programme Education (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Bachelor's Programme Environmental Science (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Bachelor's Programme Intercultural Education and Counselling (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Bachelor's Programme Mathematics (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Bachelor's Programme Physics (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Bachelor's Programme Physics, Engineering and Medicine (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Bachelor's Programme Social Studies (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Bachelor's Programme Programme Sustainability Economics (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Dual-Subject Bachelor's Programme Art and Media (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Dual-Subject Bachelor's Programme Biology (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Dual-Subject Bachelor's Programme Chemistry (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Dual-Subject Bachelor's Programme Computing Science (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Dual-Subject Bachelor's Programme Dutch Linguistics and Literary Studies (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Dual-Subject Bachelor's Programme Economic Education (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Dual-Subject Bachelor's Programme Economics and Business Administration (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Dual-Subject Bachelor's Programme Elementary Mathematics (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Dual-Subject Bachelor's Programme English Studies (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Dual-Subject Bachelor's Programme Gender Studies (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Dual-Subject Bachelor's Programme General Education (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Dual-Subject Bachelor's Programme German Studies (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Dual-Subject Bachelor's Programme History (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Dual-Subject Bachelor's Programme Material Culture: Textiles (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
Dual-Subject Bachelor's Programme Mathematics (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
Dual-Subject Bachelor's Programme Music (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
Dual-Subject Bachelor's Programme Philosophy / Values and Norms (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
Dual-Subject Bachelor's Programme Physics (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
Dual-Subject Bachelor's Programme Politics-Economics (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
Dual-Subject Bachelor's Programme Protestant Theology and Religious Education (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
Dual-Subject Bachelor's Programme Slavic Studies (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
Dual-Subject Bachelor's Programme Social Studies (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
Dual-Subject Bachelor's Programme Sport Science (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
Dual-Subject Bachelor's Programme Technology (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
Dual-Subject Bachelor's Programme Special Needs Education (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
Fach-Bachelor Pädagogisches Handeln in der Migrationsgesellschaft (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Praktische Informatik)

Responsible persons
Boll-Westermann, Susanne (Module responsibility)
Lehrenden, Die im Modul (Authorized examiners)

Prerequisites

Skills to be acquired in this module

**Professional competence** The students:
- can describe and explain an iterative process to develop interactive systems.
- can classify a method known from the lecture into that process
- name the basic concepts and characteristics of usable user interfaces
- name and explain established guidelines and heuristics of the user-centered design of interactive systems

**Methodological competence:** The students:
- can name and explain methods for context of use and/or user requirements analysis.
- can name methods for the design and prototypical implementation of interactive systems and discuss their advantages and disadvantage.
- can explain established methods for usability testing.
- can evaluate a given user interface with regard to potential usability problems.

**Social competence** The students:
- can present solutions to usability problems or results of an usability evaluation in the plenum.

**Self competence** The students:
- can accept criticisms by their peer group as valuable contributions to their solutions.

Module contents
The field of interactive systems deals with the tasks, concepts and technologies of human-computer interaction and its user-friendly and suitable design. The lecture is based on the so-called Human Centred Design Process and includes models of interaction between humans and their environment, iterative design, prototyping techniques, study and evaluation processes. Basic design principles, methods and tools are presented. Practical tasks complete the lecture.

Reader's advisory
Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale: Human Computer Interaction.
Bernhard Preim, Raimund Dachselt: Interaktive Systeme
Don Norman: The design of everyday things

Weitere Fachartikel, die in der Vorlesung vorgestellt werden

Links
http://medien.informatik.uni-oldenburg.de/lehre/
<table>
<thead>
<tr>
<th><strong>Language of instruction</strong></th>
<th>German</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Duration (semesters)</strong></td>
<td>1 Semester</td>
</tr>
<tr>
<td><strong>Module frequency</strong></td>
<td>jährlich</td>
</tr>
<tr>
<td><strong>Module capacity</strong></td>
<td>unlimited</td>
</tr>
<tr>
<td><strong>Modullevel / module level</strong></td>
<td>AS (Akzentsetzung / Accentuation)</td>
</tr>
<tr>
<td><strong>Modulart / typ of module</strong></td>
<td>Wahlpflicht / Elective</td>
</tr>
<tr>
<td><strong>Lehr-/Lernform / Teaching/Learning method</strong></td>
<td>1v + 1Ü</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Vorkenntnisse / Previous knowledge</strong></th>
<th><strong>Time of examination</strong></th>
<th><strong>Type of examination</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Final exam of module</strong></td>
<td>The presentation of the practical exercises takes place during the semester at tutorial times. The first written short test concerns contents of the first five lectures and takes place in the weeks after the fifth lecture. The second short test concerns the contents of the remaining lectures and follows shortly after the end of the lecture period. The exact dates will be announced in the first lecture as well as in the teaching management system.</td>
<td>Praktikal tasks and two written exams. Project and written exam</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Course type</strong></th>
<th><strong>Comment</strong></th>
<th><strong>SWS</strong></th>
<th><strong>Frequency</strong></th>
<th><strong>Workload of compulsory attendance</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td>2</td>
<td>WiSe</td>
<td>28</td>
</tr>
<tr>
<td>Project</td>
<td></td>
<td>2</td>
<td>WiSe</td>
<td>28</td>
</tr>
</tbody>
</table>

| **Total time of attendance for the module** | 56 h |
Module label: Media Processing

Module code: inf018

Credit points: 6.0 KP

Workload: 180 h

Applicability of the module

- Bachelor's Programme Biology (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Bachelor's Programme Business Administration and Law (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Bachelor's Programme Business Informatics (Bachelor) > Akzentsetzungsrichtung Praktische Informatik und Angewandte Informatik
- Bachelor's Programme Business Informatics (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Bachelor's Programme Chemistry (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer" more...
- Bachelor's Programme Comparative and European Law (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsrichtung - Wahlbereich Informatik
- Bachelor's Programme Computing Science (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Bachelor's Programme Economics and Business Administration (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Bachelor's Programme Education (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Bachelor's Programme Engineering Physics (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Bachelor's Programme Environmental Science (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Bachelor's Programme Intercultural Education and Counselling (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Bachelor's Programme Mathematics (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Bachelor's Programme Physics (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Bachelor's Programme Physics, Engineering and Medicine (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Bachelor's Programme Social Studies (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Bachelor's Programme Sustainability Economics (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Dual-Subject Bachelor's Programme Art and Media (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Dual-Subject Bachelor's Programme Biology (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Dual-Subject Bachelor's Programme Chemistry (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Dual-Subject Bachelor's Programme Computing Science (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Dual-Subject Bachelor's Programme Computing Science (Bachelor) > Praktische Vertiefung (60 KP)
- Dual-Subject Bachelor's Programme Dutch Linguistics and Literary Studies (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Dual-Subject Bachelor's Programme Economic Education (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Dual-Subject Bachelor's Programme Economics and Business Administration (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Dual-Subject Bachelor's Programme English Studies (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Dual-Subject Bachelor's Programme Gender Studies (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Dual-Subject Bachelor's Programme General Education (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Dual-Subject Bachelor's Programme German Studies (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Dual-Subject Bachelor's Programme History (Bachelor) > PP "Medieninformatik für Studierende musisch-künstlerischer Fächer"
- Dual-Subject Bachelor's Programme Material Culture: Textiles (Bachelor) > PP "Medieninformatik für..."
The students can explain the basics of image processing and know which algorithms exist for the basic tasks in image processing and how these are applied.

The students can apply basic methods of image processing they learned in the lecture to solve simple problems.

**Professional competence:**
The students
- can name basic characteristics of digital media
- can explain the most common methods for encoding and compressing images, video and audio
- can describe basic procedures for image enhancement, feature extraction, feature description, image analysis and image comprehension

**Methodological competence:**
The students
- can recognize and evaluate image properties and decide for suitable image processing methods
- can select existing software packages for simple image processing problems, as well as use and customize them for their specific task
- can implement simple image and media processing functions in a higher programming language (e.g., C++)

**Social competence**
The students:
- can plan, implement, and document a software project in team work
- can present the results of their work to an audience and adequately respond to criticism and questions

**Self competence**
The students:
- can accept and learn from mistakes made during the process of implementation
### Module contents
The lecture covers the technologies of media processing. In particular, the lecture focuses on image processing chain from digital imaging, through image pre- and postprocessing, and image storage to image analysis. In addition to compression techniques and color space theory (RGB, HSV, YUV, CIE XYZ, ...), the topics of the lecture include image enhancement, feature extraction, feature description, image analysis and image comprehension. The lecture furthermore discusses the encoding and analysis of video and audio.

### Reader's advisory

Literatur im Handapparat der Abteilung in der Bibliothek. Linkliste im Lernmanagementsystem zu den einzelnen Themen der Vorlesung.

### Links
http://medien.informatik.uni-oldenburg.de/lehre

### Language of instruction
German

### Duration (semesters)
1 Semester

### Module frequency
Annually

### Module capacity
unlimited

### Reference text
Useful previous knowledge: Solid programming skills in Java and/or C++, practical informatics. Interest in media processing

### Module level / module level
AS (Akzentsetzung / Accentuation)

### Modulart / typ of module
je nach Studiengang Pflicht oder Wahlpflicht

### Lehr-/Lernform / Teaching/Learning method
1V + 1Ü

### Vorkenntnisse / Previous knowledge
Gute Programmierkenntnisse in PythonJava und/oder JavaC++, Interesse an Medienverarbeitung.

### Examination
Time of examination
Type of examination
Final exam of module

Project and oral exam
The portfolio comprises two graded submodules:
- Practical group project which progress has to be presented regularly during the tutorials.
- Oral exam on the topics of the lecture.

Practical project and oral exam count 50% each to the final grade. Both practical project and oral exam must be passed individually.

### Course type
**Lecture**

**Project**

### Comment

### SWS

### Frequency

### Workload of compulsory attendance

### Total time of attendance for the module
56 h
inf019 - Compiler Construction

Module label  
Compiler Construction

Module code  
inf019

Credit points  
6.0 KP

Workload  
180 h

Applicability of the module  
- Bachelor's Programme Computing Science (Bachelor) > Wahlpflichtbereich Praktische Informatik
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Praktische Informatik)

Responsible persons  
Lehrenden, Die im Modul (Authorized examiners)
Vogel-Sonnenschein, Ute (Module responsibility)

Prerequisites

Skills to be acquired in this module

Professional competence
The students:

- name the structure of a compiler and each part of the compiling process of a programming language
- describe the standards of each phase of a compiling process
- understand and evaluate typical characteristics as well as advantages and disadvantages of different methods of the compilation stages
- practically apply the learned methods of the compilation stages
- evaluate the use of a compilation generator

Methodological competence
The students:

- link the automata theory and the formal language concepts regarding the compiler construction

Social competence
The students:

- develop and present solutions of given problems in small teams

Module contents
The module provides all steps of a compiler: scanner, parser, semantic analysis, intermediate code generation, code optimisation and machine code generation. Each step is introduced by its current methods. For the parsing step LL-Parser and LR-Parser are presented. The code optimisation step is introduced by different procedures with different conditions for the register optimisation. The lecture essentially follows the book of Aho, Lam, Sethi, Ullman which can validly be described as a compiler construction classic.

During practice the introduced methods are practically deepened by small examples and tasks, which the students must carry out independently. A compiler generator (typically ANTLR) is used to demonstrate the practical use of such a tool to the students.

