UNIVERSITÄT ZU LÜBECK

Module Guide for the Study Path

Master Computer Science 2012

Version from 11. April 2025

specialization field medical informatics

specialization field robotics and automation

specialization field bioinformatics

specialization field media informatics

specialization field software systems engineering

interdisciplinary competence

computer science

advanced curriculum algorithmics and complexity theory

advanced curriculum programming

advanced curriculum distributed information systems

advanced curriculum parallel and distributed system architecutres

advanced curriculum organic computing

advanced curriculum intelligent embedded systems

advanced curriculum signal and image processing

advanced curriculum security

advanced curriculum enterprise IT

advanced curriculum numerical image processing

advanced curriculum analysis

advanced curriculum stochastics

computer science mandatory courses

advanced curriculum imaging systems

specialization field IT security and safety

CS4240 - Syntactical Pattern Recognition (SyntakMust)

Duration:	Turnus of offer:	Credit points:	Max. group size:
1 Semester	not available anymore	4	99

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), specialization field medical informatics, 3rd semester

Classes and lectures:

- Syntactical Pattern Recognition (lecture, 2 SWS)
- Syntactical Pattern Recognition (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Syntactical description of visual objects or structures, such as chromosome types
- Transform image data in the symbolical desciption
- Grammar types for structure description: beginning with indexed and attributed grammars to tree- or web-grammars
- Stochastical linear grammars, theoretical properties such as consistency
- Method for calculating probabilities of control samples out of generated text pattern
- Generalization of stochastical grammars
- Parsing for stochastic or feature grammars
- Examples: Coronary vessels with concrete LR (1) grammar for the classification of stenosis

Qualification-goals/Competencies:

- Understanding of the use of syntactical methods for symbolic object descriptions and classification tasks
- Understanding of the distinction to the most used statistical approaches to pattern recognition
- Understanding of the usage of grammatical algorithms for classification syntactically described objects

Grading through:

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

Literature:

- K. S. Fu: Syntactic Pattern Recognition and - Englewood Cliffs, NJ: Prentice Hall
- H. Ney: Maschinelle Sprachverarbeitung: Der statistische - Informatik Spektrum 26:6, 94-102
- M. R. Ogiela, R. Tadeusiewicz: Syntactic reasoning and pattern recognition for - Artificial Intelligence in Medicine 26, 145-159

Language:

- offered only in German

CS4270-KP04, CS4270 - Medical Robotics (MedRob)

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

Course of study, specific field and term:

- Master MES 2020 (optional subject), computer science / electrical engineering, Arbitrary semester
- Master Biophysics 2019 (optional subject), Elective, 2nd semester
- Master MES 2014 (optional subject), computer science / electrical engineering, Arbitrary semester
- Master Biomedical Engineering (optional subject), Interdisciplinary modules, 2nd semester
- Master Computer Science 2012 (optional subject), advanced curriculum imaging systems, 2nd or 3rd semester
- Master Computer Science 2012 (optional subject), advanced curriculum signal and image processing, 2nd or 3rd semester
- Master MES 2011 (advanced curriculum), imaging systems, signal and image processing, 2nd semester
- Master Computer Science 2012 (compulsory), specialization field robotics and automation, 2nd semester
- Master Computer Science 2012 (optional subject), specialization field medical informatics, 2nd or 3rd semester

Classes and lectures:

- Medical Robotics (lecture, 2 SWS)
- Medical Robotics (exercise, 1 SWS)

Workload:

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

Contents of teaching:

Qualification-goals/Competencies:

- Students are able to explain the concepts of forward and inverse kinematics for the examples of 3-joint and 6-joint robots.
- They are able to apply methods of medical robot systems and to simple practical applications.
- Students are able to transfer methods of motion learning to simple practical problems.
- Students are able to modify templates for dynamic calculations in order to create the calculations for their own constructions.

Grading through:

- Oral examination

Responsible for this module:

- Prof. Dr.-Ing. Achim Schweikard

Teacher:

- Institute for Robotics and Cognitive Systems
- Prof. Dr.-Ing. Achim Schweikard

Literature:

- J. -C. Latombe: Robot Motion Planning - Dordrecht: Kluwer 1990
- J.J. Craig: Introduction to Robotics - Pearson Prentice Hall 2002
- : lecture notes (400 pages full text)

Language:

- offered only in English

Notes:

Admission requirements for taking the module:
- None

Admission requirements for participation in module examination(s):
- Successful completion of exercise assignments as specified at the beginning of the semester

Module Exam(s):
- CS4270-L1: Medical Robotics, written exam, 90min, 100% of the module grade

CS4280 - Business Information Systems (BetrInfosy)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), advanced curriculum enterprise IT, 2nd or 3rd semester
- Master Computer Science 2012 (optional subject), specialization field medical informatics, 3rd semester

Classes and lectures:

- Business Information Systems (lecture, 2 SWS)
- Business Information Systems (exercise, 1 SWS)

Workload:

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

Contents of teaching:

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Qualification-goals/Competencies:

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Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr. rer. nat. habil. Josef Ingenerf

Teacher:

- Institute of Medical Informatics
- Institute of Telematics
- Prof. Dr. Rüdiger Lohmann

Literature:

- :
- :
- :
- :

Language:

- offered only in German

CS4310 - Information Models and Ontologies in Medicine (IOM)

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

Course of study, specific field and term:

- Master Computer Science 2012 (compulsory), specialization field medical informatics, 2nd semester

Classes and lectures:

- Information Models and Ontologies in Medicine (lecture, 2 SWS)
- Information Models and Ontologies in Medicine (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Medical documentation and communication
- Structured (database), semi-structured (XML documents) and unstructured documentation (free text)
- Medical linguistics: unstructured texts
- HL7 Version 3
- Syntactical standards for messages and documents, including HL7 CDA (Clinical Document Architecture), DICOM SR (Structured Reporting)
- Semantical standards, terminologies / ontologies (ICD-10, OPS, SNOMED-CT, LOINC, UMLS)
- Standards for the integration of knowledge bases (Guidelines, Literature-DB) in clinical applications

Qualification-goals/Competencies:

- Understanding of typical applications and challenges in
- Knowledge of methods and tools for standardized documentation and communication in healthcare
- Knowledge of current standards of different structure levels: data models, documents / messages terminology

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr. rer. nat. habil. Josef Ingenerf

Teacher:

- Institute of Medical Informatics
- Prof. Dr. rer. nat. habil. Heinz Handels
- Prof. Dr. rer. nat. habil. Josef Ingenerf

Literature:

- T. Lehmann: Handbuch der Medizinischen Informatik - München: Hanser 2004
- J. Ingenerf, R. Linder, S. J. Pöppl: Informatik im Gesundheitswesen - Skript zur Pflicht-Lehreinheit im Nebenfach Medizinische Informatik im Diplom-Studiengang Informatik. Hagen: Fern-Universität Hagen 2002
- P. Haas: Medizinische Informationssysteme und Elektronische Krankenakten - Berlin: Springer 2005
- J. H. van Bemmel: Handbook of Medical Informatics - Houten/Diegem: Bohn Stafleu Van Loghum 2002

Language:

- offered only in German

CS4320 - Methods and Systems in Health Care (VSG)

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

Course of study, specific field and term:

- Master Computer Science 2012 (compulsory), specialization field medical informatics, 1st semester

Classes and lectures:

- Methods and Systems in Health Care (lecture, 2 SWS)
- Methods and Systems in Health Care (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Fundamentals and motivation of an increasing integrated care in the health care system.
- Approaches for a standardization of a wide variety of electronic data exchange formats in health care.
- Asynchronous versus synchronous communication methods of distributed software systems
- Distributed, heterogeneous hospital-information-system: communication server to ensure a consistent data management
- Method and system components of health telematic infrastructures from an international perspective.

Qualification-goals/Competencies:

- Understanding of problems and solutions in the implementation of distributed application systems in health care
- Knowledge of the essential components of a health telematics infrastructure
- Knowledge of major middleware architectures and techniques in health care with focus on the issue of data privacy

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

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

Teacher:

- Institute of Medical Informatics

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

Literature:

- B. Blobel: Analysis, Design and Implementation for Secure and Interoperable Distributed Health Information Systems - Amsterdam: IOS Press 2002
- J. Ingenerf, S. J. Pöppl: Gesundheitstelematik: Datenmodelle und notwendige Infrastrukturen - Skript zur Wahlpflicht-Lehreinheit im Nebenfach Medizinische Informatik im Diplom-Studiengang Informatik. Hagen: Fern-Universität Hagen 2003
- P. Haas: Gesundheitstelematik - Grundlagen, Anwendungen, Potenziale - Berlin: Springer 2006

Language:

- offered only in German

CS4330-KP04, CS4330 - Image Analysis and Visualization in Diagnostics and Therapy (BAVIS)

Duration:	Turnus of offer:	Credit points:	Max. group size:
1 Semester	not available anymore	4	99

Course of study, specific field and term:

- Master MES 2020 (optional subject), medical engineering science, Arbitrary semester
- Master MES 2014 (optional subject), medical engineering science, 1st or 2nd semester
- Master MES 2011 (advanced curriculum), imaging systems, signal and image processing, 2nd semester
- Master CLS 2010 (optional suject), computer science, Arbitrary semester
- Master Computer Science 2012 (compulsory), specialization field medical informatics, 2nd semester

Classes and lectures:

- Image Analysis and Visualization Systems in Diagnostics and Therapy (lecture, 2 SWS)
- Image Analysis and Visualization Systems in Diagnostics and Therapy (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Methods and algorithms for the analysis and visualization of medical images including current research activities in the field of medical image computing. The following methods and algorithms are explained:
- Data driven segmentation of multispectral image data
- Random Decision Forests for the segmentation of medical image data
- Convolutional Neural Networks and Deep Learning in Medical Image Processing
- live wire segmentation
- segmentation with active contour models and deformable models
- level set segmentation
- statistical shape models
- image registration
- atlas-based segmentation and multi atlas segmentation using non-linear registration
- visualization techniques in medicine
- direct volume rendering
- indirect volume rendering, ray tracing, ray casting
- haptic 3D interactions in virtual bodies
- virtual reality techniques in medical applications

Qualification-goals/Competencies:

- The students can classify advanced methods for medical image analysis and visualization, explain them, characterize them on the basis of their properties and select them problem-specifically for a concrete application.
- They are able to explain advanced methods of cluster analysis and classification, especially with Support Vector Machines and Random Decision Forests, and to characterize them based on their properties.
- They know different approaches to model-based segmentation, can describe the different model assumptions made here and are able to explain the optimization strategies and algorithms used here.
- They are able to assess the properties of different non-linear image registration methods and to select and parameterize similarity measures and regularization terms for a specific registration problem.
- They are familiar with methods of multi-atlas segmentation and can explain and exemplarily apply the properties of different label fusion approaches.
- They can distinguish different medical visualization techniques, classify them according to their specific advantages and disadvantages and select and apply them depending on a concrete application problem.
- They can explain different haptic interaction techniques and can classify different systems for VR simulation in medicine.

Grading through:

- Written or oral exam as announced by the examiner

Requires:

- Medical Image Computing (CS3310-KP09)
- Medical Image Computing (CS3310-KP08, CS3310SJ14)

Responsible for this module:

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

Teacher:

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

Literature:

- H. Handels: Medizinische Bildverarbeitung - 2. Auflage, Vieweg u. Teubner 2009
- T. Lehmann: Handbuch der Medizinischen Informatik - München: Hanser 2005
- M. Sonka, V. Hlavac, R. Boyle: Image Processing, Analysis and Machine - 2nd edition. Pacific Grove: PWS Publishing 1998
- B. Preim, D. Bartz: Visualization in Medicine - Elsevier, 2007

Language:

- offered only in German

Notes:

This module is no longer offered and will be replaced by the new module "CS4332-KP04 Model and AI based image processing in medicine".

Prerequisites for attending the module:
- None (The competences of the required modules are required for this module, but the modules are not a prerequisite for admission.)

Prerequisites for the exam:
- Preliminary examinations can be determined at the beginning of the semester. If preliminary work has been defined, it must have been completed and positively assessed before the initial examination.

CS4340 - Health Economy (GOEK)

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

Course of study, specific field and term:

- Bachelor MES 2011 (compulsory), medicine, 5th semester
- Master Computer Science 2012 (compulsory), specialization field medical informatics, 1st semester

Classes and lectures:

- Health Economy (lecture, 2 SWS)
- Health Economy (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- PART 1: FUNDAMENTALS OF HEALTH ECONOMIC EVALUATIONS
- Relevance and objectives of economic evaluation in the context of healthcare
- Forms of study
- Cost types
- Effectiveness measures
- Decision analyses
- Sensitivity analyses
- Evaluation of digital health applications
- PART 2: DECISION ANALYTICAL MODELING
- Decision trees
- Markov cohort models
- Microsimulations
- Mathematical models (differential equation models) for the spread of infectious diseases

Qualification-goals/Competencies:

- PART 1: FUNDAMENTALS OF HEALTH ECONOMIC EVALUATIONS
- They know the different forms of health economics studies and can differentiate between them.
- They can explain types of costs and measurement approaches for determining them in health economic studies.
- They are familiar with different measures of effectiveness and can discuss the advantages and disadvantages of each.
- They know how to conduct cost-effectiveness analyses for medical interventions / health programs.
- They know the steps of decision analysis and can carry out corresponding analyses on the basis of evaluation results.
- They can assess the suitability of data sources for health economic studies, reflect on parameter assumptions and carry out sensitivity analyses by changing assumptions and data sources.
- They can apply the knowledge they have acquired to analyze and critically assess specific studies on the cost-effectiveness of medical products and procedures.
- PART 2: DECISION ANALYTICAL MODELING
- They know the strengths and limitations of different model types and are able to make an appropriate model selection for specific application examples.
- They can develop decision trees, Markov models, microsimulations and epidemiological models (based on differential equations) for specific application examples and program them in suitable software.
- You can use the above-mentioned model types to carry out health economic evaluations.
- They can program algorithms for univariate, multivariate and probabilistic sensitivity analyses (Monte Carlo simulations) in suitable software and carry out corresponding analyses.
- You can calibrate epidemiological models using epidemiological data.

Grading through:

- written exam

Responsible for this module:

- Prof. Dr. Alexander Kuhlmann

Teacher:

- Institute for Social Medicine and Epidemiology

- Prof. Dr. Katrin Balzer
- Prof. Dr. Alexander Kuhlmann

Literature:

- :
- :
- :
- :

Language:

- offered only in German

Notes:

Prerequisites for attending the module:
- None

Prerequisites for the exam:
- Preliminary examinations can be determined at the beginning of the semester. If preliminary work has been defined, it must have been completed and positively assessed before the initial examination.

CS4350 - Knowledge Bases and Expert Systems in Medicine (WibaExpMed)

Duration:	Turnus of offer:	Credit points:	Max. group size:
1 Semester	irregularly	4	99

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), specialization field medical informatics, 2nd or 3rd semester

Classes and lectures:

- Knowledge Bases and Expert Systems in Medicine (e-learning, 2 SWS)
- Knowledge Bases and Expert Systems in Medicine (exercise, 1 SWS)

Workload:

- 60 Hours private studies and exercises
- 40 Hours work on project
- 20 Hours exam preparation

Contents of teaching:

- Logische Grundlagen der symbolischen
- Datenbanken und
- spezielle Repräsentationsformate und
- die Verarbeitung unsicheren medizinischen
- Ansätze der Entscheidungsanalyse im klinischen
- medizinisches Knowledge Engineering sowie die

Qualification-goals/Competencies:

- Kenntnis der relevanten methodischen Grundlagen
- Problembewusstsein und Analysefähigkeit zu den
- Befähigung zur Systemanalyse und zum Systementwurf
- Befähigung zur Auswahl und Anwendung geeigneter

Grading through:

- successful addressing of the project goals

Responsible for this module:

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

Teacher:

- Institute of Medical Informatics
- Prof. Dr. Dr. Klaus Spitzer

Literature:

- :
- :
- :

Language:

- offered only in German

CS5151 - Telemedicine (TeleMed)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), specialization field media informatics, 2nd or 3rd semester
- Master Computer Science 2012 (optional subject), specialization field medical informatics, 3rd semester

Classes and lectures:

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

Workload:

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

Contents of teaching:

- Introduction
- Computer and multimedia
- Media Compression Methods
- Quality of Service
- Group Communication
- Specific Telemedical Applications

Qualification-goals/Competencies:

- Understanding of the problems of digital media and especially their transmission over Networks.
- Knowledge of basic compression methods for digital media and their respective applications.
- Estimation of multimedia capabilities of traditional networks and knowledge of opportunities for improvement.
- Knowledge of the most relevant telemedicine applications nowadays and assessment of specific application situations.

Grading through:

- Oral examination

Responsible for this module:

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

Teacher:

- Institute of Medical Informatics
- Institute of Telematics

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

Literature:

- R. Steinmetz: Multimedia Technologie - 3. Auflage. Berlin: Springer 2001
- T. Lehmann: Handbuch der Medizinischen Informatik - 2. Auflage. München: Hanser 2004

Language:

- offered only in German

MA2214-KP04, MA2214 - Clinical Studies (KlinStud)

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

Course of study, specific field and term:

- Bachelor CLS 2023 (compulsory), mathematics, 3rd or 5th semester
- Master Nutritional Medicine 2023 (compulsory), medical computer science, 1st semester
- Bachelor Medical Informatics 2019 (optional subject), medical computer science, 4th to 6th semester
- Bachelor CLS 2016 (compulsory), mathematics, 3rd or 5th semester
- Master Nutritional Medicine 2019 (compulsory), medical computer science, 1st semester
- Bachelor Medical Informatics 2014 (optional subject), medical computer science, 5th or 6th semester
- Master Computer Science 2012 (optional subject), specialization field medical informatics, 3rd semester
- Bachelor Medical Informatics 2011 (optional subject), medical computer science, 4th to 6th semester
- Bachelor MES 2011 (optional subject), life sciences, 3rd or 5th semester
- Bachelor CLS 2010 (compulsory), mathematics, 3rd or 5th semester

Classes and lectures:

- Clinical Studies (lecture, 2 SWS)
- Clinical Studies (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Definition of a clinical study according to the German Drug Law, classification of clinical studies, clinical development
- Basic principles of clinical trials and measures against bias
- Regulations and study documents
- Development of a clinical study, especially a study protocol
- Contents of a study protocol
- Link to health economics
- Further topics like
- Special study designs
- Advanced statistical analyses
- Report and publication
- Systematic overview and meta-analyses
- Data management and system validation
- Professional fields in clinical studies (study statistics, data management, monitoring, quality management, pharmacovigilance, project management)

Qualification-goals/Competencies:

- Students can describe the regulatory framework of clinical trials with drugs.
- They can describe the main areas of activity in the fields of study statistics, data management, monitoring, information technology and quality assurance.
- They can explain the basic principles of clinical trials and measures to achieve these basic principles.
- They can create a study protocol.
- They can represent study populations descriptively.
- They can perform case number planning for simple clinical studies.
- Students can assign studies and their key points to the stages of clinical development.
- They can explain different study designs.
- They are informed about ethical problems and guidelines and the principles of data protection.
- Acquisition of german and english technical language

Grading through:

- portfolio exam

Requires:

- Biostatistics 1 (MA1600-KP04, MA1600, MA1600-MML)

Responsible for this module:

- PD Dr. rer. pol. Reinhard Vonthein
- Prof. Dr. rer. biol. hum. Inke König

Teacher:

- Institute of Medical Biometry and Statistics

- PD Dr. rer. pol. Reinhard Vonthein
- Prof. Dr. rer. biol. hum. Inke König

Literature:

- Gaus W., Chase D.: Klinische Studien: Regelwerke, Strukturen, Dokumente und Daten - Norderstedt: Books on Demand GmbH 2007 (2. Auflage)
- Stapff M.: Arzneimittelstudien - Eine Einführung in klinische Prüfungen für Ärzte, Studenten, medizinisches Assistenzpersonal und interessierte Laien - Germering/München: W. Zuckschwerdt Verlag GmbH 2008 (5. Auflage)
- Schumacher, M., Schulgen, G.: Methodik klinischer Studien: Methodische Grundlagen der Planung, Durchführung und Auswertung - Berlin: Springer 2008 (3. Auflage)

Language:

- German and English skills required

Notes:

Admission requirements for taking the module:
- None (The competencies of the modules listed under 'Requires' are needed for this module, but are not a formal prerequisite)

Admission requirements for participation in module examination(s):
- None

Module exam(s):
- MA2214-L1: Clinical Studies, portfolio exam, 100 % of module grade, with a total of 200 points, distributed as follows:
+ 145 points for project work with documentation and presentations
+ 55 points for 5 short term papers

The course is held annually in German and English alternately. Languages Englisch or German may be chosen for homework and project with
documentation and presentation.

