Module Guide for the Study Path

Bachelor Computer Science

Version from 22. April 2015
### 1st semester

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<tr>
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<td>Programming Languages (CS3052, ProgLan)</td>
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<td>Artificial Intelligence 1 (CS3204, KI1)</td>
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### 5th or 6th semester

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<th>Course</th>
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<tbody>
<tr>
<td>Coding and Security (CS3050, CodeSich)</td>
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<td>Parallel Computing (CS3051, ParallelVa)</td>
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<td>Programming Languages (CS3052, ProgLan)</td>
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### 5th semester

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<thead>
<tr>
<th>Course</th>
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<tr>
<td>Robotics (CS2500, Robotik)</td>
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<td>Lab class media and interaction design (CS3600, PrakMedien)</td>
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<td>Bachelor Seminar Informatics (CS3702, BachSemInf)</td>
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<td>Molecular Genetics (LS3100, MolGen)</td>
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<td>Statistics - Practical Course (MA3210, StatPrakt)</td>
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<td>English for Bachelor and Master students MLS (PS1030, Engl)</td>
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# CS1000 - Programming (Prog)

| Duration: | 1 Semester |
| Turnus of offer: | each winter semester |
| Credit points: | 8 |

## Course of study, specific field and term:
- Bachelor Medical Informatics (compulsory: aptitude test), computer science, 1st semester
- Bachelor MES (compulsory), foundations of computer science, 3rd semester
- Bachelor Computer Science (compulsory: aptitude test), computer science, 1st semester

## Classes and lectures:
- Programming (lecture, 4 SWS)
- Programming (exercise, 2 SWS)

## Workload:
- 125 Hours private studies
- 90 Hours in-classroom work
- 25 Hours exam preparation

## Contents of teaching:
- Definition: Algorithm
- Basic concepts of imperative and OO programming
- Basic data structures
- Abstract Data types

## Qualification-goals/Competencies:
- Understanding the nature of algorithms and their definition
- Basic knowledge about different programming paradigms (imperative, declarative, object-oriented, etc.)
- Profound knowledge about imperative and object-oriented programming
- Ability to define abstract data types
- In-depth knowledge of the Java programming language
- Ability to design, to implement, and to test simple programs
- Expertise to solve bigger programming tasks efficiently and timely using the acquired competences
- Learn to come up with solutions that satisfy accepted quality standards while operating with constrained resources in terms of time, man-power, etc.
- Ability to introduce new informatic or mathematical methods to products to be developed or existing solutions
- Basic understanding of product development in enterprises

## Grading through:
- exercises
- written exam

## Is requisite for:
- Algorithms and Data Structures (CS1001)

## Responsible for this module:
- Prof. Dr. Stefan Fischer

## Teacher:
- Institute of Telematics
- Prof. Dr. Stefan Fischer

## Literature:
- M. Broy: Informatik - eine grundlegende Einführung (Band 1 und 2) - Springer-Verlag 1998
- G. Goos und W. Zimmermann: Vorlesungen über Informatik (Band 1 und 2) - Springer-Verlag, 2006
- D. J. Barnes und M. Kölling: Objektorientierte Programmierung mit Java - Pearson Studium, 2003

## Language:
- offered only in German
<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
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<tr>
<td>1 Semester</td>
<td>each winter semester</td>
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</table>

### Course of study, specific field and term:
- Bachelor Medical Informatics SJ14 (compulsory), computer science, 3rd semester
- Bachelor Computer Science SJ14 (compulsory), foundations of computer science, 3rd semester
- Bachelor Medical Informatics (compulsory), computer science, 1st semester
- Bachelor MES (optional subject), computer science, 3rd semester
- Bachelor MML (optional subject), computer science, 6th semester
- Bachelor Computer Science (compulsory), foundations of computer science, 1st semester

### Classes and lectures:
- Logic (lecture, 2 SWS)
- Logic (exercise, 1 SWS)

### Workload:
- 65 Hours private studies and exercises
- 45 Hours in-classroom work
- 10 Hours exam preparation

### Contents of teaching:
- Key concepts of syntax: alphabet, string, term, formula
- Key concepts of semantics: assignment, structure, model
- Key concepts of proof calculus: axioms, proofs
- Formalization and coding of problems
- Validating correctness and satisfiability of formalizations
- Syntax and semantics of propositional logic
- Syntax and semantics of predicate logic
- Proof calculi

### Qualification-goals/Competencies:
- Students are able to explain the concepts of syntax and semantics for the examples of prepositional and predicate logic
- They are able to apply formal systems and proof systems
- They are able to transfer methods of mathematical logic to simple practical problems
- They are able to formalize discrete problems
- They are able to modify proof templates in order to create simple proofs

### Grading through:
- exercises
- written exam

### Responsible for this module:
- Prof. Dr. rer. nat. Till Tantau

### Teacher:
- Institute for Theoretical Computer Science
- Prof. Dr. rer. nat. Till Tantau
- Prof. Dr. Rüdiger Reischuk

### Literature:
- Uwe Schöning: Logik für Informatiker - Spektrum Verlag, 1995
- Kreuzer, Kühlig: Logik für Informatiker - Pearson Studium, 2006

### Language:
- offered only in German
# CS1100 - Operating systems (BetriebSys)

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<tr>
<td>Credit points:</td>
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## Course of study, specific field and term:
- Bachelor Medical Informatics (optional subject), computer science, 4th to 6th semester
- Bachelor Computer Science (compulsory), foundations of computer science, 1st semester

## Classes and lectures:
- Operating Systems (lecture, 2 SWS)
- Operating Systems (exercise, 1 SWS)

## Workload:
- 65 Hours private studies
- 45 Hours in-classroom work
- 10 Hours exam preparation

## Contents of teaching:
- Tasks and Structure
- Historical Overview of Computer and Operating Systems
- Coding of Symbols and Numbers
- Foundations of Operating Systems
- Processes, Inter-Process Communication and Process Management
- Storage Management
- Input / Output
- Files and File Systems
- Examples (UNIX, Windows, mobile OS)

## Qualification-goals/Competencies:
- Students know about the main concepts of operating systems.
- Students are able to judge, which OS concepts can be appropriately applied to novel computing architectures.
- Students are able to apply the most important strategies and algorithms for operating systems.

## Grading through:
- exercises
- written exam

## Responsible for this module:
- Prof. Dr. Stefan Fischer

## Teacher:
- Institute of Telematics
- Prof. Dr. Stefan Fischer
- Prof. Dr.-Ing. Andreas Schrader

## Literature:
- Andrew S. Tanenbaum: Moderne Betriebssysteme - 3., aktualisierte Auflage, Pearson, April 2009

## Language:
- offered only in German
# CS1300 - Introduction to Medical Informatics (EMI)

<table>
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<tr>
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## Course of study, specific field and term:
- Bachelor Medical Informatics SJ14 (compulsory: aptitude test), medical computer science, 1st semester
- Bachelor Medical Informatics (compulsory: aptitude test), medical computer science, 1st semester
- Bachelor MML (optional subject), computer science, 5th semester
- Bachelor MES (compulsory), foundations of computer science, 3rd semester
- Bachelor Computer Science (compulsory), specialization field medical informatics, 1st semester

## Classes and lectures:
- Introduction to Medical Informatics (lecture, 2 SWS)
- Introduction to Medical Informatics (exercise, 1 SWS)

## Workload:
- 55 Hours private studies
- 45 Hours in-classroom work
- 20 Hours exam preparation

## Contents of teaching:
- Basic concepts and methods of medical informatics
- Overview of the occupational field in medical informatics
- Introduction to the German healthcare system
- Introduction to eHealth: medical documentation, hospital information systems
- Medical imaging techniques
- Fundamentals of medical image computing
- Fundamentals of medical visualisation
- Health telematics
- Medical data security
- Fundamentals of knowledge based systems
- Introduction to bioinformatics
- Computer based evaluation of clinical and epidemiological studies

## Qualification-goals/Competencies:
- Overview of the methods in the art of medical informatics
- Knowledge of the institutional, organizational and legal framework in healthcare
- Knowledge of the essential concepts, methods and procedures in selected fields of medical informatics

## Grading through:
- exercises
- written exam

## Responsible for this module:
- Prof. Dr. rer. nat. habil. Heinz Handels

## Teacher:
- Institute of Medical Informatics
- Prof. Dr. rer. nat. habil. Heinz Handels
- PD Dr. rer. nat. habil. Josef Ingenerf

## Literature:
- P. Haas: Medizinische Informationssysteme und Elektronische Krankenakten - Berlin: Springer 2005

## Language:
- offered only in German
CS1400 - Introduction to Bioinformatics (EinBioinfo)

Duration: 1 Semester
Turnus of offer: each winter semester
Credit points: 4

Course of study, specific field and term:
- Bachelor Medical Informatics SJ14 (compulsory), medical computer science, 3rd semester
- Bachelor Computer Science SJ14 (compulsory), specialization field bioinformatics, 1st semester
- Bachelor Medical Informatics (compulsory), medical computer science, 3rd semester
- Bachelor MLS (compulsory), life sciences, 5th semester
- Bachelor MML (compulsory), specialization field bioinformatics, 5th semester
- Bachelor MES (optional subject), medical engineering science, 3rd or 5th semester
- Bachelor Computer Science (compulsory), specialization field bioinformatics, 1st semester

Classes and lectures:
- Introduction to Bioinformatics (lecture, 2 SWS)
- Introduction to Bioinformatics (exercise, 1 SWS)

Workload:
- 55 Hours private studies
- 45 Hours in-classroom work
- 20 Hours exam preparation

Contents of teaching:
- Life, genes & gene evolution
- Structure of the human DNA
- Sequence assembly - Industrial reading of genetic information
- DNA sequence models & hidden markov models
- Sequence alignment & dynamic programming
- DNA microarrays & GeneChip technologies
- Introduction into systems biology
- The human brain
- Neural networks / multilayer perceptrons
- Supervised & unsupervised learning

Qualification-goals/Competencies:
- Basic understanding of DNA and the coding of genetic information
- Principles of probabilistic modeling
- Application of basic algorithms for the analysis of genetic sequences
- Basic techniques and methods for the processing of genetic information
- Introduction to bioinformatic databases
- Basic understanding of Microarrays and GeneChip-Technologies
- Understanding the challenges of systems biology
- Principles of information processing in nervous systems
- Building a bridge between machine and biological (Hebbian) learning

Grading through:
- exercises
- written or oral exam as announced by the examiner

Responsible for this module:
- Prof. Dr. rer. nat. Amir Madany Mamlouk
- Prof. Dr. rer. nat. Thomas Martinetz

Teacher:
- Institute for Neuro- and Bioinformatics
- Prof. Dr. rer. nat. Amir Madany Mamlouk

Literature:
Language:
- offered only in German

Notes:
For students of the master programme Infection Biology, this is not a stand-alone module, but rather part of the module CS4011.

Computer Science students get a B certificate.
# CS1500 - Introduction to Robotics and Automation (ERA)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>1 Semester</th>
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</thead>
<tbody>
<tr>
<td>Turnus of offer:</td>
<td>each winter semester</td>
</tr>
<tr>
<td>Credit points:</td>
<td>4</td>
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</table>

## Course of study, specific field and term:
- Bachelor Medical Informatics SJ14 (optional subject), medical computer science, 5th or 6th semester
- Bachelor Computer Science SJ14 (compulsory), specialization field robotics and automation, 1st semester
- Bachelor MML (optional subject), computer science, 5th or 6th semester
- Bachelor MES (optional subject), medical engineering science, 5th semester
- Bachelor Computer Science (compulsory), specialization field robotics and automation, 1st semester

## Classes and lectures:
- Introduction to Robotics and Automation (lecture, 2 SWS)
- Introduction to Robotics and Automation (exercise, 1 SWS)

## Workload:
- 55 Hours private studies
- 45 Hours in-classroom work
- 20 Hours exam preparation

## Contents of teaching:
- Introduction
- Control systems
- Programmable Logic Controller (PLC)
- Combinatorial control
- Sequential control
- Feedback control systems
- Plants
- PID controller
- Controller parameterization
- Autonomous mobile robots
- AI-paradigms
- Elementary and emergent behaviors
- Sensors
- Actuators

## Qualification-goals/Competencies:
- The students are able to explain the principles of control systems.
- The students are able to design combinatorial and sequential control systems.
- The students are able to program simple application problems as PLC-program in the IEC-languages.
- The students are able to analyze closed-loop controlled systems (plants) and to select and parameterize a suitable feedback PID controller.
- The students are able to present the principal structure and functionality of autonomous wheel-driven robots.
- The students are able to program simple autonomous robots in a behavior-based way.

## Grading through:
- written or oral exam as announced by the examiner
- Lab exercises

## Responsible for this module:
- Prof. Dr.-Ing. Erik Maehle

## Teacher:
- Institute of Computer Engineering
  - Prof. Dr.-Ing. Erik Maehle

## Literature:
- J. Knespl: Automatisierungstechnik 1 - Regelungstechnik - Köln: Stam-Verlag 1999
Language:
- offered only in German

Notes:
Computer Science students get a B certificate.
### CS1600 - Introduction to Media Informatics (EinMedien)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>1 Semester</th>
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<tr>
<td>Credit points:</td>
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<tr>
<td>Turnus of offer:</td>
<td>each winter semester</td>
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</table>

#### Course of study, specific field and term:
- Bachelor Media Informatics SJ14 (compulsory: aptitude test), media informatics, 1st semester
- Bachelor MML (optional subject), computer science, 5th or 6th semester
- Bachelor Computer Science (compulsory), specialization field media informatics, 1st semester

#### Classes and lectures:
- Introduction to Media Informatics (lecture with exercises, 3 SWS)

#### Workload:
- 55 Hours private studies
- 45 Hours in-classroom work
- 20 Hours exam preparation

#### Contents of teaching:
- Overview of the lecture
- Social context
- Terms and theories of media
- Milestones of media technology
- Interactive media technologies
- Multimedia applications
- Human-centered media
- Designing interactive media
- Development processes for interactive media
- Ethics of new media
- Summary

#### Qualification-goals/Competencies:
- The students know the structure and the most important contents of media informatics.
- They are prepared for the following media informatics lectures.
- They know the main tasks and fields of work in media informatics.
- They know the challenges and requirements of designing interactive multimedia systems.