Reader's advisory

Essential:

- Handout

Recommended:


Links

Language of instruction  
German

Duration (semesters)  
1 Semester

Module frequency  
jährlich

Module capacity  
unlimited

Modulelevel / module level  
AS (Akzentsetzung / Accentuation)

Modulart / typ of module  
Wahlpflicht / Elective

Lehr-/Lernform / Teaching/Learning method  
V+Ü

39 / 89
<table>
<thead>
<tr>
<th>Vorkenntnisse / Previous knowledge</th>
<th>Theoretische Informatik II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examination</td>
<td>Time of examination</td>
</tr>
<tr>
<td>Final exam of module</td>
<td>At the end of the lecture period</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course type</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td>2</td>
<td>WiSe</td>
<td>28</td>
</tr>
<tr>
<td>Exercises</td>
<td></td>
<td>2</td>
<td>WiSe</td>
<td>28</td>
</tr>
</tbody>
</table>

**Total time of attendance for the module**: 56 h
### inf020 - Machine-oriented Programming

<table>
<thead>
<tr>
<th>Module label</th>
<th>Machine-oriented Programming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module code</td>
<td>inf020</td>
</tr>
<tr>
<td>Credit points</td>
<td>6.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>180 h</td>
</tr>
</tbody>
</table>

#### Applicability of the module

- Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsbereich - Wahlbereich Informatik
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Praktische Informatik)

#### Responsible persons

- Theel, Oliver (Module responsibility)
- Lehrenden, Die im Modul (Authorized examiners)

#### Prerequisites

**Professional competence**

The students:

- Comprehend special concepts and methods of low-level programming of tightly-coupled computer systems in C and their translation into NASM assembly language
- Design and implement programs in C independently and systematically translate them into a computer architecture-specific assembly language
- Implement machine-oriented software with appropriate programming and compilation techniques and concepts
- Recognize the relation of technical and practical computer science as well as the relations of high- and low-level programming

**Methodological competence**

The students:

- Understand aspects of the practical and theoretical computer science
- Understand the connection between high level language constructs and low level language constructs
- Translate C programs into NASM programs

**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 initial solutions in the light of newly learned methods

#### Module contents

- Application areas of machine-oriented programming
- Concepts of the programming language C
- Programming in C
- Setup and structure of tightly-coupled computer systems
- Intel processor architecture
- Assembly languages, in particular NASM assembly language
- Systematical translation of programs from C to NASM assembly language

This module builds a bridge between technical and practical computer science aspects and high-level and machine-oriented programming. The knowledge and skills learned in this module are relevant for machine-oriented system programming, e.g. in realising operating systems and translations of programming languages.

#### Reader's advisory

<table>
<thead>
<tr>
<th>Links</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Language of instruction</strong></td>
<td>German</td>
</tr>
<tr>
<td><strong>Duration (semesters)</strong></td>
<td>1 Semester</td>
</tr>
<tr>
<td><strong>Module frequency</strong></td>
<td>jährlich</td>
</tr>
<tr>
<td><strong>Module capacity</strong></td>
<td>unlimited</td>
</tr>
</tbody>
</table>

**Reference text**

Associated with the modules:

- Betriebssysteme I und II (as possible prerequisites)
- Verteilte Betriebssysteme (as possible specialisation)
- Betriebssysteme-Praktikum

<table>
<thead>
<tr>
<th>Module level / module level</th>
<th>AS (Akzentsetzung / Accentuation)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Modulart / typ of module</strong></td>
<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
</tr>
<tr>
<td><strong>Lehr-/Lernform / Teaching/Learning method</strong></td>
<td>V+Ü</td>
</tr>
</tbody>
</table>

**Vorkenntnisse / Previous knowledge**

Studieninhalte des ersten Studienjahres des Fach-Bachelors Informatik oder Wirtschaftsinformatik

<table>
<thead>
<tr>
<th>Examination</th>
<th>Time of examination</th>
<th>Type of examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final exam of module</td>
<td>At the end of the lecture periode</td>
<td>Written or oral exam</td>
</tr>
</tbody>
</table>

**Course type** | **Comment** | **SWS** | **Frequency** | **Workload of compulsory attendance**
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td>2</td>
<td>WiSe</td>
<td>28</td>
</tr>
<tr>
<td>Exercises</td>
<td></td>
<td>2</td>
<td>WiSe</td>
<td>28</td>
</tr>
</tbody>
</table>

**Total time of attendance for the module**

56 h
## Wahlpflichtmodule (Technische Informatik)

**inf201 - Computer Engineering II**

<table>
<thead>
<tr>
<th>Module label</th>
<th>Computer Engineering II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module code</td>
<td>inf201</td>
</tr>
<tr>
<td>Credit points</td>
<td>6.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>180 h</td>
</tr>
</tbody>
</table>

**Applicability of the module**
- Bachelor's Programme Computing Science (Bachelor) > Aufbaumodule
- 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)

**Responsible persons**
- Nebel, Wolfgang (Module responsibility)
- Lehrenden, Die im Modul (Authorized examiners)

**Prerequisites**

**Skills to be acquired in this module**

**Professional competence**
- The students:
  - describe computer components
  - design and optimise computer components
  - understand manufacturing processes for VLSI circuits

**Methodological competence**
- The students:
  - analyse computer architectures

**Social competence**
- The students:
  - discuss computer hardware and manufacturing processes competently
  - are able to transfer their knowledge of hardware design to other domains different from computer science

**Self-competence**
- The students:
  - are able to assess their own competences in relation to qualified personnel from related domains

**Module contents**

This module is the second part of the introduction to technical computer science. Typical examples of combinatory circuits, like an adder, are used to illustrate modular design methods. More advanced design methods are demonstrated on sequential circuits, i.e. circuits with memory. Additionally in this part, the electrotechnical fundamentals of computing are taught. The construction and the manufacturing process of digital components is explained and the scope of the introduction to computer architecture is broadened to cover embedded systems as well.

**Reader's advisory**
- Lecture notes - Oberschelp, W., Vossen, G.: Rechneraufbau und Rechnerstrukturen; Oldenbourg Verlag

**Links**

**Language of instruction**
- German

**Duration (semesters)**
- 1 Semester

**Module frequency**
- jährlich

**Module capacity**
- unlimited

**Modullevel / module level**
- AC (Aufbaucurriculum / Composition)

**Modulart / typ of module**
- je nach Studiengang Pflicht oder Wahlpflicht

**Lehr-/Lernform / Teaching/Learning method**
- V+Ü

**Vorkenntnisse / Previous knowledge**

**Examination**

**Time of examination**

**Type of examination**

**Final exam of module**

At the end of the lecture period

**Written or oral Exam**

<table>
<thead>
<tr>
<th>Course type</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td>3</td>
<td>WiSe</td>
<td>42</td>
</tr>
<tr>
<td>Exercises</td>
<td></td>
<td>1</td>
<td>WiSe</td>
<td>14</td>
</tr>
<tr>
<td>Course type</td>
<td>Comment</td>
<td>SWS</td>
<td>Frequency</td>
<td>Workload of compulsory attendance</td>
</tr>
<tr>
<td>-------------</td>
<td>---------</td>
<td>-----</td>
<td>-----------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td></td>
<td><strong>Total time of attendance for the module</strong></td>
<td></td>
<td></td>
<td>56 h</td>
</tr>
</tbody>
</table>
inf202 - Computer Engineering Practical

<table>
<thead>
<tr>
<th>Module label</th>
<th>Computer Engineering Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module code</td>
<td>inf202</td>
</tr>
<tr>
<td>Credit points</td>
<td>6.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>180 h</td>
</tr>
</tbody>
</table>

Applicability of the module

- Bachelor's Programme Biology (Bachelor) > Fachnahe Angebote Informatik
- Bachelor's Programme Business Administration and Law (Bachelor) > Fachnahe Angebote Informatik
- Bachelor's Programme Business Informatics (Bachelor) > Fachnahe Angebote Informatik
- Bachelor's Programme Chemistry (Bachelor) > Fachnahe Angebote Informatik
- Bachelor's Programme Comparative and European Law (Bachelor) > Fachnahe Angebote Informatik
- Bachelor's Programme Computing Science (Bachelor) > Fachnahe Angebote Informatik
- Bachelor's Programme Economics and Business Administration (Bachelor) > Fachnahe Angebote Informatik
- Bachelor's Programme Engineering Physics (Bachelor) > Fachnahe Angebote Informatik
- Bachelor's Programme Environmental Science (Bachelor) > Fachnahe Angebote Informatik
- Bachelor's Programme Intercultural Education and Counseling (Bachelor) > Fachnahe Angebote Informatik
- Bachelor's Programme Mathematics (Bachelor) > Fachnahe Angebote Informatik
- Bachelor's Programme Physics (Bachelor) > Fachnahe Angebote Informatik
- Bachelor's Programme Physics, Engineering and Medicine (Bachelor) > Fachnahe Angebote Informatik
- Bachelor's Programme Programme Social Studies (Bachelor) > Fachnahe Angebote Informatik
- Bachelor's Programme Sustainability Economics (Bachelor) > Fachnahe Angebote Informatik
- Dual-Subject Bachelor's Programme Art and Media (Bachelor) > Fachnahe Angebote Informatik
- Dual-Subject Bachelor's Programme Biology (Bachelor) > Fachnahe Angebote Informatik
- Dual-Subject Bachelor's Programme Chemistry (Bachelor) > Fachnahe Angebote Informatik
- Dual-Subject Bachelor's Programme Computing Science (Bachelor) > Fachnahe Angebote Informatik
- Dual-Subject Bachelor's Programme Computing Science (Bachelor) > Praktische Vertiefung (60 KP)
- Dual-Subject Bachelor's Programme Dutch Linguistics and Literary Studies (Bachelor) > Fachnahe Angebote Informatik
- Dual-Subject Bachelor's Programme Economic Education (Bachelor) > Fachnahe Angebote Informatik
- Dual-Subject Bachelor's Programme Economics and Business Administration (Bachelor) > Fachnahe Angebote Informatik
- Dual-Subject Bachelor's Programme Education (Bachelor) > Fachnahe Angebote Informatik
- Dual-Subject Bachelor's Programme Elementary Mathematics (Bachelor) > Fachnahe Angebote Informatik
- Dual-Subject Bachelor's Programme English Studies (Bachelor) > Fachnahe Angebote Informatik
- Dual-Subject Bachelor's Programme Gender Studies (Bachelor) > Fachnahe Angebote Informatik
- Dual-Subject Bachelor's Programme General Education (Bachelor) > Fachnahe Angebote Informatik
- Dual-Subject Bachelor's Programme German Studies (Bachelor) > Fachnahe Angebote Informatik
- Dual-Subject Bachelor's Programme History (Bachelor) > Fachnahe Angebote Informatik
- Dual-Subject Bachelor's Programme Material Culture: Textiles (Bachelor) > Fachnahe Angebote Informatik
- Dual-Subject Bachelor's Programme Mathematics (Bachelor) > Fachnahe Angebote Informatik
- Dual-Subject Bachelor's Programme Music (Bachelor) > Fachnahe Angebote Informatik
- Dual-Subject Bachelor's Programme Philosophy / Values and Norms (Bachelor) > Fachnahe Angebote Informatik
- Dual-Subject Bachelor's Programme Politics-Economics (Bachelor) > Fachnahe Angebote Informatik
- Dual-Subject Bachelor's Programme Protestant Theology and Religious Education (Bachelor) > Fachnahe Angebote Informatik
- Dual-Subject Bachelor's Programme Slavic Studies (Bachelor) > Fachnahe Angebote Informatik
- Dual-Subject Bachelor's Programme Social Studies (Bachelor) > Fachnahe Angebote Informatik
- Dual-Subject Bachelor's Programme Special Needs Education (Bachelor) > Fachnahe Angebote Informatik
- Dual-Subject Bachelor's Programme Sport Science (Bachelor) > Fachnahe Angebote Informatik
- Dual-Subject Bachelor's Programme Technology (Bachelor) > Fachnahe Angebote Informatik
- Fach-Bachelor Pädagogisches Handeln in der Migrationsgesellschaft (Bachelor) > Fachnahe Angebote Informatik
- Master of Education Programme (Vocational and Business Education) Computing Science (Master of Education) > Wahlpflichtmodule (Technische Informatik)
- Master of Education Programme (Vocational and Business Education) Computing Science (Master of Education) > Praktische Vertiefung der Informatik

Responsible persons

Mikschl, Alfred (Module responsibility)
Lehrenden, Die im Modul (Authorized examiners)

Prerequisites

Empfehlung: inf200 „Grundlagen der Technischen Informatik“
Skills to be acquired in this module

Diese Veranstaltung versetzt die Studierenden in die Lage, informationstechnische Systeme zu analysieren, einzelne Komponenten von Rechnern zu verstehen, sie zu entwerfen und zu optimieren sowie qualifiziert über domänspezifischen Hardwareentwurf zu diskutieren.