MA2600-KP04, MA2600 - Biostatistics 2 (BioStat2)

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

Course of study, specific field and term:

- Master Medical Informatics 2019 (optional subject), Medical Data Science / Artificial Intelligence, 1st or 2nd semester
- Master Biophysics 2019 (optional subject), Elective, 2nd semester
- Master Medical Informatics 2014 (optional subject), ehealth / infomatics, 1st or 2nd semester
- Master Computer Science 2012 (optional subject), specialization field medical informatics, 3rd semester
- Master Computer Science 2012 (optional subject), specialization field bioinformatics, 2nd or 3rd semester
- Master Computer Science 2012 (optional subject), advanced curriculum stochastics, 2nd semester
- Bachelor CLS 2010 (compulsory), mathematics, 4th semester

Classes and lectures:

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

Workload:

- 45 Hours in-classroom work
- 35 Hours private studies
- 25 Hours programming
- 15 Hours exam preparation

Contents of teaching:

- Knowledge of model assumptions and mathematical foundation of model assumptions for the linear model
- Knowledge of possible sources of errors in the modelling
- Competence in independent analysis of a study using the linear model
- Competence in correctly interpreting study results
- Competence in parameter interpretation and regression diagnostics
- Knowledge of model assumptions and mathematical foundation of the generalized linear model
- Competence in the independent analysis of a simple study with a dichotomous outcome
- Competence in correctly interpreting study results of a study with a dichotomous outcome

Qualification-goals/Competencies:

- The students are able to enumerate and explain the assumptions of the classical linear model.
- The students are able to describe typical applications of the classical linear model.
- The students are able to list the differences between the linear model and the logistic regression model.
- The students are able to describe possible error sources in modelling the linear model.
- The students are able to calculate the estimators (point and interval estimators, residual) in the linear model by hand.
- The students are able to evaluate the graphics for regression diagnostics in the linear model.
- The students are able to interpret the results of studies, where a linear, a logistic or a Cox regression model was applied.
- The students are able to draw and interpret Kaplan-Meier curves.
- The students are able to perform data transformations.

Grading through:

- written exam

Is requisite for:

- Multivariate Statistics (MA4944)
- Interdisciplinary Seminar (MA3300)

Requires:

- Biostatistics 1 (MA1600-KP04, MA1600, MA1600-MML)

Responsible for this module:

- Prof. Dr. rer. biol. hum. Inke König

Teacher:

- Institute of Medical Biometry and Statistics
- Prof. Dr. rer. biol. hum. Inke König
- Dr. rer. hum. biol. Markus Scheinhardt

Literature:

- Ludwig Fahrmeir, Thomas Kneib, Stefan Lang: Regression: Modelle, Methoden und Anwendungen - ISBN-13 9783540339328
- Dobson, Annette J & Barnett, Adrian: An Introduction to Generalized Linear Models, 3rd ed. - Chapman & Hall/CRC: Boca Raton (FL), 2008

Language:

- offered only in German

Notes:

Prerequisites for attending the module:
- None (The competences of the required modules are required for this module, but the modules are not a prerequisite for admission.)

Prerequisites for the exam:
- Preliminary examinations can be determined at the beginning of the semester. If preliminary work has been defined, it must have been completed and positively assessed before the initial examination.

MA3200-KP04, MA3200 - Genetic Epidemiology 1 (GenEpi1)

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

Course of study, specific field and term:

- Bachelor CLS 2023 (compulsory), mathematics, 3rd or 5th semester
- Master Medical Informatics 2019 (optional subject), Medical Data Science / Artificial Intelligence, 1st or 2nd semester
- Bachelor CLS 2016 (compulsory), mathematics, 3rd or 5th semester
- Master Medical Informatics 2014 (optional subject), ehealth / infomatics, 1st or 2nd semester
- Master Computer Science 2012 (optional subject), specialization field medical informatics, 3rd semester
- Bachelor CLS 2010 (compulsory), mathematics, 3rd or 5th semester

Classes and lectures:

- Genetic Epidemiology 1 (lecture, 2 SWS)
- Genetic Epidemiology 1 (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Monogenic and complex diseases
- Hardy-Weinberg-equilibrium
- Coupling imbalance
- Genetic markers and genotyping
- Quality control
- Basics of association analysis
- Genome-wide association studies
- Population stratification
- Gene-environment interaction
- Replication, meta-analysis and imputation
- Ethical aspects

Qualification-goals/Competencies:

- Students are able to describe the generation of genetic data, its error sources and methods of detection.
- They can select and describe the most important approaches for genetic epidemiological association studies on the level of single markers.
- They are able to apply the basic test procedures manually and to interpret the results.
- They are able to describe the statistical evaluation steps in a genome-wide association study and interpret the results.

Grading through:

- Written or oral exam as announced by the examiner

Is requisite for:

- Seminar Genetic Epidemiology (MA5129-KP04, MA5129)
- Genetic Epidemiology 2 (MA4661-KP08, MA4661)

Requires:

- Biostatistics 1 (MA1600-KP04, MA1600, MA1600-MML)

Responsible for this module:

- Prof. Dr. rer. nat. Silke Szymczak

Teacher:

- Institute of Medical Biometry and Statistics
- Prof. Dr. rer. nat. Silke Szymczak
- MitarbeiterInnen des Instituts

Literature:

- Ziegler A, König IR.: A statistical approach to genetic epidemiology. Concepts and applications. - 2010. ISBN: 978-3-527-32389-0

- Bickeböller H, Fischer, C: Einführung in die Genetische Epidemiologie - 2007. ISBN: 978-3-540-25616-8

Language:

- German or English

Notes:

Prerequisites for attending the module:
- None (The competencies of the modules listed under 'Requires' are needed for this module, but are not a formal prerequisite)

Prerequisites for the exam:
- Examination prerequisites can be defined at the beginning of the semester. If preliminary work is defined, it must have been completed and positively evaluated before the first examination.

Module exam(s):
- MA3200-L1: Genetic Epidemiology 1, oral exam, 30 min, or written exam, 90 min, 100% of module grade

MA3400-KP04, MA3400 - Biomathematics (Biomathe)

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

Course of study, specific field and term:

- Master Molecular Life Science 2023 (optional subject), mathematics / computer science, 1st semester
- Bachelor MES 2020 (optional subject), mathematics / natural sciences, 3rd semester at the earliest
- Bachelor Robotics and Autonomous Systems 2020 (optional subject), mathematics, 5th or 6th semester
- Bachelor Medical Informatics 2014 (optional subject), medical computer science, 5th or 6th semester
- Bachelor MES 2014 (optional subject), mathematics / natural sciences, 3rd or 5th semester
- Bachelor Computer Science 2014 (compulsory), specialization field bioinformatics, 5th semester
- Master MES 2011 (optional subject), mathematics, 1st semester
- Bachelor Medical Informatics 2011 (optional subject), bioinformatics, 4th to 6th semester
- Master Computer Science 2012 (optional subject), specialization field medical informatics, 3rd semester
- Bachelor MES 2011 (optional subject), mathematics, 5th semester
- Bachelor Computer Science 2012 (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:

- Examples and elementary solution methods for ordinary differential equations
- Existence and uniqueness theorems
- Dependence of solutions on initial conditions
- Linear systems (in particular with constant coefficients)
- Higher-Order linear differential equations
- Qualitative theory of nonlinear systems
- In accordance to the rules of GSP of UzL

Qualification-goals/Competencies:

- Students are able to explain basic notions from the theory of ordinarydifferential equations.
- Based on examples, students are able to explain
- Based on theorems, students are able to give conditions under which
- Students are able to find explicit solutions of simple differential equations.
- Students are able to explain how solutions of differential equations can beanalysed qualitatively.
- Students are able to present important models of the natural sciences which canbe analysed by differential equations.

Grading through:

- written exam

Requires:

- Linear Algebra and Discrete Structures 2 (MA1500-KP08, MA1500)
- Linear Algebra and Discrete Structures 1 (MA1000-KP08, MA1000)
- Analysis 2 (MA2500-KP04, MA2500)
- Analysis 1 (MA2000-KP08, MA2000)

Responsible for this module:

- PD Dr. rer. nat. Christian Bey

Teacher:

- Institute for Mathematics
- PD Dr. rer. nat. Christian Bey

Literature:

- G. Birkhoff, G.-C. Rota: Ordinary Differential Equations

- H. Heuser: Gewöhnliche Differentialgleichungen - Teubner Verlag 2009 (6. Auflage)
- M.W. Hirsch, S. Smale: Differential Equations, Dynamical Systems, and Linear Algebra
- J. D. Murray: Mathematical Biology - Springer
- J. Scheurle: Gewöhnliche Differentialgleichungen
- R. Schuster: Biomathematik - Vieweg + Teubner Studienbücher 2009
- W. Walter: Gewöhnliche Differentialgleichungen

Language:

- offered only in German

Notes:

Prerequisites for the module:
- nothing

Prerequisites for admission to the written examination:
- Successful completion of homework assignments during the semester

Module exam:
- MA3400-L1: Biomathematik, written exam, 90 min, 100 % module grade

MA4970 - Design of Experiments and Variance Analysis (VplVarianz)

Duration:	Turnus of offer:	Credit points:
1 Semester	irregularly	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), specialization field medical informatics, 3rd semester
- Master CLS 2010 (optional subject), mathematics, 1st or 3rd semester
- Bachelor CLS 2010 (optional subject), mathematics, 5th semester

Classes and lectures:

- Design of Experiments and Variance Analysis (lecture, 2 SWS)
- Design of Experiments and Variance Analysis (exercise, 1 SWS)

Workload:

- 50 Hours private studies
- 30 Hours in-classroom work
- 25 Hours programming
- 15 Hours exam preparation

Contents of teaching:

- Ability to calculate generalized inverse
- Knowledge of the differences between experiments and observational studies
- Knowledge of the advantages of the statistical design of multifactorial experiments
- Ability to interpret a suitable experimental ANOVA design
- Ability to implement a suitable experimental ANOVA design
- Ability to express the ANOVA model as regression model by matrix notation
- Ability to express and analyze models with repeated measurements
- Ability to draw up and analyze diagrams for an abstract of the results and a model diagnosis

Qualification-goals/Competencies:

- Comprehension of the theoretical principles of the design of experiments
- Comprehension of the theoretical principles of the analysis of variance

Grading through:

- written exam

Requires:

- Biostatistics 2 (MA2600-KP04, MA2600)
- Linear Models (MA4960)
- Biostatistics 1 (UngenutztMA1600-MML)

Responsible for this module:

- Prof. Dr. rer. nat. Andreas Ziegler

Teacher:

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

Literature:

- Kursbuch: Montgomery, Douglas C. 2012: Design and Analysis of Experiments. 8th ed. International Student Version - John Wiley & Sons, New York. ISBN 978-1-118-09793-9
- Supplementary literature: Kleppmann, Wilhelm. 2008: Taschenbuch Versuchsplanung. 5. Auflage - Carl Hanser, Wien. ISBN 978-3-446-41595-9
- Supplementary literature: Mason, Robert L., Gunst, Richard F., Hess, James L. 2003: Statistical Design and Analysis of Experiments. 2nd ed. - John Wiley & Sons, New York. ISBN 0-471-37216-1

Language:

- offered only in German

ME4000 - Imaging Systems 1 (BildgbSys1)

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

Course of study, specific field and term:

- Master Computer Science 2012 (compulsory), specialization field robotics and automation, 1st semester
- Master Computer Science 2012 (optional subject), advanced curriculum signal and image processing, 2nd or 3rd semester
- Master Computer Science 2012 (optional subject), specialization field medical informatics, 3rd semester
- Master Computer Science 2012 (optional subject), advanced curriculum imaging systems, 2nd or 3rd semester
- Master CLS 2010 (compulsory), computational life science / imaging, 1st semester

Classes and lectures:

- Imaging systems 1 (lecture, 2 SWS)
- Imaging systems 1 (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Signal processing (recapitulation of fundamental principles in signal processing)
- Mathematical methods in image reconstruction and signal processing
- X-Ray (fundamental principles, quantum statistics)
- Computed Tomography * devices, * current and past technology, * signal processing, * Fourier-based 2D and 3D image reconstruction, * algebraic and statistical image reconstruction, * image artifacts, * technical and clinical applications, * dose.

Qualification-goals/Competencies:

- Students are able to create an overview of the signal chain for medical imaging.
- They are able to explain the mathematical background for the reconstruction of CT images.
- They are able to explain the basics for the creation of X-ray.
- They are able to list all generations of CT devices and explain differences and advances.
- They are able to apply the Fourier transform.
- They are able to explain the mathematical basics for the two-dimensional image reconstruction.
- They are able to create and apply an algebraic approach for the reconstruction of CT images.
- They are able to create and apply an statistical approach for the reconstruction of CT images.
- They are able to outline the differences between two dimensional and three dimensional image reconstruction.
- They are able to transfer methods from two dimensional to three dimensional image reconstruction.

Grading through:

- Oral examination

Responsible for this module:

- Prof. Dr. rer. nat. Thorsten Buzug

Teacher:

- Institute of Medical Engineering
- Prof. Dr. rer. nat. Thorsten Buzug

Literature:

- T. M. Buzug: Computed Tomography, From Photon Statistics to Modern Cone Beam CT - Springer-Verlag, Berlin/Heidelberg, 2008
- T. M. Buzug: Einführung in die Computertomographie, Mathematisch-physikalische Grundlagen der Bildrekonstruktion - Springer-Verlag, Berlin/Heidelberg, 2004

Language:

- offered only in English

ME4030-KP04, ME4030 - Inverse Problems in Imaging (InversProb)

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

Course of study, specific field and term:

- Master Auditory Technology 2022 (optional subject), Auditory Technology, 2nd semester
- Master MES 2020 (optional subject), medical engineering science, Arbitrary semester
- Master Medical Informatics 2019 (optional subject), medical image processing, 1st or 2nd semester
- Master Auditory Technology 2017 (optional subject), Auditory Technology, 2nd semester
- Master MES 2014 (optional subject), medical engineering science, 1st or 2nd semester
- Master MES 2011 (optional subject), mathematics, 1st or 2nd semester
- Master Computer Science 2012 (optional subject), advanced curriculum signal and image processing, 2nd or 3rd semester
- Master Computer Science 2012 (optional subject), specialization field robotics and automation, 3rd semester
- Master Computer Science 2012 (optional subject), specialization field medical informatics, 3rd semester
- Master Computer Science 2012 (optional subject), advanced curriculum imaging systems, 2nd or 3rd semester
- Master MES 2011 (advanced curriculum), imaging systems, signal and image processing, 1st or 2nd semester
- Master CLS 2010 (optional subject), mathematics, 1st and 2nd semester

Classes and lectures:

- Tomographische Verfahren II: Inverse Probleme bei der Bildgebung (lecture, 2 SWS)
- Tomographische Verfahren II: Inverse Probleme bei der Bildgebung (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Introduction to inverse and ill-posed problems on the basis of selected examples (including seismology, impedance tomography, heat conduction, computed tomography, acoustic)
- Concept of ill-posedness of the inverse problem (Hadamard)
- Singular value decomposition and generalized inverse
- Regularization methods (eg Tikhonov, Phillips, Ivanov)
- Deconvolution
- Image restoration (deblurring, defocusing)
- Statistical methods (Bayes, maximum likelihood)
- Computed Tomography, Magnetic Particle Imaging

Qualification-goals/Competencies:

- Students are able to explain the concept of ill-posedness of the inverse problem and distinguish given inverse problems regarding good or bad posedness.
- They are able to formulate inverse problems of mathematical imaging and solve (approximate) with suitable numerical methods.
- They can assess the condition of a problem and the stability of a method.
- They master different regularization methods and are able to apply them to practical problems.
- They know methods to determine a suitable regularization.
- They can use methods of image reconstruction and restoration on real measurement data.

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr. rer. nat. Thorsten Buzug

Teacher:

- Institute of Medical Engineering
- Prof. Dr. rer. nat. Thorsten Buzug

Literature:

- Kak and Slaney: Principles of Computerized Tomographic Imaging - SIAM Series 33, New York, 2001
- Natterer and Wübbeling: Mathematical Methods in Image Reconstruction - SIAM Monographs, New York 2001

- Bertero and Boccacci: Inverse Problems in Imaging - IoP Press, London, 2002
- Andreas Rieder: Keine Probleme mit inversen Problemen - Vieweg, Wiesbaden, 2003
- Buzug: Computed Tomography - Springer, Berlin, 2008

Language:

- offered only in German

Notes:

Prerequisites for attending the module:
- None

Prerequisites for the exam:
- Preliminary examinations can be determined at the beginning of the semester. If preliminary work has been defined, it must have been completed and positively assessed before the initial examination.

MZ3100-KP04, MZ3100 - Medical Quality Management (MedizQM)

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

Course of study, specific field and term:

- Bachelor MES 2020 (compulsory), medicine, 3rd semester
- Bachelor Medical Informatics 2019 (optional subject), medical computer science, 4th to 6th semester
- Bachelor Medical Informatics 2014 (optional subject), medical computer science, 5th or 6th semester
- Bachelor MES 2014 (compulsory), medicine, 3rd semester
- Master Computer Science 2012 (optional subject), specialization field medical informatics, 3rd semester
- Bachelor MES 2011 (compulsory), medicine, 5th semester

Classes and lectures:

- Medical Quality Management (lecture, 2 SWS)
- Medical Quality Management (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Part I: Medical Qualtity Management
- Part II: Gauging, testing and engineer standards
- Part III: Industrial Qualtiy Management

Qualification-goals/Competencies:

- Part I: The students can classify the importance of quality management in the medical sector (procedural knowledge), they know the basic terms of this subject area and the contents of the EC Directives and the Medical Devices Act (factual knowledge). They have the expertise for independet evaluations of clinical studies (empowerment) and the have factual knowledge sectors of quality assurance an psychometric tests.
- Part II: The students can identify the important physiological signals from the area of anesthesiology an they know the important parameters to describe the measured signal quality (factual knowledge). They have acquired knowledge in signal recording an processing (factual knowledge) and they can analyze a invasive blood preasure system (second-prder system) independently unter supervision. They know the contents of relevant safety, quality and testing standards (factual knowledge).
- Part III: The students kno the basic components and requirements of a industrial quality management system in the medical technology branch (factual knowledge). They are able to point out the difference between corporate objetives and quality objectives (procedural knowledge). They know the specific qulity requirements for medical software, hardware (MRI) and in-virto diagnostics (factual knowledge).

Grading through:

- written exam

Responsible for this module:

- Prof. Dr. med. Hartmut Gehring

Teacher:

- Institute of Medical Engineering
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- Prof. Dr. med. Hartmut Gehring

Literature:

- Böckmann, Frankenberger, und Wille: MPG und Co. - 7. akt. Auflage 2015, TÜV-Verlag GmbH Köln, ISBN: 978-3-8429-1843-0
- Jahnke, I., Friedrich, H.-J. & Hüppe, M. (2002): Die Lübecker Fragebogen-Doppelkarte zur Erfassung der Patientenzufriedenheit: Wie differenziert sollte eine Auswertung für das Qualitätsmanagement erfolgen? - FOCUS MUL, 19,/ 82-91
- Lauterbach, Lüngen, Schrappe: Gesundheitsökonomie, Management und Evidence-based Medicine. - 3. Auflage 2010, Schattauer GmbH, ISBN 978-3-7945-2576-8
- Frodel: BWL für Mediziner - 2008, Walter de Gruyter & Co. KG, ISBN: 978-3-11-020112-3
- Lauterbach, Stock, Brunner: Gesundheitsökonomie - 2. Auflage 2009, Verlag Hans Huber, ISBN 978-3-456-84695-8

Language:

- offered only in German

Notes:

Prerequisites for attending the module:
- None

Prerequisites for the exam:
- Preliminary examinations can be determined at the beginning of the semester. If preliminary work has been defined, it must have been completed and positively assessed before the initial examination.

MZ4010-KP04, MZ4010 - Clinical Epidemiology (KlinEpi)

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

Course of study, specific field and term:

- Master CLS 2023 (compulsory), MML with specialization in Genetic Statistics, 3rd semester
- Bachelor Medical Informatics 2019 (optional subject), medical computer science, 4th to 6th semester
- Master CLS 2016 (compulsory), MML with specialization in Genetic Statistics, 3rd semester
- Bachelor Medical Informatics 2014 (compulsory), medical computer science, 5th semester
- Bachelor Medical Informatics 2011 (compulsory), medical computer science, 3rd semester
- Master CLS 2010 (compulsory), computational life science / biostatistics, 1st semester
- Master Computer Science 2012 (compulsory), specialization field medical informatics, 3rd semester

Classes and lectures:

- Clinical Epidemiology (lecture, 2 SWS)
- Clinical Epidemiology (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Introduction to epidemiology
- Diagnosis
- Frequencies
- Registers and data sources
- Geographical epidemiology
- Study designs (RCT, cohort study, case control study, cross sectional study)
- Effect measures
- Causality
- Chance, bias and confounding
- Control of errors
- Outbreak investigation

Qualification-goals/Competencies:

- Students are able to explain technical terms such as disease register, incidence, prevalence, mortality, lethality, standardization.
- They are able to explain and interpret epidemiological measures.
- They are able to assess which study design is appropriate for a certain research question.
- They are able to identify possible sources of error, bias and confounding and how they affect the study results.
- They are able to assess causal inferences in the context of different study types.
- They are able to critically appraise data, results, and epidemiological research methods as well as scientific literature in the context of medicine and epidemiology.