#### Grading through:
- exercises
- written exam

#### Is requisite for:
- Interaction Design (CS2600)

#### Responsible for this module:
- Prof. Dr.-Ing. Nicole Jochems

#### Teacher:
- Institute for Multimedia and Interactive Systems
- Prof. Dr.-Ing. Nicole Jochems

#### Literature:
- M. Herczeg: Einführung in die Medieninformatik - Oldenbourg-Verlag, 2007
- R. Malaka et al.: Medieninformatik - Eine Einführung - Pearson Verlag, 2009

#### Language:
- offered only in German
## CS1700 - Introduction to IT Security and Reliability (EinfSiZuv)

| Duration: | 1 Semester |
| Turnus of offer: | each winter semester |
| Credit points: | 4 (Typ B) |

### Course of study, specific field and term:
- Bachelor Medical Informatics SJ14 (optional subject), computer science, 5th or 6th semester
- Bachelor Computer Science SJ14 (compulsory), specialization field IT security and safety, 1st semester
- Bachelor Computer Science (compulsory), specialization field IT security and safety, 1st semester

### Classes and lectures:
- Introduction to IT Security and Reliability (lecture, 2 SWS)
- Introduction to IT Security and Reliability (exercise, 1 SWS)

### Workload:
- 55 Hours private studies
- 45 Hours in-classroom work
- 20 Hours exam preparation

### Contents of teaching:
- introduction and terms
- data protection and data security, informational self-determination
- classification of security, safety and reliability requirements and riscs
- insecure systems: examples, impacts and damages, causes
- unreliable systems: examples, impacts and damages, causes
- attack scenarios, safety-critical businesses and domains
- simple measures for enhancing safety, security and reliability, risk estimation
- legal, social and ethical aspects

### Qualification-goals/Competencies:
- get an overview on the range of problems in the area of safety, security and reliability of it systems
- learn standard methods
- reflect social aspects

### Grading through:
- exercises
- continuous, successful participation in course
- written or oral exam as announced by the examiner

### Responsible for this module:
- Prof. Dr. Rüdiger Reischuk

### Teacher:
- Institute of Computer Engineering
- Institute of Telematics
- Institute of Software Technology and Programming Languages
- Institute for Theoretical Computer Science
- Prof. Dr.-Ing. Erik Maehle
- Prof. Dr. Martin Leucker
- Prof. Dr. Stefan Fischer
- Prof. Dr. Rüdiger Reischuk

### Literature:
- current introductory literature will be introduced in the respective lectures

### Language:
- German and English skills required
# MA1000 - Linear Algebra and Discrete Structures 1 (LADS1)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>each winter semester</td>
<td>8</td>
</tr>
</tbody>
</table>

## Course of study, specific field and term:
- Bachelor Medical Informatics SJ14 (compulsory: aptitude test), mathematics, 1st semester
- Bachelor MES SJ14 (compulsory: aptitude test), mathematics, 1st semester
- Bachelor Media Informatics SJ14 (compulsory: aptitude test), mathematics, 1st semester
- Bachelor Computer Science SJ14 (compulsory: aptitude test), mathematics, 1st semester
- Bachelor Medical Informatics (compulsory: aptitude test), mathematics, 1st semester
- Bachelor Computer Science (compulsory: aptitude test), mathematics, 1st semester
- Bachelor MES (compulsory), mathematics, 1st semester
- Bachelor MML (compulsory), mathematics, 1st semester

## Classes and lectures:
- Linear Algebra and Discrete Structures 1 (lecture, 4 SWS)
- Linear Algebra and Discrete Structures 1 (exercise, 2 SWS)

## Workload:
- 125 Hours private studies
- 90 Hours in-classroom work
- 25 Hours exam preparation

## Contents of teaching:
- Basics (logic, sets, mappings, relations, orders)
- Groups, rings, fields (including permutations, cosets, complex numbers)
- Vector spaces (basis, dimension, scalar product, norm)
- Matrices
- Linear systems of equations

## Qualification-goals/Competencies:
- Students understand the basic concepts of linear algebra.
- Students understand basic thoughts and proof techniques.
- Students can explain basic relationships in linear algebra.
- Students can apply basic concepts and proof techniques to algebraic problems.
- Students have an understanding for abstract structures.
- Interdisciplinary qualifications:
  - Students have a basic competence in modeling.
  - Students can transfer theoretical concepts to similar applications.
  - Students can work as a group on elementary mathematical problems.
  - Students can present elementary solutions to their problems in front of a group.

## Grading through:
- exercises
- Presentation of one’s own solution of an exercise
- written exam

## Responsible for this module:
- Prof. Dr. Jan Modersitzki

## Teacher:
- Institute of Mathematics and Image Computing
  - Prof. Dr. Jan Modersitzki
  - N.N.

## Literature:
- D. Lau: Algebra und diskrete Mathematik I + II - Springer, 2007
Language:
  • offered only in German
## CS1200 - Fundamentals of Computer Engineering (TGI)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Semester</td>
<td>each summer semester</td>
<td>12</td>
</tr>
</tbody>
</table>

### Course of study, specific field and term:
- Bachelor MES (compulsory), foundations of computer science, 4th and 5th semester
- Bachelor Computer Science (compulsory), foundations of computer science, 2nd and 3rd semester

### Classes and lectures:
- Fundamentals of Computer Engineering (lecture, 4 SWS)
- Fundamentals of Computer Engineering (exercise, 2 SWS)
- Fundamentals of Computer Engineering (practical course, 3 SWS)

### Workload:
- 200 Hours private studies
- 135 Hours in-classroom work
- 25 Hours exam preparation

### Contents of teaching:
- Boolean algebra
- Switching functions
- Minimization
- Combinational logic
- Sequential logic
- Register-transfer languages
- Data processing units
- Control units
- Microprogramming
- Basic processor architectures
- Microcontrollers
- Assembler programming
- I/O-interfaces
- Interrupts
- Semiconductor components
- Circuit families
- Integrated circuits
- Programmable logic
- CAD-tools
- Memory technologies

### Qualification-goals/Competencies:
- Students know the most important methods for the formal description of digital circuits like Boolean algebra or register-transfer languages
- They are well acquainted with the basic design methods for digital circuits on gate and register-transfer level
- They have knowledge about basic processor architectures and their programming in machine language
- They are able to program microcontrollers for simple applications in assembly language
- They know the basic technologies for the realization of digital circuits (bipolar, MOS, CMOS)
- They are able to design simple digital circuits making use of CAD-tools, to implement and test them in different technologies (TTL, FPGAs etc.)

### Grading through:
- exercises
- continuous, successful participation in practical course
- written exam

### Responsible for this module:
- Prof. Dr.-Ing. Erik Maehle

### Teacher:
- Institute of Computer Engineering
- Prof. Dr.-Ing. Erik Maehle
Literature:

- W. Schiffmann, R. Schmitz: Technische Informatik 1 - Grundlagen der digitalen Elektrotechnik - Berlin: Springer 2004
- W. Schiffmann, R. Schmitz: Technische Informatik 2 - Grundlagen der Computertechnik - Berlin: Springer 2005

Language:

- offered only in German
## CS1001 - Algorithms and Data Structures (AuD)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>1 Semester</th>
<th>Turnus of offer:</th>
<th>each summer semester</th>
<th>Credit points:</th>
<th>8</th>
</tr>
</thead>
</table>

### Course of study, specific field and term:
- Bachelor Medical Informatics SJ14 (compulsory), computer science, 2nd semester
- Bachelor MES SJ14 (optional subject), computer science and electrical engineering, 4th or 6th semester
- Bachelor Media Informatics SJ14 (compulsory), foundations of computer science, 2nd semester
- Bachelor Computer Science SJ14 (compulsory: aptitude test), foundations of computer science, 2nd semester
- Bachelor Medical Informatics (compulsory), computer science, 2nd semester
- Bachelor MES (compulsory), foundations of computer science, 4th semester
- Bachelor MML (compulsory), foundations of computer science, 2nd semester
- Bachelor Computer Science (compulsory: aptitude test), foundations of computer science, 2nd semester

### Classes and lectures:
- Algorithms and Data Structures (lecture, 4 SWS)
- Algorithms and Data Structures (exercise, 2 SWS)

### Workload:
- 125 Hours private studies
- 90 Hours in-classroom work
- 25 Hours exam preparation

### Contents of teaching:

### Qualification-goals/Competencies:

### Grading through:
- exercises
- written exam

### Is requisite for:
- Databases (CS2700)
- Lab Course Software Engineering (CS2301)
- Software Engineering (CS2300SJ14)
- Theoretical Computer Science (CS2000)
- Algorithm Design (CS3000)

### Requires:
- Programming (CS1000)
- Introduction to Programming (CS1000SJ14)

### Responsible for this module:
- Prof. Dr. rer. nat. habil. Ralf Möller

### Teacher:
- Institute of Information Systems
- Prof. Dr. rer. nat. habil. Ralf Möller

### Literature:
Language:

- offered only in German
# CS1601 - Basics of Multimedia Systems (MMTechnik)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>each winter semester</td>
<td>4</td>
</tr>
</tbody>
</table>

## Course of study, specific field and term:
- Bachelor Media Informatics SJ14 (compulsory), media informatics, 3rd semester
- Bachelor Computer Science SJ14 (optional subject), central topics of computer science, 5th semester
- Bachelor Computer Science (optional subject), central topics of computer science, 6th semester
- Bachelor MM (optional subject), computer science, 6th semester
- Bachelor Computer Science (compulsory), specialization field media informatics, 2nd semester

## Classes and lectures:
- Basics of Multimedia Systems (lecture, 2 SWS)
- Basics of Multimedia Systems (exercise, 1 SWS)

## Workload:
- 55 Hours private studies
- 45 Hours in-classroom work
- 20 Hours exam preparation

## Contents of teaching:
- Sensation and Perception
- Analog Media Technology
- Digitalisation
- Digital Audio, Image and Video Technology
- Haptical Technologies
- Foundations of Data Compression
- Storage Media
- Media Transmission (Broadcast / Streaming)

## Qualification-goals/Competencies:
- Students are able to present to essential functions and principles of multimedia systems.
- They are able to judge possibilities and limitations of human perception.
- They are able to classify the conditions and technologies for capturing, processing, storing, transmitting and perception of multimedia.
- They can balance the specific advantages and disadvantages of analog and digital media technology.
- They are able to apply appropriate technical components and processes for the design of multimedia systems.

## Grading through:
- exercises
- written or oral exam as announced by the examiner

## Responsible for this module:
- Prof. Dr.-Ing. Andreas Schrader

## Teacher:
- Institute of Telematics
- Prof. Dr.-Ing. Andreas Schrader

## Literature:
- Thomas Görne: Tontechnik - Hanser 2011
- Ulrich Schmidt: Professionelle Videotechnik - Springer 2009

## Language:
- English, except in case of only German-speaking participants
## CS2200 - Software Ergonomics (SoftErgo)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>each summer semester</td>
<td>4</td>
</tr>
</tbody>
</table>

### Course of study, specific field and term:
- Bachelor Media Informatics SJ14 (compulsory), media informatics, 2nd semester
- (optional subject), computer science, arbitrary semester
- Bachelor Medical Informatics (optional subject), software engineering, 4th to 6th semester
- Bachelor Computer Science (compulsory), foundations of computer science, 2nd semester

### Classes and lectures:
- Software Ergonomics (lecture with exercises, 3 SWS)

### Workload:
- 55 Hours private studies
- 45 Hours in-classroom work
- 20 Hours exam preparation

### Contents of teaching:
- Motivation and introduction
- Work systems
- Effects of work
- Mental and conceptual models
- User analysis and user modeling
- Models for human-computer systems
- Temporal behavior of interactive systems
- Quality criteria for interactive systems
- Evaluation of interactive systems
- Summary

### Qualification-goals/Competencies:
- The students know the basic theories, models and criteria for user- and application-centered interactive multimedia systems.
- They are able to transfer this knowledge into development processes and to evaluate interactive systems systematically.
- They can describe work systems as well as applications in education and entertainment in a user- and task-centered way.

### Grading through:
- exercises
- written exam

### Is requisite for:
- Bachelor Project UI and Media Design (CS3210)
- Lab class media and interaction design (CS3600)
- Usability Engineering (CS3201)
- Media Production and Media Programming (CS2601)
- Interaction Design (CS2600)

### Responsible for this module:
- Univ.-Prof. Dr. rer. nat. Michael Herczeg

### Teacher:
- Institute for Multimedia and Interactive Systems
  - Univ.-Prof. Dr. rer. nat. Michael Herczeg

### Literature:
- M. Herczeg: Software-Ergonomie - 3. Auflage, Oldenbourg-Verlag, 2009
- B. Shneiderman, C. Plaisant: Designing the User Interface - Addison-Wesley, 2009

### Language:
- offered only in German
## CS3050 - Coding and Security (CodeSich)

### Duration:
1 Semester

### Turnus of offer:
each summer semester

### Credit points:
4

### Course of study, specific field and term:
- Bachelor Medical Informatics SJ14 (optional subject), computer science, 5th or 6th semester
- Bachelor Media Informatics SJ14 (optional subject), computer science, 5th or 6th semester
- Bachelor Computer Science SJ14 (optional subject), central topics of computer science, 6th semester
- Bachelor Computer Science SJ14 (compulsory), specialization field IT security and safety, 2nd semester
- Master Computer Science (optional subject), advanced curriculum security, 2nd semester
- Bachelor Computer Science (compulsory), specialization field IT security and safety, 2nd semester
- Bachelor Medical Informatics (optional subject), computer science, 4th to 6th semester
- Master MML (optional subject), computer science, arbitrary semester
- Bachelor Computer Science (optional subject), central topics of computer science, 5th or 6th semester

### Classes and lectures:
- Coding and Security (lecture with exercises, 3 SWS)

### Workload:
- 65 Hours private studies and exercises
- 45 Hours in-classroom work
- 10 Hours exam preparation

### Contents of teaching:
- information, entropie
- discrete sources and channels
- coding systems, error-tolerant codes
- codes for digital media, compression
- threats to IT-systems
- formal definition of security properties
- security primitives

### Qualification-goals/Competencies:
- detailed knowledge of the basics of information and coding theory
- deep knowledge of the concept of information
- being able to model information sources and communication networks
- being able to formalize the security of IT-systems
- knowing scenarios of attacks and protection methods

### Grading through:
- exercises
- Viva Voce or test

### Responsible for this module:
- Prof. Dr. Rüdiger Reischuk

### Teacher:
- Institute for Theoretical Computer Science
  - Prof. Dr. Rüdiger Reischuk
  - Prof. Dr. Maciej Liskiewicz

### Literature:
- R. Roth: Introduction to Coding Theory - Cambridge Univ. Press 2006
- D. Salomon: Coding for Data and Computer Communications - Springer 2005
- D. Salomon: Data Privacy and Security - Springer 2003

### Language:
- German and English skills required
## MA1500 - Linear Algebra and Discrete Structures 2 (LADS2)

<table>
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<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>each summer semester</td>
<td>8</td>
</tr>
</tbody>
</table>

### Course of study, specific field and term:
- Bachelor Medical Informatics SJ14 (compulsory), mathematics, 2nd semester
- Bachelor MES SJ14 (compulsory), mathematics, 2nd semester
- Bachelor Computer Science SJ14 (compulsory: aptitude test), mathematics, 2nd semester
- Bachelor Medical Informatics (compulsory), mathematics, 2nd semester
- Bachelor MML (compulsory), mathematics, 2nd semester
- Bachelor MES (compulsory), mathematics, 2nd semester
- Bachelor Computer Science (compulsory: aptitude test), mathematics, 2nd semester

### Classes and lectures:
- Linear Algebra and Discrete Structures 2 (lecture, 4 SWS)
- Linear Algebra and Discrete Structures 2 (exercise, 2 SWS)

### Workload:
- 125 Hours private studies
- 90 Hours in-classroom work
- 25 Hours exam preparation

### Contents of teaching:
- Determinants
- Linear mappings
- Coding theory (introduction and applications)
- Orthogonality
- Eigenvalues

### Qualification-goals/Competencies:
- Students understand advanced concepts of linear algebra.
- Students understand advanced thoughts and proof techniques.
- Students can apply advanced concepts and proof techniques to algebraic problems.
- Students can explain advanced relationships in linear algebra.
- Interdisciplinary qualifications:
  - Students can transfer advanced theoretical concepts to similar applications.
  - Students have an advanced competence in modeling.
  - Students can work as a group on elementary mathematical problems.
  - Students can present elementary solutions to their problems in front of a group.

### Grading through:
- Presentation of one’s own solution of an exercise
- written exam
- exercises

### Is requisite for:
- Optimization (MA4030)
- Numerical Linear Algebra (MA4041)
- Mathematical Methods in Image Processing (MA4500)
- Image Registration (MA5030)

### Responsible for this module:
- Prof. Dr. Jan Modersitzki

### Teacher:
- Institute of Mathematics and Image Computing
- Prof. Dr. Jan Modersitzki
- N.N.

### Literature:
- D. Lau: Algebra und diskrete Mathematik I + II - Springer, 2007

**Language:**
- offered only in German
ME1500 - Fundamentals of Physics (GrundPhys)

Duration: 1 Semester
Turnus of offer: each summer semester
Credit points: 4

Course of study, specific field and term:
- Bachelor Computer Science SJ14 (compulsory), specialization field bioinformatics, 4th semester
- Bachelor MML (compulsory), life sciences, 4th semester
- Bachelor Computer Science (compulsory), specialization field bioinformatics, 2nd semester

Classes and lectures:
- Fundamentals of Physics (lecture, 2 SWS)
- Fundamentals of Physics (exercise, 1 SWS)

Workload:
- 60 Hours private studies and exercises
- 45 Hours in-classroom work
- 15 Hours exam preparation

Contents of teaching:
- Mechanics: Newton’s laws, laws of conversation, molecular dynamics, flow in vascular system
- Mechanical oscillations and waves: wave propagation, ultrasound, Doppler effect
- Thermodynamics: temperature, entropy, ideal gas, laws of thermodynamics
- Electricity & magnetism: electrostatic field, Coulomb’s law, Ohm’s law, Lorentz force, oscillating circuit, electromagnetic waves
- Optics: wave optics, polarization, geometrical optics, law of reflection, image equation
- Atomic physics: atomic structure, radioactivity, X-ray tube

Qualification-goals/Competencies:
- The students are able to describe the content of the fundamentals of physics and to develop and draw mathematically the corresponding models by use of physical formula.
- They can judge what fundamental physics can and cannot achieve in principle.
- They are able to transfer their acquired knowledge to simple practical applications.
- They are able to classify physical problems according to their complexity and draw the solutions. Thereby, they have the expertise to first analyze complex tasks and to structure them into subtasks.
- The students have social and communication competencies to discuss within smaller tutorial groups and the methodological competence to elucidate a common solution for the physical exercises.
- They have the communication competency to present their results in front of the tutorial group.