Fachkompetenz:
Die Studierenden

- beschreiben einzelne Komponenten von Rechnern
- entwerfen und optimieren einzelne Komponenten von Rechnern
- entwerfen und optimieren Automaten
- spezifizieren und implementieren autonome Systeme

Methodenkompetenz
Die Studierenden

- synthetisieren Rechnerarchitekturen
- können Methoden des Hardwareentwurfs auf verschiedene Systeme transferieren

Sozialkompetenz
Die Studierenden

- diskutieren qualifiziert über Hardware

Selbstkompetenz
Die Studierenden

- sind dazu in der Lage, ihren Kenntnisstand klar gegen Fachkräfte verwandter Disziplinen abzugrenzen

Module contents
Dieses Modul ist der praktische Teil der Veranstaltung Einführung in die Technische Informatik

Reader's advisory
Skript zur Veranstaltung, Patterson, D.A., Hennesy, J.L.: Computer Organisation and Design: The Hardware/Software Interface

Links

Language of instruction
German

Duration (semesters)
1 Semester

Module frequency
Jedes Sommersemester

Module capacity
unlimited

Module level / module level
AC (Aufbaucurriculum / Composition)

Modulart / typ of module
Wahlpflicht / Elective

Lehr-/Lernform / Teaching/Learning method
P

Vorkenntnisse / Previous knowledge

Examination
Time of examination
Type of examination
Final exam of module
Am Ende der Vorlesungszeit
PK

Course type
Practical training

SWS
4

Frequency
SuSe

Workload attendance
56 h
## inf203 - Embedded Systems I

<table>
<thead>
<tr>
<th>Module label</th>
<th>Embedded Systems I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module code</td>
<td>inf203</td>
</tr>
<tr>
<td>Credit points</td>
<td>6.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>180 h</td>
</tr>
</tbody>
</table>

**Applicability of the module**
- 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)

**Prerequisites**

**Responsible persons**
- Nebel, Wolfgang (Module responsibility)
- Fränzle, Martin Georg (Module responsibility)
- Lehrenden, Die im Modul (Authorized examiners)

**Skills to be acquired in this module**

**Professional competence**
The students:
- name functional and non-functional requirements to specify embedded systems
- discuss design space and associated embedded systems design methods
- name control and feedback control systems’ core concepts
- characterise the fundamental digital signal processing algorithms

**Methodological competence**
The students:
- design and develop embedded feedback control systems with modelling tools
- implement an embedded hardware-/software system according to a given specification
- analyze various specification languages according to different properties

**Social competence**
The students:
- implement solutions to given problems in teams
- present results of computer science problems to groups
- organize themselves as a team to solve a larger problem using project management methods

**Self-competence**
The students:
- acknowledge the limits of their ability to cope with pressure during the implementation process of systems
- solve excercises self-responsibly

**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 overview of embedded systems and their design. The process of digital signals is especially important for telecommunications and multimedia. For this purpose, the module introduces digital signal processing algorithms. The principles of feedback control are introduced by exemplary transport applications. Subsequently, the module provides the specifications and language characteristics of the embedded system design. For this purpose, graphical data-flow modelling languages (for instance Simulink) and control-flow specifications (for instance State Charts) are presented. The module closes with the concepts of possible architectures and communication models.

Hands-on exercises with the tools Matlab/Simulink/StateFlow support the module contents.

**Reader's advisory**

Slides and:
Secondary literature:

- Artikelserie zum MPEG-2-Standard 3/94 - 10/94 und das Tutorial "Digitale Bildcodierung" 1/92 - 1/93, beides in "Fernseh- und Kinotechnik" (BIS: Zelt ZA 1536)

Links

Language of instruction

German

Duration (semesters)

1 Semester

Module frequency

jährlich

Module capacity

unlimited

Reference text

This module is compulsory for students who are specialising in "Eingebettete Systeme und Mikrorobotik".

Associates with the modules:

In the module "Eingebettete Systeme II" additional relevant topics such as design processes, HW/SW-Partitioning, High-Level-Synthesis and Hardware description languages are discussed. The modules Eingebettete Systeme I und II offer cross-references to the module "Rechnerarchitektur", "Realzeitbetriebssysteme" and semantic orientated modules of theoretical computer science. It is possible to enhance the knowledge of embedded systems design by attending the modules "System Level Design" and "Low energy System Design".

Module level / module level

AS (Akzentsetzung / Accentuation)

Moduleart / typ of module

je nach Studiengang Pflicht oder Wahlpflicht

Lehr-/Lernform / Teaching/Learning method

V+Ü

Vorkenntnisse / Previous knowledge

- Grundlagen der technischen Informatik
- Technische Informatik

Examination

Time of examination

At the end of the semester

Type of examination

Written or oral exam

Course type

Comment

SWS Frequency Workload of compulsory attendance

Lecture 3 WiSe 42
Exercises 1 WiSe 14

Total time of attendance for the module

56 h
inf204 - Embedded Systems II

<table>
<thead>
<tr>
<th>Module label</th>
<th>Embedded Systems II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module code</td>
<td>inf204</td>
</tr>
<tr>
<td>Credit points</td>
<td>6.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>180 h</td>
</tr>
</tbody>
</table>

**Applicability of the module**
- 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)

**Responsible persons**
- Nebel, Wolfgang (Module responsibility)
- Fränzle, Martin Georg (Module responsibility)
- Lehrenden, Die im Modul (Authorized examiners)

**Prerequisites**

**Skills to be acquired in this module**

**Professional competence:**
The students:

- name embedded systems architectures
- name specific hardware components and -architecture designs, particularly processor designs
- characterise the design spaces and associated embedded systems design techniques
- decompose subcomponents of feedback control systems and implement their tasks in different design spaces
- develop software-/hardware components
- describe fault-tolerance architecture principles
- describe real-time and safety requirements analysing techniques
- characterise hardware synthesis

**Methodological competence:**
The students:

- estimate the consequences of design decisions in terms of energy usage, performance and reliability
- component allocations, and designs
- implement an embedded hardware-/software system according to a given specification
- model hardware with a hardware description languages
- analyze Hardware-/Software systems using event-bases simulation

**Social competence:**
The students:

- implement solutions to given problems in teams
- present results of computer science problems to groups
- organize themselves as a team to solve a larger problem using project management methods

**Self-competence:**
The students:

- acknowledge the limits of their ability to cope with pressure during the implementation process of systems
- deal self responsibly with exercises

**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 is the continuation of the module “Eingebettete Systeme I” and deals with different architectures of embedded systems and processors. The module provides system partitioning methods and the synthesis of hardware components.
Hands-on exercises with development tools, hardware description languages and simulation support the module contents.

**Reader's advisory**

**Slides and:**


**Secondary literature:**


**Links**

<table>
<thead>
<tr>
<th>Language of instruction</th>
<th>German</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration (semesters)</td>
<td>1 Semester</td>
</tr>
<tr>
<td>Module frequency</td>
<td>jährlich</td>
</tr>
<tr>
<td>Module capacity</td>
<td>unlimited</td>
</tr>
<tr>
<td>Reference text</td>
<td>This module is supposed to be a compulsory module for students who are specialising in &quot;Eingebettete Systeme und Mikrorobotik&quot;.</td>
</tr>
<tr>
<td>Modullevel / module level</td>
<td>AS (Akzentsetzung / Accentuation)</td>
</tr>
<tr>
<td>Modulart / typ of module</td>
<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
</tr>
<tr>
<td>Lehr-/Lernform / Teaching/Learning method</td>
<td>V+Ü</td>
</tr>
</tbody>
</table>

**Vorkenntnisse / Previous knowledge**

**Course type**

<table>
<thead>
<tr>
<th>Examination</th>
<th>Time of examination</th>
<th>Type of examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final exam of module</td>
<td>At the end of the lecture times</td>
<td>Written or oral Exam</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course type</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td>3</td>
<td>SuSe</td>
<td>42</td>
</tr>
<tr>
<td>Exercises</td>
<td></td>
<td>1</td>
<td>SuSe</td>
<td>14</td>
</tr>
</tbody>
</table>

**Total time of attendance for the module**

56 h
inf205 - Formal Methods in Embedded System Design

**Module label**
Formal Methods in Embedded System Design

**Module code**
inf205

**Credit points**
6.0 KP

**Workload**
180 h

**Applicability of the module**
- 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)

**Responsible persons**
Fränzle, Martin Georg (Module responsibility)
Lehrenden, Die im Modul (Authorized examiners)

**Prerequisites**

**Skills to be acquired in this module**
Embedded computer systems sustain a permanent interaction with their environment. This interaction may lead to hardly predictable stimuli and response sequences, which complicates the design and validation of such systems tremendously. As in more mature engineering disciplines, formal analytical models have been proposed as a remedy. Their role in the design flow is equivalent to the use of structural analysis and material science within, e.g., building statics. Pertinent formal methods for and formal models of embedded systems cover, for instance, execution time, power demand, and possible system dynamics. As they represent relevant aspects of a system in a formal, mathematical way, they often permit automatic analysis - i.e., to derive characteristic data - and automatic certificate generation. The distinguishing factor to more traditional forms of analysis like testing and profiling is the exhaustive form of analysis achieved by mathematical methods, which guarantee that the results apply for any environmental interaction. This is in stark contrast to the inherently incomplete coverage provided by test-based methods. The lectures explain a series of increasingly more expressive formal models and the related automatic analysis techniques. The exercise classes complement these theoretical insights by hands-on experience with state of the art formal analysis tools and offer the possibility to build such tools oneself.

**Professional competence**
The students:
- Evaluate the consequences of certificates applied by formal methods
- Evaluate the suitability of available verification tools for a partial aspect and system class
- Use these tools and interpret their results and improve the examined system
- Prepare system models for automatic analysis methods and abstract or encode the systems symbolically (or otherwise) accordingly
- Design and implement verification algorithms

**Methodological competence**
The students:
- Are able to model complex and heterogeneous systems by adequate mathematical modelling techniques
- Know pertinent mathematical models for system dynamics and are able to transfer them to other problem domains.