Grading through:

- written exam

Responsible for this module:

- Prof. Dr. med. Alexander Katalinic

Teacher:

- Institute for Social Medicine and Epidemiology
- Prof. Dr. med. Alexander Katalinic
- MitarbeiterInnen des Instituts

Literature:

- L. Gordis: Epidemiology - Oxford: Elsevier; 5th edition 2013
- R. H. Fletcher: Clinical Epidemiology. The Essentials. - Lippincott Williams & Wilki; 5th rev. edition 2012
- :

Language:

- offered only in German

Notes:

Prerequisites for attending the module:
- None

Prerequisites for participation in the exam(s):
- None

Module exam(s):
- MZ4010-L1, Clinical Epidemiology, written exam, 90 min, 100 % of module grade

MZ4020 - Procedures for clinical diagnostic and therapy (VkDiagTher)

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

Course of study, specific field and term:

- Master Computer Science 2012 (compulsory), specialization field medical informatics, 2nd semester

Classes and lectures:

- Procedures for clinical diagnostic and therapy (lecture, 2 SWS)
- Procedures for clinical diagnostic and therapy (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Diagnosefindung (Anamnese, Befund)
- Organ bzw. teilgebietsorientierte Darstellung von internistischen Erkrankungen
- Kardiologie/Gef¨aßerkrankungen (z.B. Art. Hypertonie, arterielle Verschlusskrankheiten,Herzinfarkt, Rhythmusstörungen, Schock, Lungenembolie)
- Pulmonologie (z.B. Pneumonie, Asthma, chronologisch obstruktive Lungenerkrankung)
- Gastroenterologie (z.B. Ulcuserkrankung, entzündliche Darmerkrankungen,Pankratitis, Hepatitis, Colon-Ca)
- Endokrinologie (z.B. Diabetes, Schilddrüsen- und Nebennierenfunktionsstörung)
- Nephrologie (z.B. akutes Nierenversagen, Glomerulonephritis, Dialyse)
- Hämatologie und Onkologie (z.B. Anämie, Hämolyse, Plasmozytom, Lymphom)
- Infektionskrankheiten (z.B. Varizellen, Scharlach, Tbc, HIV, Sepsis)
- Rheumatologie (z.B. Rheumatoide Arthritis, Polymyalgiarheumatica)

Qualification-goals/Competencies:

- Übersicht über die Symptomatik, Diagnostik und Therapie ausgewählter Krankheiten aus den verschiedenen Bereichen der Inneren Medizinerapie
- Einblick in Methoden ärztlichen Handelns
- Anwendung medizinischer Grundkenntnisse auf ausgewählte Krankheitsbilder
- Befähigung zur selbstständigen Einarbeitung in einzelne Krankheitsbilder bei gegebenen Fragestellungen

Grading through:

- written exam

Responsible for this module:

- Prof. Dr. med. Hendrik Lehnert

Teacher:

- Medical Clinic I
- Dr. med. Peter Wellhöner

Literature:

- H. Renz-Polster, J. Braun: Basislehrbuch Innere Medizin - 3. Auflage. München: Urban und Fischer
- L. Geisler: Innere Medizin - Stuttgart: Kohlhammer 2002

Language:

- offered only in German

CS4170 - Parallel Computer Systems (ParaRSys)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), advanced curriculum parallel and distributed system architecutres, 2nd or 3rd semester
- Master Computer Science 2012 (optional subject), specialization field robotics and automation, 3rd semester

Classes and lectures:

- Parallel Computer Systems (lecture, 2 SWS)
- Parallel Computer Systems (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Motivation and limitations for parallel and distributed processing
- Parallel computing models
- Taxonomy of parallel computers
- Multi/manycore-systems
- Graphic Processing Units (GPUs)
- OpenCL
- Specification languages
- Hardware architectures
- System management of many-core systems

Qualification-goals/Competencies:

- Students are able to characterize different parallel computing architectures.
- They are able to explain models of parallel computing.
- They are able to make use of common programming interfaces for parallel computing systems.
- They are able to judge which kind of parallel computing system is best suited for a dedicated problem and how many cores should be used.
- They are able to evaluate the pros and cons of different hardware architectures.
- They are able to write programs for parallel computing systems under considerations of the underlying hardware architecture.
- They are able to compare methods for dynamic voltage and frequency scaling (DVFS) for manycore systems.

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr.-Ing. Thilo Pionteck (Nachfolger NN)

Teacher:

- Institute of Computer Engineering
- Prof. Dr.-Ing. Thilo Pionteck (Nachfolger NN)

Literature:

- G. Bengel, C. Baun, M. Kunze, K. U. Stucky: Masterkurs Parallele und Verteilte Systeme - Vieweg + Teubner, 2008
- M. Dubois, M. Annavaram, P. Stenström: Parallel Computer Organization and Design - University Press 2012
- B. R. Gaster, L. Howes, D. R. Kaeli, P. Mistry, D. Schaa: Heterogeneous Computing with OpenCL - Elsevier/Morgan Kaufman 2013
- B. Wilkinson; M. Allen: Parallel Programming - Englewood Cliffs: Pearson 2005
- J. Jeffers, J. Reinders: Intel Xeon Phi Coprozessor High-Performance Programming - Elsevier/Morgan Kaufman 2013
- D. A. Patterson, J. L. Hennessy: Computer Organization and Design - Morgan Kaufmann, 2013

Language:

- offered only in German

Notes:

Only CS4170-KP06 Parallel Computer Systems is now offered for 6 credits.

CS4172-KP04, CS4172 - Dependability of Computing Systems (ZuverlRSys)

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

Course of study, specific field and term:

- Bachelor Computer Science 2019 (optional subject), major subject informatics, Arbitrary semester
- Bachelor Robotics and Autonomous Systems 2020 (optional subject), computer science, 5th or 6th semester
- Bachelor Computer Science 2016 (optional subject), major subject informatics, Arbitrary semester
- Bachelor Robotics and Autonomous Systems 2016 (optional subject), computer science, 5th or 6th semester
- Bachelor IT-Security 2016 (compulsory), IT-Security, 6th semester
- Bachelor Computer Science 2014 (optional subject), central topics of computer science, 6th semester
- Bachelor Computer Science 2014 (compulsory), specialization field IT security and safety, 6th semester
- Bachelor Computer Science 2012 (compulsory), specialization field IT security and safety, 6th semester
- Master Computer Science 2012 (optional subject), advanced curriculum security, 2nd or 3rd semester
- Master Computer Science 2012 (optional subject), specialization field software systems engineering, 3rd semester
- Master Computer Science 2012 (optional subject), advanced curriculum parallel and distributed system architecutres, 2nd or 3rd semester
- Master Computer Science 2012 (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 valuate and compare suitable fault tolerance techniques and to select them for a given application area.

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr.-Ing. Mladen Berekovic

Teacher:

- Institute of Computer Engineering
- Prof. Dr.-Ing. Mladen Berekovic

Literature:

- E. Dubrova: Fault-Tolerant Design - Springer 2013
- K. Echtle: Fehlertoleranzverfahren - Springer 1990
- I. Koren, C. M. Krishna: Fault Tolerant Systems - Morgan-Kaufman 2007
- K. Trivedi: Probability and Statistics with Reliability, Queuing, and Computer Science Applications - Wiley 2001

Language:

- offered only in German

Notes:

Admission requirements for taking the module:
- None

Admission requirements for participation in module examination(s):
- Successful completion of exercise assignments as specified at the beginning of the semester

Module Exam(s):
- CS4172-L1: Dependability of Computing Systems, written exam, 90min, 100% of the module grade

CS4250-KP04, CS4250 - Computer Vision (CompVision)

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

Course of study, specific field and term:

- Master CLS 2023 (optional subject), computer science, 2nd or 3rd semester
- Master MES 2020 (optional subject), computer science / electrical engineering, Arbitrary semester
- Master Computer Science 2019 (optional subject), Elective, Arbitrary semester
- Master Media Informatics 2020 (optional subject), computer science, Arbitrary semester
- Master Biophysics 2019 (optional subject), Elective, 2nd semester
- Master Biomedical Engineering (optional subject), advanced curriculum, 2nd semester
- Master CLS 2016 (optional subject), computer science, 2nd or 3rd semester
- Master MES 2014 (optional subject), computer science / electrical engineering, 1st or 2nd semester
- Master Media Informatics 2014 (optional subject), computer science, Arbitrary semester
- Master Computer Science 2012 (optional subject), advanced curriculum imaging systems, 2nd or 3rd semester
- Master CLS 2010 (compulsory), computational life science / imaging, 2nd semester
- Master MES 2011 (advanced curriculum), imaging systems, signal and image processing, 2nd semester
- Master Computer Science 2012 (optional subject), advanced curriculum signal and image processing, 2nd or 3rd semester
- Master Computer Science 2012 (compulsory), specialization field robotics and automation, 2nd semester
- Master Computer Science 2012 (compulsory), specialization field bioinformatics, 2nd semester
- Master Computer Science 2012 (optional subject), advanced curriculum intelligent embedded systems, 2nd semester

Classes and lectures:

- Computer Vision (lecture, 2 SWS)
- Computer Vision (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Introduction to human and computer vision
- Sensors, cameras, optics and projections
- Image features: edges, intrinsic dimension, Hough transform, Fourier descriptors, snakes
- Range imaging and 3-D cameras
- Motion and optical flow
- Object recognition
- Example applications

Qualification-goals/Competencies:

- Students can understand the basics of computer vision.
- They can explain and perform camera choice and calibration.
- They can explain and apply the basic methods for feature extraction, motion estimation, and object recognition.
- They can indicate appropriate methods for different kinds of computer-vision applications.

Grading through:

- Oral examination

Responsible for this module:

- Prof. Dr.-Ing. Erhardt Barth

Teacher:

- Institute for Neuro- and Bioinformatics
- Prof. Dr.-Ing. Erhardt Barth

Literature:

- Richard Szeliski: Computer Vision: Algorithms and Applications - Springer, Boston, 2011
- David Forsyth and Jean Ponce: Computer Vision: A Modern Approach - Prentice Hall, 2003

Language:

- English, except in case of only German-speaking participants

Notes:

Admission requirements for taking the module:
- None

Admission requirements for participation in module examination(s):
- Regular participation in the exercises as specified at the beginning of the semester
- Successful completion of exercise slips as specified at the beginning of the semester

Module exam(s):
- CS4250-L1: Computer Vision, oral exam, 100% of module grade

Is identical to module XM2330 of the University of Applied Sciences Lübeck

CS4405-KP04, CS4405 - Neuroinformatics (NeuroInf)

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

Course of study, specific field and term:

- Master CLS 2023 (compulsory), computer science, 2nd semester
- Master Auditory Technology 2022 (optional subject), Auditory Technology, 2nd semester
- Master Auditory Technology 2017 (optional subject), Auditory Technology, 2nd semester
- Master MES 2020 (optional subject), computer science / electrical engineering, Arbitrary semester
- Master CLS 2016 (compulsory), computer science, 2nd semester
- Master Robotics and Autonomous Systems 2019 (optional subject), Elective, 1st or 2nd semester
- Master MES 2014 (optional subject), computer science / electrical engineering, Arbitrary semester
- Master MES 2011 (optional subject), mathematics, 2nd semester
- Bachelor MES 2011 (optional subject), optional subject medical engineering science, 6th semester
- Master Computer Science 2012 (optional subject), advanced curriculum organic computing, 2nd or 3rd semester
- Master MES 2011 (advanced curriculum), imaging systems, signal and image processing, 2nd semester
- Master Computer Science 2012 (optional subject), advanced curriculum intelligent embedded systems, 2nd or 3rd semester
- Master Computer Science 2012 (compulsory), specialization field robotics and automation, 2nd semester
- Master Computer Science 2012 (compulsory), specialization field bioinformatics, 2nd semester
- Master CLS 2010 (compulsory), computer science, 2nd semester

Classes and lectures:

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

Workload:

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

Contents of teaching:

- The human brain and abstract neuron models
- Learning with a single neuron:* Perceptrons* Max-Margin Classification* LDA and logistic Regression
- Network architectures:* Hopfield-Networks* Multilayer-Perceptrons* Deep Learning
- Unsupervised Learning:* k-means, Neural Gas and SOMs* PCA & ICA* Sparse Coding

Qualification-goals/Competencies:

- The students are able to understand the principle function of a single neuron and the brain as a whole.
- They know abstract neuronal models and they are able to name practical applications for the different variants.
- They are able to derive a learning rule from a given error function.
- They are able to apply (and implement) the proposed learning rules and approaches to solve unknown practical problems.

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr. rer. nat. Thomas Martinetz

Teacher:

- Institute for Neuro- and Bioinformatics
- Prof. Dr. rer. nat. Thomas Martinetz
- Prof. Dr. rer. nat. Amir Madany Mamlouk

Literature:

- S. Haykin: Neural Networks - London: Prentice Hall, 1999
- J. Hertz, A. Krogh, R. Palmer: Introduction to the Theory of Neural Computation - Addison Wesley, 1991
- T. Kohonen: Self-Organizing Maps - Berlin: Springer, 1995
- H. Ritter, T. Martinetz, K. Schulten: Neuronale Netze: Eine Einführung in die Neuroinformatik selbstorganisierender Netzwerke - Bonn: Addison Wesley, 1991

Language:

- offered only in German

Notes:

Admission requirements for taking the module:
- None

Admission requirements for participation in module examination(s):
- Successful completion of exercises as specified at the beginning of the semester

Module Exam(s):
- CS4405-L1: Neuroinformatics, written exam, 90 min, 100% of module grade

According to the old version of the MES Bachelor Examination Regulations (until WS 2011/2012), an elective subject is scheduled for the 4th semester instead of the 6th semester.

CS4660-KP04, CS4660 - Process Control Systems (ProzFueSys)

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

Course of study, specific field and term:

- Master Robotics and Autonomous Systems 2019 (optional subject), Module part Current Issues Robotics and Automation, Arbitrary semester
- Master Psychology 2016 (optional subject), interdisciplinary competence, 3rd semester
- Master psychology 2013 (optional subject), interdisciplinary competence, 3rd semester
- Master Media Informatics 2014 (compulsory), computer science, 3rd semester
- Master Computer Science 2012 (optional subject), specialization field robotics and automation, 2nd or 3rd semester
- Master Computer Science 2012 (compulsory), specialization field media informatics, 2nd semester
- Master Entrepreneurship in Digital Technologies 2020 (optional subject), specific, Arbitrary semester

Classes and lectures:

- Process Control Systems (lecture, 2 SWS)
- Process Control Systems (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Introduction and Overview
- Incidents and Accidents
- Error, Failure and Responsibility
- Human Factors
- Mental, conceptual and technical Models
- Task Analysis and Task Modelling
- Event Analysis and Event Modelling
- Task Allocation
- Situation Awareness
- Diagnoses und Contingency
- Interaction in real-time: Conception and Design
- Risk and Safety
- Operations and Safety

Qualification-goals/Competencies:

- The students know the most important theories, methods and systems for monitoring and controlling processes.
- They know the definitions of the terms risk and security and why they are applied in different ways.
- They can assess what needs to be considered in the development of mission- and safety-critical human-machine systems and how to proceed methodically.

Grading through:

- written exam

Responsible for this module:

- Prof. Dr. phil. André Calero Valdez

Teacher:

- Institute for Multimedia and Interactive Systems
- Prof. Dr. phil. André Calero Valdez

Literature:

- M. Herczeg: Prozessführungssysteme Sicherheitskritische Mensch-Maschine-Systeme und Interaktive Medien zur Überwachung und Steuerung von Prozessen in Echtzeit - München: de Gruyter - Oldenbourg-Verlag, 2014
- M. Herczeg: Software-Ergonomie: Theorien, Modelle und Kriterien für gebrauchstaugliche interaktive Computersysteme - 4. erweiterte und aktualisierte Auflage. De Gruyter Studium, 2018
- M. Herczeg: Interaktionsdesign - München: Oldenbourg-Verlag, 2006
- J. Reason: Human Error - Boston: Cambridge University Press, 1990
- J. Rasmussen, L. P. Goodstein, A. M. Peijtersen: Cognitive Systems Engineering - New York: Wiley, 1994

Language:

- offered only in German

Notes:

Prerequisites for attending the module:
- None

Prerequisites for the exam:
- Successful completion of homework assignments during the semester.

CS5150-KP04, CS5150 - Organic Computing (OrganicCom)

Duration:	Turnus of offer:	Credit points:
1 Semester	irregularly	4

Course of study, specific field and term:

- Master Entrepreneurship in Digital Technologies 2020 (advanced module), specific, Arbitrary semester
- Master Medical Informatics 2019 (optional subject), bioinformatics, 1st or 2nd semester
- Master Medical Informatics 2014 (optional subject), bioinformatics, 1st or 2nd semester
- Master Computer Science 2012 (optional subject), advanced curriculum parallel and distributed system architecutres, 2nd or 3rd semester
- Master CLS 2010 (optional subject), computer science, Arbitrary semester
- Master Computer Science 2012 (compulsory), advanced curriculum organic computing, 2nd or 3rd semester
- Master Computer Science 2012 (optional subject), specialization field robotics and automation, 3rd semester

Classes and lectures:

- Organic Computing (lecture, 2 SWS)
- Organic Computing (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Basic principles of Organic Computing
- Self-organization and emergence
- Architecture and design of Organic Computing systems
- Organic Computing for distributed systems
- Organic Computing in Neuro- and Bionformatics
- Organic Grid
- Autonomous Systems

Qualification-goals/Competencies:

- Students are able to utilize the principles of organic computing on exemplary designs.
- They are able to explain the principles of Organic Computing.
- They are able to analyze emergence behavior in Organic Computing systems.

Grading through:

- written exam

Responsible for this module:

- Prof. Dr.-Ing. Mladen Berekovic

Teacher:

- Institute of Computer Engineering
- Dr. rer. nat. Javad Ghofrani

Literature:

- C. Müller-Schloer, H. Schmeck, T. Ungerer: Organic Computing A Paradigm Shift for Complex Systems - Birkhäuser, 2011
- R. P. Würtz: Organic Computing - Springer, 2008
- C. Klüver, J. Kluever, J. Schmidt: Modellierung komplexer Prozesse durch naturanaloge Verfahren - Springer Vieweg 2012

Language:

- offered only in German

Notes:

Admission requirements for taking the module:
- None

Admission requirements for participation in module examination(s):
- Successful completion of exercise assignments as specified at the beginning of the semester

Module Exam(s):
- CS5150-L1: Organic Computing, oral exam, 100% of the module grade

CS5170-KP04, CS5170 - Hardware/Software Co-Design (HWSWCod)

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

Course of study, specific field and term:

- Master Computer Science 2019 (compulsory), Canonical Specialization SSE, Arbitrary semester
- Master Computer Science 2019 (optional subject), Elective, Arbitrary semester
- Master Media Informatics 2020 (optional subject), computer science, Arbitrary semester
- Master Robotics and Autonomous Systems 2019 (optional subject), Elective, 1st or 2nd semester
- Master Computer Science 2014 (compulsory), specialization field software systems engineering, 1st or 2nd semester
- Master MES 2011 (advanced curriculum), imaging systems, signal and image processing, 1st or 3rd semester
- Master Media Informatics 2014 (optional subject), computer science, Arbitrary semester
- Master Computer Science 2012 (optional subject), specialization field robotics and automation, 2nd or 3rd semester
- Master Computer Science 2012 (optional subject), advanced curriculum parallel and distributed system architecutres, 2nd or 3rd semester
- Master Computer Science 2012 (optional subject), advanced curriculum intelligent embedded systems, 2nd or 3rd semester
- Master Computer Science 2012 (compulsory), specialization field software systems engineering, 2nd semester

Classes and lectures:

- Hardware/Software Co-Design (lecture, 2 SWS)
- Hardware/Software Co-Design (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- System design flow
- Basic architectures for HW/SW systems
- System design and modelling
- System synthesis
- Algorithms for scheduling
- System partitioning
- Algorithms for system partitioning
- Design systems
- Performance analysis
- System design and specification with SystemC
- Application examples

Qualification-goals/Competencies:

- Students are able to determine a suitable hardware/software architecture for a given system description
- They are able to determine and describe the pros and cons of implementation alternatives
- They are able to apply methods for system partitioning
- They are able to translate non-formal system descriptions into formal models
- They are able to explain the different steps in system synthesis
- They are able to estimate the quality of system designs
- They are able to create system descriptions in SystemC

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr.-Ing. Mladen Berekovic

Teacher:

- Institute of Computer Engineering
- Prof. Dr.-Ing. Mladen Berekovic

Literature:

- F. Kesel: Modellierung von digitalen Systemen mit SystemC - Oldenbourg Verlag 2012
- Teich, J., Haubelt, C.: Digital Hardware/Software-Systeme. Synthese und Optimierung - Berlin: Springer 2007

Language:

- offered only in German

Notes:

Admission requirements for taking the module:
- None

Admission requirements for participation in module examination(s):
- Successful completion of exercise assignments as specified at the beginning of the semester

Module Exam(s):
- CS5170-L1: Hardware/Software Co-Design, oral exam, 100% of the module grade

CS5204-KP04, CS5204 - Artificial Intelligence 2 (KI2)

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

Course of study, specific field and term:

- Master MES 2020 (optional subject), computer science / electrical engineering, Arbitrary semester
- Master Robotics and Autonomous Systems 2019 (optional subject), Elective, 1st or 2nd semester
- Master Biophysics 2019 (optional subject), Elective, 1st semester
- Master MES 2014 (optional subject), computer science / electrical engineering, Arbitrary semester
- Master Biomedical Engineering (optional subject), Interdisciplinary modules, 2nd semester
- Master CLS 2016 (optional subject), computer science, 3rd semester
- Master Computer Science 2012 (optional subject), advanced curriculum intelligent embedded systems, 2nd or 3rd semester
- Master Computer Science 2012 (optional subject), specialization field robotics and automation, 3rd semester

Classes and lectures:

- Artificial Intelligence 2 (lecture, 2 SWS)
- Artificial Intelligence 2 (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Support Vector Machines and Dualization
- Classification
- Regression
- Time-Series Prediction
- Lagrange Multipliers
- Sequential Minimal Optimization
- Geometric Reasoning

Qualification-goals/Competencies:

- The students are able to choose a method for machine learning for a given application amongst a variety of such methods.
- The chosen method can be customized to the needs of the application. The process of customization goes well beyond straightforward search of parameters and involves adjustments to the basic mathematical techniques.This leads to innovative applications for machine learning, designed and implemented by the students.The starting point are support vector machines.