Grading through:
- exercises
- written exam

Responsible for this module:
- Prof. Dr. rer. nat. Alfred Vogel
- Dr. rer. nat. Norbert Linz

Teacher:
- Institute of Biomedical Optics
- Dr. rer. nat. Norbert Linz

Literature:
- Giancoli: Physik

Language:
- offered only in German
# Module Guide

## ME1550 - Einführung in die Medizintechnik (EinfMedtec)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
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</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>each summer semester</td>
<td>4</td>
</tr>
</tbody>
</table>

### Course of study, specific field and term:
- Bachelor Medical Informatics (compulsory), medical computer science, 2nd semester
- Bachelor MES (compulsory), medical engineering science, 2nd semester
- Bachelor Computer Science (compulsory), specialization field robotics and automation, 2nd semester
- Bachelor Computer Science (compulsory), specialization field medical informatics, 2nd semester

### Classes and lectures:
- Einführung in die Medizintechnik (lecture, 2 SWS)
- Einführung in die Medizintechnik (exercise, 1 SWS)

### Workload:
- 55 Hours private studies
- 45 Hours in-classroom work
- 20 Hours exam preparation

### Contents of teaching:
- Abriss zur historischen Entwicklung von Medizin und Medizintechnik
- Grundlagen der Anatomie und Physiologie
- Verfahren der Funktionsdiagnostik
- Bildgebende Systeme
- Therapiesysteme
- Monitoring
- Medizinische Informationsverarbeitung
- Wichtige gesetzliche Vorschriften
- Medizintechnische Anwendungen

### Qualification-goals/Competencies:
- Grundlagen der medizinischen Messtechnik
- Verständnis komplexer Zusammenhänge bei der Messtechnik physiologischer Parameter
- Kompetenz im Umgang mit Messunsicherheiten

### Grading through:
- written or oral exam as announced by the examiner
- exercises

### Responsible for this module:
- Prof. Dr. rer. nat. Thorsten Buzug

### Teacher:
- Institute of Medical Engineering
- MitarbeiterInnen des Instituts
- Prof. Dr. rer. nat. Thorsten Buzug

### Literature:
- :
- :
- :
- :
- :

### Language:
- offered only in German
## CS2300 - Software Engineering I (SWTech)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
<th>Max. group size:</th>
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</thead>
<tbody>
<tr>
<td>2 Semester</td>
<td>each winter semester</td>
<td>8</td>
<td>12</td>
</tr>
</tbody>
</table>

### Course of study, specific field and term:
- Bachelor Medical Informatics (compulsory), computer science, 3rd and 4th semester
- Bachelor MML (optional subject), computer science, 5th and 6th semester
- Bachelor Computer Science (compulsory), foundations of computer science, 3rd and 4th semester

### Classes and lectures:
- **Software Engineering I (lecture, 2 SWS)**
- **Software Engineering I (exercise, 1 SWS)**
- **Software Engineering I (project work, 3 SWS)**

### Workload:
- 60 Hours private studies and exercises
- 45 Hours in-classroom work
- 45 Hours in-classroom work
- 40 Hours group work
- 35 Hours work on project
- 15 Hours exam preparation

### Contents of teaching:
- overview on major fields of software engineering
- Software development, software process models
- Basic concepts of software systems
- System analysis and requirements engineering
- Software design and software architectures
- Implementation
- Testing and integration
- Installation, acceptance, maintainance

### Qualification-goals/Competencies:
- Understanding software design as an engineering process
- Knowledge of major software process models and description formalisms for software artefacts
- Ability to model software systems on different levels of abstraction
- Ability to systematically design software systems whose implementation meets the requirements
- Knowing the basic concepts of object-oriented modelling and design
- Usage of UML and CASE tools
- Qualification to work in a team, to present artefacts, to comply to standards and to observe time limits

### Grading through:
- exercises
- programming project
- written or oral exam as announced by the examiner

### Requires:
- Algorithms and Data Structures (CS1001)
- Programming (CS1000)

### Responsible for this module:
- Prof. Dr. Martin Leucker

### Teacher:
- Institute of Software Technology and Programming Languages
  - Prof. Dr. Martin Leucker

### Literature:
- B. Brügge, A. H. Dutot: Objektorientierte Softwaretechnik mit UML, Entwurfsmustern und Java - Pearson Studium 2004
- B. Oestereich: Analyse und Design mit der UML 2.1 - Objektorientierte Softwareentwicklung - Oldenbourg 2006
D. Bjorner: Software Engineering 1-3 - Springer 2006

Language:
- offered only in German
### CS2000 - Theoretical Computer Science (TI)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>each winter semester</td>
<td>8</td>
</tr>
</tbody>
</table>

#### Course of study, specific field and term:
- Bachelor MES (optional subject), computer science, 5th semester
- Bachelor Medical Informatics SJ14 (compulsory), computer science, 3rd semester
- Bachelor Computer Science SJ14 (compulsory), foundations of computer science, 3rd semester
- Bachelor Media Informatics SJ14 (compulsory), computer science, 3rd semester
- Bachelor Computer Science (compulsory), foundations of computer science, 3rd semester

#### Classes and lectures:
- Theoretical Computer Science (lecture, 4 SWS)
- Theoretical Computer Science (exercise, 2 SWS)

#### Workload:
- 135 Hours private studies and exercises
- 90 Hours in-classroom work
- 15 Hours exam preparation

#### Contents of teaching:
- Formalization of problems using languages
- formal grammars
- regular languages, finite automata
- context free language, push down automata
- sequential computational models: Turing machines, register machines
- sequential complexity classes
- simulations, reductions, completeness
- satisfiability problem, NP-completeness
- (In-)decidability and enumerability
- halting problem and Church-Turing thesis

#### Qualification-goals/Competencies:
- Students are able to present the theoretical foundation of syntax and operational semantics of programming languages
- They are able to transform formalizations using theorems of theoretical computer science.
- They can classify problems according to their computational complexity
- They are able to model algorithmic problems and solve them using appropriate tools
- They can judge what computer science can and cannot achieve in principle

#### Grading through:
- exercises and project assignments
- Viva Voce or test

#### Is requisite for:
- Algorithm Design (CS3000)
- Programming Languages (CS3052)
- Parallel Computing (CS3051)

#### Responsible for this module:
- Prof. Dr. Rüdiger Reischuk

#### Teacher:
- Institute for Theoretical Computer Science
- Prof. Dr. Rüdiger Reischuk
- Prof. Dr. rer. nat. Till Tantau
- Prof. Dr. Maciej Liskiewicz

#### Literature:
Language:
  - offered only in German
<table>
<thead>
<tr>
<th>Duration:</th>
<th>1 Semester</th>
<th>Turnus of offer:</th>
<th>each winter semester</th>
<th>Credit points:</th>
<th>4</th>
</tr>
</thead>
</table>

**Course of study, specific field and term:**
- Bachelor MES SJ14 (optional subject), computer science and electrical engineering, 5th semester
- Bachelor Medical Informatics SJ14 (optional subject), medical computer science, 5th or 6th semester
- Bachelor Computer Science SJ14 (optional subject), central topics of computer science, 5th semester
- Bachelor Computer Science SJ14 (compulsory), specialization field robotics and automation, 3rd semester
- Bachelor Medical Informatics (optional subject), applied computer science, 4th to 6th semester
- Bachelor Computer Science (optional subject), central topics of computer science, 5th semester
- Master MML (optional subject), computer science, 3rd semester
- Bachelor Medical Informatics (optional subject), medical engineering science, 3rd or 5th semester
- Bachelor Computer Science (compulsory), specialization field robotics and automation, 3rd semester

**Classes and lectures:**
- Robotics (lecture, 2 SWS)
- Robotics Exercise (exercise, 1 SWS)

**Workload:**
- 55 Hours private studies
- 45 Hours in-classroom work
- 20 Hours exam preparation

**Contents of teaching:**
- Description of serial robotic systems: This part includes the basic components like different types of joints, sensors and actors. Exemplarily, the differing kinematic types are introduced. Also, the mathematical backgrounds are presented, necessary for the description of robots. The direct and inverse kinematics for typical 6-jointed industrial robots is explained.
- Parallel robot systems: This part deals with the transfer of the results and mathematical models of part 1 onto robotic systems with parallel kinematics.
- Movement: Robot movements along trajectories/geometric paths are analyzed. Different techniques of path planning are presented as well as methods to determine the configuration space and to perform velocity planning and kinematics.
- Robot Control: Techniques of control theory and examples of programming techniques in robotics are introduced. Sensor and systems calibration as a typical application of robotics is explained in detail.

**Qualification-goals/Competencies:**
- The students are able to solve application-oriented exercises with mathematical background self-dependent, timely and in team work.
- They have gained basic understanding for the kinematic features of serial and simple parallel robots (includes knowledge of transformations, Euler-/Tail-Bryan-Angles, quaternions, etc.)
- They made first experiences with the programming of simple robotic applications.
- They comprehend the complexity and necessity for different path and dynamic planning techniques.
- The students gained an insight into simple methods for system and sensor calibration.

**Grading through:**
- written exam

**Is requisite for:**
- Lab Course Robotics and Automation (CS3501)

**Requires:**
- Analysis 1 (MA2000)
- Linear Algebra and Discrete Structures 1 (MA1000)

**Responsible for this module:**
- Prof. Dr.-Ing. Achim Schweikard

**Teacher:**
- Institute for Robotics and Cognitive Systems
- Prof. Dr.-Ing. Achim Schweikard
- Dr. rer. nat. Floris Ernst
Literature:

- A. Schweikard, F. Ernst: Medical Robotics - Springer Verlag, 2015
- M. Spong et al.: Robot Modeling and Control - Wiley & Sons, 2005
- J.-P. Merlet: Parallel Robots - Springer Verlag, 2006
- M. Haun: Handbuch Robotik - Springer Verlag, 2007
- S. Niku: Introduction to Robotics: Analysis, Control, Applications - Wiley & Sons, 2010

Language:

- offered only in German
# CS2600 - Interaction Design (InterakDes)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
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<tbody>
<tr>
<td>1 Semester</td>
<td>each winter semester</td>
<td>4</td>
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## Course of study, specific field and term:
- Bachelor Computer Science (optional subject), central topics of computer science, 5th semester
- Bachelor Medical Informatics (optional subject), computer science, 4th to 6th semester
- Bachelor Computer Science (compulsory), specialization field media informatics, 3rd semester

## Classes and lectures:
- Interaction Design (lecture with exercises, 3 SWS)

## Workload:
- 55 Hours private studies
- 45 Hours in-classroom work
- 20 Hours exam preparation

## Contents of teaching:
- Introduction and overview
- Basic models of multimedia and interactive systems
- System paradigms
- Design patterns
- Modalities of interaction
- Information output and output devices
- Information input and input devices
- Help systems
- History systems
- Activity management systems
- Individualization of interactive systems
- Summary

## Qualification-goals/Competencies:
- The students are able to use systematically and theoretically founded methods for the design of user interfaces of interactive systems.
- Besides the psychological and computer science basics they build up knowledge about methods from the areas of graphic design and communication design.
- They are capable of categorizing existing systems and develop concepts for improving them.

## Grading through:
- exercises
- written exam

## Is requisite for:
- Lab class media and interaction design (CS3600)
- Media Production and Media Programming (CS2601)
- Usability Engineering (CS3201)

## Requires:
- Software Ergonomics (CS2200)

## Responsible for this module:
- Dr. Thomas Winkler

## Teacher:
- Institute for Multimedia and Interactive Systems
- Dr. Thomas Winkler

## Literature:
- M. Herczeg: Interaktionsdesign - Oldenbourg-Verlag, 2006
- B. Shneiderman, C. Plaisant: Designing the User Interface - Addison-Wesley, 2009
Language:
  • offered only in German
### CS3410 - Lab Course IT Security (PraktSiZuv)

<table>
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<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
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<tbody>
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<td>1 Semester</td>
<td>each winter semester</td>
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</table>

**Course of study, specific field and term:**
- Bachelor Computer Science SJ14 (compulsory), specialization field IT security and safety, 5th semester
- Bachelor Computer Science (compulsory), specialization field IT security and safety, 3rd semester

**Classes and lectures:**
- Lab Course IT Security (practical course, 3 SWS)

**Workload:**
- 60 Hours work on project
- 30 Hours group work
- 30 Hours in-classroom work

**Contents of teaching:**
- security analysis for a specific application case
- design and implementation of methods to improve security

**Qualification-goals/Competencies:**
- practical experience in designing and implementing security tools

**Grading through:**
- successful addressing of the project goals
- documentation

**Responsible for this module:**
- Prof. Dr. Rüdiger Reischuk

**Teacher:**
- Institute for Theoretical Computer Science
  - Prof. Dr. Stefan Fischer
  - Prof. Dr. Martin Leucker
  - Prof. Dr. Rüdiger Reischuk

**Literature:**
- depends on the specific topic

**Language:**
- offered only in German
## LS1100-INF - Basic Chemistry (ChemINF)

| Duration: 1 Semester | Turnus of offer: each winter semester | Credit points: 4 |

**Course of study, specific field and term:**
- Bachelor Medical Informatics SJ14 (optional subject), medical computer science, 5th or 6th semester
- Bachelor MES SJ14 (optional subject), mathematics / natural sciences, 3rd or 5th semester
- Bachelor Computer Science SJ14 (compulsory), specialization field bioinformatics, 3rd semester
- Bachelor MES (optional subject), optional subject medical engineering science, 3rd or 5th semester
- Bachelor Medical Informatics (optional subject), bioinformatics, 4th to 6th semester
- Bachelor Computer Science (compulsory), specialization field bioinformatics, 3rd semester

**Classes and lectures:**
- Basic Chemistry (lecture, 2 SWS)
- Basic Chemistry (exercise, 1 SWS)

**Contents of teaching:**
- Organisation of matter and the periodic table of the elements
- Chemical bonds, molecules and ions
- Chemical formula and stoichiometry
- The three-dimensional structure of molecules: From the VSEPR model to molecular orbitals
- Special properties of water
- Chemical Equilibrium
- Acids and Bases
- Redox reactions and electrochemistry
- Complexes and metal-ligand bonds
- Interactions between matter and radiation - Spectroscopy
- Thermodynamics
- Chemical Kinetics

**Qualification-goals/Competencies:**
- Understanding basic chemical concepts
- Basics of inorganic chemistry

**Grading through:**
- written exam

**Responsible for this module:**
- PD Dr. phil. nat. Thomas Weimar

**Teacher:**
- Institute of Chemistry
- Dr. Kerstin Lüdtke-Buzug
- PD Dr. phil. nat. Thomas Weimar

**Literature:**
- Schmuck et al.: Chemie für Mediziner - Pearson Studium
- Binnewies et al.: Allgemeine und Anorganische Chemie - Spektrum

**Language:**
- offered only in German
## MA2000 - Analysis 1 (Ana1)

<table>
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<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
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<td>each winter semester</td>
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### Course of study, specific field and term:
- Bachelor Medical Informatics SJ14 (compulsory), mathematics, 1st semester
- Bachelor Media Informatics SJ14 (compulsory), mathematics, 1st semester
- Bachelor MES SJ14 (compulsory, aptitude test), mathematics, 1st semester
- Bachelor Computer Science SJ14 (compulsory), mathematics, 1st semester
- Bachelor Medical Informatics (compulsory), mathematics, 3rd semester
- Bachelor MML (compulsory), mathematics, 1st semester
- Bachelor MES (compulsory), mathematics, 1st semester
- Bachelor Computer Science (compulsory), mathematics, 3rd semester