**Social competence**
The students:
- Develop and implement fundamental verification algorithms in teams
- Discuss the relative merits of alternative algorithms and formalisms

**Self-competence**
The students:
- can assess their technical and methodological understanding
- reflect on their problem-solving competence with reference to the procedures and methods presented

**Module contents**
The module explains semantic models for reactive, real-time, and hybrid discrete-continuous systems and gives examples for pertinent specification logics. It gradually develops state-exploratory verification algorithms, both of explicit-state and symbolic shape, as relevant to the development of reliable hardware and software systems. The lectures present the semantic, logical, and algorithmic foundations of the automatic analysis for embedded software systems. The exercise classes complement this by providing space for experimenting with formalisms and tools in teams. The second half of the semester is dedicated to the semester project, which either deals with implementing an automatic verifier or with in-depth usage of existing tools on examples of industrially relevant size

**Reader's advisory**

**Links**

**Language of instruction**
German

**Duration (semesters)**
1 Semester

**Module frequency**
jährlich

**Module capacity**
unlimited

**Module level / module level**
AS (Akzentsetzung / Accentuation)

**Modulart / typ of module**
je nach Studiengang Pflicht oder Wahlpflicht
**Lehr-/Lernform / Teaching/Learning method**

V+Ü

**Vorkenntnisse / Previous knowledge**


<table>
<thead>
<tr>
<th>Examination</th>
<th>Time of examination</th>
<th>Type of examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final exam of module</td>
<td>at the end of the semester</td>
<td>Semester project</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course type</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td>3</td>
<td>WiSe</td>
<td>42</td>
</tr>
<tr>
<td>Exercises</td>
<td></td>
<td>1</td>
<td>WiSe</td>
<td>14</td>
</tr>
</tbody>
</table>

**Total time of attendance for the module**

56 h
## Module Label
**inf207 - Electrical Engineering**

<table>
<thead>
<tr>
<th>Module Code</th>
<th>inf207</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit Points</td>
<td>6.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>180 h</td>
</tr>
</tbody>
</table>

### Applicability of the Module
- 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) > Nicht Informatik

### Responsible Persons
- Hein, Andreas (Module responsibility)
- Lehrenden, Die im Modul (Authorized examiners)

### Prerequisites

### Skills to be acquired in this module

#### Professional competence:
The students:
- Analyse linear electrical networks (direct current and alternating current)
- Name basic concepts to calculate and to use electrical and magnetic fields
- List the characteristics of simple electrical elements (two terminal networks)
- Calculate the parameters of simple electrical networks/wirings
- Apply computer based analysing tools
- Design and implement simple networks/wirings

#### Methodological competence:
The students:
- Transfer calculation methods onto complex dynamic systems
- Implement electrical system models

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

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

### Module contents

#### Basic concepts (electric dimensions and units)
- Network elements
- Calculation of linear direct current networks (Ohms law, Kirchhoff's circuit law, superposition principle)
- Characteristics, calculations and representations of electric and magnetic fields
- Construction elements (capacitor and coil)
- Extensions of periodical dimensions dependent on time, pointer representation, calculations with complex root-mean-square value pointers

### Reader's advisory

#### Essential:
- Slides

#### Recommended:
<table>
<thead>
<tr>
<th>Links</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Language of instruction</td>
<td>German</td>
</tr>
<tr>
<td>Duration (semesters)</td>
<td>1 Semester</td>
</tr>
<tr>
<td>Module frequency</td>
<td>jährlich</td>
</tr>
<tr>
<td>Module capacity</td>
<td>unlimited</td>
</tr>
<tr>
<td>Modullevel / module level</td>
<td>AS (Akzentsetzung / Accentuation)</td>
</tr>
<tr>
<td>Modulart / typ of module</td>
<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
</tr>
<tr>
<td>Lehr-/Lernform / Teaching/Learning method</td>
<td>V+Ü</td>
</tr>
<tr>
<td>Vorkenntnisse / Previous knowledge</td>
<td>Modul Analysis II oder Numerik</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examination</th>
<th>Time of examination</th>
<th>Type of examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final exam of module</td>
<td>At the End of the Semester</td>
<td>Hands-on exercises / written exam or oral exam</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course type</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td>3</td>
<td>SuSe</td>
<td>42</td>
</tr>
<tr>
<td>Exercises</td>
<td></td>
<td>1</td>
<td>SuSe</td>
<td>14</td>
</tr>
</tbody>
</table>

**Total time of attendance for the module** 56 h
inf208 - Microrobotics and Microsystems Technology

Module label: Microrobotics and Microsystems Technology
Module code: inf208
Credit points: 6.0 KP
Workload: 180 h

Applicability of the module:
- 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) > Nicht Informatik

Responsible persons:
Fatikow, Sergej (Module responsibility)
Lehrenden, Die im Modul (Authorized examiners)

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, electro rheological and other actuators); microsensors: principles and examples (force and pressure, position and speed, acceleration, biological and chemical, temperature and other sensors); MST and information processing; microsystem design and simulation; classification of microrobots; coarse positioning of a microrobot; fine positioning of a microrobot; handling of microparts: problems and solutions; micro grasp techniques; microassembly; process automation by microrobots; desktop robot cell in SEM

Reader's advisory:
Essential:
Lecture notes

Recommended:


Secondary Literature (only available for some subareas!):

- Elbel, Th.: Mikrosensorik, Vieweg, Wiesbaden, 1996
- Völklein, F. und Zetterer, Th.: Einführung in die Mikrosystemtechnik, Vieweg, Wiesbaden, 2000

Links

Language of instruction  German
Duration (semesters)  1 Semester
Module frequency  jährlich
Module capacity  unlimited
Reference text  Associated with the modules:
  Embedded Systems and Microrobotics
Modullevel / module level  AS (Akzentsetzung / Accentuation)
Modulart / typ of module  je nach Studiengang Pflicht oder Wahlpflicht
Lehr-/Lernform / Teaching/Learning method  V+Ü
Vorkenntnisse / Previous knowledge  Analysis II oder Numerik
Examination  Time of examination  Type of examination
Final exam of module  At the end of the semester  Oral exam in German
Course type  Comment  SWS  Frequency  Workload of compulsory attendance
Lecture  3  WiSe  42
Exercises  1  WiSe  14
Total time of attendance for the module  56 h
inf209 - Control Theory

<table>
<thead>
<tr>
<th>Module label</th>
<th>Control Theory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module code</td>
<td>inf209</td>
</tr>
<tr>
<td>Credit points</td>
<td>6.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>180 h</td>
</tr>
</tbody>
</table>

**Applicability of the module**
- 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) > Nicht Informatik

**Responsible persons**
- Fatikow, Sergej (Module responsibility)
- Hein, Andreas (Module responsibility)
- Lehrenden, Die im Modul (Authorized examiners)

**Prerequisites**
- Module Differential Equations
- Module Basics Electrical Engineering

**Skills to be acquired in this module**

**Professional competence**
The students:
- Describe the core principles of steering and control of technical systems
- Discuss the modelling core concepts of systems and their controllers
- Name methods to determine the quality of controlled systems
- Model technical systems with differential equations and their transfer functions
- Develop control structures, evaluate their stability and determine their optimal control parameters

**Methodological competence**
The students:
- Are aware of the technical challenges and solve them by including the implementations of other disciplines and methods

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

**Self-competence**
The students:
- Get used to the specific challenges of the development of controlled systems

**Module contents**
Basics; analog transfer elements: linear time invariant (LTI-) systems; simulation and modeling; step response; frequency response; frequency response locus; differential equations and transfer function; control loop stability; types of controlled systems; types of linear controllers; linear control loops: reference and disturbance reaction of the controlled system; rules for control loop optimization; methods of analysis and synthesis, implementation; computer based control MATLAB/Simulink

**Reader's advisory**
- Unbehauen, H.:Regelungstechnik I, Klassische Verfahren zur Analyse und Synthese linearer kontinuierlicher Regentsysteme
- Lutz, H. und Wendt, W.:Taschenbuch der Regelungstechnik
- further reading will be announced at lecture

**Links**
<table>
<thead>
<tr>
<th>Language of instruction</th>
<th>German</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration (semesters)</td>
<td>1 Semester</td>
</tr>
<tr>
<td>Module frequency</td>
<td>jährlich</td>
</tr>
<tr>
<td>Module capacity</td>
<td>unlimited</td>
</tr>
<tr>
<td>Module level / module level</td>
<td>AS (Akzentsetzung / Accentuation)</td>
</tr>
<tr>
<td>Module type / type of module</td>
<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
</tr>
<tr>
<td>Lehr-/Lernform / Teaching/Learning method</td>
<td>V+Ü</td>
</tr>
<tr>
<td>Vorkenntnisse / Previous knowledge</td>
<td>- Differenzialgleichungen</td>
</tr>
<tr>
<td></td>
<td>- Analysis II</td>
</tr>
<tr>
<td></td>
<td>- Grundlagen der Elektrotechnik</td>
</tr>
<tr>
<td>Examination</td>
<td></td>
</tr>
<tr>
<td>Time of examination</td>
<td></td>
</tr>
<tr>
<td>Type of examination</td>
<td></td>
</tr>
<tr>
<td>Final exam of module</td>
<td>At the end of the lecture period</td>
</tr>
<tr>
<td></td>
<td>Hands-on exercises and written or oral exam</td>
</tr>
<tr>
<td>Course type</td>
<td>Comment</td>
</tr>
<tr>
<td></td>
<td>SWS</td>
</tr>
<tr>
<td></td>
<td>Frequency</td>
</tr>
<tr>
<td></td>
<td>Workload of compulsory attendance</td>
</tr>
<tr>
<td>Lecture</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>WiSe</td>
</tr>
<tr>
<td></td>
<td>42</td>
</tr>
<tr>
<td>Exercises</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>WiSe</td>
</tr>
<tr>
<td></td>
<td>14</td>
</tr>
<tr>
<td>Total time of attendance for the module</td>
<td>56 h</td>
</tr>
</tbody>
</table>
inf210 - Signal and Image Processing

Module label: Signal and Image Processing
Module code: inf210
Credit points: 6.0 KP
Workload: 180 h

Applicability of the module
- 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) > Nicht Informatik

Responsible persons
- Hein, Andreas (Module responsibility)
- Fränzle, Martin Georg (Module responsibility)
- Lehrende, Die im Modul (Authorized examiners)

Prerequisites

Skills to be acquired in this module

Professional competence
The students:
- Name the concepts of signal and image processing in technical systems
- Name the methods/algorithms of preprocessing, filtering, classification, interpretation and visualisation of signals and pictures
- Select algorithms appropriately
- Evaluate the effectiveness of algorithms
- Design algorithms and processing chains and evaluate their quality

Methodological competence
The students:
- Get used to specific subjects of signal and image processing

Social competence
The students:
- Present solutions for specific questions in signal and image processing

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

Module contents
- Basic Concepts
- Signal Processing
- Signal Spaces and Signal Processing Systems
- Discrete and Constant Signals
- Labelling of Signal Transmitters with Test Signals
- Representations Areas and Transformations
- Time-Discrete Systems and Scanning
- Estimation and Filtering
- Construction with MATLAB
- Image Processing
- Introduction/Range of Applications
- Functional Transformation
- Image Enhancement/Filtering
- Segmentation
- 3D Reconstruction an Visualization

Reader's advisory
essential:
Slides
**recommended:**
- Meyer, M.; Signalverarbeitung: Analoge und digitale Signale, Systeme und Filter
- Grüningen, D. C. v.; Digitale Signalverarbeitung: mit einer Einführung in die kontinuierlichen Signale und Systeme
- Tönnies, K.; Grundlagen der Bildverarbeitung; Pearson Studium 2005
- Lehmann, Th.; Oberschelp, W.; Pelinak, E.; Pepges, R.; Bildverarbeitung in der Medizin; Springer Verlag 1997
- Handels, H.; Medizinische Bildverarbeitung; Teubner Verlag, Stuttgart - Leipzig 2000