Grading through:

- Oral examination

Responsible for this module:

- Prof. Dr.-Ing. Achim Schweikard

Teacher:

- Institute for Robotics and Cognitive Systems
- Prof. Dr.-Ing. Achim Schweikard

Literature:

- P. Norvig, S. Russell: Künstliche Intelligenz - München: Pearson 2004

Language:

- offered only in English

Notes:

Note: Module will not be offered in winter semester 2024/2025

Admission requirements for taking the module:
- None

Admission requirements for participation in module examination(s):
- None

Module Exam(s):
- CS5204-L1: Artificial Intelligence 2, written exam, 90min, 100% of the module grade

CS5255 - Elements of Audio and Image Coding (AudioBild)

Duration:	Turnus of offer:	Credit points:
1 Semester	irregularly	4

Course of study, specific field and term:

- Master CLS 2010 (optional subject), imaging systems, Arbitrary semester
- Master Computer Science 2012 (optional subject), advanced curriculum signal and image processing, 2nd or 3rd semester
- Master Computer Science 2012 (optional subject), specialization field robotics and automation, 3rd semester
- Master Computer Science 2012 (optional subject), specialization field media informatics, 2nd or 3rd semester

Classes and lectures:

- Elements of Audio and Image Coding (lecture, 2 SWS)
- Elements of Audio and Image Coding (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Introduction to information theory
- Fundamentals of data compression and quantization
- Wavelets, transforms, and filterbanks for coding
- Principles of perceptual audio coding
- Standardized audio coders, such as mp3 and AAC
- Lossless audio coding
- Principles and standards of image compression (JPEG, JPEG2000)
- Progressive image compression
- Visual perception and masking
- Principles of video coding
- Principles of error correction and concealment

Qualification-goals/Competencies:

- Students are able to describe the different models of auditory and visual perception.
- They are able to implement optimal transforms and coding techniques.
- They are able to explain various applications of the above mentioned principles in audio, image, and video coding.

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr.-Ing. Alfred Mertins

Teacher:

- Institute for Signal Processing
- Prof. Dr.-Ing. Alfred Mertins

Literature:

- K. Sayood: Introduction to Data Compression - San Diego: Academic Press, 2nd edition 2000

Language:

- offered only in German

Notes:

Prerequisites for attending the module:
- None

Prerequisites for the exam:
- Successful completion of assignments during the semester.

Modul exam:
- CS5255-L1: Elements of Audio and Image Coding, written or oral exam, 100% of modul grade

CS5260 - Digital Speech and Audio Signal Processing (SprachAudi)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), advanced curriculum signal and image processing, 2nd or 3rd semester
- Master MES 2011 (advanced curriculum), imaging systems, signal and image processing, 1st or 2nd semester
- Master Computer Science 2012 (optional subject), advanced curriculum intelligent embedded systems, 2nd or 3rd semester
- Master Computer Science 2012 (optional subject), specialization field robotics and automation, 3rd semester
- Master Computer Science 2012 (optional subject), specialization field media informatics, 2nd or 3rd semester

Classes and lectures:

- Digital Speech and Audio Signal Processing (lecture, 2 SWS)
- Digital Speech and Audio Signal Processing (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Speech production and human hearing
- Physical models of the auditory System
- Dynamic compression
- Spectral analysis: Spectrum and Cepstrum
- Spectral perception and masking
- Vocal tract models
- Linear prediction
- Coding in time and frequency domains
- Speech synthesis
- Noise reduction and echo compensation
- Source localization and spatial reproduction
- Basics of automatic speech recognition

Qualification-goals/Competencies:

- Students are able to describe the basics of human speech production and the corresponding mathematical models.
- They are able to describe the process of human auditory perception and the corresponding signal processing tools for mimicing auditory perception.
- They are able to present basic knowledge of statistical speech modeling and automatic speech recognition.
- They can describe and use signal processing methods for source separation and room-acoustic measurements.

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr.-Ing. Alfred Mertins

Teacher:

- Institute for Signal Processing
- Prof. Dr.-Ing. Alfred Mertins

Literature:

- L. Rabiner, B.-H. Juang: Fundamentals of Speech Recognition - Upper Saddle River: Prentice Hall 1993
- J. O. Heller, J. L. Hansen, J. G. Proakis: Discrete-Time Processing of Speech Signals - IEEE Press

Language:

- offered only in German

CS5270 - Mobile Robots (MobilRob)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), advanced curriculum intelligent embedded systems, 2nd or 3rd semester
- Master Computer Science 2012 (compulsory), specialization field robotics and automation, 1st semester
- Master Computer Science 2012 (optional subject), advanced curriculum organic computing, 3rd semester

Classes and lectures:

- Mobile Robots (lecture, 2 SWS)
- Mobile Robots (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Reactive behaviour
- Sensors
- Actuators, kinematics of the drives
- Hybrid deliberative/reactive behaviour
- Strategies of actions
- maps, self-localization
- Routing and navigation
- Robot learning
- Multi-robots
- Human-robot interaction
- Currentds trends exempary robots

Qualification-goals/Competencies:

- Students know the most importent types of mobile autonomous robots (wheel-driven, walking and climbing robots etc.) and their kinematics.
- They have developed an understanding of sensors and actuators and their application to robotics
- They understand the basic methods of self-localization, planning and navigation and can apply them to real applications
- They are able to design and to program mobile robots

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr.-Ing. Mladen Berekovic

Teacher:

- Institute of Computer Engineering
- Prof. Dr.-Ing. Mladen Berekovic

Literature:

- :
- :
- :

Language:

- offered only in German

CS5275-KP04, CS5275 - Selected Topics of Signal Analysis and Enhancement (AMSAV)

Duration:	Turnus of offer:	Credit points:
1 Semester	every second semester	4

Course of study, specific field and term:

- Master MES 2020 (optional subject), medical engineering science, Arbitrary semester
- Master Medical Informatics 2019 (optional subject), Medical Data Science / Artificial Intelligence, 1st or 2nd semester
- Master MES 2014 (optional subject), medical engineering science, Arbitrary semester
- Master Medical Informatics 2014 (optional subject), medical image processing, 1st or 2nd semester
- Master CLS 2010 (optional subject), computer science, Arbitrary semester
- Master Computer Science 2012 (optional subject), specialization field bioinformatics, 3rd semester
- Master MES 2011 (advanced curriculum), imaging systems, signal and image processing, 1st or 2nd semester
- Master Computer Science 2012 (optional subject), advanced curriculum signal and image processing, 2nd or 3rd semester
- Master Computer Science 2012 (optional subject), specialization field robotics and automation, 3rd semester
- Master Computer Science 2012 (optional subject), advanced curriculum intelligent embedded systems, 2nd or 3rd semester

Classes and lectures:

- Selected Topics of Signal Analysis and Enhancement (lecture, 2 SWS)
- Selected Topics of Signal Analysis and Enhancement (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Introduction to statistical signal analysis
- Autocorrelation and spectral estimation
- Linear estimators
- Linear optimal filters
- Adaptive filters
- Multichannel signal processing, beamforming, and source separation
- Compressed sensing
- Basic concepts of multirate signal processing
- Nonlinear signal processing algorithms
- Application scenarios in auditory technology, enhancement, and restauration of one- and higher-dimensional signals, Sound-field measurement, noise reduction, deconvolution (listening-room compensation), inpainting

Qualification-goals/Competencies:

- Students are able to explain the basic elements of stochastic signal processing and optimum filtering.
- They are able to describe and apply linear estimation theory.
- Students are able to describe the concepts of adaptive signal processing.
- They are able to describe and apply the concepts of multichannel signal processing.
- They are able to describe the concept of compressed sensing.
- They are able to analyze and design multirate systems.
- Students are able to explain various applications of nonlinear and adaptive signal processing.
- They are able to create and implement linear optimum filters and nonlinear signal enhancement techniques on their own.

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr.-Ing. Markus Kallinger

Teacher:

- Institute for Signal Processing
- Prof. Dr.-Ing. Markus Kallinger

Literature:

- A. Mertins: Signaltheorie: Grundlagen der Signalbeschreibung, Filterbänke, Wavelets, Zeit-Frequenz-Analyse, Parameter- und

Signalschätzung - Springer-Vieweg, 3. Auflage, 2013
- S. Haykin: Adaptive Filter Theory - Prentice Hall, 1995

Language:

- German and English skills required

Notes:

Prerequisites for attending the module:
- None

Prerequisites for the exam:
- Successful completion of homework assignments during the semester (at least 50%).

Modul exam:
- CS5275-L1: Selected Topics of Signal Analysis and Enhancement, written or oral exam, 100% of modul grade

CS5280 - Seminar Robotics and Automation (SemRobAuto)

Duration:	Turnus of offer:	Credit points:
1 Semester	irregularly	4 (Typ B)

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), specialization field robotics and automation, 3rd semester

Classes and lectures:

- Advanced Seminar Robotics and Automation (seminar, 2 SWS)

Workload:

- 90 Hours work on an individual topic with written and oral presentation
- 30 Hours in-classroom work

Contents of teaching:

- Different topics from the fields of robotics and artificial intelligence for term papers are offered.
- The students learn the correct reading of scientific papers, research and investigation, correct quotation and structuring, and self-contained writing and presentation of their own scientific elaboration as a preparation for their final examination.

Qualification-goals/Competencies:

- The participants are able to do research on scientific publications, to analyze the contents and to understand them.
- The students are able to investigate self-dependently scientific publications, to analyze and understand their contents.
- The participants can analyze and reproduce the tenor with regard to their scope of work. The students are competent to write and present their own scientific work.

Grading through:

- presentation

Responsible for this module:

- Prof. Dr.-Ing. Achim Schweikard
- Prof. Dr.-Ing. Mladen Berekovic

Teacher:

- Institute for Robotics and Cognitive Systems
- Institute of Computer Engineering

- Prof. Dr.-Ing. Mladen Berekovic
- Prof. Dr.-Ing. Achim Schweikard

Language:

- German and English skills required

CS5295-KP04 - Project Robotics and Automation (PrRobAuto)

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

Course of study, specific field and term:

- Master Computer Science 2014 (compulsory), specialization field robotics and automation, 2nd or 3rd semester
- Master Computer Science 2012 (compulsory), specialization field robotics and automation, 3rd semester

Classes and lectures:

- Project Robotics and Automation (practical course, 3 SWS)

Workload:

- 45 Hours group work
- 45 Hours in-classroom work
- 30 Hours private studies

Contents of teaching:

- Combination of robotics and navigation
- Introduction to / advanced project management
- Realization of different robotic tasks in virtual and real environment
- Perception of objects and advanced sensoring tasks
- Collision detection
- Lokalization and Mapping
- Path planning
- Machine Vision
- Implementation of safety functions
- Programming of a Graphical User Interface (GUI)

Qualification-goals/Competencies:

- The students are able
- They have gained / intensified their mathematical skills concerning e.g. localization and mapping and path planning in combination with robotics and navigation.
- They are able to realize complex processes with real time requests.
- They can work as a team and are able to manage the project and to the realization in accordance with predefined milestones.
- They have experience in the areas of usability and safety.
- They can document and present their projects results.

Grading through:

- documentation

Requires:

- Mobile Robots (CS2110-KP04, CS2110)
- Lab Course Robotics and Automation (CS3501-KP04, CS3501)
- Robotics (CS2500-KP04, CS2500)

Responsible for this module:

- Prof. Dr.-Ing. Achim Schweikard

Teacher:

- Institute for Electrical Engineering in Medicine
- Institute for Robotics and Cognitive Systems
- Institute of Computer Engineering

- Prof. Dr.-Ing. Mladen Berekovic
- Prof. Dr.-Ing. Achim Schweikard
- Prof. Dr. Philipp Rostalski

Literature:

- Jazar: Theory of applied Robotics: Kinematics, Dynamics and Control
- Spong et al: Robot Modeling and Control - Wiley & Sons, 2005
- Siegwart et.al.: Autonomous Mobile Robots - MIT Press 2011

- Thrun et.al.: Probablistic Robotics - MIT Press 2005

Language:

- offered only in German

Notes:

Admission requirements for taking the module:
- None (the competencies of the modules listed under

CS5410-KP04 - Artificial Life (ArtiLife)

Duration:	Turnus of offer:	Credit points:
1 Semester	irregularly	4

Course of study, specific field and term:

- Master Biophysics 2019 (optional subject), Elective, 1st or 2nd semester
- Master CLS 2010 (optional subject), computer science, Arbitrary semester
- Master CLS 2010 (optional subject), life sciences, Arbitrary semester
- Master Computer Science 2012 (optional subject), specialization field robotics and automation, 3rd semester
- Master Computer Science 2012 (optional subject), specialization field bioinformatics, 3rd semester

Classes and lectures:

- Artificial Life (lecture, 2 SWS)
- Artificial Life (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Properties, flavors and kinds of (artificial) life
- Artificial chemistry and self-replicating code
- Introduction to information theory
- Introduction to statistical mechanics and thermodynamics
- Complex networks and NK models
- Evolutionary algorithms
- Emergence
- Cellular automata
- Game of life
- Tierra
- Ant algorithms

Qualification-goals/Competencies:

- Students are able to classify models of artificial life, artificial chemistry and self-replicating code.
- Students have the competence to explain the mathematical concepts of information theory.
- Students are able to implement and mathematically analyze cellular automata and complex networks.
- Students can formulate mutualistic interactions through Boolean networks and game-theoretic models and can relate them to biological or socioeconomic systems.
- Students have the methodogical competence to design evolutionary algorithms and to review them in the context of statistical mechanics and thermodynamics.

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- PD Dr. rer. nat. Jens Christian Claussen

Teacher:

- Institute for Neuro- and Bioinformatics
- Prof. Dr. rer. nat. Thomas Martinetz
- PD Dr. rer. nat. Jens Christian Claussen

Literature:

- Christoph Adami: Introduction to Artificial Life - Springer Verlag, 1998

Language:

- English, except in case of only German-speaking participants

Notes:

Prerequisites for attending the module:
- None

Prerequisites for the exam:
- Successful completion of homework and project assignments during the semester.

CS5420 - Fuzzy and Neuro-Fuzzy Systems (FuzzySys)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), advanced curriculum intelligent embedded systems, 2nd or 3rd semester
- Master Computer Science 2012 (optional subject), specialization field robotics and automation, 3rd semester
- Master Computer Science 2012 (optional subject), specialization field bioinformatics, 3rd semester

Classes and lectures:

- Fuzzy and Neuro-Fuzzy Systems (lecture, 2 SWS)
- Fuzzy and Neuro-Fuzzy Systems (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Introduction
- Fuzzy sets
- Operations on fuzzy sets
- Further concepts of fuzzy sets
- Approximative inference
- Fuzzy sytems
- Application classes of fuzzy systems
- Design and Implementation of fuzzy systems
- Neuro-fuzzy systems

Qualification-goals/Competencies:

- Students are well acquainted with the theoretical foundations and methods for fuzzy and neuro-fuzzy systems
- They are able to critically judge the potential of these methods for various application areas
- They can design fuzzy and neuro-fuzzy systems for suitable applications and implement them in real systems

Grading through:

- written exam

Responsible for this module:

- Prof. Dr.-Ing. Mladen Berekovic

Teacher:

- Institute of Computer Engineering
- Prof. Dr.-Ing. Mladen Berekovic

Literature:

- :
- :
- :
- :
- :

Language:

- offered only in German

CS5430 - Seminar Machine Learning (SemMaschL)

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

Course of study, specific field and term:

- Master CLS 2010 (optional subject), computer science, Arbitrary semester
- Master Computer Science 2012 (optional subject), specialization field robotics and automation, 3rd semester
- Master Computer Science 2012 (optional subject), specialization field bioinformatics, 3rd semester

Classes and lectures:

- Seminar Machine Learning (seminar, 2 SWS)

Workload:

- 70 Hours private studies
- 30 Hours in-classroom work
- 20 Hours work on an individual topic with written and oral presentation

Contents of teaching:

- Independent study of a specific field of machine learning

Qualification-goals/Competencies:

- The students are able to read and understand scientific publications in the field of machine learning.
- They are able to present orally and in a written paper the content of scientific publications in the field of machine learning.

Grading through:

- term paper

Responsible for this module:

- Prof. Dr. rer. nat. Thomas Martinetz

Teacher:

- Institute for Neuro- and Bioinformatics

- Prof. Dr. rer. nat. Thomas Martinetz
- Prof. Dr.-Ing. Erhardt Barth
- MitarbeiterInnen des Instituts

Language:

- German and English skills required

Notes:

Prerequisites for attending the module:
- None

Prerequisites for the exam:
- Successful completion of homework assignments during the semester.

CS5450-KP04, CS5450 - Machine Learning (MaschLern)

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

Course of study, specific field and term:

- Master CLS 2023 (optional subject), computer science, 3rd semester
- Master Auditory Technology 2022 (optional subject), computer science, 1st semester
- Master MES 2020 (optional subject), computer science / electrical engineering, Arbitrary semester
- Master Media Informatics 2020 (optional subject), computer science, Arbitrary semester
- Master Medical Informatics 2019 (optional subject), Medical Data Science / Artificial Intelligence, 1st or 2nd semester
- Master Auditory Technology 2017 (optional subject), computer science, 1st semester
- Master CLS 2016 (optional subject), computer science, 3rd semester
- Master MES 2014 (optional subject), computer science / electrical engineering, Arbitrary semester
- Master MES 2011 (optional subject), mathematics, 1st or 2nd semester
- Master MES 2011 (advanced curriculum), imaging systems, signal and image processing, 1st or 2nd semester
- Master Medical Informatics 2014 (optional subject), computer science, 1st or 2nd semester
- Master CLS 2010 (optional suject), computer science, Arbitrary semester
- Master Computer Science 2012 (optional subject), specialization field robotics and automation, 3rd semester
- Master Computer Science 2012 (optional subject), specialization field bioinformatics, 3rd semester

Classes and lectures:

- Machine Learning (lecture, 2 SWS)
- Machine Learning (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Representation learning, including manifold learning
- Statistical learning theory
- VC dimension and support vector machines
- Boosting
- Deep learning
- Limits of induction and importance of data ponderation

Qualification-goals/Competencies:

- Students can understand and explain various machine-learning problems.
- They can explain and apply different machine learning methods and algorithms.
- They can chose and then evaluate an appropriate method for a particular learning problem.
- They can understand and explain the limits of automatic data analysis.

Grading through:

- Oral examination

Responsible for this module:

- Prof. Dr.-Ing. Erhardt Barth

Teacher:

- Institute for Neuro- and Bioinformatics
- Prof. Dr.-Ing. Erhardt Barth
- Prof. Dr. rer. nat. Thomas Martinetz

Literature:

- Chris Bishop: Pattern Recognition and Machine Learning - Springer ISBN 0-387-31073-8
- Vladimir Vapnik: Statistical Learning Theory - Wiley-Interscience, ISBN 0471030031

Language:

- English, except in case of only German-speaking participants

Notes:

Admission requirements for taking the module:
- None

Admission requirements for participation in module examination(s):
- None

Module exam(s):
- CS5450-L1: Machine Learning, oral examination, 100% of module grade

CS4440-KP04, CS4440 - Molecular Bioinformatics (MolBioInfo)

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

Course of study, specific field and term:

- Master CLS 2023 (optional subject), computer science, 3rd semester
- Master Molecular Life Science 2023 (optional subject), mathematics / computer science, 1st semester
- Master CLS 2016 (optional subject), computer science, 3rd semester
- Master MES 2011 (advanced curriculum), biophysics and biomedical optics, 2nd semester
- Master CLS 2010 (optional subject), computer science, 1st or 3rd semester
- Master Computer Science 2012 (compulsory), specialization field bioinformatics, 1st semester

Classes and lectures:

- Molecular Bioinformatics (lecture, 2 SWS)
- Molecular Bioinformatics (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Methods for fast genome comparison
- Analysis of data describing gene expression profiles and sequence variation
- Advanced usage of biological databases (for sequences, motifs, structures, gene regulation and interactions)

Qualification-goals/Competencies:

- The students can apply indexing based software to Next Generation sequence data.
- They can use and design databases for molecularbiological research.
- They are able to detect statistically significant changes in Microarray data.