### Classes and lectures:
- Analysis 1 (lecture, 4 SWS)
- Analysis 1 (exercise, 2 SWS)

### Workload:
- 125 Hours private studies
- 90 Hours in-classroom work
- 25 Hours exam preparation

### Contents of teaching:
- Sequences and series
- Functions and continuity
- Differentiability, Taylor series
- Multivariate differential calculus

### Qualification-goals/Competencies:
- Teaching the basics of mathematical thought
- The students learn to understand fundamental terms of analysis such as convergence, continuity, differentiability
- The students acquire secure competence in using terms, equations, inequations, functions
- The students learn to apply different proof techniques

### Grading through:
- exercises
- written exam

### Is requisite for:
- Analysis 2 (MA2500)

### Responsible for this module:
- Prof. Dr. rer. nat. Jürgen Prestin

### Teacher:
- Institute for Mathematics
- Prof. Dr. rer. nat. Jürgen Prestin

### Literature:
- K. Fritzsche: Grundkurs Analysis 1 +2
- H. Heuser: Lehrbuch der Analysis 1+2

### Language:
- offered only in German
## MZ2100 A - Module Part: Course Anatomy (Anatomie)

<table>
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<th>Duration:</th>
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<td>1 Semester</td>
<td>each winter semester</td>
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### Course of study, specific field and term:
- Bachelor MES SJ14 (compulsory), medicine, 1st semester
- Bachelor Medical Informatics SJ14 (compulsory), medical computer science, 1st semester
- Bachelor Medical Informatics (compulsory), medical computer science, 1st semester
- Bachelor MES (compulsory), medicine, 1st semester
- Bachelor Computer Science (compulsory), specialization field medical informatics, 3rd semester

### Classes and lectures:
- Anatomy (lecture, 2 SWS)

### Workload:
- 45 Hours private studies
- 30 Hours in-classroom work
- 15 Hours exam preparation

### Contents of teaching:
- ...
- ...
- ...
- ...
- ...
- ...

### Qualification-goals/Competencies:
- ...
- ...
- ...
- ...
- ...

### Grading through:
- written exam

### Responsible for this module:
- Prof. Dr. med. Jürgen Westermann

### Teacher:
- Institute of Anatomy
- Dr. med. Reinhard Eggers

### Literature:

### Language:
- offered only in German
<table>
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<th>Duration: 1 Semester</th>
<th>Turnus of offer: each winter semester</th>
<th>Credit points: 3</th>
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**Course of study, specific field and term:**
- Bachelor Medical Informatics SJ14 (compulsory), medical computer science, 3rd semester
- Bachelor MES SJ14 (compulsory), medicine, 1st semester
- Bachelor Medical Informatics (compulsory), medical computer science, 1st semester
- Bachelor MES (compulsory), medicine, 1st semester
- Bachelor Computer Science (compulsory), specialization field medical informatics, 3rd semester

**Classes and lectures:**
- Pathology (lecture, 2 SWS)

**Workload:**
- 45 Hours private studies
- 30 Hours in-classroom work
- 15 Hours exam preparation

**Contents of teaching:**
- To place the specialty of pathology in the context of medicine as a whole (looking to history and future)
- Specific methods of investigation in pathology
- To define terms like health, illness, death, aetiology, pathogenesis
- To define typical terms of medical statistics
- Description of morphological changes of cells and tissue with implications to diagnosis
- Basic mechanisms of pathogenesis, typical clinical progression of disease in different organ systems
- IT-applications in the area of pathology which support diagnostic work (Lab-devices, interfaces to connect lab and clinical systems as well as a private doctor’s office, tele pathology)

**Qualification-goals/Competencies:**
- Students are able to relate important historical dates and persons of pathology to diagnostic methods. They can describe methods like descriptive pathology, gross section, immunohistochemistry and molecular pathology.
- They are able to define terms like health, illness, death, aetiology and pathogenesis. Evaluating a case report, they will recognize the right definition.
- They are able to evaluate a given problem and determine appropriate descriptive terms like incidence or mortality.
- They are able to analyse a small case report. They will recognize and explain different changes of cells and tissues in connection to a limited number of given diagnoses.
- They are able to name and describe different informatics application which are used in the pathology lab.
- They can specify the needs a pathologist will have to the technology. This will cover the benefit and the usability for the diagnostic work.

**Grading through:**
- written exam

**Responsible for this module:**
- Prof. Dr. med. Alfred C. Feller

**Teacher:**
- Department of Pathology
- MitarbeiterInnen des Instituts
- Dipl.-Ing. Harald Hatje

**Literature:**

**Language:**
- offered only in German
<table>
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<th>Duration:</th>
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<tr>
<td>1 Semester</td>
<td>each winter semester</td>
<td>6</td>
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</tbody>
</table>

**Course of study, specific field and term:**
- Bachelor Computer Science (compulsory), specialization field medical informatics, 3rd semester

**Classes and lectures:**
- MZ2100 B (course, 2 SWS)
- MZ2100 A (course, 2 SWS)

**Workload:**
- 90 Hours private studies
- 60 Hours in-classroom work
- 30 Hours exam preparation

**Contents of teaching:**

**Qualification-goals/Competencies:**

**Grading through:**
- written exam

**Responsible for this module:**
- Prof. Dr. med. Jürgen Westermann

**Teacher:**
- Department of Pathology
- Institute of Anatomy
- Prof. Dr. med. Jürgen Westermann
- N.N.

**Language:**
- offered only in German
# CS2100 - Computer Architecture and Embedded Systems (RAES)

**Duration:** 1 Semester  
**Turnus of offer:** each summer semester  
**Credit points:** 8

**Course of study, specific field and term:**  
- Bachelor Computer Science (compulsory), foundations of computer science, 4th semester

**Classes and lectures:**  
- Modulteil CS2100 A: Rechnerarchitektur (course, 3 SWS)  
- Modulteil CS2100 B: Embedded Systems (course, 3 SWS)

**Contents of teaching:**  
- see the module parts

**Qualification-goals/Competencies:**  
- Students know the microarchitectures of modern processors and the corresponding methods for performance enhancement (caches, pipelining, VLIW etc.) as well other important computer components (busses, storage hierarchies, I/O-units)  
- They have knowledge about the most important parallel computer architectures (multiprocessors, vector processors etc.)  
- They are able to judge methods for performance evaluation (benchmarks, monitoring, queuing models etc.) and to make use of them  
- They have an overview on the principles of non-von-Neumann computers (data flow computers, reduction machines etc.)  
- They know the most important target hardware architectures for embedded systems  
- They are able to model embedded systems conceptionally and to specify them formally  
- They are well acquainted with the model-based design, tool-based implementation and test of simple embedded systems

**Grading through:**  
- exercises  
- written exam

**Requires:**  
- Fundamentals of Computer Engineering (CS1200)

**Responsible for this module:**  
- Prof. Dr.-Ing. Erik Maehle  
- Prof. Dr.-Ing. Thilo Pionteck

**Teacher:**  
- Institute of Computer Engineering

**Literature:**  
- :

**Language:**  
- offered only in German
# CS2100 A - Module part: Computer Architecture (RA)

<table>
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<tr>
<th>Duration:</th>
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<tbody>
<tr>
<td>Turnus of offer:</td>
<td>each summer semester</td>
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<tr>
<td>Credit points:</td>
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</tbody>
</table>

## Course of study, specific field and term:
- Bachelor Computer Science (compulsory), foundations of computer science, 4th semester

## Classes and lectures:
- Computer Architecture (lecture, 2 SWS)
- Computer Architecture (exercise, 1 SWS)

## Workload:
- 60 Hours private studies
- 45 Hours in-classroom work
- 15 Hours exam preparation

## Contents of teaching:
- Basic terms and concepts
- Modern processor architectures
- Computer components
- Multiprocessors, multicomputer
- Vector processors, array processors
- Performance evaluation
- Non-von-Neumann computers

## Qualification-goals/Competencies:
- Students know the microarchitectures of modern processors and the corresponding methods for performance enhancement (caches, pipelining, VLIW etc.) as well other important computer components (busses, storage hierarchies, I/O-units)
- They have knowledge about the most important parallel computer architectures (multiprocessors, vector processors etc.)
- They are able to judge methods for performance evaluation (benchmarks, monitoring, queuing models etc.) and to make use of them
- They have an overview on the principles of non-von-Neumann computers (data flow computers, reduction machines etc.)

## Grading through:
- exercises
- written exam

## Requires:
- Fundamentals of Computer Engineering (CS1200)

## Responsible for this module:
- **Prof. Dr.-Ing. Erik Maehle**

## Teacher:
- Institute of Computer Engineering
- **Prof. Dr.-Ing. Erik Maehle**

## Literature:
- D.A. Patterson, J.L. Hennessy: Rechnerorganisation und -entwurf - Die Hardware/Software-Schnittstelle - Oldenbourg Wissenschaftsverlag 2011

## Language:
- offered only in German
# CS2100 B - Module part: Embedded Systems (EmbedSa)

<table>
<thead>
<tr>
<th>Duration:</th>
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<tbody>
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<td>Turnus of offer:</td>
<td>each summer semester</td>
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<tr>
<td>Credit points:</td>
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</tbody>
</table>

## Course of study, specific field and term:
- Bachelor Computer Science (compulsory), foundations of computer science, 4th semester

## Classes and lectures:
- Embedded Systems (exercise, 1 SWS)
- Embedded Systems (lecture, 2 SWS)

## Workload:
- 60 Hours private studies
- 45 Hours in-classroom work
- 15 Hours exam preparation

## Contents of teaching:
- Target architectures (microcontrollers, FPGAs etc.)
- Conceptional models
- Peripheral buses
- Scheduling algorithms
- Specification languages
- Transformation from specification to implementation
- Development tools

## Qualification-goals/Competencies:
- Students are able to explain the differences between desktop systems and embedded systems.
- They are able to select an appropriate hardware architecture for an embedded system.
- They are able to select appropriate communication protocols for interfacing peripheral components.
- They are able to control peripheral components with a microcontroller.
- They are able to model embedded systems conceptually and to specify them formally.
- They are well acquainted with the model-based design and tool-based implementation and of simple embedded systems.

## Grading through:
- exercises
- written exam

## Requires:
- Fundamentals of Computer Engineering (CS1200)

## Responsible for this module:
- Prof. Dr.-Ing. Thilo Pionteck

## Teacher:
- Institute of Computer Engineering
- Prof. Dr.-Ing. Thilo Pionteck

## Literature:
- U. Brinkschulte, T. Ungerer: Mikrocontroller und Mikroprozessoren - Berlin: Springer 2010

## Language:
- offered only in German
# CS2150 - Computer Networks (CN)

<table>
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<th>Duration:</th>
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<tbody>
<tr>
<td>1 Semester</td>
<td>each summer semester</td>
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</table>

## Course of study, specific field and term:
- Bachelor Medical Informatics (compulsory), computer science, 4th semester
- Bachelor MES (optional subject), applied computer science, 6th semester
- Bachelor Computer Science (compulsory), foundations of computer science, 4th semester

## Classes and lectures:
- Computer Networks (lecture, 2 SWS)
- Computer Networks (exercise, 1 SWS)

## Workload:
- 65 Hours private studies
- 45 Hours in-classroom work
- 10 Hours exam preparation

## Contents of teaching:
- Computer Networks and the Internet
- Application Layer
- Transport Layer
- Network Layer
- Link and Physical Layer

## Qualification-goals/Competencies:
- At the end of the course, students know the most important concepts of computer networks
- Students know the importance of the different layers of the OSI and Internet protocol suite along with the most important protocols and services of each layer
- The students are able to decide which network technologies to use to meet the requirements of any given application scenario
- The students know how the Internet works and are able to program small applications
- Students can apply the most important methods and algorithms from the field of networks

## Grading through:
- exercises
- written exam

## Responsible for this module:
- Prof. Dr. Stefan Fischer

## Teacher:
- Institute of Telematics
- Prof. Dr. Stefan Fischer

## Literature:
- Andrew S. Tanenbaum: Computernetzwerke - Pearson Studium, 2012

## Language:
- offered only in German
## CS2601 - Media Production and Media Programming (MedienProd)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>1 Semester</th>
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<td>Turnus of offer:</td>
<td>each summer semester</td>
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<tr>
<td>Credit points:</td>
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</tbody>
</table>

### Course of study, specific field and term:
- Bachelor Computer Science (compulsory), specialization field media informatics, 4th semester

### Classes and lectures:
- Media Production and Media Programming (lecture with exercises, 3 SWS)

### Workload:
- 55 Hours private studies and exercises
- 45 Hours in-classroom work
- 20 Hours exam preparation

### Contents of teaching:
- Introduction and Overview
- Media production: Graphics and Images
- Media production: Movies and Animations
- Media production: Audio
- Media production: 3D-Modelling
- Media production: Hypermedia
- Media production: Content-Management-Systems
- Media programming: Models and architectures
- Media programming: Interfaces
- Media programming: Languages and libraries
- Summary and Outlook

### Qualification-goals/Competencies:
- Students can evaluate technical production methods and tools for programming and production of interactive multimedia computer applications.
- Students can develop and prototype problem-oriented concepts for interactive multimedia computer applications.

### Grading through:
- exercises, project, oral or written exam

### Requires:
- Interaction Design (CS2600)
- Software Ergonomics (CS2200)

### Responsible for this module:
- Univ.-Prof. Dr. rer. nat. Michael Herczeg

### Teacher:
- Institute for Multimedia and Interactive Systems
- Univ.-Prof. Dr. rer. nat. Michael Herczeg
- Prof. Dr.-Ing. Nicole Jochems
- MitarbeiterInnen des Instituts

### Literature:
- M. Herczeg: Interaktionsdesign - München: Oldenbourg-Verlag, 2006
- M. Herczeg: Software-Ergonomie - 3. Auflage, Oldenbourg-Verlag, 2009

### Language:
- offered only in German
<table>
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<th>Turnus of offer:</th>
<th>each summer semester</th>
<th>Credit points:</th>
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**Course of study, specific field and term:**

- Bachelor MES (optional subject), computer science, 4th or 6th semester
- Bachelor Medical Informatics SJ14 (compulsory), computer science, 4th semester
- Bachelor MES SJ14 (optional subject), computer science and electrical engineering, 4th or 6th semester
- Bachelor Media Informatics SJ14 (compulsory), foundations of computer science, 4th semester
- Bachelor Computer Science SJ14 (compulsory), foundations of computer science, 4th semester
- Bachelor Medical Informatics (compulsory), computer science, 2nd semester
- Master MML (optional subject), computer science, 2nd semester
- Bachelor MML (optional subject), computer science, 6th semester
- Bachelor Computer Science (compulsory), foundations of computer science, 4th semester

**Classes and lectures:**

- Databases (lecture, 2 SWS)
- Databases (exercise, 1 SWS)

**Workload:**

- 55 Hours private studies
- 45 Hours in-classroom work
- 20 Hours exam preparation

**Contents of teaching:**

- ...

**Qualification-goals/Competencies:**

- ...

**Grading through:**

- exercises
- written exam

**Is requisite for:**

- Nonstandard Database Systems (CS3202)

**Requires:**

- Introduction to Programming (CS1000SJ14)
- Algorithms and Data Structures (CS1001)
- Programming (CS1000)

**Responsible for this module:**

- Prof. Dr. rer. nat. habil. Ralf Möller

**Teacher:**

- Institute of Information Systems
- Prof. Dr. rer. nat. habil. Ralf Möller
<table>
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</table>
# CS3052 - Programming Languages (ProgLan)

**Duration:** 1 Semester  
**Turnus of offer:** each summer semester  
**Credit points:** 4

### Course of study, specific field and term:

- Master Computer Science (compulsory), advanced curriculum programming, 2nd or 3rd semester
- Bachelor Computer Science (compulsory), specialization field IT security and safety, 4th semester
- Bachelor MML (optional subject), computer science, 5th or 6th semester
- Bachelor Computer Science (optional subject), central topics of computer science, 5th or 6th semester

### Classes and lectures:

- Progamming Languages (lecture, 2 SWS)
- Progamming Languages (exercise, 1 SWS)

### Workload:

- 60 Hours private studies and exercises
- 45 Hours in-classroom work
- 15 Hours exam preparation

### Contents of teaching:

- Overview on programming languages
- Syntactic description of programming languages
- Language elements for data structures
- Type systems for programming languages
- Language elements for control structures
- Language elements for abstraction and modularization
- Typing and type systems
- Semantics of programming languages
- Language paradigms
- Language elements for concurrent programming
- Tools for programming languages

### Qualification-goals/Competencies:

- The students can characterize major programming languages and can compare their application domains.
- They can understand, adapt and extend syntactic and semantic descriptions of programming languages.
- They can analyse the structure and principles of programming languages.
- They can learn on their own and classify new language elements.
- They can argue on the support of type systems for writing correct programs.
- They can evaluate possible programming languages for an application.