<table>
<thead>
<tr>
<th>Links</th>
<th>Language of instruction</th>
<th>German</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration (semesters)</td>
<td>1 Semester</td>
<td></td>
</tr>
<tr>
<td>Module frequency</td>
<td>jährlich</td>
<td></td>
</tr>
<tr>
<td>Module capacity</td>
<td>unlimited</td>
<td></td>
</tr>
<tr>
<td>Modullevel/module level</td>
<td>AS (Akzentsetzung / Accentuation)</td>
<td></td>
</tr>
<tr>
<td>Modular type/module type</td>
<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
<td></td>
</tr>
<tr>
<td>Lehr-/Lernform / Teaching/Learning method</td>
<td>V+Ü</td>
<td></td>
</tr>
<tr>
<td>Vorkenntnisse / Previous knowledge</td>
<td>Modul math040 Analysis II b: Differentialrechnung mehrerer Variablen</td>
<td></td>
</tr>
<tr>
<td>Examination</td>
<td>Time of examination</td>
<td></td>
</tr>
<tr>
<td>Final exam of module</td>
<td>At the end of the semester</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hands-on exercises and written or oral exam</td>
<td></td>
</tr>
<tr>
<td>Course type</td>
<td>Comment</td>
<td>SWS</td>
</tr>
<tr>
<td>Lecture</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Exercises</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Frequency</td>
<td>WiSe</td>
</tr>
<tr>
<td>Total time of attendance for the module</td>
<td></td>
<td>56 h</td>
</tr>
<tr>
<td></td>
<td>Workload of compulsory attendance</td>
<td></td>
</tr>
</tbody>
</table>
Wahlpflichtmodule (Theoretische Informatik)

inf402 - Graph Transformation Systems

<table>
<thead>
<tr>
<th>Module label</th>
<th>Graph Transformation Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module code</td>
<td>inf402</td>
</tr>
<tr>
<td>Credit points</td>
<td>6.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>180 h</td>
</tr>
</tbody>
</table>

**Applicability of the module**

- Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsbereich - Wahlbereich Informatik
- Dual-Subject Bachelor's Programme Computing Science (Bachelor) > Wahlpflicht Theoretische Informatik (30 KP)
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Theoretische Informatik)

**Responsible persons**

Lehrenden, Die im Modul (Authorized examiners)

Lehrenden, Die im Modul (Module responsibility)

**Prerequisites**

Modelling of systems, introduction to graph transformation systems, sequential and parallel independence, termination and confluence.

**Skills to be acquired in this module**

- Know the basics of graph transformation systems and graph programs
- Describe graph transformation systems and graph programs
- Define the Turing completeness of graph programs
- Model systems and system changes
- Prove sequential and parallel independence of derivations
- Prove termination and confluence of graph transformation systems

**Professional competence**

The students:

- Recognize graph transformation systems as a versatile tool for modelling in computer science

**Methodological competence**

The students:

- Work together in small groups to solve problems
- Present solutions to problems to groups of other students

**Social competence**

The students:

- Learn persistence in pursuing difficult tasks
- Learn precision in writing down solutions

**Module contents**

Graphs are practically used in all areas of computer science to display complex structures. Some examples are flow charts, circuit diagrams, record structures, parse trees and functional and logical expressions. Such structures can be dynamically changed by graph rewriting systems. The changing process is represented by rewriting rules. This module gives an introduction to the field of graph transformation systems. It deals with reversibility, embedding and restriction of derivations, sequential and parallel independency, termination and confluence.

**Reader's advisory**


**Links**

- Language of instruction: German
- Duration (semesters): 1 Semester
<table>
<thead>
<tr>
<th><strong>Module frequency</strong></th>
<th>im 2-Jahres-Zyklus</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module capacity</strong></td>
<td>unlimited</td>
</tr>
<tr>
<td><strong>Modullevel / module level</strong></td>
<td>AS (Akzentsetzung / Accentuation)</td>
</tr>
<tr>
<td><strong>Modulart / typ of module</strong></td>
<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
</tr>
<tr>
<td><strong>Lehr-/Lernform / Teaching/Learning method</strong></td>
<td>V+Ü</td>
</tr>
<tr>
<td><strong>Vorkenntnisse / Previous knowledge</strong></td>
<td>inf401: Theoretische Informatik II</td>
</tr>
<tr>
<td><strong>Examination</strong></td>
<td>Time of examination</td>
</tr>
<tr>
<td><strong>Final exam of module</strong></td>
<td>At the end of the lecture period</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Course type</strong></th>
<th><strong>Comment</strong></th>
<th><strong>SWS</strong></th>
<th><strong>Frequency</strong></th>
<th><strong>Workload of compulsory attendance</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td>3</td>
<td>SuSe or WiSe</td>
<td>42</td>
</tr>
<tr>
<td>Exercises</td>
<td></td>
<td>1</td>
<td>SuSe or WiSe</td>
<td>14</td>
</tr>
</tbody>
</table>

**Total time of attendance for the module**: 56 h
## inf403 - Cryptology

<table>
<thead>
<tr>
<th>Module label</th>
<th>Cryptology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module code</td>
<td>inf403</td>
</tr>
<tr>
<td>Credit points</td>
<td>6.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>180 h</td>
</tr>
</tbody>
</table>

### Applicability of the module
- Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsbereich - Wahlbereich Informatik
- Dual-Subject Bachelor's Programme Computing Science (Bachelor) > Wahlpflicht Theoretische Informatik (30 KP)
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Theoretische Informatik)

### Responsible persons
Lehrenden, Die im Modul (Module responsibility)
Lehrenden, Die im Modul (Authorized examiners)

### Prerequisites

### Skills to be acquired in this module
Cryptology is a key technology for the security of worldwide computer nets. Modern cryptographic techniques are used to keep data secret, sign electronic messages, control computer network access, secure electronic financial transactions, protect copyrights, among others. In view of these applications users should be able to assess the efficiency and security of these key technologies. For this purpose, it is important not only to know the function of cryptographic processes, it is also important to understand their mathematical basics. Both is explained in this module.

**Professional competence**
The students:
- identify basic concepts of cryptography and explain them by examples
- know relevant cryptosystems, apply them and assess their security
- are familiar in using mathematical basics of cryptographic algorithms
- implement cryptographic algorithms and prove their correctness and estimations of their complexity

**Methodological competence**
The students:
- assess the efficiency and security of cryptographic processes
- extend their knowledge about algorithms and their complexity
- develop their implementation skills in particular the handling of very large numbers
- analyze simple encryption using well-known and own techniques

**Social competence**
The students
- use the language of mathematics to discuss in groups with different knowledge about problems
- present their ideas in an understandable way
- expand and improve their own ideas through the proposals of their fellow students

**Self-competence**
The students:
- reflect their knowledge about security in IT systems
- reflect their knowledge about algorithms and their complexity
- experience the development of a new field of knowledge within a short amount of time
- discover new applications of mathematical contexts

### Module contents
- A) Mathematical Basics: Integers; Polynomials; Congruences; Residue Class Rings
- B) Encryption
- C) Probability and Perfect Security
- D) Symmetric Encryption (DES, AES)
- E) Generation of Prime Numbers
- F) Public-Key-Encryption
- G) Factorisation and Discrete Logarithms
- H) Cryptographic Hash Functions and Digital Signatures
- I) Identification and Certification

### Reader's advisory
Lecture notes; further literature will be announced in the lecture.
<table>
<thead>
<tr>
<th>Links</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Language of instruction</strong></td>
</tr>
<tr>
<td><strong>Duration (semesters)</strong></td>
</tr>
<tr>
<td><strong>Module frequency</strong></td>
</tr>
<tr>
<td><strong>Module capacity</strong></td>
</tr>
<tr>
<td><strong>Modullevel / module level</strong></td>
</tr>
<tr>
<td><strong>Modulart / typ of module</strong></td>
</tr>
<tr>
<td><strong>Lehr-/Lernform / Teaching/Learning method</strong></td>
</tr>
<tr>
<td><strong>Vorkenntnisse / Previous knowledge</strong></td>
</tr>
<tr>
<td><strong>Examination</strong></td>
</tr>
<tr>
<td><strong>Final exam of module</strong></td>
</tr>
<tr>
<td><strong>Course type</strong></td>
</tr>
<tr>
<td>Lecture</td>
</tr>
<tr>
<td>Exercises</td>
</tr>
<tr>
<td><strong>Total time of attendance for the module</strong></td>
</tr>
</tbody>
</table>
inf404 - Petri Nets

Module label
Petri Nets

Module code
inf404

Credit points
6.0 KP

Workload
180 h

Applicability of the module
- Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsbereich - Wahlbereich Informatik
- Dual-Subject Bachelor's Programme Computing Science (Bachelor) > Wahlpflicht Theoretische Informatik (30 KP)
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Theoretische Informatik)

Responsible persons
Lehrende, Die im Modul (Authorized examiners)
Lehrende, Die im Modul (Module responsibility)

Prerequisites

Skills to be acquired in this module
The behaviour of modern, highly parallel, digital systems may be extremely complex. Graphical and algorithmic support may be very valuable in facilitating their design, construction, and analysis. Petri nets are a basic, widely used graphical model for the specification of parallel systems. They also provide and support a range of flexible algorithmic methods for the analysis of such systems. This module teaches the basic theory and applications of Petri nets, for the purpose of specifying and visualising, as well as for constructing and analysing highly parallel systems.

Professional competence
The students:
- define basic concepts of Petri nets
- classify Petri nets according to their salient properties
- analyse and synthesise Petri nets
- apply Petri nets in the context of well-defined problems

Methodological competence
The students:
- can apply specification and analysis methods based on Petri nets

Social competence
The students:
- present solutions to given problems to a wider audience

Module contents
- Basic concepts of Petri net theory.
- Petri net languages.
- Reachability and coverability.
- Marking equation.
- Linear-algebraic and graph-theoretic structure of Petri nets.
- Free-choice nets.
- Program verification using traps.
- Computing functions with nets.
- Unfoldings.
- High-level nets.

Reader's advisory

Links
Languages of instruction
German, English

Duration (semesters)
1 Semester
<table>
<thead>
<tr>
<th><strong>Module frequency</strong></th>
<th>jährlich</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module capacity</strong></td>
<td>unlimited</td>
</tr>
<tr>
<td><strong>Modullevel / module level</strong></td>
<td>AS (Akzentsetzung / Accentuation)</td>
</tr>
<tr>
<td><strong>Modulart / typ of module</strong></td>
<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
</tr>
<tr>
<td><strong>Lehr-/Lernform / Teaching/Learning method</strong></td>
<td>V+Ü</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Vorkenntnisse / Previous knowledge</strong></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th><strong>Final exam of module</strong></th>
<th>Time of examination</th>
<th>Type of examination</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>At the end of the lecture period</td>
<td>Written or oral exam</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Course type</strong></th>
<th><strong>Comment</strong></th>
<th><strong>SWS</strong></th>
<th><strong>Frequency</strong></th>
<th><strong>Workload of compulsory attendance</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td>2</td>
<td>WiSe</td>
<td>28</td>
</tr>
<tr>
<td>Exercises</td>
<td></td>
<td>2</td>
<td>WiSe</td>
<td>28</td>
</tr>
</tbody>
</table>

**Total time of attendance for the module**: 56 h
Inf405 - Algorithmic Graph Theory

Module label: Algorithmic Graph Theory
Module code: inf405
Credit points: 6.0 KP
Workload: 180 h

Applicability of the module:
- Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsbereich - Wahlbereich Informatik
- Dual-Subject Bachelor's Programme Computing Science (Bachelor) > Wahlpflicht Theoretische Informatik (30 KP)
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Theoretische Informatik)

Responsible persons:
Lehrende, Die im Modul (Authorized examiners)
Lehrende, Die im Modul (Module responsibility)

Prerequisites:

Skills to be acquired in this module:
Graphs are the most frequently used abstraction in computer science. Every system which consists of discrete states or objects and relations between these can be modelled as a graph. Most applications require efficient algorithms to process such graphs (Turau, 1996). This module provides typical graph theory problems and algorithmic solutions. They are discussed with regard to their efficiency and applicability and many of the algorithms will be implemented. An important aspect of this module is to consider different approaches to problems and learn different solution strategies.