Grading through:

- written exam

Requires:

- Introduction to Bioinformatics (CS1400-KP04, CS1400)

Responsible for this module:

- Prof. Dr. rer. nat. Thomas Martinetz

Teacher:

- Institute for Neuro- and Bioinformatics

- Prof. Dr. Bernhard Haubold
- Prof. Dr. rer. nat. Thomas Martinetz
- MitarbeiterInnen des Instituts
- Prof. Lars Bertram

Literature:

- M. S. Waterman: Introduction to Computational Biology - London: Chapman and Hall 1995
- B. Haubold, T. Wiehe: Introduction to Computational Biology - Birkhäuser 2007
- R. Durbin, S. Eddy, A. Krogh, G. Mitchison: Biological sequence analysis. Probabilistic models - Cambridge, MA: Cambridge University Press
- J. Setubal, J. Meidanis: Introduction to computational molecular - Pacific Grove: PWS Publishing Company
- D. M. Mount: Bioinformatics - Sequence and Genome - New York: Cold Spring Harbor Press

Language:

- English, except in case of only German-speaking participants

Notes:

Prerequisites for the module:
- None

Prerequisites for admission to the written examination:
- Successful completion of exercises as specified at the beginning of the semester

Module exam(s):
- CS4440-L1: Molecular Bioinformatics, written exam, 90 min, 100 % of module grade

CS5440-KP04, CS5440 - Seminar Neuro- and Bioinformatics (SemNeurBio)

Duration:	Turnus of offer:	Credit points:
1 Semester	irregularly	4

Course of study, specific field and term:

- Master Biophysics 2019 (optional subject), Elective, 1st or 2nd semester
- Master Computer Science 2012 (optional subject), specialization field bioinformatics, 3rd semester
- Master CLS 2010 (optional subject), computer science, Arbitrary semester

Classes and lectures:

- Seminar Neuro- and Bioinformatics (seminar, 2 SWS)

Workload:

- 70 Hours private studies
- 30 Hours in-classroom work
- 20 Hours work on an individual topic with written and oral presentation

Contents of teaching:

- Introduce students to a current research topic in Neuro- and Bioinformatics

Qualification-goals/Competencies:

- The students are able to read and understand scientific publications in the field of neuro- uand bioinformatics.
- They are able to present orally and in a written paper the content of scientific publications in the field of neuro- and bioinformatics.
- They can master basic scientific methodology.
- They can summarize a scientific topic in written form.
- They can give an intelligible and concise oral presentation of a current research topic.
- They have communication competency to discuss a current research topic.

Grading through:

- oral presentation
- term paper

Responsible for this module:

- Prof. Dr.-Ing. Erhardt Barth
- Prof. Dr. rer. nat. Thomas Martinetz

Teacher:

- Institute for Neuro- and Bioinformatics

- Prof. Dr. rer. nat. Thomas Martinetz
- Prof. Dr.-Ing. Erhardt Barth
- MitarbeiterInnen des Instituts

Language:

- English, except in case of only German-speaking participants

Notes:

Prerequisites for attending the module:
- None

CS5549-KP04 - Project Bioinformatics (PrBioinfo)

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

Course of study, specific field and term:

- Master Computer Science 2014 (compulsory), specialization field bioinformatics, 1st, 2nd, or 3rd semester
- Master Computer Science 2012 (compulsory), specialization field bioinformatics, 3rd semester

Classes and lectures:

- Projektpraktikum Bioinformatik (practical course, 3 SWS)

Workload:

- 45 Hours private studies
- 45 Hours in-classroom work
- 30 Hours group work

Contents of teaching:

- Project for solving a molecular biology problem with computational methods
- Project for implementing biological information principles in technical systems

Qualification-goals/Competencies:

- The students can plan a project and realize in a team and with milestones.
- They can apply bioinformatics software.
- They are able to implement learning algorithms.

Grading through:

- continuous, successful participation in practical course, >80%

Responsible for this module:

- Prof. Dr. rer. nat. Thomas Martinetz

Teacher:

- Institute for Neuro- and Bioinformatics

- Prof. Dr. rer. nat. Thomas Martinetz
- Prof. Dr.-Ing. Erhardt Barth
- Prof. Dr. Bernhard Haubold
- MitarbeiterInnen des Instituts

Language:

- German and English skills required

LS2000-INF/MIW - Biochemistry 1 (Bioch1)

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

Course of study, specific field and term:

- Bachelor MES 2011 (optional subject), life sciences, 5th semester
- Master Computer Science 2012 (optional subject), specialization field bioinformatics, 3rd semester

Classes and lectures:

- Biochemie 1 (lecture, 3 SWS)

Workload:

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

Contents of teaching:

- Grundeigenschaften von Biosystemen, Biomoleküle
- Proteine: Struktur und Dynamik
- Enzyme: Struktur, Funktion, Regulation
- Intermediärstoffwechsel
- Biomembranen und Zellatmung

Qualification-goals/Competencies:

- Verständnis der Strukturen und Funktion grundlegender Biomoleküle
- Verständnis der biochemischen Zusammenhänge und ihrer Bedeutung für den zellulären Stoffwechsel zu verstehen
- Vermittlung der Prinzipien biochemischer Trenn- und Analyseverfahren

Grading through:

- written exam

Responsible for this module:

- Prof. Dr. rer. nat. Rolf Hilgenfeld

Teacher:

- Institute of Biochemistry
- Prof. Dr. rer. nat. Rolf Hilgenfeld
- Prof. Dr. rer. nat. Stefan Anemüller
- Dr. math. et dis. nat. Jeroen Mesters

Literature:

- :

Language:

- offered only in English

LS3151-KP04, LS3151 - Molecular Biology (MolBioINF)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2019 (compulsory), Canonical Specialization Bioinformatics and Systems Biology, Arbitrary semester
- Master Computer Science 2019 (optional subject), Elective, Arbitrary semester
- Master Medical Informatics 2019 (optional subject), bioinformatics, 1st or 2nd semester
- Master Computer Science 2014 (compulsory), specialization field bioinformatics, 1st, 2nd, or 3rd semester
- Master Medical Informatics 2014 (optional subject), bioinformatics, 1st or 2nd semester
- Master Computer Science 2012 (compulsory), specialization field bioinformatics, 2nd semester

Classes and lectures:

- Molecular Biology (lecture, 2 SWS)
- Molecular Biology (seminar, 2 SWS)

Workload:

- 60 Hours private studies
- 60 Hours in-classroom work

Contents of teaching:

- Lecture: Molecular basis for processing and analysis of biological data (nucleic acids, genome sequencing, DNA polymorphism, infection biology, host genome and virus infection, stem cell biology)
- Seminar: Scientific article reading and oral presentation
- understanding scientific context
- training in reading English in science

Qualification-goals/Competencies:

- Students are able to present basic molecular biological requirements for processing and analysis of biological data.
- They are able to explain the molecular biological terms genome, transcriptome and proteome.
- They acquire the competence to handle English literature and to present it in a scientific oral presentation.

Grading through:

- Oral examination

Responsible for this module:

- Prof. Dr. rer. nat. Norbert Tautz

Teacher:

- Institute of Virology and Cell Biology

- Dr. rer. nat. Olaf Isken
- Prof. Dr. rer. nat. Norbert Tautz

Literature:

- Alberts et al.: Molecular Biology of Cells - Garland Science
- Lodish et al.: Molecular Cell Biology - Freeman

Language:

- offered only in German

Notes:

Seminar-dates by appointment, prior registration is mandatory

Prerequisites for attending the module:
- None

Prerequisites for the exam:
- attendance, >90%

MA1600-KP04, MA1600, MA1600-MML - Biostatistics 1 (BioStat1)

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

Course of study, specific field and term:

- Bachelor CLS 2023 (compulsory), mathematics, 2nd semester
- Bachelor Biophysics 2024 (compulsory), Elective Computer Science, 4th semester
- Bachelor Nutritional Medicine 2024 (compulsory), mathematics / natural sciences, 4th semester
- Bachelor MES 2014 (optional subject), mathematics / natural sciences, 3rd semester at the earliest
- Bachelor Computer Science 2019 (optional subject), Extended optional subjects, Arbitrary semester
- Bachelor Computer Science 2019 (compulsory), Canonical Specialization Bioinformatics and Systems Biology, 6th semester
- Bachelor Medical Informatics 2019 (compulsory), medical computer science, 6th semester
- Bachelor MLS 2018 (compulsory), life sciences, 6th semester
- Bachelor Nutritional Medicine 2018 (compulsory), mathematics / computer science, 6th semester
- Bachelor CLS 2016 (compulsory), mathematics, 2nd semester
- Bachelor CLS 2010 (compulsory), mathematics, 2nd semester
- Bachelor Computer Science 2016 (optional subject), advanced curriculum, Arbitrary semester
- Bachelor Computer Science 2016 (compulsory), Canonical Specialization Bioinformatics, 4th semester
- Bachelor MLS 2016 (compulsory), life sciences, 6th semester
- Bachelor Biophysics 2016 (compulsory), Elective Computer Science, 4th semester
- Bachelor Nutritional Medicine 2016 (compulsory), mathematics / computer science, 6th semester
- Bachelor Medical Informatics 2014 (compulsory), medical computer science, 4th semester
- Bachelor Computer Science 2014 (compulsory), specialization field bioinformatics, 6th semester
- Master MES 2011 (advanced curriculum), biophysics and biomedical optics, 2nd semester
- Bachelor Medical Informatics 2011 (compulsory), medical computer science, 4th semester
- Master Computer Science 2012 (optional subject), specialization field bioinformatics, 2nd or 3rd semester
- Master Computer Science 2012 (compulsory), advanced curriculum stochastics, 2nd semester
- Bachelor Computer Science 2012 (optional subject), specialization field bioinformatics, 6th semester
- Bachelor MLS 2009 (compulsory), life sciences, 6th semester
- Bachelor MES 2011 (optional subject), medical engineering science, 6th semester
- Bachelor Molecular Life Science 2024 (compulsory), mathematics / computer science, 4th semester

Classes and lectures:

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

Workload:

- 66 Hours private studies
- 39 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, other distributions
- Diagnostic tests, reference range, normal range, coefficient of variation
- Statistical testing
- Sample size calculations
- Confidence intervals
- Selected statistical tests I
- Selected statistical tests II
- Linear simple regression
- Analysis of variance (one-way-classification)
- Clinical trials
- Multiple Testing: Bonferroni, Bonferroni-Holm, Bonferroni-Holm-Shaffer, Wiens, hierarchical Testing

Qualification-goals/Competencies:

- With regard to the roles of GSP of the University of Lübeck and of the DFG-guidelines the student were able to work with the following statistical methods:The students are able to calculate descriptive statistics.
- They are able to calculate quantiles and surfaces of the normal distribution.
- They are able to explain terms of diagnostic testing, such as sensitivity or specificity.
- They are able to list the basic principles of statistical testing, sample size calculation and confidence interval construction.

- They are able to carry out a set of elementary statistical tests, such as t-test, test of proportions, X2 independence test, and to interpret the results.
- They are able to explain the basic principles of linear regression.
- They are able to apply the linear simple regression.
- They are able to explain the basic idea for the one-way analysis of variance (ANOVA).
- They are able to explain the results table for the one-way and two-way ANOVA.
- They are able to interpret the results of the ANOVA.
- They know the basic principles of clinical therapeutic studies.
- They know the assumptions that need to be fulfilled for the application of specific statistical tests.
- They are able to calculate simple adjustments for multiple comparisons.

Grading through:

- written exam

Is requisite for:

- Module part: Biostatistics 2 (MA2600 T)
- Biostatistics 2 (MA2600-KP07)
- Biostatistics 2 (MA2600-KP04, MA2600)

Responsible for this module:

- Prof. Dr. rer. biol. hum. Inke König

Teacher:

- Institute of Medical Biometry and Statistics

- Prof. Dr. rer. biol. hum. Inke König
- MitarbeiterInnen des Instituts

Literature:

- Matthias Rudolf, Wiltrud Kuhlisch: Biostatistik: Eine Einführung für Biowissenschaftler - 1. Auflage, Pearson: Deutschland
- Lothar Sachs, Jürgen Hedderich: Angewandte Statistik: Methodensammlung mit R - 15. Auflage, Springer: Heidelberg

Language:

- offered only in German

Notes:

Prerequisites for attending the module:
- None

Prerequisites for the exam:
- Active and regular participation in the exercise groups as specified at the beginning of the semester.

Module exam:
-MA1600-L1: Biostatistics 1, written exam, 90 min, 100 % of module grade

MA4020-KP04, MA4020 - Stochastics 2 (Stoch2)

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

Course of study, specific field and term:

- Master Biophysics 2019 (optional subject), Elective, 1st semester
- Master MES 2011 (optional subject), mathematics, 1st semester
- Master Computer Science 2012 (optional subject), specialization field bioinformatics, 3rd semester
- Master Computer Science 2012 (compulsory), advanced curriculum stochastics, 3rd semester
- Master Computer Science 2012 (optional subject), advanced curriculum analysis, 3rd semester
- Bachelor MES 2011 (optional subject), mathematics, 5th semester

Classes and lectures:

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

Workload:

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

Contents of teaching:

- Lebesgue integral and Riemann integral
- Transformations of measures and integrals
- Product measures and Fubini's theorem
- Moments and dependency measures
- Normally distributed random vectors and distributions closely related to the normal distribution

Qualification-goals/Competencies:

- Studends get insights into basic stochastic structures
- They master techniques of integration being relevant to stochastics
- They master the treatment of (particularly normally distributed) random vectors and their distributions
- They are able to formalize complex stochastic problems

Grading through:

- written exam
- Exercises

Is requisite for:

- Modeling Biological Systems (MA4450)
- Stochastic processes and modeling (MA4610-KP04, MA4610)

Requires:

- Stochastics 1 (MA2510-KP04, MA2510)
- Linear Algebra and Discrete Structures 2 (MA1500-KP08, MA1500)
- Analysis 2 (MA2500-KP04, MA2500)

Responsible for this module:

- Nachfolge von Prof. Dr. rer. nat. Karsten Keller

Teacher:

- Institute for Mathematics
- Nachfolge von Prof. Dr. rer. nat. Karsten Keller

Literature:

- J. Elstrodt: Maß- und Integrationstheorie - Springer
- M. Fisz: Wahrscheinlichkeitsrechnung und mathematische Statistik - Deutscher Verlag der Wissenschaften

Language:

- offered only in German

Notes:

The lecture is identical to that in module MA4020-MML.

Prerequisites for attending the module:
- None

Prerequisites for the exam:
- Successful completion of homework assignments during the semester.

MA4400 - Chaos and Complexity of Biological Systems (CKBS)

Duration:	Turnus of offer:	Credit points:
1 Semester	irregularly	4

Course of study, specific field and term:

- Bachelor CLS 2010 (optional subject), mathematics, 5th or 6th semester
- Master MES 2011 (optional subject), mathematics, 1st or 2nd semester
- Master Computer Science 2012 (optional subject), specialization field bioinformatics, 2nd or 3rd semester
- Master MES 2011 (advanced curriculum), biophysics and biomedical optics, 1st or 2nd semester
- Master CLS 2010 (optional subject), mathematics, Arbitrary semester

Classes and lectures:

- Chaos and Complexity of Biological Systems (lecture, 2 SWS)
- Chaos and Complexity of Biological Systems (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Time-discrete dynamical systems and stochastic processes
- Nonlinearity and chaos
- Ergodicity
- Symbolic dynamics
- Information-theoretic complexity measures
- Ordinal time series analysis
- Biological and medical applications, in particular EEG analysis

Qualification-goals/Competencies:

- Students get insights into basic aspects of nonlinear dynamics
- They have skills in analyzing and modeling complex data and time series
- They have competencies in simulating and illustrating nonlinear dynamic phenomena

Grading through:

- Written or oral exam as announced by the examiner

Requires:

- Stochastics 1 (MA2510-KP04, MA2510)
- Analysis 1 (MA2000-KP08, MA2000)

Responsible for this module:

- Nachfolge von Prof. Dr. rer. nat. Karsten Keller

Teacher:

- Institute for Mathematics
- Nachfolge von Prof. Dr. rer. nat. Karsten Keller

Literature:

- M. Brin, G. Stuck: Introduction to Dynamical Systems - Cambridge University Press 2002
- J. M. Amigó: Permutation Complexity in Dynamical Systems - Springer 2010
- R. L. Devaney: An Introduction to Chaotic Dynamical Systems - Westview Press 2003

Language:

- depends on the chosen courses

Notes:

lecture notes in English

Prerequisite tasks for taking the exam can be announced at the beginning of the semester. If any prerequisite tasks are defined, they

must be completed and passed before taking the exam for the first time.

MA4450 - Modeling Biological Systems (MoBS)

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

Course of study, specific field and term:

- Master MES 2011 (optional subject), mathematics, 1st semester
- Master MES 2011 (advanced curriculum), biophysics and biomedical optics, 1st semester
- Master Computer Science 2012 (compulsory), specialization field bioinformatics, 1st semester
- Master Computer Science 2012 (optional subject), advanced curriculum organic computing, 2nd or 3rd semester

Classes and lectures:

- Modeling Biological Systems (lecture, 2 SWS)
- Modeling Biological Systems (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Elementary time-discrete deterministic models
- Structured time-discrete population dynamics
- Generating functions, Galton-Watson-processes
- Modeling of data and data analysis

Qualification-goals/Competencies:

- Students have knowledge of elementary time-discrete models for modeling biological processes
- They develop skills in connecting ideas from different fields of mathematics
- They have competencies in data analysis and modelling
- They develop competencies in interdisciplinary work

Grading through:

- Exercises
- written exam

Requires:

- Stochastics 1 (MA2510-KP04, MA2510)
- Analysis 2 (MA2500-KP04, MA2500)
- Linear Algebra and Discrete Structures 2 (MA1500-KP08, MA1500)

Responsible for this module:

- Nachfolge von Prof. Dr. rer. nat. Karsten Keller

Teacher:

- Institute for Mathematics
- Nachfolge von Prof. Dr. rer. nat. Karsten Keller

Literature:

- F. Braer, C. Castillo-Chavez: Mathematical Models in Population Biology and Epidemiology - New York: Springer 2000
- H. Caswell: Matrix Population Modells - Sunderland: Sinauer Associates 2001
- S. N. Elaydi: An Introduction to Difference Equations - New York: Springer 1999
- B. Huppert: Angewandte Lineare Algebra - Berlin: de Gruyter 1990
- U. Krengel: Einführung in die Wahrscheinlichkeitstheorie und Statistik - Wiesbaden: Vieweg 2002
- E. Seneta: Non-negative Matrices and Markov Chains - New York: Springer 1981

Language:

- offered only in German

Notes:

The lecture is identical to that in module MA4450-MML. For students in the master Infection Biology programme, this is not a stand-alone

module, but rather part of module CS4011.

CS3115-KP04, CS5156-KP04, CS5156 - System Architectures for Multimeda (SysArchMM)

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

Course of study, specific field and term:

- Bachelor IT-Security 2016 (optional subject), specific, Arbitrary semester
- Bachelor Media Informatics 2020 (optional subject), computer science, 5th or 6th semester
- Bachelor Computer Science 2019 (optional subject), major subject informatics, Arbitrary semester
- Master Medical Informatics 2014 (optional subject), computer science, 1st or 2nd semester
- Master Media Informatics 2014 (optional subject), computer science, Arbitrary semester
- Master Computer Science 2012 (optional subject), advanced curriculum signal and image processing, 2nd or 3rd semester
- Master Computer Science 2012 (optional subject), specialization field software systems engineering, 3rd semester
- Master Computer Science 2012 (optional subject), advanced curriculum parallel and distributed system architecutres, 2nd or 3rd semester
- Master Computer Science 2012 (optional subject), specialization field media informatics, 2nd or 3rd semester

Classes and lectures:

- System Architectures for Multimedia (lecture, 2 SWS)
- System Architectures for Multimedia (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Performance requirements of multimedia systems on computer and systems
- Instruction set extensions for x86 processors
- System architecture of game consoles and multimedia systems
- Hardware structures for the realization of basic image and video processing operations
- System integration of hardware accelerators
- Programming of multimedia applications with OpenGL
- Protection and authentication of multimedia data

Qualification-goals/Competencies:

- Students are able to categorize instruction set extensions of processors for multimedia applications.
- They are able to discuss the characteristics of the system structure of game consoles and multimedia systems.
- They are able to implement image and video processing algorithms in software by making best use of instruction set extensions.
- They are able to evaluate the usefulness of specific processor architectures and system structures for the realization of multimedia systems.
- They are able to determine appropriate hardware structures for the implementation of image and video processing algorithms.
- They are able to write simple graphic applications with OpenGL.