### Grading through:

- exercises
- written or oral exam as announced by the examiner

### Requires:

- Theoretical Computer Science (CS2000)
- Algorithms and Data Structures (CS1001)
- Programming (CS1000)

### Responsible for this module:

- Prof. Dr. Martin Leucker

### Teacher:

- Institute of Software Technology and Programming Languages
- Dr. Annette Stümpel
- Prof. Dr. Martin Leucker

### Literature:

- T.W. Pratt, M.V. Zelkowitz: Programming Languages: Design and Implementation - Prentice Hall 2000
<table>
<thead>
<tr>
<th>Language:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>German and English skills required</td>
<td></td>
</tr>
</tbody>
</table>
CS3204 - Artificial Intelligence 1 (KI1)

Duration: 1 Semester
Turnus of offer: each summer semester
Credit points: 4

Course of study, specific field and term:
- Bachelor Medical Informatics SJ14 (optional subject), computer science, 5th or 6th semester
- Bachelor Media Informatics SJ14 (optional subject), computer science, 5th or 6th semester
- Bachelor Computer Science SJ14 (optional subject), central topics of computer science, 6th semester
- Bachelor Computer Science SJ14 (compulsory), specialization field robotics and automation, 6th semester
- Bachelor Medical Informatics (optional subject), applied computer science, 4th to 6th semester
- Bachelor MML (optional subject), computer science, 6th semester
- Bachelor MES (optional subject), medical engineering science, 6th semester
- Bachelor Computer Science (compulsory), specialization field robotics and automation, 4th semester
- Bachelor Computer Science (optional subject), central topics of computer science, 5th or 6th semester

Classes and lectures:
- Artificial Intelligence (lecture, 2 SWS)
- Artificial Intelligence (exercise, 1 SWS)

Workload:
- 55 Hours private studies
- 45 Hours in-classroom work
- 20 Hours exam preparation

Contents of teaching:
- Part 1: Search strategies
  As an introduction and a prerequisite for most of the principles of artificial intelligence search strategies are introduced and explained. We will introduce uninformed, informed, local search, adversial search as well as heuristic search. The concept of agents will be presented.
- Part 2: Learning and reasoning
  Revision of the foundations of mathematical logic and probability. Principles of machine learning (supervised and unsupervised) are introduced. An introduction to fuzzy logic is also included.
- Part 3: Applications of artificial intelligence
  Typical applications in the fields or robotics, machine vision, and industrial image and data processing are identified. Ethical issues and risks of the development of artificial intelligence are discussed.

Qualification-goals/Competencies:
- The students are able to handle scope-oriented tutorials with a mathematical background in a team, and timely.
- They have developed an understanding for the benefits and disadvantages of the different search and problem solving techniques.
- The students are in a position to choose and apply independently appropriate algorithms for search and learning issues.
- They have gained an insight into the complex development of systems with artificial intelligence and the distinction of its various forms.
- The students have an understanding of the risks and possible technological consequences of the development of systems with strong AI.

Grading through:
- written exam

Is requisite for:
- Artificial Intelligence 2 (CS5204)

Responsible for this module:
- Prof. Dr.-Ing. Achim Schweikard

Teacher:
- Institute for Robotics and Cognitive Systems
- Prof. Dr.-Ing. Achim Schweikard
- MitarbeiterInnen des Instituts
- Dr. rer. nat. Floris Ernst

Literature:
- C-M. Bishop: Pattern Recognition and Machine Learning - Springer Verlag, 2007
<table>
<thead>
<tr>
<th>Language:</th>
<th>offered only in German</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notes:</td>
<td>Desirable pre-condition for a CS3701 Project in the field of Artificial Intelligence</td>
</tr>
</tbody>
</table>
# CS3300 - Informatics in Health Care - eHealth (eHealth)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Course of study, specific field and term:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>• Bachelor Computer Science (compulsory), specialization field medical informatics, 4th semester</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Classes and lectures:</th>
<th>Credit points:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Informatics in Health Care - eHealth (lecture, 2 SWS)</td>
<td>5</td>
</tr>
<tr>
<td>Informatics in Health Care - eHealth (exercise, 2 SWS)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Workload:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 70 Hours private studies</td>
</tr>
<tr>
<td>• 60 Hours in-classroom work</td>
</tr>
<tr>
<td>• 20 Hours exam preparation</td>
</tr>
</tbody>
</table>

## Contents of teaching:

- Health Care System: organization, legislation and funding
- Distributed patient care and patient records
- Medical Documentation and Communication
- Coding of diagnoses and procedures
- Hospital Information Systems
- DRG-based compensation system and accounting of cases
- Telematics in medicine: electronic health insurance card

## Qualification-goals/Competencies:

- Insight into the methods and procedures of subfields of medical informatics
- Ability to independent processing of selected tasks with specialized tools
- Ability to assess the upcoming IT challenges in view of the current political and economical developments in the health care system

## Grading through:

- exercises
- written or oral exam as announced by the examiner

## Responsible for this module:

- Prof. Dr. rer. nat. habil. Heinz Handels

## Teacher:

- Institute of Medical Informatics
- PD Dr. rer. nat. habil. Josef Ingenerf

## Literature:

- P. Haas: Medizinische Informationssysteme und Elektronische Krankenakten - Berlin: Springer 2005

## Language:

- offered only in German
**LS2500 - Biology (Bio)**

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>each summer semester</td>
<td>4</td>
</tr>
</tbody>
</table>

**Course of study, specific field and term:**
- Bachelor Computer Science SJ14 (compulsory), specialization field bioinformatics, 2nd semester
- Bachelor MES (optional subject), medical engineering science (expiring), 4th semester
- Bachelor Computer Science (compulsory), specialization field bioinformatics, 4th semester

**Classes and lectures:**
- Biology for computer scientists (lecture, 2 SWS)
- Biology for computer scientists (practical course, 1 SWS)

**Workload:**
- 75 Hours private studies
- 45 Hours in-classroom work

**Contents of teaching:**
- Structure and function of biological macromolecules
- structure and function of biological macromolecules
- structure of cells
- cytoskeleton
- chromosomes
- epigenetics
- replication
- transcription
- translation
- cell cycle
- mitosis
- formal genetics
- mutation and inherited disease
- Viruses

**Qualification-goals/Competencies:**
- Ability, to understand and reproduce the basics in the areas listed under "content of teaching" and to use them in the further studies

**Grading through:**
- written exam

**Is requisite for:**
- Molecular Genetics (LS3100)

**Responsible for this module:**
- Prof. Dr. rer. nat. Enno Hartmann

**Teacher:**
- Institute for Biology
- Prof. Dr. rer. nat. Enno Hartmann
- PD Dr. rer. nat. Bärbel Kunze
- Prof. Dr. rer nat. Rainer Duden
- Dr. rer. nat. Nicole Sommer

**Literature:**
- Campbell & Reece: Biologie - Pearson
- Purves, Sadava, Orians, Heller: Biologie - Spektrum
- Markl - Klett

**Language:**
- offered only in German
MA2500 - Analysis 2 (Ana2)

Duration: 1 Semester  
Turnus of offer: each summer semester  
Credit points: 4

Course of study, specific field and term:
- Bachelor Medical Informatics SJ14 (compulsory), mathematics, 2nd semester
- Bachelor Computer Science SJ14 (compulsory), mathematics, 2nd semester
- Bachelor Medical Informatics (compulsory), mathematics, 4th semester
- Bachelor MES (compulsory), mathematics, 2nd semester
- Bachelor Computer Science (compulsory), mathematics, 4th semester

Classes and lectures:
- Analysis 2 (lecture, 2 SWS)
- Analysis 2 (exercise, 1 SWS)

Workload:
- 60 Hours private studies
- 45 Hours in-classroom work
- 15 Hours exam preparation

Contents of teaching:
- indefinite and definite integrals
- fundamental theorem of calculus
- function series, power series
- trigonometric polynomials
- Fourier series, Fourier coefficients
- convergence of Fourier series

Qualification-goals/Competencies:
- The students gain a deeper insight into some selected aspects of analysis.

Grading through:
- exercises
- written exam

Is requisite for:
- Optimization (MA4030)
- Mathematical Methods in Image Processing (MA4500)
- Image Registration (MA5030)

Requires:
- Analysis 1 (MA2000)

Responsible for this module:
- Prof. Dr. rer. nat. Jürgen Prestin

Teacher:
- Institute for Mathematics
- Prof. Dr. rer. nat. Jürgen Prestin

Literature:
- H. Heuser: Lehrbuch der Analysis 1+2
- K. Fritzsche: Grundkurs Analysis 1+2
- N. Henze: Stochastik für Einsteiger
- U. Krengel: Einführung in die Wahrscheinlichkeitstheorie und Statistik

Language:
- offered only in German
MA2510 - Stochastics 1 (Stoch1)

Duration: 1 Semester
Turnus of offer: each summer semester
Credit points: 4

Course of study, specific field and term:
- Bachelor Medical Informatics SJ14 (optional subject), mathematics, 5th or 6th semester
- Bachelor MES SJ14 (optional subject), mathematics / natural sciences, 4th or 6th semester
- Bachelor Computer Science SJ14 (compulsory), mathematics, 4th semester
- Bachelor Computer Science (compulsory), mathematics, 4th semester
- Bachelor MES (compulsory), mathematics, 4th semester
- Bachelor MML (compulsory), mathematics, 2nd semester

Classes and lectures:
- Stochastics 1 (lecture, 2 SWS)
- Stochastic 1 (exercise, 1 SWS)

Workload:
- 65 Hours private studies and exercises
- 45 Hours in-classroom work
- 10 Hours exam preparation

Contents of teaching:
- probability spaces
- basics of combinatorics
- conditional probability and stochastic independency
- random variables
- important discrete and continuous one-dimensional probability distributions
- characteristics of distributions
- law of large numbers, central limit theorem
- modeling examples from the life sciences

Qualification-goals/Competencies:
- Students are able to explain basic stochastic models formally correct and in the context of their application
- They are able to formalize stochastic problems
- They are able to identify basic combinatorial patterns and to use them for solving stochastic problems
- They understand central statements of elementary stochastics

Grading through:
- exercises
- written exam

Is requisite for:
- Stochastic processes and modeling (MA4610)
- Modeling Biological Systems (MA4450-MML)
- Modeling Biological Systems (MA4450)
- Stochastics 2 (MA4020-MML)
- Stochastics 2 (MA4020)

Requires:
- Analysis 1 (MA2000)

Responsible for this module:
- Prof. Dr. Karsten Keller

Teacher:
- Institute for Mathematics
- Prof. Dr. Karsten Keller

Literature:
- N. Henze: Stochastik für Einsteiger - Vieweg
- U. Krengel: Einführung in die Wahrscheinlichkeitstheorie - Vieweg
<table>
<thead>
<tr>
<th>Language:</th>
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<tr>
<td>- offered only in German</td>
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## CS3051 - Parallel Computing (ParallelVa)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
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</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>normally each year in the summer semester</td>
<td>4</td>
</tr>
</tbody>
</table>

### Course of study, specific field and term:
- Master Medical Informatics SJ14 (optional subject), computer science, 1st or 2nd semester
- Bachelor Computer Science SJ14 (optional subject), central topics of computer science, 5th or 6th semester
- Master Computer Science (optional subject), advanced curriculum programming, 2nd and 3rd semester
- Bachelor Computer Science (optional subject), central topics of computer science, 5th or 6th semester
- Master Computer Science (optional subject), advanced curriculum algorithmics and complexity theory, 2nd or 3rd semester

### Classes and lectures:
- Parallel Computing (lecture with exercises, 3 SWS)

### Workload:
- 65 Hours private studies and exercises
- 45 Hours in-classroom work
- 10 Hours exam preparation

### Contents of teaching:
- Parallel architectures
- Programming language support for parallel programming
- Design methodologies for parallel algorithms
- Implementation of parallel algorithms
- Parallel search and sorting
- Parallel graph algorithms
- Parallel formula evaluation
- Speedup, efficiency, parallel complexity classes
- Limits of parallelism and lower bounds

### Qualification-goals/Competencies:
- Students are able to describe the design and function of parallel systems.
- They are able to design and implement parallel algorithms.
- They are able to analyze parallel systems and programs.
- They are able to describe the limits of parallel systems.

### Grading through:
- exercises and project assignments
- Viva Voce or test

### Requires:
- Theoretical Computer Science (CS2000)

### Responsible for this module:
- Prof. Dr. rer. nat. Till Tantau

### Teacher:
- Institute for Theoretical Computer Science
- Prof. Dr. rer. nat. Till Tantau

### Literature:
- Jaja: An Introduction to Parallel Algorithms - Addison Wesley, 1992
- Quinn: Parallel Programming in C with MPI and OpenMP - McGraw Hill, 2004

### Language:
- English, except in case of only German-speaking participants
# CS3110 - Computer-Aided Design of Digital Circuits (SchaltEntw)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Credit points:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>4</td>
</tr>
</tbody>
</table>

## Course of study, specific field and term:
- Bachelor MES SJ14 (optional subject), computer science and electrical engineering, 5th or 6th semester
- Bachelor Computer Science SJ14 (optional subject), central topics of computer science, 5th or 6th semester
- Bachelor MES (optional subject), applied computer science, 3rd, 5th, or 6th semester
- Bachelor MML (optional subject), computer science, 5th or 6th semester
- Bachelor Computer Science (optional subject), central topics of computer science, 5th or 6th semester

## Classes and lectures:
- Computer-Aided Design of Digital Circuits (lecture, 2 SWS)
- Computer-Aided Design of Digital Circuits (exercise, 1 SWS)

## Contents of teaching:
- Abstraction levels in circuit design
- Design cycle and design strategies
- FPGA architectures
- Introduction of the hardware description language VHDL
- Design of standard components in VHDL
- Circuit design at different abstraction levels
- Circuit design for synthesis
- VHDL simulation cycle
- VHDL circuit design for FPGAs
- Designing Testbenches
- High-Level-Synthesis

## Qualification-goals/Competencies:
- Based on a non-formal description of a digital system, students are able to design digital circuits using VHDL
- They are able to simulate and test VHDL descriptions
- They are able to explain the internal structures of FPGAs
- They are able to determine which VHDL construct will result in which circuit structure
- They are able to explain the VHDL simulation cycle
- They are able to write synthesizable VHDL code

## Grading through:
- exercises
- Viva Voce
- written exam

## Requires:
- Fundamentals of Computer Engineering 2 (CS1202)

## Responsible for this module:
- Prof. Dr.-Ing. Thilo Pionteck

## Teacher:
- Institute of Computer Engineering
- Prof. Dr.-Ing. Thilo Pionteck

## Literature:
- F. Kesel, R. Bartholomä: Entwurf von digitalen Schaltungen und Systemen mit HDLs und FPGAs - Oldenbour Verlag 2009
- C.Maxfield: The Design Warrior’s Guide to FPGAs - Newnes 2004

## Language:

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56
offered only in German
| Duration: 1 Semester | Turnus of offer: each winter semester | Credit points: 4 |

**Course of study, specific field and term:**
- Master MES (optional subject), mathematics, 1st semester
- Master MES (advanced curriculum), imaging systems, signal and image processing, 1st semester
- Bachelor Computer Science (optional subject), central topics of computer science, 5th or 6th semester
- Bachelor MES (optional subject), medical engineering science, 3rd or 5th semester
- Bachelor Computer Science (compulsory), specialization field robotics and automation, 5th semester

**Classes and lectures:**
- Electronics and Microsystems (lecture, 2 SWS)
- Electronics and Microsystems (exercise, 1 SWS)

**Workload:**
- 55 Hours private studies
- 45 Hours in-classroom work
- 20 Hours exam preparation

**Contents of teaching:**
- Analysis of DC-networks
- Transient analysis in the time-domain
- Network analysis in the frequency domain
- Passive filters
- Oscillator circuits
- Diodes
- Bipolar and field-effect transistors
- Amplifiers
- Operational amplifiers
- Active filters
- Sensors
- Digital-analog converters
- Analog-digital converters
- Introduction to Microsystems engineering

**Qualification-goals/Competencies:**
- Students know the most important electronic components and corresponding basic circuits.
- They are qualified to design and analyse basic active and passive electronic circuits.
- They have basic knowledge about the methods of microsystems engineering and its application areas.