Professional competence:
The students:
- identify basic terms of graph theory and optimization and illustrate them with examples
- name typical graph theory problems and algorithmic solutions
- identify situations where graph algorithms can be applied
- discuss typical graph theory problems and algorithmic solutions with regard to their efficiency and applicability.
- implement graph algorithms
- know proof strategies and are able to apply them

Methodological competence:
The students:
- extend their knowledge about algorithms and their complexity
- develop their programming skills
- expand their range of methods of mathematical modelling

Social competence:
The students:
- use the language of mathematics to discuss problems in groups with different knowledge levels
- present their ideas in a comprehensible way
- Expand and improve their own ideas through the comments of their fellow students

Self-competence:
The students:
- reflect their knowledge about algorithms and their complexity
- develop appropriate solutions for given problems
- challenge methods of resolution

Module contents:
A) Trees
B) Search Algorithms
C) Graph Coloring
D) Flows in Networks
E) Applications of Network Algorithms
F) Shortest Paths
G) Approximation Algorithms

Reader's advisory:
A detailed bibliography is contained in the lecture notes of this module.
## Links

<table>
<thead>
<tr>
<th>Language of instruction</th>
<th>German</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration (semesters)</td>
<td>1 Semester</td>
</tr>
<tr>
<td>Module frequency</td>
<td>jährlich</td>
</tr>
<tr>
<td>Module capacity</td>
<td>unlimited</td>
</tr>
<tr>
<td>Modullevel / module level</td>
<td>AS (Akzentsetzung / Accentuation)</td>
</tr>
<tr>
<td>Modulart / typ of module</td>
<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
</tr>
<tr>
<td>Lehr-/Lernform / Teaching/Learning method</td>
<td>V+Ü</td>
</tr>
<tr>
<td>Vorkenntnisse / Previous knowledge</td>
<td>Grundveranstaltungen Mathematik und Informatik</td>
</tr>
</tbody>
</table>

### Examination

<table>
<thead>
<tr>
<th>Final exam of module</th>
<th>Time of examination</th>
<th>Type of examination</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>At the end of the lecture period</td>
<td>Written exam</td>
</tr>
</tbody>
</table>

### Course type

<table>
<thead>
<tr>
<th>Course type</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td>3</td>
<td>SuSe</td>
<td>42</td>
</tr>
<tr>
<td>Exercises</td>
<td></td>
<td>1</td>
<td>SuSe</td>
<td>14</td>
</tr>
</tbody>
</table>

### Total time of attendance for the module

56 h
# Program Verification

## Module label
Program Verification

## Module code
inf407

## Credit points
6.0 KP

## Workload
180 h

## Applicability of the module
- Bachelor’s Programme Computing Science (Bachelor) > Akzentsetzungsbereich - Wahlbereich Informatik
- Dual-Subject Bachelor’s Programme Computing Science (Bachelor) > Wahlpflicht Theoretische Informatik (30 KP)
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Theoretische Informatik)

## Responsible persons
Olderog, Ernst-Rüdiger (Module responsibility)
Lehrenden, Die im Modul (Authorized examiners)

## Prerequisites

## Skills to be acquired in this module
Introduction to methods for proving the correctness of sequential, parallel, and distributed programs.

### Professional competence
The students:

- Describe operational semantics of sequential, parallel, and distributed programs
- Know the concepts of partial and total correctness of programs
- Establish soundness and completeness of proof systems
- Construct input-output specifications of programs
- Conduct correctness proofs for programs of different classes with the help of proof rules
- Check interference and deadlock freedom of parallel programs
- Transform parallel and distributed programs into nondeterministic programs

### Methodological competence
The students:

- Recognize correctness as an important aspect of programs and informatics 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
Program verification is a systematic approach to show the absence of errors in programs. For this purpose desirable behavioural properties of a given program are proven. For instance, a sorting program should only deliver sorted arrays.

Partial correctness, termination, and the absence of runtime errors are essential for sequential programs. Additional behavioural properties are of interest for parallel programs: absence of interference, absence of deadlocks, and fair behaviour.

The module focuses on the verification of parallel programs. For this purpose classic methods of Hoare’s logic are combined with more recent techniques of program transformation. Sequential programs are covered in preparation for this.

## Reader’s advisory
**essential:**

**Or the extended English version:**
<table>
<thead>
<tr>
<th>Links</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Language of instruction</strong></td>
<td>German</td>
</tr>
<tr>
<td><strong>Duration (semesters)</strong></td>
<td>1 Semester</td>
</tr>
<tr>
<td><strong>Module frequency</strong></td>
<td>unregelmäßig</td>
</tr>
<tr>
<td><strong>Module capacity</strong></td>
<td>unlimited</td>
</tr>
<tr>
<td><strong>Modul level / module level</strong></td>
<td>AS (Akzentsetzung / Accentuation)</td>
</tr>
<tr>
<td><strong>Modulart / typ of module</strong></td>
<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
</tr>
<tr>
<td><strong>Lehr-/Lernform / Teaching/Learning method</strong></td>
<td>V+Ü</td>
</tr>
<tr>
<td><strong>Vorkenntnisse / Previous knowledge</strong></td>
<td>Theoretische Informatik I und II</td>
</tr>
<tr>
<td><strong>Examination</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Time of examination</strong></td>
<td>At the end of the lecture period</td>
</tr>
<tr>
<td><strong>Type of examination</strong></td>
<td>Written exam or oral exam</td>
</tr>
<tr>
<td><strong>Course type</strong></td>
<td>Comment</td>
</tr>
<tr>
<td>Lecture</td>
<td></td>
</tr>
<tr>
<td>Exercises</td>
<td></td>
</tr>
<tr>
<td><strong>Total time of attendance for the module</strong></td>
<td></td>
</tr>
</tbody>
</table>
inf408 - Algorithms for Software Verification

<table>
<thead>
<tr>
<th>Module label</th>
<th>Algorithms for Software Verification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module code</td>
<td>inf408</td>
</tr>
<tr>
<td>Credit points</td>
<td>6.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>180 h</td>
</tr>
</tbody>
</table>

Applicability of the module
- Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsbereich - Wahlbereich Informatik
- Dual-Subject Bachelor's Programme Computing Science (Bachelor) > Wahlpflicht Theoretische Informatik (30 KP)
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Theoretische Informatik)

Responsible persons
- Olderog, Ernst-Rüdiger (Module responsibility)
- Lehrenden, Die im Modul (Authorized examiners)

Prerequisites

Skills to be acquired in this module

Professional competence
The students:
- conduct CTL model checking using examples
- construct abstract Kripke structures on the basis of given data abstractions and apply abstraction refinement to examples
- characterise the concepts of simulation and bisimulation
- understand the concept of data and transition abstraction
- describe model checking methods as instances of fixed-point algorithms

Methodological competence
The students:
- specify reactive systems by means of Kripke structures and CTL formulas
- implement model checking methods using Java

Social competence
The students:
- work in small groups

Self-competence
The students:
- reflect their actions and use newly learned methods

Module contents

Software systems consist of complex data and control structures and growing state spaces, which makes testing their correctness difficult. The big challenge for computer science is the development of automatic methods to analyse and to verify software systems' properties. In this course, algorithms for program analysis and model checking are presented and applied. The algorithms process transition systems generated from software and use abstraction techniques for data and transitions to make the state spaces analysable.

Topics:
- Kripke structures, transition systems, temporal logic CTL and CTL*, fixed-point algorithms for recursive CTL-operators, model checking algorithms for CTL, simulation and bisimulation of Kripke structures, theorems on the preservation of properties under (bi-) simulations, existential und universal abstraction of Kripke structures, counterexample-guided abstraction refinement (CEGAR method)

Reader's advisory
- E.M. Clarke, O. Grumberg, S. Jha, Y. Lu, and H. Veith, Counterexample-guided abstraction refinement

<table>
<thead>
<tr>
<th>Links</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Language of instruction</td>
<td>German</td>
</tr>
<tr>
<td>Duration (semesters)</td>
<td>1 Semester</td>
</tr>
<tr>
<td>Module frequency</td>
<td>unregelmäßig</td>
</tr>
<tr>
<td>Module capacity</td>
<td>unlimited</td>
</tr>
<tr>
<td>Module level / module level</td>
<td>AS (Akzentsetzung / Accentuation)</td>
</tr>
<tr>
<td>Modulart / typ of module</td>
<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
</tr>
<tr>
<td>Lehr-/Lernform / Teaching/Learning method</td>
<td>V+Ü</td>
</tr>
<tr>
<td>Vorkenntnisse / Previous knowledge</td>
<td>Grundveranstaltungen in Informatik und Mathematik</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examination</th>
<th>Time of examination</th>
<th>Type of examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final exam of module</td>
<td>First week of lecture-free period</td>
<td>Written exam or oral exam</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course type</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td>2</td>
<td>SuSe or WiSe</td>
<td>28</td>
</tr>
<tr>
<td>Exercises</td>
<td></td>
<td>2</td>
<td>SuSe or WiSe</td>
<td>28</td>
</tr>
</tbody>
</table>

Total time of attendance for the module 56 h
**inf409 - Formal Languages**

<table>
<thead>
<tr>
<th>Module label</th>
<th>Formal Languages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module code</td>
<td>inf409</td>
</tr>
<tr>
<td>Credit points</td>
<td>6.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>180 h</td>
</tr>
<tr>
<td>Applicability of the module</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bachelor's Programme Computing Science (Bachelor) &gt; Akzentsetzungsbereich - Wahlbereich Informatik</td>
</tr>
<tr>
<td></td>
<td>Dual-Subject Bachelor's Programme Computing Science (Bachelor) &gt; Wahlpflicht Theoretische Informatik (30 KP)</td>
</tr>
<tr>
<td></td>
<td>Master of Education Programme (Gymnasium) Computing Science (Master of Education) &gt; Wahlpflichtmodule (Theoretische Informatik)</td>
</tr>
</tbody>
</table>

**Responsible persons**

Lehrenden, Die im Modul (Authorized examiners)

Lehrenden, Die im Modul (Module responsibility)

**Prerequisites**

**Skills to be acquired in this module**

Introduction to syntactic analysis and compiler construction.

**Professional competence**

The students:

- Know the fundamentals of syntactic analysis and compiler construction
- Describe the complexity of fundamental syntactic analysis algorithms
- Construct no-left-recursive-grammars and grammars in normal form
- Test LL(k) and LR(k) characteristics of context-free grammars
- Construct LL(k)-Parsing and LR(k)-Parsing-Action and GOTO tables
- Apply basic syntax analysis algorithms

**Methodological competence**

The students:

- Perceive syntax analysis algorithms as a essential tool in computer science

**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 writing down solutions

**Module contents**

The course introduces the fundamentals of syntax analysis and considers backtrack parsing (Top-Down & Bottom-Up Backtracking), tabular parsing methods (Cocke-Younger-Kasami & Earley) und One- Pass No Backtrack Parsing (LL(k) und LR(k)).