Grading through:

- see Notes

Responsible for this module:

- Prof. Dr.-Ing. Mladen Berekovic

Teacher:

- Institute of Computer Engineering
- Prof. Dr.-Ing. Mladen Berekovic

Literature:

- P. A. Henning: Taschenbuch Multimedia - München: Fachbuchverlag Leipzig 2007
- A. S. Tanenbaum: Moderne Betriebssysteme - München: Pearson 2009
- D. G. Bailey: Design for Embedded Image Processing on FPGAs - Wiley & Sons 2011
- D. Kusswurm: Modern x86 Assembly Language Programming - Apress 2015
- A. Nischwitz, M. Fischer, P. Haberäcker, G. Socher: Computergrafik und Bildverarbeitung - Vieweg + Teubner, 2011

Language:

- offered only in German

Notes:

Admission requirements for taking the module:
- None

Admission requirements for participation in module examination(s):
- Successful completion of exercise assignments as specified at the beginning of the semester

Module Exam(s):
- CS3115-L1: System Architectures for Multimeda, oral exam, 100% of the module grade

CS3202-KP04, CS3202 - Nonstandard Database Systems (NDB)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Bachelor Medical Informatics 2014 (optional subject), computer science, 5th or 6th semester
- Bachelor Media Informatics 2014 (optional subject), computer science, 5th or 6th semester
- Bachelor Computer Science 2014 (optional subject), central topics of computer science, 5th or 6th semester
- Bachelor Medical Informatics 2011 (optional subject), Applied computer science, 4th to 6th semester
- Master Computer Science 2012 (optional subject), specialization field media informatics, 2nd or 3rd semester
- Master CLS 2010 (optional suject), computer science, Arbitrary semester
- Bachelor CLS 2010 (optional subject), computer science, 6th semester
- Master Computer Science 2012 (optional subject), advanced curriculum distributed information systems, 2nd or 3rd semester
- Bachelor Computer Science 2012 (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:

- Written or oral exam as announced by the examiner

Requires:

- Databases (CS2700-KP04, 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. Rigaux, M. Scholl, A. Voisard: Spatial Databases With Applications to GIS - Morgan Kaufmann, 2001
- P. Revesz: Introduction to Constraint Databases - Springer, 2002
- P. Revesz: Introduction to Databases- From Biological to Spatio-Temporal - Springer 2010
- S. Ceri, A. Bozzon, M. Brambilla, E. Della Valle, P. Fraternali, S. Quarteroni: Web Information Retrieval - Springer, 2013
- S. Chakravarthy, Q. Jiang: Stream Data Processing A Quality of Service Perspective - Springer, 2009
- D. Suciu, D. Olteanu, Chr. Re, Chr. Koch: Probabilistic Databases - Morgan & Claypool, 2011

Language:

- offered only in German

CS4155 - Communication Systems for Multimedia Applications (KMA)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (compulsory), specialization field media informatics, 2nd semester

Classes and lectures:

- Communication Systems for Multimedia Applications (lecture, 2 SWS)
- Communication Systems for Multimedia Applications (practical course, 1 SWS)

Workload:

- 60 Hours private studies
- 30 Hours in-classroom work
- 15 Hours exam preparation
- 15 Hours group work

Contents of teaching:

- Media Compression (of Real-time Media)
- Multimedia Operating Systems
- Server and Databases for Multimedia
- Media Transmission (Broadcast / Streaming)
- Communication Protocols for Multimedia
- Media Synchronisation and Adaptation
- Quality of Service
- Applications

Qualification-goals/Competencies:

- Participants know about the challenges of transmitting and processing multimedia data in distributed computer systems.
- They know the foundational mechanism and techniques for the provision and transmission of media.
- For each of the components they now the principal solutions to address the respective challenges.
- They are able to apply their knowledge for building simple implementations.

Grading through:

- 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:

- Ralf Steinmetz, Klara Nahrstedt: Multimedia Systems - Springer 2004
- Ralf Schmitz et al.: Kompendium Medieninformatik: Mediennetze - Springer 2006
- Stephen Weinstein: The Multimedia Internet - Springer 2005

Language:

- German and English skills required

Notes:

Dieses Modul wird durch das Modul CS4555 Medienübertragung ersetzt.

CS4620 - Psychological Foundations of Media Informatics (PsyMedien)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (compulsory), specialization field media informatics, 1st semester

Classes and lectures:

- Psychological Foundations of Media Informatics (lecture with exercises, 4 SWS)

Workload:

- 60 Hours in-classroom work
- 40 Hours private studies
- 20 Hours exam preparation

Contents of teaching:

- Introduction
- General methods of psychology
- Fundamentals of work psychology
- Fundamentals of media psychology
- Fundamentals of perception psychology
- Fundamentals of cognitive psychology
- Evaluation methods
- Summary

Qualification-goals/Competencies:

- The students know the methodology of psychology and can integrate this in an interdisciplinary context in Media Informatics.
- They are in able to work with psychological methods, and to read and understand psychological studies.
- They know the important findings of the work, media, perception and cognitive psychology, and are able to apply these in the context of multimedia and interactive systems.
- They can collaborate effectively in interdisciplinary teams with psychologists.

Grading through:

- written exam

Responsible for this module:

- Prof. Dr. rer. nat. Michael Herczeg

Teacher:

- Institute for Multimedia and Interactive Systems
- Prof. Dr. rer. nat. Michael Herczeg

Literature:

- P.G. Zimbardo & R.J. Gerrig: Psychologie. Eine Einführung - München: Pearson, 2004
- W. Edelmann: Lernpsychologie - Weinheim: Beltz Verlag, 2000
- G. Bente, R. Mangold & P. Vorderer: Lehrbuch der Medienpsychologie - Göttingen: Hogrefe-Verlag, 2004
- E. Ulich: Arbeitspsychologie - Stuttgart: Schäffer-Poeschel, 2005
- N. Birbaumer & R.F. Schmidt: Biologische Psychologie - Berlin: Springer-Verlag, 2005

Language:

- offered only in German

CS4640-KP04 - Hypermediasystems (HyperMeSys)

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

Course of study, specific field and term:

- Master Media Informatics 2014 (compulsory), media informatics, 1st semester
- Master Computer Science 2012 (compulsory), specialization field media informatics, 2nd semester

Classes and lectures:

- Hyper Media Systems (lecture, 2 SWS)
- Hyper Media Systems (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Introduction and Overview
- History
- Navigation, Orientation and Search
- Semantic Web and Hypermedia Systems
- Applications and Examples
- Adaptability and adaptivity

Qualification-goals/Competencies:

- Students know the definition and the theoretical foundations of hypermedia systems and can explain these.
- They are able to identify and predict the difficulties and potentials of hypermedia systems based on historical and technological considerations.
- They can analyze, design, implement and evaluate hypermedia applications considering users and context.

Grading through:

- written exam

Responsible for this module:

- Prof. Dr. rer. nat. Michael Herczeg

Teacher:

- Institute for Multimedia and Interactive Systems

- Prof. Dr. rer. nat. Michael Herczeg
- Prof. Dr.-Ing. Nicole Jochems

Literature:

- J. Nielsen: Multimedia, Hypertext und Internet - Wiesbaden: Vieweg, 1996
- R. Schulmeister: Grundlagen Hypermedialer Lernsysteme: Theorie, Didaktik, Design - München: Oldenbourg-Verlag, 2002

Language:

- offered only in German

CS4650-KP04 - Augmented, Mixed and Virtual Reality (AMVReality)

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

Course of study, specific field and term:

- Master Media Informatics 2014 (compulsory), computer science, 3rd semester
- Master Computer Science 2012 (compulsory), specialization field media informatics, 3rd semester

Classes and lectures:

- Augmented, Mixed and Virtual Reality (lecture, 2 SWS)
- Augmented, Mixed and Virtual Reality (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Introduction and Overview
- Historical developments
- Applications of augmented, mixed and virtual reality (AMVR)
- Theoretical principles of AMVR
- Interaction models for AMVR
- Implementation of AMVR systems
- Evaluation of AMVR systems
- Looking into the future of AMVR

Qualification-goals/Competencies:

- The students know the basic principles and system models of augmented, mixed and virtual reality.
- They are able to estimate the effort for the development of these types of systems.
- They understand the positive and negative effects of such systems.

Grading through:

- written exam

Responsible for this module:

- Dr. Thomas Winkler

Teacher:

- Institute for Multimedia and Interactive Systems
- Dr. Thomas Winkler

Literature:

- Dörner; Broll; Grimm; Jung (Hrsg.): Virtual und Augmented Reality (VR / AR): Grundlagen und Methoden der Virtuellen und Augmentierten Realität - Springer Vieweg, 2014

Language:

- offered only in German

CS5155 - Mobile Multimedia Systems (MobiMMSys)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), specialization field media informatics, 2nd or 3rd semester

Classes and lectures:

- Mobile Multimedia Systems (lecture, 2 SWS)
- Mobile Multimedia Systems (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Introduction
- Requirements of Mobile Multimedia Systems
- Mobile Devices
- Interaction with Mobile Devices
- Mobile Multimedia Applications
- Mobile Multimedia Data Formats
- Mobile Multimedia Software Systems
- Media Transport in Wireless Mobile Networks
- Operating Systems for mobile Systems
- Development and Programming for Android
- Digital Audio and Video Broadcasting (DAB/DVB)

Qualification-goals/Competencies:

- Students know about the main tasks and challenges of mobile multimedia systems.
- Students know current technical solutions for the realisation of mobile multimedia systems.
- Students are able to implement mobile multimedia applications for mobile devices.

Grading through:

- Oral examination

Responsible for this module:

- Prof. Dr.-Ing. Andreas Schrader

Teacher:

- Institute of Telematics
- Prof. Dr.-Ing. Andreas Schrader

Literature:

- Amitabh Kumar: Implementing Mobile TV - Focal Press 2010
- Shelly Powers: HTML5 Media - O'Reilly Media 2011
- Shawn Van Every: Pro Android Media: Developing Graphics, Music, Video, and Rich Media Apps for Smartphones and Tablets - Apress 2010
- Roland Schmitz et al.: Kompendium Medieninformatik: Mediennetze - Springer 2006
- Diverse authors: Dedicated Scientific Papers from relevant conferences - MobiMedia, MoMM, MuM, AmbiSys, etc.

Language:

- German and English skills required

CS5157 - Media Compression (MedienKomp)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), specialization field media informatics, 2nd or 3rd semester

Classes and lectures:

- Media Compression (lecture with exercises, 3 SWS)

Workload:

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

Contents of teaching:

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Qualification-goals/Competencies:

- Verständnis der algorithmischen Grundlagen zur Kompression digitaler Daten
- Kenntnis der aktuellen Verfahren
- Fähigkeit zur Beurteilung von Güte- und Sicherheitseigenschaften
- Erkennen von Grenzen der Komprimierung

Grading through:

- Viva Voce or test

Requires:

- Algorithmics (CS4000)

Responsible for this module:

- Prof. Dr. Maciej Liskiewicz

Teacher:

- Institute for Theoretical Computer Science
- Prof. Dr. Maciej Liskiewicz

Literature:

- :
- :
- :
- :

Language:

- English, except in case of only German-speaking participants

CS5159 - Ubiquitous Computing (UbiqComp)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master CLS 2010 (optional subject), mathematics, 2nd or 3rd semester
- Bachelor CLS 2010 (optional subject), mathematics, 5th or 6th semester
- Master Computer Science 2012 (optional subject), advanced curriculum organic computing, 2nd or 3rd semester
- Master Computer Science 2012 (optional subject), specialization field media informatics, 2nd or 3rd semester

Classes and lectures:

- Ubiquitous Computing (lecture with exercises, 3 SWS)

Workload:

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

Contents of teaching:

- The
- Technology trends: information technology, new materials
- Wireless communication and mobile computing
- Spontaneous networking
- Context awareness: location, context, and situation
- Smart labels (RFIDs) and wireless chipcards
- Embedded systems and sensors
- Energy aspects
- Wearable computing
- Interaction with invisible computers
- Software infrastructures
- Selected research projects
- Applications scenarios
- Social implications

Qualification-goals/Competencies:

- Understand fundamental challenges, concepts, approaches, and limitations of UC
- Follow and judge recent UC research papers
- Design, implementation, and analysis of exemplary UC systems

Grading through:

- Viva Voce or test

Responsible for this module:

- Prof. Dr.-Ing. Thilo Pionteck (Nachfolger NN)

Teacher:

- Institute of Computer Engineering
- Prof. Dr.-Ing. Thilo Pionteck (Nachfolger NN)

Literature:

- Friedemann Mattern (Ed.): Die Informatisierung des Alltags - Leben in smarten Umgebungen - Springer-Verlag, 2007
- Elgar Fleisch, Friedemann Mattern (Eds.): Das Internet der Dinge - Ubiquitous Computing und RFID in der Praxis - Springer-Verlag, 2005

Language:

- offered only in German

CS5210 - Electronic Business Processes (EGeschProz)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Media Informatics 2014 (optional subject), computer science, Arbitrary semester
- Master Computer Science 2012 (optional subject), specialization field media informatics, 2nd or 3rd semester

Classes and lectures:

- Electronic Business Processes (lecture, 2 SWS)
- Electronic Business Processes (practical course, 1 SWS)

Workload:

- 60 Hours private studies
- 30 Hours in-classroom work
- 15 Hours exam preparation
- 15 Hours group work

Contents of teaching:

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Qualification-goals/Competencies:

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Grading through:

- Oral examination

Responsible for this module:

- Prof. Dr. Stefan Fischer

Teacher:

- Institute of Telematics
- Prof. Dr. Stefan Fischer

Language:

- offered only in German

CS5605 - Media Theory and Semiotics (MTheoSemio)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), specialization field media informatics, 2nd or 3rd semester

Classes and lectures:

- Medientheorie und Semiotik (lecture with exercises, 3 SWS)

Workload:

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

Contents of teaching:

Qualification-goals/Competencies:

Grading through:

- Written or oral exam as announced by the examiner

Requires:

- Human-Computer-Interaction (CS4230)

Responsible for this module:

- Dr. Thomas Winkler

Teacher:

- Institute for Multimedia and Interactive Systems
- Dr. Thomas Winkler

Literature:

- :
- :
- :
- :

Language:

- offered only in German

CS5610-KP04, CS5610 - Computer-Supported Teaching and Learning (CGLehrLern)

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

Course of study, specific field and term:

- Bachelor Media Informatics 2020 (optional subject), media informatics, 5th or 6th semester
- Bachelor Media Informatics 2014 (optional subject), computer science, 5th or 6th semester
- Master Computer Science 2012 (optional subject), specialization field media informatics, 2nd and 3rd semester

Classes and lectures:

- Computer-Supported Teaching and Learning (lecture, 2 SWS)
- Computer-Supported Teaching and Learning (exercise, 1 SWS)

Workload:

- 75 Hours private studies
- 45 Hours in-classroom work

Contents of teaching:

- Introduction to the course
- Introduction to the field of application and research
- Pedagogical foundations
- Overview Digital teaching-learning scenarios
- Digital transformation within the university context
- Learning spaces and learning environments
- Classification of educational technologies
- Standards for teaching and learning technologies
- Development processes
- Learning Analytics
- Gamification
- Legal framework

Qualification-goals/Competencies:

- Students are able to summarize fundamentals, principles and applications of computer-based teaching and learning systems.
- They are able to analyze trends and developments in the field and to assess them with regard to their use in concrete application contexts.
- They have the ability to familiarize themselves with an existing open source system and to develop it further independently along the applicable specifications.

Grading through:

- portfolio exam - the concrete examination elements and their weights will be published in the course

Responsible for this module:

- Prof. Dr.-Ing. Nicole Jochems

Teacher:

- Institute for Multimedia and Interactive Systems
- Prof. Dr.-Ing. Nicole Jochems
- MitarbeiterInnen des Instituts

Literature:

- H. Kritzenberger: Multimediale und Interaktive Lernräume - München: Oldenbourg, 2005
- J. Haake, G. Schwabe & M. Wessner: CSCL-Kompendium 2.0 - München: Oldenbourg, 2012
- S. Schön, M. Ebner: Lehrbuch für Lernen und Lehren mit Technologien - Berlin, epubli 2. Auflage, 2013

Language:

- offered only in German

Notes:

Prerequisites for attending the module:
- None

Prerequisites for the exam:
- None

Exam(s):
- CS5610-L1 Computergestütztes Lernen und Lehren, Portfolio exam, 100% of the module grade

CS5615-KP04, CS5615 - Computer-Supported Cooperative Work (CSCW) in Safety-Critical Contexts (CGKoop)

Duration:	Turnus of offer:	Credit points:
1 Semester	Currently not available	4

Course of study, specific field and term:

- Bachelor Media Informatics 2020 (optional subject), media informatics, 5th or 6th semester
- Bachelor IT-Security 2016 (optional subject), computer science, Arbitrary semester
- Bachelor Media Informatics 2014 (optional subject), media informatics, 5th or 6th semester
- Master Computer Science 2012 (optional subject), specialization field media informatics, 2nd or 3rd semester

Classes and lectures:

- Computer-Supported Cooperative Work (CSCW) in Safety-Critical Contexts (lecture, 2 SWS)
- Computer-Supported Cooperative Work (CSCW) in Safety-Critical Contexts (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Introduction
- Socio-technical systems
- Designing groupware
- Classifying groupware
- Supporting awareness
- Supporting communication
- Supporting coordination
- Supporting teams
- Supporting communities
- Technical integration
- User interfaces for groupware

Qualification-goals/Competencies:

- The students know the basics, principles and applications of computer-supported cooperative work (CSCW) and how to apply them.
- They can describe representative platforms and systems for CSCW.
- They are able to analyze, design, implement and evaluate CSCW systems in an application- and user-oriented way.

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- N.N.

Teacher:

- Institute for Multimedia and Interactive Systems

Literature:

- T. Gross & M. Koch: Computer-Supported Cooperative Work - München: Oldenbourg-Verlag, 2007
- D. Coleman: Groupware - Collaborative Strategies for Corportate LANSs and Intranets - San Francisco: Prentice-Hall 1997
- G. Schwabe et al.(Hrsg.): CSCW-Kompendium - Berlin: Springer 2001
- F. Lehner, S. Dustdar (Hrsg.): Telekooperation in Unternehmen - Wiesbaden: Deutscher Universitäts-Verlag 1997
- M. Beaudouin-Lafon (Hrsg.): Computer-Supported Cooperative Work - New York: Wiley 1998

Language:

- offered only in German

Notes:

Admission requirements for taking the module:
- None

Admission requirements for participation in module examination(s):
- Successful completion of exercises as specified at the beginning of the semester.

Module examination(s):
- CS5615-L1 Computer-aided cooperation in safety-critical systems, written exam, 90min, 100% of the module grade.

CS5640-KP04 - Sociology of Media Networks (SozioNMed)

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

Course of study, specific field and term:

- Master Media Informatics 2014 (optional subject), media informatics, Arbitrary semester
- Master Computer Science 2012 (optional subject), specialization field media informatics, 2nd or 3rd semester

Classes and lectures:

- Sociology of Media Networks (lecture, 2 SWS)
- Sociology of Media Networks (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Introduction and Overview
- Sociology and Computer Science
- Social structures in network societies
- Society in media networks
- Sociological basics of the network society
- Ethics in media networks

Qualification-goals/Competencies:

- The students can use the sociological basics, theories and statistics for orientation in the informational network society.
- They are able to understand and predict moral conflicts arising due to technological developments and can explain the resulting advantages and disadvantages concerning society.

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr. rer. nat. Michael Herczeg

Teacher:

- Institute for Multimedia and Interactive Systems
- Prof. Dr. rer. nat. Michael Herczeg
- MitarbeiterInnen des Instituts

Literature:

- :
- :
- :

Language:

- offered only in German

CS5650-KP04 - Computer and Media Art (CMKunst)

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

Course of study, specific field and term:

- Master Media Informatics 2020 (optional subject), media informatics, Arbitrary semester
- Master Media Informatics 2014 (optional subject), media informatics, Arbitrary semester
- Master Computer Science 2012 (optional subject), specialization field media informatics, 2nd or 3rd semester

Classes and lectures:

- Computer- and Media-Art (lecture, 2 SWS)
- Computer- and Media-Art (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Introduction and Overview
- History of Technology and Art
- Introduction to the art of modernism
- Digital technology as a tool and reflected medium of CMA
- Sound and music
- Political art
- Interactive installations and environments
- Telepresence, telematics, telerobotics - body and identity
- Art & AI
- VR and AR art
- Artificial Life and Artificial Life Art
- Summary and outlook

Qualification-goals/Competencies:

- The students know the importance of computers and interactive media for the arts.
- hey are able to understand and judge media art technologically and artistically in the cultural context.
- They understand the mutual importance of technology and art in a historical reflection.

Grading through:

- Regular attendance at seminars
- written homework

Responsible for this module:

- Dr. Thomas Winkler

Teacher:

- Institute for Multimedia and Interactive Systems
- Dr. Thomas Winkler

Language:

- offered only in German

Notes:

Admission requirements for taking the module:
- None

Admission requirements for participation in module examination(s):
- Active participation in the exercises in small groups as specified at the beginning of the semester

Module examination(s):
- CS5650-L1 Computer and Media Art, term paper, 100% of the module grade

CS5660-KP04 - Music and Computer (MusikComp)

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

Course of study, specific field and term:

- Bachelor Media Informatics 2020 (optional subject), media informatics, 5th or 6th semester
- Bachelor Media Informatics 2014 (optional subject), computer science, 5th or 6th semester
- Master Computer Science 2012 (optional subject), specialization field media informatics, 2nd or 3rd semester

Classes and lectures:

- Music and Computer (lecture, 2 SWS)
- Music and Computer (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Introduction, Overview, Scientific, Artificial and Ordinary Background
- History of Music Technology
- Analog and Digital Soundrecording
- Audio-Software (theory and practice)
- Analog Soundproduction, Electrical Instruments, Electronic Music aud Synthesizer
- Digital Soundsynthesis, Virtual Studio Technology (theory and practice)
- nalog and Digital Soundcontrolling, MIDI-Technology
- MIDI-Software, esp. Sequenzer (theory and practice)
- Musical Programming, Interactive Performance (theory and practice)
- Interface-Technology
- Digital Performance

Qualification-goals/Competencies:

- The students know the theories, methods and technologies for digital music and its production.
- They can analyse, plan, implement and evaluate applications of digital music together with musicians as well as with experts from musical science and from audio technology.