**Grading through:**
- exercises
- written exam
- e-tests

**Requires:**
- Fundamentals of Computer Engineering (CS1200)

**Responsible for this module:**
- Prof. Dr.-Ing. Erik Maehle

**Teacher:**
- Institute of Computer Engineering
- Prof. Dr.-Ing. Erik Maehle

**Literature:**
- Tietze, U.; Schenk, Ch.; Gamm, E.: Halbleiter-Schaltungstechnik - Berlin: Springer 2012
Language:
- offered only in German
# CS3202 - Nonstandard Database Systems (NDB)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>1 Semester</th>
<th>Turnus of offer:</th>
<th>each winter semester</th>
<th>Credit points:</th>
<th>4</th>
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</thead>
</table>

## Course of study, specific field and term:
- Bachelor Medical Informatics SJ14 (optional subject), computer science, 5th or 6th semester
- Bachelor Media Informatics SJ14 (optional subject), computer science, 5th or 6th semester
- Bachelor Computer Science SJ14 (optional subject), central topics of computer science, 5th or 6th semester
- Bachelor Medical Informatics (optional subject), applied computer science, 4th to 6th semester
- Master Computer Science (optional subject), specialization field media informatics, 2nd or 3rd semester
- Master MML (optional subject), computer science, arbitrary semester
- Bachelor MML (optional subject), computer science, 6th semester
- Master Computer Science (optional subject), advanced curriculum distributed information systems, 2nd or 3rd semester
- Bachelor Computer Science (optional subject), central topics of computer science, 5th or 6th semester

## Classes and lectures:
- Nonstandard Database Systems (lecture, 2 SWS)
- Nonstandard Database Systems (exercise, 1 SWS)

## Workload:
- 65 Hours private studies
- 45 Hours in-classroom work
- 10 Hours exam preparation

## Contents of teaching:
- introduction
- semistructured databases
- Temporal and spatial databases (temporally restricted validity, multidimensional index structures)
- Sequence Databases
- Databases for data streams (window concept)
- Databases for incomplete information (e.g., constraint databases)
- Probabilistic databases
- Databases with answer ranking (top-k queries)

## Qualification-goals/Competencies:
- Knowledge: Students can name the main features of standard databases and, in addition, can explain which non-standard database models emerge if features are dropped. They can describe the main ideas behind non-standard databases presented in the course by explaining the main features of respective query languages (syntax and semantics) as well as the most important implementation techniques used for their practical realization.
- Skills: Students can apply query languages for non-standard data models introduced in the course to retrieve desired structures from sample datasets in order to satisfy information needs specified textually in natural language. Students are able to represent data in the relational data model using encoding techniques presented in the course such that they can demonstrate how new formalisms relate to or can be implemented in SQL (in particular, SQL-99). In case an SQL transformation cannot be found, students can explain and apply dedicated algorithms for query answering. Students can demonstrate how index structures help answering queries fast by showing how index structures are built, updated, and exploited for query answering. The participants of the course can derive query answers by evaluating queries step by step and by deriving optimized query execution plans.
- Social skills: Students work in teams to handle assignments, and they are encouraged to present their solution to other students in small presentations (in lab classes). In addition, self-dependence is fostered by giving pointers to query evaluation engines for various formalism presented in the lecture such that students get familiar with data models and query languages by self-controlled work.

## Grading through:
- exercises
- written or oral exam as announced by the examiner

## Requires:
- Databases (CS2700)

## Responsible for this module:
- Prof. Dr. rer. nat. habil. Ralf Möller

## Teacher:
- Institute of Information Systems
Prof. Dr. rer. nat. habil. Ralf Möller

Literature:
- S. Abiteboul, P. Buneman, D. Suciu: Data on the Web - From Relations to Semistructured Data and XML - Morgan Kaufmann, 1999
- J. Chomicki, G. Saake (Eds.): Logics for Databases and Information Systems - Springer, 1998
- P. Revesz: Introduction to Constraint Databases - Springer, 2002
- P. Revesz: Introduction to Databases - From Biological to Spatio-Temporal - Springer 2010
- S. Chakravarthy, Q. Jiang: Stream Data Processing A Quality of Service Perspective - Springer, 2009

Language:
- English, except in case of only German-speaking participants
# CS3203 - Image processing (Bildverarbeitung)

| Duration: 1 Semester | Turnus of offer: each summer semester | Credit points: 4 |

## Course of study, specific field and term:
- Bachelor Computer Science (optional subject), specialization field bioinformatics, 6th semester
- Bachelor Medical Informatics (compulsory), computer science, 6th semester
- Master MES (compulsory), medical engineering science (expiring), 2nd semester
- Master MML (compulsory), mathematics, 2nd semester
- Bachelor Computer Science (compulsory), specialization field robotics and automation, 6th semester
- Bachelor Computer Science (optional subject), central topics of computer science, 5th or 6th semester

## Classes and lectures:
- Image processing (lecture, 2 SWS)
- Image processing (exercise, 1 SWS)

## Workload:
- 55 Hours private studies
- 45 Hours in-classroom work
- 20 Hours exam preparation

## Contents of teaching:
- Introduction, interest of visual information
- Fourier transformation
- Sampling and sampling theorem
- Filtering
- Image enhancement
- Edge detection
- Multiresolution concepts: Gaussian and Laplacian Pyramid, wavelets
- Principles of image compression
- Segmentation
- Morphological image processing

## Qualification-goals/Competencies:
- Students will have basic knowledge of two-dimensional system theory.
- They are able to describe the main techniques for image analysis and image enhancement.
- They are able to apply the learned principles in practice.

## Grading through:
- exercises
- programming project
- written or oral exam as announced by the examiner

## Requires:
- Signal processing (CS3100)
- Analysis 1 (MA2000)

## Responsible for this module:
- Prof. Dr.-Ing. Alfred Mertins

## Teacher:
- Institute for Signal Processing
- Prof. Dr.-Ing. Alfred Mertins

## Literature:

## Language:
- offered only in German
## CS3205 - Computer Graphics (CompGrafik)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>each summer semester</td>
<td>4</td>
</tr>
</tbody>
</table>

### Course of study, specific field and term:
- Bachelor Medical Informatics SJ14 (optional subject), computer science, 5th or 6th semester
- Bachelor MES SJ14 (optional subject), computer science and electrical engineering, 4th or 6th semester
- Bachelor Media Informatics SJ14 (compulsory), media informatics, 6th semester
- Bachelor Computer Science SJ14 (optional subject), central topics of computer science, 5th or 6th semester
- Bachelor Medical Informatics (optional subject), computer science, 4th to 6th semester
- Bachelor Computer Science (optional subject), advanced curriculum imaging systems, 2nd or 3rd semester
- Bachelor MML (optional subject), mathematics, 6th semester
- Bachelor Computer Science (optional subject), central topics of computer science, 5th or 6th semester
- Master MML (optional subject), mathematics, 2nd semester
- Bachelor Computer Science (compulsory), specialization field media informatics, 5th or 6th semester

### Classes and lectures:
- Computer Graphics (lecture, 2 SWS)
- Computer Graphics (exercise, 1 SWS)

### Workload:
- 55 Hours private studies
- 45 Hours in-classroom work
- 20 Hours exam preparation

### Contents of teaching:
- Homogeneous coordinates and geometrical transformations
- Planar and perspective projections
- Polygon meshes
- Bezier curves and surfaces
- B-spline curves and surfaces
- Culling and Clipping
- Hidden surface removal
- Raster graphics algorithms
- Illumination and shading

### Qualification-goals/Competencies:
- Knowledge and understanding of the basic concepts, algorithms and methods
- Ability to implement the basic algorithms
- Ability to assess the possibilities and limitations of the learned techniques

### Grading through:
- exercises
- written exam

### Requires:
- Linear Algebra and Discrete Structures 1 (MA1000)

### Responsible for this module:
- Prof. Dr. rer. nat. habil. Heinz Handels

### Teacher:
- Institute of Medical Informatics
- Dr. rer. nat. Jan Ehrhardt

### Literature:
- Foley et. al: Grundlagen der Computergrafik - Addison-Wesley, 1994

### Language:
- offered only in German
<table>
<thead>
<tr>
<th><strong>MA3110 - Numerics 1 (Num1)</strong></th>
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<tbody>
<tr>
<td><strong>Duration:</strong> 1 Semester</td>
</tr>
<tr>
<td><strong>Course of study, specific field and term:</strong></td>
</tr>
<tr>
<td>- Bachelor MES SJ14 (optional subject), mathematics / natural sciences, 3rd or 5th semester</td>
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<tr>
<td>- Bachelor Computer Science SJ14 (optional subject), central topics of computer science, 5th semester</td>
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<tr>
<td>- Master MES (optional subject), mathematics, 1st semester</td>
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<tr>
<td>- Bachelor MES (optional subject), mathematics, 3rd semester</td>
</tr>
<tr>
<td>- Bachelor Computer Science (optional subject), mathematics, 5th or 6th semester</td>
</tr>
<tr>
<td>- Bachelor Medical Informatics SJ14 (optional subject), mathematics, 5th or 6th semester</td>
</tr>
<tr>
<td><strong>Classes and lectures:</strong></td>
</tr>
<tr>
<td>- Numerics 1 (lecture, 2 SWS)</td>
</tr>
<tr>
<td>- Numerics 1 (exercise, 1 SWS)</td>
</tr>
<tr>
<td><strong>Workload:</strong></td>
</tr>
<tr>
<td>- 55 Hours private studies</td>
</tr>
<tr>
<td>- 45 Hours in-classroom work</td>
</tr>
<tr>
<td>- 20 Hours exam preparation</td>
</tr>
<tr>
<td><strong>Contents of teaching:</strong></td>
</tr>
<tr>
<td>- Round-off errors and condition</td>
</tr>
<tr>
<td>- Direct solvers for linear equations</td>
</tr>
<tr>
<td>- LR decomposition</td>
</tr>
<tr>
<td>- Perturbation theory</td>
</tr>
<tr>
<td>- Cholesky decomposition</td>
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<tr>
<td>- QR decomposition, least squares fit</td>
</tr>
<tr>
<td><strong>Qualification-goals/Competencies:</strong></td>
</tr>
<tr>
<td>- Basic understanding of numeric tasks</td>
</tr>
<tr>
<td>- Mastering the modern programming language MATLAB</td>
</tr>
<tr>
<td>- Experience in the implementation of theoretical algorithms</td>
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<tr>
<td>- Ability to judge the quality of a method (accuracy, stability, complexity)</td>
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<tr>
<td><strong>Grading through:</strong></td>
</tr>
<tr>
<td>- exercises</td>
</tr>
<tr>
<td>- programming exercises</td>
</tr>
<tr>
<td>- written exam</td>
</tr>
<tr>
<td><strong>Requires:</strong></td>
</tr>
<tr>
<td>- Linear Algebra and Discrete Structures 2 (MA1500)</td>
</tr>
<tr>
<td>- Linear Algebra and Discrete Structures 1 (MA1000)</td>
</tr>
<tr>
<td>- Analysis 2 (MA2500)</td>
</tr>
<tr>
<td>- Analysis 1 (MA2000)</td>
</tr>
<tr>
<td><strong>Responsible for this module:</strong></td>
</tr>
<tr>
<td>- Prof. Dr. Andreas Rößler</td>
</tr>
<tr>
<td><strong>Teacher:</strong></td>
</tr>
<tr>
<td>- Institute for Mathematics</td>
</tr>
<tr>
<td>- Prof. Dr. Andreas Rößler</td>
</tr>
<tr>
<td><strong>Literature:</strong></td>
</tr>
<tr>
<td>Language:</td>
</tr>
<tr>
<td>Notes:</td>
</tr>
</tbody>
</table>
### MA3445 - Graph Theory (Graphen)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>every second year</td>
<td>4</td>
</tr>
</tbody>
</table>

#### Course of study, specific field and term:
- Bachelor Medical Informatics SJ14 (optional subject), mathematics, 5th or 6th semester
- Master MES SJ14 (optional subject), mathematics / natural sciences, 1st or 2nd semester
- Bachelor Computer Science SJ14 (optional subject), central topics of computer science, 5th or 6th semester
- Master MML (optional subject), mathematics, arbitrary semester
- Master MES (optional subject), mathematics, 1st or 2nd semester
- Bachelor MML (optional subject), mathematics, 5th or 6th semester
- Bachelor Computer Science (optional subject), mathematics, 5th or 6th semester

#### Classes and lectures:
- Graph theory (lecture, 2 SWS)
- Graph theory (exercise, 1 SWS)

#### Workload:
- 55 Hours private studies
- 45 Hours in-classroom work
- 20 Hours exam preparation

#### Contents of teaching:
- Hamiltonian graphs and degree sequences
- Menger's theorem - new proofs
- Matchings and decompositions of graphs
- The theorems of Turan and Ramsey
- Vertex and edge colourings
- The four colour theorem

#### Qualification-goals/Competencies:
- Ability to solve discrete problems using graph theoretical methods
- Knowledge of proof techniques and ideas of discrete mathematics
- Knowledge of fundamental and selected recent research results

#### Grading through:
- exercises
- Viva Voce

#### Requires:
- Linear Algebra and Discrete Structures 2 (MA1500)
- Linear Algebra and Discrete Structures 1 (MA1000)

#### Responsible for this module:
- PD Dr. rer. nat. Hanns-Martin Teichert

#### Teacher:
- Institute for Mathematics
- PD Dr. rer. nat. Hanns-Martin Teichert

#### Literature:
- F. Harary: Graph Theory - Reading, MA:.Addison-Wesley 1969
- R. Diestel: Graphentheorie - Berlin: Springer 2000
- B. Bollobas: Modern Graph Theory - Berlin: Springer 1998

#### Language:
- offered only in German
CS3000 - Algorithm Design (AlgoDesign)

Duration: 1 Semester  
Turnus of offer: each winter semester  
Credit points: 4

Course of study, specific field and term:
- Bachelor Medical Informatics SJ14 (optional subject), computer science, 5th or 6th semester
- Bachelor Computer Science SJ14 (compulsory), foundations of computer science, 5th semester
- Bachelor MML (optional subject), computer science, 5th or 6th semester
- Bachelor Computer Science (compulsory), foundations of computer science, 5th semester

Classes and lectures:
- Algorithm Design (lecture, 2 SWS)
- Algorithm Design (exercise, 1 SWS)

Workload:
- 65 Hours private studies and exercises
- 45 Hours in-classroom work
- 10 Hours exam preparation

Contents of teaching:
- Dynamic programming and heuristic search methods
- Complex data structures and union find data structures
- Efficiency analysis and correctness proofs
- Probabilistic algorithms
- Online algorithms
- Graph, matching and scheduling problems
- String processing
- Approximation algorithms

Qualification-goals/Competencies:
- Knowledge of the principles of algorithm design
- Being able to apply these principles to concrete problems
- Proficiency in solving algorithmic problems

Grading through:
- exercises and project assignments
- written exam

Requires:
- Theoretical Computer Science (CS2000)
- Algorithms and Data Structures (CS1001)

Responsible for this module:
- Prof. Dr. Rüdiger Reischuk

Teacher:
- Institute for Theoretical Computer Science
- Prof. Dr. Rüdiger Reischuk
- Prof. Dr. rer. nat. Till Tantau

Literature:
- J. Kleinberg, E. Tardos: Algorithm Design - Addison Wesley, 2005

Language:
- offered only in German
<table>
<thead>
<tr>
<th>CS3100 - Signal processing (SignalV)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Duration:</strong> 1 Semester</td>
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<td><strong>Turnus of offer:</strong> each winter semester</td>
</tr>
<tr>
<td><strong>Credit points:</strong> 4</td>
</tr>
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</table>

**Course of study, specific field and term:**
- Bachelor Medical Informatics (compulsory), computer science, 5th semester
- Master MES (compulsory), medical engineering science (expiring), 1st semester
- Master MML (compulsory), mathematics, 1st semester
- Bachelor Computer Science (compulsory), foundations of computer science, 5th semester

**Classes and lectures:**
- Signal processing (lecture, 2 SWS)
- Signal processing (exercise, 1 SWS)

**Workload:**
- 55 Hours private studies
- 45 Hours in-classroom work
- 20 Hours exam preparation

**Contents of teaching:**
- Linear time-invariant systems
- Impulse response
- Convolution
- Fourier transform
- Transfer function
- Correlation and energy density of deterministic signals
- Sampling
- Discrete-time signals and systems
- Discrete-time Fourier transform
- z-Transform
- FIR and IIR filters
- Block diagrams
- FIR filter design
- Discrete Fourier transform (DFT)
- Fast Fourier transform (FFT)
- Characterization and processing of random signals

**Qualification-goals/Competencies:**
- Students are able to explain the fundamentals of linear system theory.
- They are able to describe the basic elements of signal processing.
- They will have a command of methods for the description and analysis of continuous-time and discrete-time signals and systems.
- They are able to design digital filters and know various structures for their implementation.
- They are able to explain the basic techniques for describing and processing of random signals.