**Reader's advisory**


**Links**

- Language of instruction: German
- Duration (semesters): 1 Semester
- Module frequency: im 2-Jahres-Zyklus
- Module capacity: unlimited
- Modullevel / module level: AS (Akzentsetzung / Accentuation)
<table>
<thead>
<tr>
<th>Modulart / typ of module</th>
<th>je nach Studiengang Pflicht oder Wahlpflicht</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lehr-/Lernform / Teaching/Learning method</td>
<td>V+Ü</td>
</tr>
<tr>
<td>Vorkenntnisse / Previous knowledge</td>
<td>Theoretische Informatik II</td>
</tr>
<tr>
<td>Examination</td>
<td>Time of examination</td>
</tr>
<tr>
<td>Final exam of module</td>
<td>At the end of the lecture period</td>
</tr>
<tr>
<td>Course type</td>
<td>Comment</td>
</tr>
<tr>
<td>Lecture</td>
<td></td>
</tr>
<tr>
<td>Exercises</td>
<td></td>
</tr>
<tr>
<td>Total time of attendance for the module</td>
<td></td>
</tr>
</tbody>
</table>
Inf410 - Formal Methods

Module label: Formal Methods
Module code: inf410
Credit points: 6.0 KP
Workload: 180 h

Applicability of the module:
- Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsbereich - Wahlbereich Informatik
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Theoretische Informatik)

Responsible persons:
Wehrheim, Heike (Module responsibility)
Lehrenden, Die im Modul (Authorized examiners)

Prerequisites:

Skills to be acquired in this module:
Formal methods are mathematically well-defined languages for the modelling of systems. The students get to know different formal methods and learn about their usage for the modelling and analysis of systems. For a given task, they choose adequate formalisms and their corresponding analysis technique, apply these and interpret the outcome of the analysis.

**Professional competence**
The students:
- apply mathematical formalisms to the modelling of systems,
- choose an adequate modelling formalism for some given task,
- formally specify systems,
- choose suitable analysis techniques,
- interpret results of analysis runs.

**Methodological competence**
The students:
- carry out formal correctness proofs,
- employ analysis tools,
- define the semantics of formal specification languages.

**Social competence**
The students:
- discuss the advantages and disadvantages of modelling formalisms.

**Self-competence**
The students:
- organise themselves for the work in the module.

Module contents:
- Short recap of predicate logic, use of predicate logic in program verification,
- Petri nets,
- Process algebra CCS,
- Timed automata,
- Z.

Reader's advisory:

Links:
Language of instruction: German
Duration (semesters): 1 Semester
Module frequency: unlimited
Module capacity: unlimited
Reference text: Useful previous knowledge: Course Logic
<table>
<thead>
<tr>
<th>Modulniveau / module level</th>
<th>MM (Mastermodul / Master module)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modulart / typ of module</td>
<td>Wahlpflicht / Elective</td>
</tr>
</tbody>
</table>

### Lehr-/Lernform / Teaching/Learning method

### Vorkenntnisse / Previous knowledge

<table>
<thead>
<tr>
<th>Examination</th>
<th>Time of examination</th>
<th>Type of examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final exam of module</td>
<td>Weekly assignments, oral examination at the end</td>
<td>Portfolio</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course type</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td>2</td>
<td>SuSe or WiSe</td>
<td>28</td>
</tr>
<tr>
<td>Exercises</td>
<td></td>
<td>2</td>
<td>SuSe or WiSe</td>
<td>28</td>
</tr>
</tbody>
</table>

**Total time of attendance for the module** 56 h
Wahlpflichtmodule (Angewandte Informatik)

inf521 - Medical Informatics

<table>
<thead>
<tr>
<th>Module label</th>
<th>Medical Informatics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module code</td>
<td>inf521</td>
</tr>
<tr>
<td>Credit points</td>
<td>6.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>180 h</td>
</tr>
</tbody>
</table>

**Applicability of the module**
- 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 (Angewandte Informatik)

**Responsible persons**
Kaspar, Mathias (Module responsibility)
Lehrenden, Die im Modul (Authorized examiners)

**Prerequisites**

**Skills to be acquired in this module**
This module provides an introduction to the medical informatics and medical technology.

**Professional competence** The students:
- know the medical and healthcare computer science applications
- know typical IT solutions and infrastructures
- know the legal framework to process care data
- know medical classifications and nomenclatures and the DRG-System and are able to apply them

**Methodological competence** The students:
- know bio-medical research requirements and patient data privacy methods
- know communication standards and apply them in small-scale scenarios
- know and apply patient safety and risk management methods
- know and apply biosignal and image processing methods

**Social competence** The students:
- Realise the importance of communication during the software development process between developer, customer and user of a successful and secure system. Feedback, request, respectful cooperation and the empathy of other disciplines' working processes are of great importance.

**Self-competence** The students:
- Realise their responsibility as a medical informatic and reflect their impact on patients, medical employers and hospitals (corporates)

**Module contents**
- Medical informatics introduction / medical documentation
- Medical documentation / progression of disease - Healthcare information systems
- Terminology and classification / Medical controlling
- Image processing / interoperability and communication standards - Medical data privacy
- Medical research
- Analyses of information system data
- Decision making support and process management
- MI/MT patient safetiness (Regulatory Affairs)
- Telemedicine / Customer Health informatics
- Medical technology introduction, biomedical technology
- Biosignal processing, sensor technology - Robotics, prosthetics

**Reader's advisory**
- Jan van Bemmel, M.A. Musen, Mark A. Musen (Hrsg.): Handbook of Medical Informatics. Springer, Heidelberg 1997
- Christian Johner und Peter Haas (Hrsg.): Praxishandbuch IT im Gesundheitswesen - Carl Hanser Verlag München 2009

**Links**
- Language of instruction: German
- Duration (semesters): 1 Semester
- Module frequency: jährlich
- Module capacity: unlimited
- Modullevel / module level: AS (Akzentsetzung / Accentuation)
- Modulart / typ of module: je nach Studiengang Pflicht oder Wahlpflicht
- Lehr-/Lernform / Teaching/Learning method: V+Ü
## Vorkenntnisse / Previous knowledge

<table>
<thead>
<tr>
<th>Examination</th>
<th>Time of examination</th>
<th>Type of examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final exam of module</td>
<td>At the end of the lecture period</td>
<td>Written or oral exam</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course type</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td>2</td>
<td>SuSe</td>
<td>28</td>
</tr>
<tr>
<td>Exercises</td>
<td></td>
<td>2</td>
<td>SuSe</td>
<td>28</td>
</tr>
</tbody>
</table>

**Total time of attendance for the module**: 56 h
inf530 - Artificial Intelligence

<table>
<thead>
<tr>
<th>Module label</th>
<th>Artificial Intelligence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module code</td>
<td>inf530</td>
</tr>
<tr>
<td>Credit points</td>
<td>6.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>180 h</td>
</tr>
<tr>
<td>Applicability of the module</td>
<td></td>
</tr>
<tr>
<td>Bachelor's Programme Business Informatics (Bachelor) &gt; Akzentsetzungsbereich Praktische Informatik und Angewandte Informatik</td>
<td></td>
</tr>
<tr>
<td>Bachelor's Programme Computing Science (Bachelor) &gt; Akzentsetzungsbereich - Wahlbereich Informatik</td>
<td></td>
</tr>
<tr>
<td>Master of Education Programme (Gymnasium) Computing Science (Master of Education) &gt; Wahlpflichtmodule (Angewandte Informatik)</td>
<td></td>
</tr>
<tr>
<td>Master of Education Programme (Vocational and Business Education) Computing Science (Master of Education) &gt; Akzentsetzungsbereich</td>
<td></td>
</tr>
</tbody>
</table>

Responsible persons

Sauer, Jürgen (Module responsibility)
Lehrenden, Die im Modul (Authorized examiners)

Prerequisites

Skills to be acquired in this module

The students are familiar with the basic concepts of artificial intelligence (AI). They know the concept of rational agents and their behavior. They know how to implement expert systems. They also know basic search and problem solving techniques as well as techniques of knowledge representation. The students can compare different problem solving techniques and use them within other problem contexts.

Professional competence

The students:

- describe the concept of rational agents and their behavior in an agent environment
- name and describe the basic search and problem solving techniques of Artificial Intelligence
- describe and implement expert systems
- describe basic techniques of knowledge representation

Methodological competence

The students:

- acknowledge the basic methods of AI
- transfer AI methods to other application areas
- evaluate AI methods regarding their appropriateness for distinct problem areas
- modify and adapt AI methods for specific application areas

Social competence

The students:

- work in teams
- present results to groups

Self-competence

The students:

- reflect their results with regard to the methods of AI

Module contents

- Overview of AI
- Rational agents and agent based systems
- Search and other problem solving techniques
- Knowledge representation
- Planning

Reader's advisory

<table>
<thead>
<tr>
<th>Links</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language of instruction</td>
</tr>
<tr>
<td>Duration (semesters)</td>
</tr>
<tr>
<td>Module frequency</td>
</tr>
<tr>
<td>Module capacity</td>
</tr>
<tr>
<td>Module level / module level</td>
</tr>
<tr>
<td>Modulart / typ of module</td>
</tr>
<tr>
<td>Lehr-/Lernform / Teaching/Learning method</td>
</tr>
<tr>
<td>Vorkenntnisse / Previous knowledge</td>
</tr>
<tr>
<td>Examination Time of examination Type of examination</td>
</tr>
<tr>
<td>Final exam of module</td>
</tr>
<tr>
<td>Course type Comment SWS Frequency Workload of compulsory attendance</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Total time of attendance for the module</td>
</tr>
</tbody>
</table>
inf600 - Business Informatics I

<table>
<thead>
<tr>
<th>Module label</th>
<th>Business Informatics I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module code</td>
<td>inf600</td>
</tr>
<tr>
<td>Credit points</td>
<td>6.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>180 h</td>
</tr>
</tbody>
</table>

Applicability of the module
- Bachelor's Programme Business Informatics (Bachelor) > Basiscurriculum
- Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsbereich - Wahlbereich Informatik
- Bachelor's Programme Economics and Business Administration (Bachelor) > Studienrichtung Wirtschaftsinformatik
- Bachelor's Programme Sustainability Economics (Bachelor) > Wahlpflichtbereich
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Angewandte Informatik)
- Master of Education Programme (Vocational and Business Education) Computing Science (Master of Education) > Pflichtbereich

Responsible persons
- Sauer, Jürgen (Module responsibility)
- Lehrende, Die im Modul (Authorized examiners)

Prerequisites

Skills to be acquired in this module
- Business informatics regards itself as an interdisciplinary subject. It connects business administration with computer science. Business informatics also includes information technologies as well as technical subjects and research topics. It is more than just an intersection of research fields and offers e.g. special methods to coordinate corporate strategies and information processing.
- The module introduces the entire scope of the field of business informatics.

Professional competence
- The students:
  - Describe the key aspects of business informatics
  - Differentiate business informatics as an interdisciplinary subject from other subjects
  - Characterise the functionality of essential application systems and management structures, from the strategical to the tactical and operative level.
  - Consider and evaluate case studies and layout options for the conception, development, implementation, usage and maintenance of operational sociotechnical applications systems

Methodological competence
- The students:
  - Model technical and sociotechnical processes using suitable tools
  - Analyse business processes and the demands on their modification and their technical assistance
  - Abstract from complex systems in a suitable way to improve the manageability of models

Social competence
- The students:
  - Present their solutions in front of other groups
  - Discuss their outcomes

Self-competence
- The students:
  - Develop solutions for case studies in groups
  - Construct an argument based on acquired knowledge

Module contents
- The main topics of business informatics are the presentation and evaluation of configuration options to conceptualise, develop, implement, use and maintain operational sociotechnical application systems. The lecture focuses on information systems of the networked company. Technical, economic, organisational, and psychosocial aspects are considered. The understanding of these relations will be trained by means of case studies taken from Laudon et al. (cf. suggested reading). The lecture gives an overview of the following business informatics fields.
  - Information systems, (object of BI)
  - Application systems
  - E-Commerce and E-Business
  - Ethical, social and political aspects
- Business process integration
- Knowledge management
- Support of decision making
- Reorganisation of companies
- Economic evaluation

For a better understanding of each subject, it is recommended to take specific modules later in the course of studies.