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr.-Ing. Nicole Jochems

Teacher:

- Institute for Multimedia and Interactive Systems
- PD Dr. habil. Joachim Stange-Elbe

Literature:

- Peter Manning: Electronic and Computer Music - Oxford University Press, 2013

Language:

- offered only in German

Notes:

Prerequisites for attending the module:
- None

Prerequisites for the exam:
- None

Exam(s):
- CS5660-L1 Musik und Computer, Klausur, 90min, 100% der Modulnote

CS5670 - Design theory and esthetics of interactive media (Design)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), specialization field media informatics, 2nd or 3rd semester

Classes and lectures:

- Designtheory and Esthetics of interactive media (lecture with exercises, 3 SWS)

Workload:

- 55 Hours private studies and exercises
- 30 Hours in-classroom work
- 20 Hours exam preparation
- 15 Hours group work

Contents of teaching:

- Introduction and Overview
- Subregions of the Design and its Present Importance
- History of Interaction- and Interface Design
- Design Theory
- Aesthetics
- Design Principles and Design Methods
- Text and Typography
- Image-Sound Media
- Surfaces, Objects and Structures
- Interactive Objects

Qualification-goals/Competencies:

- Students are capable of scientific and theoretical reflection of interactive, multimedia design.
- They can use basic methods for designing interactive multimedia systems.
- They are familiar with selected examples of interactive, multimedia designs.

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Dr. Thomas Winkler

Teacher:

- Institute for Multimedia and Interactive Systems
- Dr. Thomas Winkler

Literature:

- G.M. Buurmann (Hrsg.): Total Interaction: Theory and Practice of a New Paradigm for the Design Disciplines - Birkhäuser Verrlag, 2005
- M. Herczeg: Interaktionsdesign - Oldenbourg-Verlag, 2006

Language:

- offered only in German

Notes:

Das Modul wird ab WS 2014/15 abgelöst durch CS4235 - Medien- und Designtheorie.

CS5680-KP04 - Master Seminar Media informatics (MSemMedien)

Duration:	Turnus of offer:	Credit points:	Max. group size:
1 Semester	normally each year in the summer semester	4 (Typ B)	15

Course of study, specific field and term:

- Master Media Informatics 2014 (compulsory), interdisciplinary competence, 2nd semester
- Master Computer Science 2012 (optional subject), specialization field media informatics, 2nd or 3rd semester

Classes and lectures:

- Master Seminar Media Informatics (seminar, 2 SWS)

Workload:

- 60 Hours work on an individual topic with written and oral presentation
- 30 Hours in-classroom work
- 30 Hours private studies

Contents of teaching:

- Familiarize with a challenging academic topic of media informatics
- Self dependent work on a scientific problem and its solution methods
- Presentation and discussion of results

Qualification-goals/Competencies:

- Students can work up a scientific topic thoroughly.
- They are capable of presenting the results in a written documentation and an oral presentation.
- They can present and discuss a scientific problem in English.
- They can comment scientific work from a critical point of view.
- They can follow a scientific presentation and question it in an open discussion.

Grading through:

- term paper
- oral presentation

Responsible for this module:

- Prof. Dr.-Ing. Nicole Jochems

Teacher:

- Institute for Multimedia and Interactive Systems

- Prof. Dr. rer. nat. Michael Herczeg
- Prof. Dr.-Ing. Nicole Jochems
- MitarbeiterInnen des Instituts

Literature:

- : is selected individually

Language:

- German and English skills required

CS4010 - Safety and Security (SafeSec)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (compulsory), specialization field IT security and safety, 2nd semester
- Master Computer Science 2012 (optional subject), advanced curriculum security, 2nd semester
- Master Computer Science 2012 (compulsory), specialization field software systems engineering, 2nd semester

Classes and lectures:

- Safety 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:

- Temporal logics
- Concurrency
- Basic concepts of safety
- Formal modeling of safety requirements
- Verification of safety requirements
- Model checking and tools for verification
- Basic concepts of security
- Verification of protocols

Qualification-goals/Competencies:

- Ability to formalize and analyze the safety properties of a systems
- Ability to analyze the security properties of systems
- Knowledge of the basic techniques of model-checking
- Understanding the limits of automatic verification

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr. Rüdiger Reischuk

Teacher:

- Institute for Theoretical Computer Science

- Prof. Dr. Rüdiger Reischuk
- Prof. Dr. Maciej Liskiewicz

Literature:

- M. Huth, M. Ryan: Logic in Computer Science - Cambridge 2004
- Z. Manna, A. Pnueli: Temporal Verification of Reactive Systems :Safety - Springer 1995
- D. Salomon: Data Privacy and Security - Springer 2003
- C. Baier, P. Katoen: Principles of Model Checking - MIT Press 2008
- H. Tipton, M. Krause: Information Security Management - Auerbach 2000/2001
- E. Clarke, O. Grumberg, D. Peled: Model Checking - MIT Press 1999

Language:

- English, except in case of only German-speaking participants

CS4015 - Requirements Engineering (ReqEng)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), specialization field software systems engineering, 3rd semester

Classes and lectures:

- Requirements Engineering (lecture, 2 SWS)
- Requirements Engineering (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Requirements engineering as a phase of the software life cycle
- Classification of requirements
- Description of requirements
- Methods for requirements engineering
- Validation of requirements
- Analysis of a requirements document
- Management and tracing of requirements
- Requirements in particular application domains

Qualification-goals/Competencies:

- Understanding the importance of RE for the software development process
- Knowledge the basic procedures and description methods used for requirements engineering
- Ability to identify and to describe functional and nonfunctional requirements of an application
- Ability to analyse a given requirements document
- Recognizing the difficulties when elucidating the requirements of real world projects

Grading through:

- Written or oral exam as announced by the examiner

Requires:

- Software Construction (CS4120)
- Specification and Modelling (CS4020)

Responsible for this module:

- Prof. Dr. Martin Leucker

Teacher:

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

Literature:

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Language:

- English, except in case of only German-speaking participants

CS4030 - Semantics and Verification (SemVeri)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), specialization field software systems engineering, 3rd semester

Classes and lectures:

- Semantics and Verification (lecture, 2 SWS)
- Semantics and Verification (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Logic calculi
- operational, denotational and axiomatic semantics
- Verification and software development
- Foundations of verifying imperative programs
- Verification of sequential programs
- Tools for verification

Qualification-goals/Competencies:

- Understanding semantics and its impact
- Understanding the demand for verification
- Knowing the verification rules of important classes of imperative programs
- Ability to manually verify small imperative programs

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr. Martin Leucker

Teacher:

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

Literature:

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Language:

- English, except in case of only German-speaking participants

CS4120 - Software Construction (SoftKon)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (compulsory), advanced curriculum programming, 2nd or 3rd semester
- Master Computer Science 2012 (compulsory), specialization field software systems engineering, 1st semester

Classes and lectures:

- Software Construction (lecture, 2 SWS)
- Software Construction (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Challenges when designing and maintaining large software systems
- Object-oriented software design
- Software architectures
- Software components
- Design patterns
- Refactoring and reengineering
- Product lines
- CASE tools

Qualification-goals/Competencies:

- Knowing the concepts and methods of object-oriented software development
- Ability to perform object-oriented analysis and design
- Familiarity with the basic software architectures
- Knowing common component models
- Ability to use design patterns in an adequate way
- Knowledge of basic methods for reengineering software

Grading through:

- Viva Voce or test

Responsible for this module:

- Prof. Dr. Martin Leucker

Teacher:

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

Literature:

- P. Clements, L. Northrop: Software Product Lines - Addison Wesley 2007
- M. Fowler, K. Beck, J. Brant, W. Opdyke, D. Roberts: Refactoring: Improving the Design of Existing Code - Addison Wesley 1999
- E. Gamma, R. Helm, R. Johnson, J. Vlissides: Design Patterns: Elements of Reusable Object-Oriented Software - Pearson 2000
- B. Meyer: Object-Oriented Software Construction - Prentice Hall 1997
- C. Szyperski: Component Software - Beyond Object-Oriented Programming - Addison-Wesley 2002

Language:

- English, except in case of only German-speaking participants

CS4136 - Software and System Testing (Testen)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), specialization field IT security and safety, 1st or 2nd semester
- Master Computer Science 2012 (optional subject), specialization field software systems engineering, 2nd or 3rd semester
- Master Computer Science 2012 (optional subject), advanced curriculum programming, 2nd or 3rd semester

Classes and lectures:

- Software and System Testing (lecture, 2 SWS)
- Software and System Testing (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Quality aspects of software systems
- Analysis and verification techniques for software systems
- Testing levels
- Testing process
- Kinds of tests
- Test case generation

Qualification-goals/Competencies:

- Basic knowledge of analysis and verification techniques
- Familiarity with the specification of correctness and safety properties
- Knowledge on different techniques for testing hardware and software systems
- Knowledge on the operation process of test case generation tools
- Ability to develop software of higher quality with the learned techniques

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr. Martin Leucker

Teacher:

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

Literature:

- G.J. Myers: The Art of Software Testing - John Wiley, 1979
- B. Beizer: Software Testing Techniques - Van Nostrand Reinhold, 1999
- M. Broy, B. Jonsson, J.-P. Katoen, M. Leucker, A. Pretschner: Model-Based Testing of Reactive Systems - Springer, 2005

Language:

- English, except in case of only German-speaking participants

Notes:

It is recommended to attend this module in combination with module CS4137 Runtime Verification.

CS4137 - Runtime Verification (RV)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), specialization field IT security and safety, 1st or 2nd semester
- Master Computer Science 2012 (optional subject), specialization field software systems engineering, 2nd or 3rd semester
- Master Computer Science 2012 (optional subject), advanced curriculum programming, 2nd or 3rd semester

Classes and lectures:

- Runtime Verification (lecture, 2 SWS)
- Runtime Verification (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Quality aspects of software systems
- Analysis and verification techniques for software systems
- Specification of correctness properties
- synthesis of monitors for the observation of software systems
- diagnosis of errors in software systems
- realization of monitoring frameworks

Qualification-goals/Competencies:

- Basic knowledge of analysis and verification techniques
- Familiarity with the specification of correctness and safety properties
- Knowledge of techniques for the synthesis of monitors
- Ability to develop software of higher quality with the learned techniques

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr. Martin Leucker

Teacher:

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

Literature:

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- :
- :

Language:

- English, except in case of only German-speaking participants

Notes:

It is recommended to attend this module in combination with module CS4136 Software and System Testing.

CS4138 - Model Checking (ModelCheck)

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

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), specialization field IT security and safety, 1st or 2nd semester
- Master Computer Science 2012 (optional subject), specialization field software systems engineering, 2nd or 3rd semester
- Master Computer Science 2012 (optional subject), advanced curriculum programming, 2nd or 3rd semester

Classes and lectures:

- Model Checking (lecture, 2 SWS)
- Model Checking (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Quality aspects of software systems
- Analysis and verification techniques for software systems
- Basic techniques for model checking
- Advanced techniques for model checking

Qualification-goals/Competencies:

- Basic knowledge of analysis and verification techniques
- Familiarity with the specification of correctness and safety properties
- Knowledge on different techniques for model checking hardware and software systems
- Knowledge on the structure of model checkers

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr. Martin Leucker

Teacher:

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

Literature:

- :

Language:

- English, except in case of only German-speaking participants

Notes:

It is recommended to attend this module in combination with module CS4137 Runtime Verification and with module CS4010 Safety and Security.

CS4140-KP04, CS4140 - Mobile and Distributed Databases (MVDB)

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

Course of study, specific field and term:

- Master Media Informatics 2020 (optional subject), computer science, Arbitrary semester
- Master Medical Informatics 2019 (optional subject), ehealth / infomatics, 1st or 2nd semester
- Master Medical Informatics 2014 (optional subject), ehealth / infomatics, 1st or 2nd semester
- Master Media Informatics 2014 (optional subject), computer science, Arbitrary semester
- Master Computer Science 2012 (optional subject), advanced curriculum distributed information systems, 3rd semester
- Master Computer Science 2012 (compulsory), specialization field software systems engineering, 1st semester

Classes and lectures:

- Mobile and Distributed Databases (lecture, 2 SWS)
- Mobile and Distributed Databases (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- The contents of the lecture covers query processing, transactions and replication in
- - centralised database management systems
- - parallel database management systems
- - distributed database management systems
- - mobile database management systems

Qualification-goals/Competencies:

- Students can explain the differences between centralised, parallel, distributed and mobile database management systems.
- They can judge about the practical suitability of different synchronization approaches for distributed and mobile transactions for a given problem.
- They can apply approaches for distributed and mobile query processing.
- They can choose suitable replication approaches for a given application and justify their choices.
- They can recognize and deal with the special difficulties and sources of error in distributed and mobile environments.

Grading through:

- Oral examination

Responsible for this module:

- Prof. Dr. Sven Groppe

Teacher:

- Institute of Information Systems
- Prof. Dr. Sven Groppe

Literature:

- A. Kemper, A. Eickler: Datenbanksysteme - 2006
- T. Conolly, C. Begg: Database Systems - A Practical Approach to Design, Implementation, and Management - Addison-Wesley 2005
- E. Rahm: Mehrrechner-Datenbanksysteme - Addison-Wesley 1994
- P. Dadam: Verteilte Datenbanken und Client/Server Systeme - Springer 1996
- H. Höpfner, C. Türker, B. König-Ries: Mobile Datenbanken und Informationssysteme - dpunkt.verlag 2005
- B. Mutschler, G. Specht: Mobile Datenbanksysteme - Springer 2004
- V. Kumar: Mobile Database Systems - Wiley-Interscience 2006

Language:

- offered only in German

Notes:

Admission requirements for taking the module:
- None

Admission requirements for participation in module examination(s):
- Active participation in lecture and tutorial

Module Examination(s):
- CS4140-L1: Mobile and Distributed Databases, oral exam, 100% of module grade.

CS4142 - Anfrageverarbeitung und Transaktionen (AnfrTrans)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), specialization field software systems engineering, 3rd semester
- Master Computer Science 2012 (optional subject), advanced curriculum distributed information systems, 2nd or 3rd semester

Classes and lectures:

- Anfrageverarbeitung und Transaktionen (lecture, 2 SWS)
- Anfrageverarbeitung und Transaktionen (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Introduction
- Architecture of Data Base Systems
- Basic Optimzation Concepts
- Basics in Storage Management
- Transaction Management in Data Base Systems
- Distributed Data Bases
- Data Structures for Content Based Access
- Byte-oriented Files
- Sequentielle record-oriented files
- Files with Direct Record Access
- A structural Modell for DBMS
- System Buffer Management
- Record Management
- Access Paths
- Record-oriented Data Base Interface
- Set-oriented Data Base Interface
- Error Recovery

Qualification-goals/Competencies:

- Knowledge of the basic architecture of data base systems
- Knowledge of basic implemetation and optimization concepts in data base systems

Grading through:

- written exam

Responsible for this module:

- Prof. Dr. Sven Groppe

Teacher:

- Institute of Information Systems
- Prof. Dr. Sven Groppe

Literature:

- :
- :

Language:

- offered only in German

CS4151-KP04, CS4151 - Architectures for Distributed Applications (SVA)

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

Course of study, specific field and term:

- Master MES 2020 (optional subject), computer science / electrical engineering, Arbitrary semester
- Master Media Informatics 2020 (optional subject), computer science, Arbitrary semester
- Master Medical Informatics 2019 (optional subject), ehealth / infomatics, 1st or 2nd semester
- Master Medical Informatics 2014 (optional subject), ehealth / infomatics, 1st or 2nd semester
- Master MES 2014 (optional subject), computer science / electrical engineering, 1st or 2nd semester
- Master Media Informatics 2014 (optional subject), computer science, Arbitrary semester
- Master Computer Science 2012 (optional subject), advanced curriculum distributed information systems, 2nd semester
- Master Computer Science 2012 (optional subject), advanced curriculum parallel and distributed system architecutres, 2nd or 3rd semester
- Master Computer Science 2012 (compulsory), specialization field software systems engineering, 2nd semester
- Master Computer Science 2012 (compulsory), advanced curriculum enterprise IT, 2nd semester

Classes and lectures:

- Architectures for Distributed Applications (lecture, 2 SWS)
- Architectures for Distributed Applications (exercise, 1 SWS)

Workload:

- 45 Hours in-classroom work
- 45 Hours private studies
- 30 Hours exam preparation

Contents of teaching:

- Motivation
- Software Architectures
- Basics: HTTP, XML & Co
- N-Tier Applications
- Service-Oriented and Event-Driven Architectures (SOA and EDA)
- Web-Oriented Architectures (Web 2.0)
- Overlay Networks
- Peer-to-Peer
- Grid and Cloud Computing
- Internet of Things

Qualification-goals/Competencies:

- The students are able to name the most important archiectures for distributed systems, explain them, and compare them to each other.
- For each architecture, they know the most prominent and important implementation platforms and basically know how to use them.
- For a given problem, they can analyze which architecture is best suited to solve it, and they can design a plan for the solution's realization.

Grading through:

- Oral examination

Responsible for this module:

- Prof. Dr.-Ing Horst Hellbrück

Teacher:

- Institute of Telematics
- Prof. Dr.-Ing Horst Hellbrück

Literature:

- J. Dunkel, A. Eberhart, S. Fischer, C. Kleiner, A. Koschel: Systemarchitekturen für verteilte Anwendungen - Hanser-Verlag 2008
- I. Melzer et.al.: Service-Orientierte Architekturen mit Web Services - Spektrum-Verlag 2010

Language:

- offered only in German

Notes:

Admission requirements for taking the module:
- None

Admission requirements for participation in module examination(s):
- Successful completion of exercises as specified at the beginning of the semester.

Module Exam(s):
- CS4151-L1 System Architectures for Distributed Applications, oral exam, 100% of module grade.

CS5140-KP04, CS5140 - Semantic Web (SemWeb)

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

Course of study, specific field and term:

- Master Media Informatics 2020 (optional subject), computer science, Arbitrary semester
- Master Medical Informatics 2019 (optional subject), ehealth / infomatics, 1st or 2nd semester
- Master Medical Informatics 2014 (optional subject), ehealth / infomatics, 1st or 2nd semester
- Master Media Informatics 2014 (optional subject), computer science, Arbitrary semester
- Master Computer Science 2012 (optional subject), advanced curriculum distributed information systems, 2nd or 3rd semester
- Master Computer Science 2012 (optional subject), specialization field software systems engineering, 2nd or 3rd semester

Classes and lectures:

- Semantic Web (lecture, 2 SWS)
- Semantic Web (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Introduction with overview of the W3C Semantic Web family of languages
- Data management for Semantic Web data, in particular indexing approaches
- Query processing for Semantic Web queries (central, parallel, and distributed, in particular in the cloud)
- Processing strategies for Semantic Web rules and ontologies

Qualification-goals/Competencies:

- Students can judge about the possibilities and limits of the Semantic Web.
- They can evaluate the consequences of the Semantic Web approach for data modelling, adminstration and processing, and finally for applications.
- They can develop Semantic Web applications.
- They can explain and apply specialized approaches for Semantic Web databases.
- They can discuss about open research questions in the area of the Semantic Web.

Grading through:

- Oral examination

Responsible for this module:

- Prof. Dr. Sven Groppe

Teacher:

- Institute of Information Systems
- Prof. Dr. Sven Groppe

Literature:

- P. Hitzler, M. Krötzsch, S. Rudolph: Foundations of Semantic Web Technologies - Chapman & Hall / CRC, 2009
- T. Segaran, J. Taylor, C. Evans: Programming the Semantic Web - O'Reilly, 2009
- F. Bry, J. Maluszynski: Semantic Techniques for the Web - Springer, 2009
- J. T. Pollock: Semantic Web for Dummies - Wiley, 2009
- J. Hebeler, M. Fisher, R. Blace, A. Perez-Lopez, M. Dean: Semantic Web Programming - Wiley, 2009
- G. Antoniou, F. van Harmelen: A Semantic Web Primer - MIT Press, 2008
- V. Kashyap, C. Bussler, M. Moran: The Semantic Web - Springer, 2008
- S. Groppe: Data Management and Query Processing in Semantic Web Databases - Springer, 2011

Language:

- offered only in German

Notes:

Admission requirements for taking the module:
- None

Admission requirements for participation in module examination(s):
- Active participation in lecture and tutorial

Module Exam(s):
- CS5140-L1: Semantic Web, oral exam, 100% of module grade.

CS5158-KP04, CS5158 - Advanced Internet Technologies (AdInternet)

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

Course of study, specific field and term:

- Master Media Informatics 2020 (optional subject), computer science, Arbitrary semester
- Master Medical Informatics 2019 (optional subject), ehealth / infomatics, 1st or 2nd semester
- Master Medical Informatics 2014 (optional subject), ehealth / infomatics, 1st or 2nd semester
- Master Media Informatics 2014 (optional subject), computer science, Arbitrary semester
- Master Computer Science 2012 (optional subject), advanced curriculum enterprise IT, 2nd or 3rd semester
- Master Computer Science 2012 (optional subject), specialization field software systems engineering, 2nd or 3rd semester
- Master Computer Science 2012 (optional subject), advanced curriculum distributed information systems, 2nd or 3rd semester

Classes and lectures:

- Advanced Internet Technologies (lecture, 2 SWS)
- Advanced Internet Technologies (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Introduction and fundamentals
- Fundamental Internet design principles
- Problems of today's Internet architecture
- Backbone Technologies
- Mobile Internet
- IPv6 und related topics
- Delay Tolerant Networks (DTN)
- Internet of Services / Internet of Things
- Peer-To-Peer networks
- Big Data
- Goals, architectures, algorithms, and protocols for the future Internet

Qualification-goals/Competencies:

- Understand the fundamental design decisions that have led to today's Internet architecture
- Understand the original design goals of the Internet and realize the implications that the emphasis on certain of them has on today's networks
- Learn about essential, universally valid criteria for the design of networks and applications (e.g., end-to-end argument, fate sharing, etc.)
- Know technological as well as societal developments that have led to massive changes in the Internet's infrastructure (growth, innovations, mobile communications,)
- Identify problems of the Internet's architecture and understand potential solutions by comparing different approaches
- Become acquainted with the Future Internet research field and learn about novel approaches to research and shape the Internet of the future

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr. Stefan Fischer

Teacher:

- Institute of Telematics
- Dr. Mohamed Hail

Literature:

- Olivier Hersent, David Boswarthick, Omar Elloumi: The Internet of Things: Key Applications and Protocols - Wiley, 2012
- Athanasios V. Vasilakos, Yan Zhang, Thrasyvoulos Spyropoulos: Delay Tolerant Networks: Protocols and Applications - CRC Press, 2012
- E. Pacitti, R. Akbarinia, M. El-Dick: P2P Techniques for Decentralized Applications - Morgan & Claypool Publishers

Language:

- German and English skills required

Notes:

Admission requirements for taking the module:
- None

Admission requirements for participation in module examination(s):
- None

Module Examination(s):
- CS5158-L1: Advanced Internet Technologies, oral examination, 100% of module mark.