**Grading through:**
- exercises
- written or oral exam as announced by the examiner

**Is requisite for:**
- Image processing (CS3203)

**Requires:**
- Analysis 1 (MA2000)

**Responsible for this module:**
- Prof. Dr.-Ing. Alfred Mertins

**Teacher:**
- Institute for Signal Processing
- Prof. Dr.-Ing. Alfred Mertins
Literature:

Language:
  - offered only in German
<table>
<thead>
<tr>
<th>CS3200 - Software Engineering II (SWEng)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Duration:</strong> 1 Semester</td>
</tr>
<tr>
<td><strong>Turnus of offer:</strong> each winter semester</td>
</tr>
<tr>
<td><strong>Credit points:</strong> 4</td>
</tr>
</tbody>
</table>

**Course of study, specific field and term:**
- Bachelor Medical Informatics (optional subject), software engineering, 4th to 6th semester
- Bachelor MML (optional subject), computer science, 5th or 6th semester
- Bachelor MES (compulsory), foundations of computer science, 5th semester
- Bachelor Computer Science (compulsory), foundations of computer science, 5th semester

**Classes and lectures:**
- Software Engineering II (lecture, 2 SWS)
- Software Engineering II (exercise, 1 SWS)

**Workload:**
- 60 Hours private studies and exercises
- 45 Hours in-classroom work
- 15 Hours exam preparation

**Contents of teaching:**
- Introduction to software engineering
- Software management
- Software quality assurance
- Software evolution
- Software reuse
- Re-engineering and phase-out
- Software productivity, expense, and estimation
- Legal aspects

**Qualification-goals/Competencies:**
- Knowing the basic procedures of software engineering
- Quality awareness
- Knowing activities and factors of software management
- Ability to organize software projects and to evaluate software engineering processes
- Understanding software evolution

**Grading through:**
- exercises
- written or oral exam as announced by the examiner

**Responsible for this module:**
- PD Dr. Gerhard Buntrock

**Teacher:**
- Institute of Software Technology and Programming Languages
- PD Dr. Gerhard Buntrock

**Literature:**

**Language:**
- offered only in German
# Module Guide

## CS3310-INF - Image and Signal Processing in Medicine 1 (MBS)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
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</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>each winter semester</td>
<td>5</td>
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</tbody>
</table>

### Course of study, specific field and term:
- Bachelor Computer Science (compulsory), specialization field medical informatics, 5th semester

### Classes and lectures:
- Image and signal processing in medicine 1 (lecture, 2 SWS)
- Image and signal processing in medicine 1 (exercise, 2 SWS)

### Workload:
- 70 Hours private studies
- 60 Hours in-classroom work
- 20 Hours exam preparation

### Contents of teaching:
- Motivation, principles and applications of medical image and signal processing
- Signal processing in electrocardiography (ECG)
- Signal processing in the electroencephalogram (EEG)
- Structure and formats of medical images
- Fundamentals of pattern recognition (segmentation, feature extraction, classification, interpretation)
- Histograms and image transformations
- Image filtering with local operators
- Segmentation: thresholding, region growing
- Morphological operators
- Application and evaluation of segmentation methods
- Basic methods for the visualization of medical images and image sequences
- Basic methods of image registration: rigid image registration
- Combined signal and image analysis in functional MRI
- Application examples

### Qualification-goals/Competencies:
- Basic knowledge of methods and procedures of medical image processing
- Ability to evaluate and apply the application methods and algorithms in the respective phase of image processing pipelines
- Overview of the scope of medical image processing by many examples
- Capacity for communication and processing of medical image data
- Knowledge of methods for combined analysis of signal and image sequences in medicine

### Grading through:
- exercises
- written exam

### Responsible for this module:
- Prof. Dr. rer. nat. habil. Heinz Handels

### Teacher:
- Institute of Medical Informatics
- Prof. Dr. rer. nat. habil. Heinz Handels

### Literature:

### Language:
- offered only in German
## CS3400 - Seminar Data Security (SemDatensi)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
<th>Max. group size:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>each winter semester</td>
<td>4 (Typ B)</td>
<td>15</td>
</tr>
</tbody>
</table>

**Course of study, specific field and term:**
- Bachelor Computer Science SJ14 (compulsory), specialization field IT security and safety, 3rd semester
- Bachelor Computer Science (compulsory), specialization field IT security and safety, 5th semester

**Classes and lectures:**
- Seminar on Data Security (seminar, 2 SWS)

**Workload:**
- 40 Hours written report
- 35 Hours private studies
- 30 Hours in-classroom work
- 15 Hours oral presentation (including preparation)

**Contents of teaching:**
- Literature search, selecting appropriate sources
- Investigate a security problem
- Presentation and discussion of the problem and its solutions

**Qualification-goals/Competencies:**
- Being able to investigate and represent a basic topic in the area of IT security

**Grading through:**
- Recitation
- Term paper

**Responsible for this module:**
- Prof. Dr. Rüdiger Reischuk

**Teacher:**
- Institute for Theoretical Computer Science
- Prof. Dr. rer. nat. habil. Ralf Möller
- Prof. Dr. Stefan Fischer
- Prof. Dr. Martin Leucker
- Prof. Dr. Rüdiger Reischuk
- Prof. Dr. Maciej Liskiewicz

**Literature:**
- Topic specific literature will be provided
- :

**Languages:**
- Offered only in German
- German and English skills required

**Notes:**
- Students have to register and select their topic at a preparing meeting the previous semester
### CS3501 - Lab Course Robotics and Automation (PraktRob)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>each winter semester</td>
<td>4 (Typ B)</td>
</tr>
</tbody>
</table>

#### Course of study, specific field and term:
- Bachelor Computer Science SJ14 (compulsory), specialization field robotics and automation, 5th semester
- Bachelor Computer Science (compulsory), specialization field robotics and automation, 5th semester

#### Classes and lectures:
- Lab Class Robotics and Automation (practical course, 3 SWS)

#### Workload:
- 45 Hours in-classroom work
- 45 Hours group work
- 30 Hours private studies

#### Contents of teaching:
- Combination of robotics and navigation
- Introduction to project management
- Realization of different robotic tasks in virtual and real environment
- Kinematics (direct and inverse)
- Implementation in the environments using sensor technology
- Human-Robot-Interaction

#### Qualification-goals/Competencies:
- The students know different concepts of robot and navigation system control.
- They are able to implement the combination of robotics and navigation for simple tasks.
- The students are in a position to do the project planning and realize it in teamwork according to predefined milestones.

#### Grading through:
- exercises
- continuous, successful participation in practical course, >80%
- programming project

#### Requires:
- Robotics (CS2500)

#### Responsible for this module:
- Prof. Dr.-Ing. Erik Maehle
- Prof. Dr.-Ing. Achim Schweikard

#### Teacher:
- Institute of Computer Engineering
- Institute for Robotics and Cognitive Systems
- Prof. Dr.-Ing. Achim Schweikard
- Prof. Dr.-Ing. Erik Maehle

#### Literature:
- Jazar: Theory of applied Robotics: Kinematics, Dynamics and Control

#### Language:
- offered only in German
| Course of study, specific field and term: |  |
|----------------------------------------|  |
| • Bachelor Computer Science (compulsory), specialization field media informatics, 5th semester |  |

| Classes and lectures: | Workload: |  |
|----------------------|-----------|  |
| • Lab class media and interaction design (practical course, 6 SWS) | • 170 Hours group work |  |
|  | • 30 Hours written report |  |
|  | • 30 Hours oral presentation (including preparation) |  |
|  | • 10 Hours in-classroom work |  |

| Contents of teaching: |  |
|----------------------|  |
| • Requirements analysis |  |
| • System and media design |  |
| • depending on the project: text, image, video, audio and 3D animation as well as related tools and programming languages |  |
| • Media production and media programming |  |
| • Evaluation of the product |  |
| • Project documentation |  |
| • Project presentation |  |

| Qualification-goals/Competencies: |  |
|----------------------------------|  |
| • The students have experienced a complete development process for the production of an interactive multimedia application. |  |
| • They know the various media-related methods and tools in practice. |  |
| • They are able to reflect on their own work critically. |  |
| • They know the advantages and problems of teamwork. |  |

| Grading through: |  |
|------------------|  |
| • Recitation |  |
| • written report |  |
| • programming project |  |

| Requires: |  |
|-----------|  |
| • Media Production and Media Programming (CS2601) |  |
| • Interaction Design (CS2600) |  |
| • Software Ergonomics (CS2200) |  |

| Responsible for this module: |  |
|-----------------------------|  |
| • Prof. Dr.-Ing. Nicole Jochems |  |

| Teacher: |  |
|----------|  |
| • Institute for Multimedia and Interactive Systems |  |
| • MitarbeiterInnen des Instituts |  |

| Language: |  |
|----------|  |
| • offered only in German |  |
CS3702 - Bachelor Seminar Informatics (BachSemInf)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Credit points:</th>
<th>Max. group size:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>4 (Typ B)</td>
<td>15</td>
</tr>
</tbody>
</table>

**Course of study, specific field and term:**
- Bachelor Computer Science SJ14 (compulsory), interdisciplinary competence, 5th semester
- Bachelor Computer Science (compulsory), interdisciplinary competence, 5th semester

**Classes and lectures:**
- Seminar (seminar, 2 SWS)

**Workload:**
- 40 Hours written report
- 35 Hours private studies
- 30 Hours in-classroom work
- 15 Hours oral presentation (including preparation)

**Contents of teaching:**
- Familiarization in a scientific topic
- Working on a scientific topic and its answers for problems
- Presentation and discussion of the topic in English

**Qualification-goals/Competencies:**
- The students are able to analyze, judge and develop a scientific topic.
- They are able to present the results in a written documentation and in a talk in an scientific way
- The are able to present and discuss a scientific topic in English.
- They are able to classify and differentiate the topic in the wider academic context.
- They improve their language competency.

**Grading through:**
- Recitation
- term paper

**Responsible for this module:**
- Studiengangsleiter Informatik

**Teacher:**
- Institutes of Computer Science and Engineering
- Alle prüfungsberechtigten DozentInnen des Studienganges

**Literature:**
- Topic and literature are chosen individually.

**Language:**
- offered only in English
## LS3100 - Molecular Genetics (MolGen)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>each winter semester</td>
<td>4</td>
</tr>
</tbody>
</table>

### Course of study, specific field and term:
- Bachelor Medical Informatics (optional subject), bioinformatics, 4th to 6th semester
- Bachelor Computer Science (compulsory), specialization field bioinformatics, 5th semester

### Classes and lectures:
- Molecular genetics for computer scientists (lecture, 1 SWS)
- Molecular genetics for computer scientists (practical course, 2 SWS)

### Workload:
- 60 Hours private studies
- 45 Hours in-classroom work
- 15 Hours exam preparation

### Contents of teaching:
- Structure of DNA
- Causes of mutations
- Generation of genetically modified bacteria (Designs of the experiment at the computer, isolation of DNA, restriction cutting of DNA, PCR, ligation of DNA into plasmids, transformation of bacteria, restriction analysis, sequencing of DNA)
- Molecular evolution of DNA and its analysis by bioinformatical methods

### Qualification-goals/Competencies:
- Ability, to understand and reproduce theoretical knowledge in molecular genetics and apply it in the following studies
- Basic practical skills in molecular genetics including the use of bioinformatics in the daily laboratory routine

### Grading through:
- Viva Voce
- written exam

### Requires:
- Biology (LS2500)

### Responsible for this module:
- PD Dr. rer. nat. Bärbel Kunze
- Prof. Dr. rer. nat. Enno Hartmann

### Teacher:
- Institute for Biology
- PD Dr. rer. nat. Bärbel Kunze
- Prof. Dr. rer. nat. Enno Hartmann
- Dr. rer. nat. Nicole Sommer

### Literature:
- Campbell & Reece: Biologie - Pearson
- Purves, Sadava, Orians, Heller: Biologie - Spektrum
- Markl: Biologie - Klett
- T.A. Brown: Gentechnologie für Einsteiger - Spektrum

### Language:
- offered only in German
# MA3210 - Statistics - Practical Course (StatPrakt)

<table>
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<tr>
<th><strong>Duration:</strong></th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>each winter semester</td>
<td>3 (Typ B)</td>
</tr>
</tbody>
</table>

**Course of study, specific field and term:**
- Bachelor Computer Science (optional subject), specialization field bioinformatics, 5th semester
- Bachelor Computer Science (optional subject), specialization field medical informatics, 5th semester
- Bachelor MML (compulsory), mathematics, 5th semester

**Classes and lectures:**
- Statistics - Practical Course (practical course, 2 SWS)

**Workload:**
- 60 Hours work on project
- 30 Hours in-classroom work

**Contents of teaching:**
- Data management
- Literate programming (Sweave or knitr)
- Descriptive statistics (frequency tables, measures of location and dispersion)
- Simple graphics (box-whisker plot, scatter plots, histograms)
- t-Test, Mann-Whitney U-test, Kruskal-Wallis-test
- Bootstrap
- Programming of functions

**Qualification-goals/Competencies:**
- Independent data management in R
- Independent realization of simple statistical analyses
- Independent generation of simple graphics
- Independent creation of literate programming scripts
- Independent calculation of bootstrap confidence intervals
- Independent writing of functions

**Grading through:**
- continuous, successful participation in practical course, >80%

**Is requisite for:**
- Genetic Epidemiology 2 (MA4661)
- Prognostic models (MA4660)

**Requires:**
- Biostatistics 1 (MA1600)

**Responsible for this module:**
- Prof. Dr. rer. nat. Andreas Ziegler

**Teacher:**
- Institute of Medical Biometry and Statistics
- Prof. Dr. rer. nat. Andreas Ziegler

**Literature:**

**Language:**
- offered only in German
Notes:

This module is for bachelor medical informatics and bachelor computer science (compulsory field of application: bioinformatics or medical informatics) only an additional offer. It is not eligible for the study.
## Duration:
- **1 Semester**
- **Turnus of offer:** each winter semester
- **Credit points:** 4

### Course of study, specific field and term:
- Bachelor Medical Informatics SJ14 (optional subject), medical computer science, 5th or 6th semester
- Bachelor MES SJ14 (optional subject), mathematics / natural sciences, 3rd or 5th semester
- Bachelor Computer Science SJ14 (compulsory), specialization field bioinformatics, 5th semester
- Master MES (optional subject), mathematics, 1st semester
- Bachelor Medical Informatics Science (optional subject), bioinformatics, 4th to 6th semester
- Bachelor Computer Science (optional subject), specialization field medical informatics, 3rd semester
- Bachelor MES (optional subject), mathematics, 5th semester
- Bachelor Computer Science (compulsory), specialization field bioinformatics, 5th semester

### Classes and lectures:
- Biomathematics (lecture, 2 SWS)
- Biomathematics (exercise, 1 SWS)

### Workload:
- 55 Hours private studies and exercises
- 45 Hours in-classroom work
- 20 Hours exam preparation

### Contents of teaching:
- Basics of differential equations
- Differential equations of first order
- Linear differential equations of n-th order
- Systems of linear differential equations with constant coefficients
- Notes on numerics and qualitative analysis; the prey-predator model