**Reader's advisory**

- Frank, Gronau (2002), Systemanalyse im Unternehmen Oldenbourg (Gebundene Ausgabe - Juni 2002)

<table>
<thead>
<tr>
<th>Links</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language of instruction</td>
</tr>
<tr>
<td>Duration (semesters)</td>
</tr>
<tr>
<td>Module frequency</td>
</tr>
<tr>
<td>Module capacity</td>
</tr>
<tr>
<td>Module level / module level</td>
</tr>
<tr>
<td>Modulart / typ of module</td>
</tr>
<tr>
<td>Lehr-/Lernform / Teaching/Learning method</td>
</tr>
</tbody>
</table>

**Vorkenntnisse / Previous knowledge**

<table>
<thead>
<tr>
<th>Examination</th>
<th>Time of examination</th>
<th>Type of examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final exam of module</td>
<td>At the end of the lecture period</td>
<td>Tasks and active partaking during the exercises / written exam or oral exam</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course type</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td>2</td>
<td>WiSe</td>
<td>28</td>
</tr>
<tr>
<td>Exercises</td>
<td></td>
<td>2</td>
<td>WiSe</td>
<td>28</td>
</tr>
</tbody>
</table>

**Total time of attendance for the module**

56 h
inf601 - Business Informatics II

Module label: Business Informatics II
Module code: inf601
Credit points: 6.0 KP
Workload: 180 h

Applicability of the module:
- Bachelor's Programme Business Informatics (Bachelor) > Aufbaucurriculum - Pflichtbereich
- Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsbereich - Wahlbereich Informatik
- Bachelor's Programme Economics and Business Administration (Bachelor) > Studienrichtung Wirtschaftsinformatik
- Bachelor's Programme Sustainability Economics (Bachelor) > Wahlpflichtbereich
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Angewandte Informatik)

Responsible persons:
Marx Gomez, Jorge (Module responsibility)
Lehrenden, Die im Modul (Authorized examiners)

Prerequisites:
The module provides the fundamentals and tasks of information management to create an IT strategy. Tasks are especially considered from a strategic perspective and brought closer by methodological skills for each task.

Professional competence
The students:

- name the strategic aspects of information management and identify their impact on technical and operational information management
- examine the essential questions of enterprise reorganization in connection with an information system and recognize the influence of the Internet and its services on commercial processes and information systems by an exemplary system, e.g. SAP R/3
- identify different approaches to information management (Information Resource Management, Management approach, management approach, personal information management) and understand why determining the value of information management is necessary and how it is done
- specify the objectives of information management, differentiate and classify its tasks appropriately
- recognize the methodological characteristics of information management
- transfer the concept of architecture to the information infrastructure
- assess the importance to plan features for strategic IT-design oriented on IT-architecture
- schedule the procedures concerning the strategical situation analysis of the competition analysis, the information infrastructure and the environmental analysis with the objective to transfer them to simple problems
- name the key contents of strategical IT objectives and are aware of difficulties in determining the measurement category
- identify and learn the scope and central tasks of business process and environmental management (as excursion) and the significance for information management

Methodological competence
The students:

- perform information management tasks using methods of Information Engineering and thereby learn how to transfer and employ the methods to other fields, e.g. economy
- learn by practice advantages and disadvantages of different methods and can use them as part of the optimized IT strategy based on the acquired knowledge.

Social competence
The students:

- construct solutions to case studies given in the group, i.e. the development of an IT strategy
- discuss the solutions on a technical level
- present the solutions to case studies as part of the exercises

Self-competences
The Students:
accept criticism and understand it as a precondition for the further development of one's own actions

Module contents
The proportion of information technology in the investment budget of companies is rising continuously. For instance, banks spend 25% of all investments for their information systems. Information is not just a production factor, it is also an element of competition. Information is increasingly important for business. The business informatics deals with these economic tasks of information technology.
Information systems in businesses and organisations are of central concern. The interdisciplinary nature of business informatics raises questions about proceedings, problems of models (modelling in a narrow sense) and the application in specific problem domains.

Contents of this module are:

- Information management principles and tasks
- IT architectures
- Infrastructure of information and communication technology
- Strategic, administrative and operative information engineering

Reader's advisory

- Heinrich, Stelzer (2011): Informationsmanagement - Grundlagen, Aufgaben, Methoden. Oldenbourg Verlag
- Krcmar (2015): Informationsmanagement. Springer Verlag

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

Language of instruction
German

Duration (semesters)
1 Semester

Module frequency
jährlich

Module capacity
unlimited

Modullevel / module level
AS (Akzentsetzung / Accentuation)

Modulart / typ of module
je nach Studiengang Pflicht oder Wahlpflicht

Lehr-/Lernform / Teaching/Learning method
V+Ü

Vorkenntnisse / Previous knowledge

Examination
Time of examination
Usually two weeks after lecture time
Type of examination
Written exam max. 120 minutes

Course type
Comment
SWS
Frequency
Workload of compulsory attendance

Lecture
2
SuSe
28

Exercises
2
SuSe
28

Total time of attendance for the module
56 h
inf603 - Planning and Simulation in Logistics

<table>
<thead>
<tr>
<th>Module label</th>
<th>Planning and Simulation in Logistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module code</td>
<td>inf603</td>
</tr>
<tr>
<td>Credit points</td>
<td>6.0 KP</td>
</tr>
<tr>
<td>Workload</td>
<td>180 h</td>
</tr>
</tbody>
</table>

**Applicability of the module**
- 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 (Angewandte Informatik)

**Responsible persons**
- Sauer, Jürgen (Module responsibility)
- Lehrenden, Die im Modul (Authorized examiners)

**Prerequisites**

**Skills to be acquired in this module**
Introduction to the problems/challenges of simulation and planning of applications in production and logistics. The students will learn the simulation with a tool in hands-on exercises.

**Learning objectives:**
The Students have knowledge of basic problems/challenges of simulating and planning in the field of production and logistic. They know approaches and algorithms to solve simulation and planning problems/challenges. They are able to model solutions for simple production problems/challenges with a simulation tool and are able to solve given tasks with it.

They are able:
- to identify, classify and associate solutions to problems/challenges
- to model and implement a production plan with the simulation tool

**Professional competence**
The students:
- Characterise basic problems/challenges of the production planning and logistic simulation
- Name approaches/concepts and algorithms to solve simulation and planning problems/challenges
- Identify, classify and assign solutions to planning problems/challenges
- Model and implement a given production process with a simulation tool

**Methodological competence**
The students:
- Model small production problems with a simulation tool and solve given tasks with the tool

**Social competence**
The students:
- Develop solutions to given simulation problems in small groups
- Present the solutions to other groups

**Self-competence**
The students:
- Reflect their own solutions in conjunction with other solutions

**Module contents**
This module provides the basic production and logistic planning and simulation approaches/concepts. Supply chain planning problems are introduced and simple algorithmic solutions are introduced and implemented. The hands-on simulation with a tool is provided by a case study from the production.

**Reader's advisory**
- selected material on the simulation tool
- others will be announced in the lecture

**Links**
<table>
<thead>
<tr>
<th>Language of instruction</th>
<th>German</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Duration (semesters)</strong></td>
<td>1 Semester</td>
</tr>
<tr>
<td><strong>Module frequency</strong></td>
<td>jährlich</td>
</tr>
<tr>
<td><strong>Module capacity</strong></td>
<td>unlimited</td>
</tr>
<tr>
<td><strong>Modullevel / module level</strong></td>
<td>AS (Akzentsetzung / Accentuation)</td>
</tr>
<tr>
<td><strong>Modulart / typ of module</strong></td>
<td>je nach Studiengang Pflicht oder Wahlpflicht</td>
</tr>
<tr>
<td><strong>Lehr-/Lernform / Teaching/Learning method</strong></td>
<td>V+Ü</td>
</tr>
<tr>
<td><strong>Vorkenntnisse / Previous knowledge</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examination</th>
<th>Time of examination</th>
<th>Type of examination</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Final exam of module</strong></td>
<td>At the end of the lecture period</td>
<td>Portfolio consisting of: Active involvement, presentation and documentation of results, hands-on achievements</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course type</th>
<th>Comment</th>
<th>SWS</th>
<th>Frequency</th>
<th>Workload of compulsory attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td>2</td>
<td>WiSe</td>
<td>28</td>
</tr>
<tr>
<td>Exercises</td>
<td></td>
<td>2</td>
<td>WiSe</td>
<td>28</td>
</tr>
</tbody>
</table>

**Total time of attendance for the module** 56 h
inf608 - eBusiness

Module label: eBusiness
Module code: inf608
Credit points: 6.0 KP
Workload: 180 h

Applicability of the module:
- Bachelor's Programme Business Informatics (Bachelor) > Aufbaucurriculum - Pflichtbereich
- Bachelor's Programme Computing Science (Bachelor) > Akzentsetzungsbereich - Wahlbereich Informatik
- Bachelor's Programme Economics and Business Administration (Bachelor) > Studienrichtung Wirtschaftsinformatik
- Master of Education Programme (Gymnasium) Computing Science (Master of Education) > Wahlpflichtmodule (Angewandte Informatik)
- Master of Education Programme (Vocational and Business Education) Computing Science (Master of Education) > Akzentsetzungsbereich

Responsible persons:
Marx Gomez, Jorge (Module responsibility)
Lehrenden, Die im Modul (Authorized examiners)

Prerequisites:

Skills to be acquired in this module:
The module provides an introduction to the "Electronic Business" (e-business). The graduates know the fundamental and current technologies, advanced concepts, applications and competitive strategies of the "Electronic-Commerce" (e-commerce). The knowledge and abilities acquired in this module are directly applicable in study and business. They are deepening the basics from the module „Wirtschaftsinformatik II“. They provide a professional e-business consulting background and the skills to design software products for this area of business in practice.

Professional competence
The students:
- Name and discuss the eBusiness key challenges
- Discuss the chances of the added value and the changes of commercial models by the internet
- Define the concepts of e-business and e-commerce.
- Discuss the change of retail trade and the transactions between companies in e-business
- Name current payment systems and communication technologies
- Discuss the possibilities of the internet in order to simplify the administration and the coordination of internal and external business processes
- Characterise the challenges for the management caused by e-business and e-commerce
- Differentiate the concepts of e-business
- Assess applications with regard to economic points of view
- Practically learn how to handle core technologies of e-business

Methodological competence
The students:
- Assess the core technologies of e-business and e-commerce
- Apply methods in case studies

Social competence
The students:
- Develop case studies on basis of given problems in groups
- Present their solutions

Self-competence
The students:
- Learn about their own limitations while planning and developing e-commerce applications

Module contents:
The module provides the following contents:
- The definition of the core e-business concepts and the technical conditions for the implementation
- Introduction of the variations of e-commerce, especially the Business-to-Consumer (B2C) and Business-2-Business (B2B) concepts and the current research in this field
- Discussion on the economic aspects of e-business based on the theory of informational added value
- Technological basics of the web and current development technologies for e-commerce web
applications and security mechanisms with focus on online-shops and applications (hands-on exercise topics: HTTP, JSP and SQLInjection, PHP, XML, XML-Security, data modelling, Online-Shop development and Online-Shop administration)

Reader's advisory


Links

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

Language of instruction

German

Duration (semesters)

1 Semester

Module frequency

jährlich

Module capacity

unlimited

Modullevel / module level

AS (Akzentsetzung / Accentuation)

Modulart / typ of module

je nach Studiengang Pflicht oder Wahlpflicht

Lehr-/Lernform / Teaching/Learning method

V+Ü

Vorkenntnisse / Previous knowledge

Examination

Time of examination

At the end of the lecture period

Type of examination

Written or oral exam

Course type

Comment

SWS

Frequency

Workload of compulsory attendance

Lecture

2

SuSe

28

Exercises

2

SuSe

28

Total time of attendance for the module

56 h

88 / 89