### Qualification-goals/Competencies:
- Learning the basics of ordinary differential equations
- Ability to apply differential equations
- Learning by means of examples how to use differential equations for models in biology, chemistry and medicine
- Basic understanding of simple numerical methods

### Grading through:
- exercises
- written exam

### Responsible for this module:
- Prof. Dr. rer. nat. Jürgen Prestin
- PD Dr. rer. nat. Hanns-Martin Teichert

### Teacher:
- Institute for Mathematics
- PD Dr. rer. nat. Hanns-Martin Teichert

### Literature:
- J. D. Murray: Mathematical Biology - Springer
- R. Schuster: Biomathematik - Vieweg + Teubner Studienbücher 2009

### Language:
- offered only in German
# PS3700 - Presentation and Documentation (PundD)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Credit points:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>3 (Typ B)</td>
</tr>
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<table>
<thead>
<tr>
<th>Turnus of offer:</th>
</tr>
</thead>
<tbody>
<tr>
<td>each winter semester</td>
</tr>
</tbody>
</table>

## Course of study, specific field and term:
- Bachelor Medical Informatics (compulsory), interdisciplinary competence, 5th semester
- Bachelor Computer Science (compulsory), interdisciplinary competence, 5th semester

## Classes and lectures:
- Presentation and documentation (exercise, 2 SWS)

## Workload:
- 60 Hours private studies
- 30 Hours in-classroom work

## Contents of teaching:
- Techniques of scientific investigation
- Techniques of scientific writing
- Bibliographical reference and citations in scientific papers
- Desktop publishing: LaTeX, OpenOffice, MS Word
- Structuring of Talks
- Skills for talks
- LaTeX, Impress, and Powerpoint presentations - Do's and don'ts

## Qualification-goals/Competencies:
- The Students know about the most important presentation technologies
- They obtained some insight into technologies about scientific writing and documentation
- They are able to apply their skills in talks and in writing scientific papers

## Grading through:
- Recitation
- continuous, successful participation in course
- participation in discussions

## Responsible for this module:
- PD Dr. Gerhard Buntrock

## Teacher:
- Institute for Theoretical Computer Science
- Institute of Software Technology and Programming Languages

## Literature:
- Matthias Karmasin, Rainer Ribing: Die Gestaltung wissenschaftlicher Arbeiten - UTB 2011

## Language:
- offered only in German
### CS3201 - Usability Engineering (UsabEng)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>1 Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turnus of offer:</td>
<td>each summer semester</td>
</tr>
<tr>
<td>Credit points:</td>
<td>4</td>
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</table>

#### Course of study, specific field and term:
- Bachelor Media Informatics SJ14 (compulsory), media informatics, 5th semester
- Bachelor Computer Science SJ14 (optional subject), central topics of computer science, 5th semester
- Bachelor Medical Informatics (optional subject), software engineering, 4th to 6th semester
- Bachelor Computer Science (compulsory), specialization field media informatics, 6th semester
- Bachelor Computer Science (optional subject), central topics of computer science, 6th semester

#### Classes and lectures:
- Usability Engineering (lecture with exercises, 3 SWS)

#### Workload:
- 55 Hours private studies
- 45 Hours in-classroom work
- 20 Hours exam preparation

#### Contents of teaching:
- Introduction and motivation
- Systems Engineering
- Software Engineering
- Usability Engineering
- Media Engineering
- Interdisciplinary teams and social processes
- Task analysis
- User analysis
- Organizational and contextual analysis
- Modeling and design of interactive systems
- Criteria for interactive systems
- Evaluation of interactive systems
- Summary

#### Qualification-goals/Competencies:
- Students are able to explain the basic user-centered development processes for interactive multimedia systems.
- They are able to apply and adapt basic processes for specific projects and needs.
- They are able to explain that these processes are influenced by formal and informal requirements as well as social structures and behaviors.

#### Grading through:
- exercises and project assignments
- written or oral exam as announced by the examiner

#### Requires:
- Software Ergonomics (CS2200)

#### Responsible for this module:
- Univ.-Prof. Dr. rer. nat. Michael Herczeg

#### Teacher:
- Institute for Multimedia and Interactive Systems
- Univ.-Prof. Dr. rer. nat. Michael Herczeg
- Prof. Dr.-Ing. Nicole Jochems

#### Literature:
- Deborah J. Mayhew: The Usability Engineering Lifecycle - Morgan Kaufmann Publ., 1999
- Mary B. Rosson, John M. Carroll: Usability Engineering: Scenario-Based Development of Human-Computer Interaction - Morgan Kaufmann Publ., 2002
Language:
- offered only in German
<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
<th>Max. group size:</th>
</tr>
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<tbody>
<tr>
<td>1 Semester</td>
<td>each summer semester</td>
<td>6 (Typ B)</td>
<td>12</td>
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</table>

**Course of study, specific field and term:**
- Bachelor Computer Science (compulsory), interdisciplinary competence, 6th semester

**Classes and lectures:**
- Bachelor Project Computer Science (team work, 4 SWS)

**Workload:**
- 90 Hours group work
- 60 Hours in-classroom work
- 20 Hours written report
- 10 Hours oral presentation (including preparation)

**Contents of teaching:**
- Team-based planning and realization of a complete software/hardware project ranging from requirement engineering to installation while observing standards and deadlines

**Qualification-goals/Competencies:**
- Students have the communication competency to elucidate the system requirements with customers
- They have methodological competence to analyse complex tasks, to structure them into subtasks, and to implement them in team work
- They have the management competency to estimate the costs, to plan the activities, and to allocate the resources meeting the goals of the project
- They are able to integrate components into an overall application while ensuring quality
- They have the methodological competence to manage created artifacts and documenting implementations.
- They have the communication competency to write down and present (partial) results

**Grading through:**
- Recitation
- written report
- successful addressing of the project goals

**Requires:**
- Software Engineering II (CS3200)
- Software Engineering I (CS2300)
- Fundamentals of Computer Engineering (CS1200)
- Theoretical Computer Science (CS2000)
- Algorithms and Data Structures (CS1001)
- Programming (CS1000)

**Responsible for this module:**
- Studiengangsleiter Informatik

**Teacher:**
- Institutes of Computer Science and Engineering
- Alle prüfungsberechtigten DozentInnen des Studienganges

**Language:**
- offered only in German
### CS3990 - Bachelor Thesis Computer Science (BScInf)

<table>
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<th>Duration:</th>
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<tbody>
<tr>
<td>1 Semester</td>
<td>each semester</td>
<td>15</td>
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</tbody>
</table>

#### Course of study, specific field and term:
- Bachelor Computer Science SJ14 (compulsory), computer science, 6th semester
- Bachelor Computer Science (compulsory), computer science, 6th semester

#### Classes and lectures:
- Bachelor Thesis Computer Science (supervised self studies, 1 SWS)
- Colloquium (presentation (incl. preparation), 1 SWS)

#### Workload:
- 360 Hours work on an individual topic (research and development) and written elaboration
- 90 Hours oral presentation and discussion (including preparation)

#### Contents of teaching:
- investigating a given problem in informatics or application areas and developing a good solution
- colloquium to represent the results including a discussion with the referees

#### Qualification-goals/Competencies:
- solving a moderately difficult problem with state of the art methods in informatics
- being able to write a scientific thesis
- being able to present own results in a scientific talk

#### Grading through:
- Recitation
- written report

#### Responsible for this module:
- Studiengangsleiter Informatik

#### Teacher:
- Institutes of Computer Science and Engineering
- Alle prüfungsberechtigten DozentInnen des Studienganges

#### Literature:
- depends on subject

#### Language:
- thesis can be written in German or English
CS4172 - Dependability of Computing Systems (ZuverlRSys)

Duration: 1 Semester  
Turnus of offer: each summer semester  
Credit points: 4

Course of study, specific field and term:
- Bachelor Computer Science SJ14 (optional subject), central topics of computer science, 6th semester
- Bachelor Computer Science SJ14 (compulsory), specialization field IT security and safety, 6th semester
- Bachelor Computer Science (compulsory), specialization field IT security and safety, 6th semester
- Master Computer Science (optional subject), advanced curriculum security, 2nd or 3rd semester
- Master Computer Science (optional subject), specialization field software systems engineering, 3rd semester
- Master Computer Science (optional subject), advanced curriculum parallel and distributed system architectures, 2nd or 3rd semester
- Master Computer Science (optional subject), specialization field robotics and automation, 3rd semester

Classes and lectures:
- Dependability of Computing Systems (lecture, 2 SWS)
- Dependability of Computing Systems (exercise, 1 SWS)

Workload:
- 55 Hours private studies
- 45 Hours in-classroom work
- 20 Hours exam preparation

Contents of teaching:
- Basic terms
- General redundancy techniques
- Fault diagnosis
- Reconfiguration and recovery
- Fault masking
- Examples for fault-tolerant systems

Qualification-goals/Competencies:
- The students are able to present the most important fault types in hardware and software and their abstraction to fault models.
- They are able to elucidate the basic redundancy techniques (static and dynamic redundancy, hybrid forms etc.).
- They are able to explain various methods for fault diagnosis, reconfiguration, recovery and fault masking.
- They are able to describe typical application examples and sample fault-tolerant computers.
- They are able to analyze fault tolerance techniques quantitatively by mathematical reliability models.
- They are able to evaluate and compare suitable fault tolerance techniques and to select them for a given application area.

Grading through:
- exercises
- written or oral exam as announced by the examiner

Responsible for this module:
- Prof. Dr.-Ing. Erik Maehle

Teacher:
- Institute of Computer Engineering
- Prof. Dr.-Ing. Erik Maehle

Literature:
- E. Dubrova: Fault-Tolerant Design - Springer 2013
- K. Echtle: Fehlertoleranzverfahren - Springer 1990

Language:
- offered only in German
# CS4180 - Security in Networks and Distributed Systems (SicherNet)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
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<tbody>
<tr>
<td>1 Semester</td>
<td>each summer semester</td>
<td>4</td>
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</tbody>
</table>

**Course of study, specific field and term:**
- Bachelor Medical Informatics SJ14 (optional subject), computer science, 5th or 6th semester
- Bachelor Computer Science SJ14 (optional subject), central topics of computer science, 6th semester
- Bachelor Computer Science SJ14 (compulsory), specialization field IT security and safety, 4th semester
- Bachelor Computer Science (compulsory), specialization field IT security and safety, 6th semester
- Master Computer Science (optional subject), advanced curriculum security, 2nd or 3rd semester
- Master Computer Science (optional subject), advanced curriculum enterprise IT, 2nd or 3rd semester

**Classes and lectures:**
- Security in Networks and Distributed Systems (lecture, 2 SWS)
- Security in Networks and Distributed Systems (exercise, 1 SWS)

**Workload:**
- 60 Hours private studies
- 45 Hours in-classroom work
- 15 Hours exam preparation

**Contents of teaching:**
- Fundamentals of network security
- Attacks
- Cryptology
- Acquire a basic understanding of formal and organizational aspects of network security (IT-Grundschutz, ITIL security)
- Integrity & Authentication, Authorization, and Accountability
- Key Distribution
- Certificates and Digital Signatures
- Protocols (Physical & Data-Link, Network & Transport, Application Layer)
- Firewalls
- IT Grundschutz & ITIL
- Societal aspects

**Qualification-goals/Competencies:**
- Acquire a basic understanding of security issues (important terms, security objectives, communication models, network security models, attacker models, difference between safety and security)
- Understand the different security risks in networks and distributed systems
- Learn about the different types of attacks and their classification
- Understand the basics of cryptography: substitution ciphers (Caesar, Vigenère, etc.), Enigma, One-Time Pad, stream ciphers (structure, RC4), block ciphers (Feistel Networks, DES, AES), operation modes (ECB, CBC, PCBC, CFB, OFB, Counter), padding, asymmetric systems (Diffie-Hellmann, RSA)
- Understand integrity, authentication, authorization, and accountability
- Understanding of digital certificates, public key infrastructures and learn about important standards such as X.509
- Lean about important security solutions on different layers of the ISO/OSI stack
- Understand firewalls

**Grading through:**
- written or oral exam as announced by the examiner

**Responsible for this module:**
- Prof. Dr. Stefan Fischer

**Teacher:**
- Institute of Telematics
- Prof. Dr. Stefan Fischer

**Literature:**

Language:
- offered only in German
MA1600 - Biostatistics 1 (BioStat1)

Duration: 1 Semester

Turnus of offer: each summer semester

Credit points: 4

Course of study, specific field and term:
- Bachelor Computer Science SJ14 (compulsory), specialization field bioinformatics, 6th semester
- Master MES (advanced curriculum), biophysics and biomedical optics, 2nd semester
- Bachelor Medical Informatics (compulsory), medical computer science, 4th semester
- Master Computer Science (optional subject), specialization field bioinformatics, 2nd or 3rd semester
- Master Computer Science (compulsory), advanced curriculum stochastics, 2nd semester
- Bachelor Computer Science (optional subject), specialization field bioinformatics, 6th semester
- Bachelor MLS (compulsory), life sciences, 6th semester
- Bachelor MES (optional subject), medical engineering science, 6th semester
- Bachelor Computer Science (compulsory), specialization field medical informatics, 6th semester
- Bachelor Medical Informatics SJ14 (compulsory), medical computer science, 4th semester

Classes and lectures:
- Biostatistics 1 (lecture, 2 SWS)
- Biostatistics 1 (exercise, 1 SWS)

Workload:
- 60 Hours private studies
- 45 Hours in-classroom work
- 15 Hours exam preparation

Contents of teaching:
- Descriptive statistics
- Probability theory, including random variables, density, and cumulative distribution function
- Normal distribution
- Diagnostic tests, reference range, normal range, coefficient of variation
- Statistical testing
- Sample size calculations
- Confidence intervals
- Selected statistical tests I
- Selected statistical tests II
- Analysis of variance (one-way-classification)
- Simple linear regression
- Clinical trials

Qualification-goals/Competencies:
- Knowledge of the most important methods of descriptive statistics
- Basic understanding of the approach to testing and estimation
- Practice in basic statistical test and estimation methods

Grading through:
- written exam

Is requisite for:
- Biostatistics 2 (MA2600)

Responsible for this module:
- Prof. Dr. rer. nat. Andreas Ziegler

Teacher:
- Institute of Medical Biometry and Statistics
- Prof. Dr. rer. nat. Andreas Ziegler

Literature:

Language:
• offered only in German
### PS1030 - English for Bachelor and Master students MLS (Engl)

<table>
<thead>
<tr>
<th>Duration:</th>
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<tbody>
<tr>
<td>2 Semester</td>
<td>each summer semester</td>
<td>4</td>
</tr>
</tbody>
</table>

### Course of study, specific field and term:
- Master MES SJ14 (optional subject), no specific field, 2nd semester
- Bachelor MES SJ14 (optional subject), no specific field, 4th or 6th semester
- Master MLS (optional subject), interdisciplinary competence, arbitrary semester
- Bachelor Computer Science (optional subject), computer science, arbitrary semester
- Bachelor MES (optional subject), medical engineering science, arbitrary semester
- Master MML (optional subject), interdisciplinary competence, arbitrary semester
- Bachelor MLS (optional subject), interdisciplinary competence, arbitrary semester

### Classes and lectures:
- English for Bachelor and Master students MLS (exercise, 4 SWS)
- 60 Hours private studies
- 60 Hours in-classroom work

### Workload:
- 60 Hours private studies
- 60 Hours in-classroom work

### Contents of teaching:
- **Exercise**: The content follows a curriculum, modified depending on the given skills and the thematic interests of the participants.
- Creating a CV in English

### Qualification-goals/Competencies:
- Acquisition of basic skills in spoken and written English
- Improvement of communication in English
- Improvement of reading and writing of texts in English, including technical literature

### Grading through:
- exercises
- continuous, successful participation in course
- written exam

### Responsible for this module:
- B. Sc. Sara Meitner, GradCertMol

### Teacher:
- University of Luebeck
- B. Sc. Sara Meitner, GradCertMol

### Literature:
- Publications and articles

### Language:
- offered only in English

### Notes:
- no credits for Bachelor Informatik and Molecular Life Science