(Was also part of CS4518-KP12)

CS5480 - Seminar Software Systems Engineering (SemSSE)

Duration:	Turnus of offer:	Credit points:	Max. group size:
1 Semester	not available anymore	4 (Typ B)	15

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), specialization field software systems engineering, 3rd semester

Classes and lectures:

- Seminar Software Systems Engineering (seminar, 2 SWS)

Workload:

- 60 Hours work on an individual topic with written and oral presentation
- 30 Hours private studies
- 30 Hours in-classroom work

Contents of teaching:

- Advanced topics from the field of software systems engineering

Qualification-goals/Competencies:

- Instructing methods for scientific work
- Ability to acquaint oneself with a scientific subject
- Ability to summarize the contents in written form
- Ability to give a talk about complex issues in a comprehensible way using proper terminology
- Ability to discuss scientific problems

Grading through:

- participation in discussions

Requires:

- Mobile and Distributed Databases (CS4140-KP04, CS4140)
- Architectures for Distributed Applications (CS4151-KP04, CS4151)
- Software Construction (CS4120)

Responsible for this module:

- Prof. Dr. rer. nat. habil. Ralf Möller
- Prof. Dr. Stefan Fischer
- Prof. Dr. Martin Leucker

Teacher:

- Institute for Theoretical Computer Science
- Institute of Telematics
- Institute of Information Systems
- Institute of Software Technology and Programming Languages

- Prof. Dr. Martin Leucker
- Prof. Dr. Stefan Fischer
- Prof. Dr. rer. nat. habil. Ralf Möller

Language:

- offered only in English

CS5490 - Lab Software Systems Engineering (PrSSE)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4 (Typ B)

Course of study, specific field and term:

- Master Computer Science 2012 (compulsory), specialization field software systems engineering, 3rd semester

Classes and lectures:

- Lab Software Systems Engineering (programming project, 3 SWS)

Workload:

- 65 Hours private studies
- 45 Hours in-classroom work
- 10 Hours oral presentation (including preparation)

Contents of teaching:

- Design and implementation of an advanced component-based software/hardware system in team work

Qualification-goals/Competencies:

- Advanced skills in designing complex software/hardware systems
- Ability to derive a system design from a requirements specification
- Ability to plan a component-based architecture meeting the system design
- Ability to implement, to test, and to integrate components
- Ability to document, to present, to evaluate and to improve the implemented system
- Ability to cooperate within a teamfor a successful project

Grading through:

- documentation

Requires:

- Architectures for Distributed Applications (CS4151-KP04, CS4151)
- Software Construction (CS4120)
- Mobile and Distributed Databases (CS4140-KP04, CS4140)

Responsible for this module:

- Prof. Dr. rer. nat. habil. Ralf Möller
- Prof. Dr. Stefan Fischer
- Prof. Dr. Martin Leucker

Teacher:

- Institute for Theoretical Computer Science
- Institute of Information Systems
- Institute of Telematics
- Institute of Software Technology and Programming Languages

- Prof. Dr. Martin Leucker
- Prof. Dr. rer. nat. habil. Ralf Möller
- Prof. Dr. Stefan Fischer

Language:

- English, except in case of only German-speaking participants

CS5700 - Case study in professional product development (Fallstudie)

Duration:	Turnus of offer:	Credit points:	Max. group size:
2 Semester	not available anymore	10 (Typ B)	12

Course of study, specific field and term:

- Master Computer Science 2012 (compulsory), interdisciplinary competence, 2nd and 3rd semester

Classes and lectures:

- Project Management (seminar, 2 SWS)
- Product Developement (team work, 8 SWS)

Workload:

- 150 Hours group work
- 100 Hours private studies
- 30 Hours written report
- 20 Hours oral presentation (including preparation)

Contents of teaching:

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Qualification-goals/Competencies:

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Grading through:

- continuous, successful participation in course

Responsible for this module:

- Studiengangsleitung Informatik

Teacher:

- Institutes of the Department of Computer Science/ Engineering
- Alle prüfungsberechtigten Dozentinnen/Dozenten des Studienganges

Language:

- English, except in case of only German-speaking participants

CS5820-KP04, CS5820 - Legal foundations for IT (ITRecht)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4 (Typ B)

Course of study, specific field and term:

- Master Interdisciplinary Courses (optional subject), Interdisciplinary modules, Arbitrary semester
- Master Medical Informatics 2014 (optional subject), interdisciplinary competence, 1st or 2nd semester
- Master MES 2014 (optional subject), no specific field, 1st or 2nd semester
- Bachelor MES 2014 (optional subject), no specific field, Arbitrary semester
- Master Computer Science 2012 (optional subject), interdisciplinary competence, 3rd semester

Classes and lectures:

- Legal Foundations for IT (lecture, 1 SWS)
- Legal Foundations for IT (seminar, 1 SWS)

Workload:

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

Contents of teaching:

- Introduction and Overview
- Personality rights, freedom of the press and the media, and freedom of speech
- Regulatory objectives: information and law
- Youth protection and self-regulation
- Privacy and Data Protection
- Press and advertising law
- Copyright, trademark, patent law
- German Data Protection Act (TDG) and Teleservice Data Protection Act(TDDSG), Signature Act (SigG), German Interstate Media Services Agreement(MDStV)
- Contract law and e- contracting
- International aspects
- Case Studies
- Summary and Outlook

Qualification-goals/Competencies:

- The students know the legal basis for the production and use of software and digital media.
- The students know the legal basis for the operation of IT and communications systems.

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Studiengangsleitung Informatik

Teacher:

- external institution
- externe Lehrbeauftragte

Literature:

- :
- :
- :

Language:

- English, except in case of only German-speaking participants

CS5840-KP04, CS5840 - Seminar in English (SemiEngl)

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

Course of study, specific field and term:

- Master Artificial Intelligence 2023 (optional subject), for equivalence check, Arbitrary semester
- Master Computer Science 2019 (optional subject), interdisciplinary competence, Arbitrary semester
- Master Computer Science 2014 (optional subject), interdisciplinary competence, Arbitrary semester
- Master Computer Science 2012 (optional suject), interdisciplinary competence, Arbitrary semester

Classes and lectures:

- Seminar in Englisch (seminar, 2 SWS)

Workload:

- 90 Hours work on an individual topic with written and oral presentation
- 30 Hours in-classroom work

Contents of teaching:

- Familiarization in a demanding scientific topic
- Working on a scientific topic and its answers for problems on their own
- Presentation and discussion of the topic in English

Qualification-goals/Competencies:

- The students can obtain a solid grounding a demanding scientific topic.
- They can review a scientific work.
- They are able to present the results in a written documentation and in a talk in an understandable way.
- The can present and discuss a scientific topic in English.
- They can follow a scientific presentation and assess critically in an open discussion.

Grading through:

- oral presentation
- Written report

Responsible for this module:

- Studiengangsleitung Informatik

Teacher:

- Institutes of the Department of Computer Science/ Engineering
- Alle prüfungsberechtigten Dozentinnen/Dozenten des Studienganges

Literature:

- is selected individually:

Language:

- offered only in English

Notes:

Prerequisites for attending the module:
- None

Prerequisites for the exam:
- Successful participation in the seminar incl. elaboration, presentation, contributions to the discussion according to the requirements at the beginning of the semester.

Module exam(s):
CS5840-L1: English Language Seminar, Seminar, 100% of (non-existent) module grade.

Registration and topic assignment in a preliminary meeting at the end of the preceding semester.

PS5810-KP04, PS5810 - Scientific Teaching and Tutoring (WLehrKP04)

Duration:	Turnus of offer:	Credit points:
1 Semester	irregularly	4 (Typ B)

Course of study, specific field and term:

- Bachelor Interdisciplinary Courses for health sciences (optional subject), interdisciplinary competence, Arbitrary semester
- Master Computer Science 2019 (optional subject), interdisciplinary competence, Arbitrary semester
- Master Entrepreneurship in Digital Technologies 2020 (optional subject), interdisciplinary competence, Arbitrary semester
- Master Interdisciplinary Courses (optional subject), Interdisciplinary modules, Arbitrary semester
- Bachelor Interdisciplinary Courses (optional subject), Interdisciplinary modules, Arbitrary semester
- Master CLS 2016 (optional subject), Interdisciplinary modules, 3rd semester
- Master Entrepreneurship in Digital Technologies 2014 (optional subject), interdisciplinary competence, Arbitrary semester
- Master Media Informatics 2014 (optional subject), interdisciplinary competence, Arbitrary semester
- Master MES 2014 (optional subject), no specific field, 1st or 2nd semester
- Bachelor MES 2014 (optional subject), no specific field, Arbitrary semester
- Master Computer Science 2014 (optional subject), interdisciplinary competence, Arbitrary semester
- Master CLS 2010 (optional suject), interdisciplinary competence, 3rd semester
- Master Computer Science 2012 (optional subject), interdisciplinary competence, Arbitrary semester

Classes and lectures:

- Theory and Practice of Good Teaching (seminar, 1 SWS)
- Work as a tutor in a lecture (practical course, 2 SWS)

Workload:

- 60 Hours private studies and exercises
- 45 Hours oral presentation (including preparation)
- 15 Hours in-classroom work

Contents of teaching:

- Organizing and running a scientific lecture
- Basic didactics of scientific teaching
- Practical work in tutorials

Qualification-goals/Competencies:

- The participants are able to lead a student working group and to communicate technical issues to it appropriately.
- Basic pedagogical and didactical skills

Grading through:

- continuous participation in all courses of the module

Responsible for this module:

- Prof. Dr. rer. nat. Nico Bunzeck
- Prof. Dr. rer. nat. Jürgen Prestin

Teacher:

- Institute for Mathematics
- PD Dr. rer. nat. Jörn Schnieder
- Alle prüfungsberechtigten Dozentinnen/Dozenten des Studienganges
- Corinna Lütsch

Language:

- depends on the chosen courses

Notes:

The seminar must be attended before working as a tutor. This activity cannot be remunerated.

The course instructor in charge of the respective course will issue a certificate of achievement for the module.

PS5830-KP04, PS5830 - Start-up and New Business (StartUp)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4 (Typ B)

Course of study, specific field and term:

- Master Media Informatics 2014 (optional subject), Interdisciplinary modules, Arbitrary semester
- Bachelor Robotics and Autonomous Systems 2016 (optional subject), interdisciplinary competence, 5th or 6th semester
- Master Medical Informatics 2014 (optional subject), interdisciplinary competence, 1st or 2nd semester
- Master MES 2014 (optional subject), no specific field, 1st or 2nd semester
- Bachelor MES 2014 (optional subject), no specific field, Arbitrary semester
- Master Computer Science 2014 (optional subject), interdisciplinary competence, Arbitrary semester
- Bachelor MES 2011 (optional subject), interdisciplinary competence, Arbitrary semester
- Bachelor Computer Science 2014 (optional subject), central topics of computer science, 5th or 6th semester
- Master CLS 2010 (optional suject), interdisciplinary competence, 2nd or 3rd semester
- Master Computer Science 2012 (optional subject), interdisciplinary competence, 2nd or 3rd semester

Classes and lectures:

- Start-up and New Business (seminar, 1 SWS)
- Start-up and New Business (practical course, 1 SWS)

Workload:

- 45 Hours private studies
- 30 Hours in-classroom work
- 30 Hours written report
- 15 Hours oral presentation (including preparation)

Contents of teaching:

- Entre-/ Intrapreneurship
- Business Modelling
- Technology product, value propositions, and customer benefit
- Target groups, customer segments, and customer relations
- Sales channels, marketing and sources of income
- Key ressources / activities / partners
- costs and financing, including funding programs
- special subjects: quality, acceptance for trading, legal form of organization, a.o.

Qualification-goals/Competencies:

- The students have gained basic insights in the field of Start-up, new product development and new business development.
- They have acquired a sound knowledge of business modelling and planing.
- They are able to develop a business plan based on a particular project.
- They are able to assess the chances and risks of a start-up and new product / new business development.

Grading through:

- contributions to the discussion

Responsible for this module:

- Prof. Dr. Martin Leucker

Teacher:

- Institute of Software Technology and Programming Languages
- Dr. Raimund Mildner

Literature:

- Aktuelle Forschungsartikel werden in der Veranstaltung bekanntgegeben.:

Language:

- offered only in German

CS5990-KP30, CS5990 - Master Thesis Computer Science (MasterInf)

Duration:	Turnus of offer:	Credit points:
1 Semester	each semester	30

Course of study, specific field and term:

- Master Computer Science 2019 (compulsory), computer science, 4th semester
- Master Computer Science 2014 (compulsory), computer science, 4th semester
- Master Computer Science 2012 (compulsory), computer science, 4th semester

Classes and lectures:

- Master's Thesis (supervised self studies, 1 SWS)
- Colloquium (colloquium, 1 SWS)

Workload:

- 870 Hours research for and write up of a thesis
- 30 Hours oral presentation and discussion (including preparation)

Contents of teaching:

- individual studies under supervision

Qualification-goals/Competencies:

- The students are able to structure a comprehensive and complex problem from the field of computer sciece or its applications and to solve it within limited time.
- They are able to get acquainted with a problem int he field of computer science in a detailed way, to analyse corresponding literature, to work out a solution and to document the solution in a written thesis.
- They can evaluate their solution critically and present it in a talk and defend it in a scientific discussion.

Grading through:

- oral presentation
- Written report

Responsible for this module:

- Studiengangsleitung Informatik

Teacher:

- Institutes of the Department of Computer Science/ Engineering
- Alle prüfungsberechtigten Dozentinnen/Dozenten des Studienganges

Literature:

- links will be given by the supervisor:

Language:

- thesis can be written in German or English

Notes:

requirements for starting a master's thesis see Academic Regulations and Procedures for Students, e.g. at least 75 credit points

CS3051-KP04, CS3051 - Parallel Computing (ParallelVa)

Duration:	Turnus of offer:	Credit points:
1 Semester	normally each year in the summer semester	4

Course of study, specific field and term:

- Bachelor Computer Science 2019 (optional subject), major subject informatics, Arbitrary semester
- Bachelor Computer Science 2019 (optional subject), Canonical Specialization SSE, 4th semester
- Bachelor Media Informatics 2020 (optional subject), computer science, 5th or 6th semester
- Bachelor Robotics and Autonomous Systems 2020 (optional subject), computer science, 5th or 6th semester
- Bachelor Computer Science 2016 (optional subject), Canonical Specialization Web and Data Science, 4th semester
- Bachelor Computer Science 2016 (optional subject), major subject informatics, Arbitrary semester
- Bachelor Computer Science 2016 (optional subject), Canonical Specialization SSE, 4th semester
- Bachelor Robotics and Autonomous Systems 2016 (optional subject), computer science, 5th or 6th semester
- Bachelor IT-Security 2016 (optional subject), computer science, Arbitrary semester
- Master Medical Informatics 2014 (optional subject), computer science, 1st or 2nd semester
- Bachelor Computer Science 2014 (optional subject), central topics of computer science, 5th or 6th semester
- Master Computer Science 2012 (optional subject), advanced curriculum programming, 2nd and 3rd semester
- Bachelor Computer Science 2012 (optional subject), central topics of computer science, 5th or 6th semester
- Master Computer Science 2012 (optional subject), advanced curriculum algorithmics and complexity theory, 2nd or 3rd semester

Classes and lectures:

- Parallel Computing (lecture, 2 SWS)
- Parallel Computing (exercise, 1 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:

- Studentes 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:

- Viva Voce or test

Requires:

- Theoretical Computer Science (CS2000-KP08, 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:

- offered only in German

Notes:

Admission requirements for taking the module:
- None (the competencies of the modules listed under

CS4003 - Computational Complexity (Komplex)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), specialization field IT security and safety, 2nd or 3rd semester
- Master Computer Science 2012 (compulsory), advanced curriculum algorithmics and complexity theory, 2nd or 3rd semester
- Master CLS 2010 (optional subject), computer science, 2nd semester

Classes and lectures:

- Computational Complexity (lecture with exercises, 3 SWS)

Workload:

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

Contents of teaching:

- structure of time and space classes
- comparison of different reducibilities
- circuit complexity
- probabilistic complexity classes
- Polynomial Hierarchy
- separation of complexity classes
- oracle Turing machines and relativisation

Qualification-goals/Competencies:

- ability to classify problems according to various complexity measures
- knowledge of relations between different machine models and complexity measures
- understanding of the terms diagonalisation, simulation, configuration graph, reductions and completeness, relativisation, and logical characterisation

Grading through:

- Oral examination

Requires:

- Algorithmics (CS4000)

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:

- :
- :
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- :

Language:

- English, except in case of only German-speaking participants

CS4006 - Combinatorial Optimization (KombOpt)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), advanced curriculum algorithmics and complexity theory, 2nd or 3rd semester

Classes and lectures:

- Combinatorial Optimization (lecture, 2 SWS)
- Combinatorial Optimization (exercise, 1 SWS)

Workload:

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

Contents of teaching:

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Qualification-goals/Competencies:

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Grading through:

- Oral examination

Requires:

- Algorithmics (CS4000)

Responsible for this module:

- Prof. Dr. Rüdiger Reischuk

Teacher:

- Institute for Mathematics
- Institute for Theoretical Computer Science

- Prof. Dr. Rüdiger Reischuk
- PD Dr. rer. nat. Hanns-Martin Teichert

Literature:

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Language:

- offered only in German

CS4008 - Advanced Algorithmics and Data Structures (AuD2)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (compulsory), advanced curriculum algorithmics and complexity theory, 2nd or 3rd semester

Classes and lectures:

- Advanced Algorithmics (lecture with exercises, 3 SWS)

Workload:

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

Contents of teaching:

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Qualification-goals/Competencies:

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Grading through:

- Oral examination

Requires:

- Algorithmics (CS4000)

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:

- :
- :
- :

Language:

- English, except in case of only German-speaking participants

CS4016 - Cryptology (Krypto)

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

Course of study, specific field and term:

- Master Computer Science 2012 (compulsory), specialization field IT security and safety, 1st semester
- Master Computer Science 2012 (compulsory), advanced curriculum security, 2nd or 3rd semester
- Master Computer Science 2012 (optional subject), advanced curriculum algorithmics and complexity theory, 2nd or 3rd semester

Classes and lectures:

- Cryptology (lecture with exercises, 3 SWS)

Workload:

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

Contents of teaching:

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Qualification-goals/Competencies:

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Grading through:

- 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:

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Language:

- English, except in case of only German-speaking participants

CS4018 - Computer Algebra (CompAlgebr)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master CLS 2010 (optional suject), computer science, Arbitrary semester
- Master Computer Science 2012 (optional subject), advanced curriculum algorithmics and complexity theory, 2nd or 3rd semester

Classes and lectures:

- Computer Algebra (lecture with exercises, 3 SWS)

Workload:

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

Contents of teaching:

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- Polynome, Matrizen
- Multiplikationsalgorithmen, FFT, DFT
- Gr
- formale Differentiation und

Qualification-goals/Competencies:

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-

Grading through:

- Oral examination

Requires:

- Algorithmics (CS4000)

Responsible for this module:

- Prof. Dr. Rüdiger Reischuk

Teacher:

- Institute for Theoretical Computer Science
- Prof. Dr. Rüdiger Reischuk

Literature:

- :
- :

Language:

- English, except in case of only German-speaking participants

CS5010 - Wissenschaftliches Rechnen (ScienComp)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), advanced curriculum algorithmics and complexity theory, 2nd or 3rd semester
- Bachelor MES 2011 (optional subject), medical engineering science, 3rd, 5th, or 6th semester
- Bachelor CLS 2010 (optional subject), computer science, 6th semester

Classes and lectures:

- Scientific Computing (lecture, 2 SWS)
- Scientific Computing (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- lineare und nichtlineare Gleichungssysteme, Eigenwertberechnungen
- High-Performance Computing (Parallesierungstechniken)
- Modellierungsaspekte

Qualification-goals/Competencies:

- Numerische Simulation von naturwissenschaftlichen Vorgängen
- Anwendung auf praxisrelevante Fragestellungen

Grading through:

- written exam

Responsible for this module:

- Prof. Dr. Rüdiger Reischuk

Teacher:

- Institute for Theoretical Computer Science
- Prof. Dr. Rüdiger Reischuk

Language:

- offered only in German

CS5099 - Seminar Algorithmics and Complexity Theory (SemAlgKomp)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4 (Typ B)

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), advanced curriculum algorithmics and complexity theory, 2nd or 3rd semester

Classes and lectures:

- Algorithmics (seminar, 2 SWS)

Workload:

- 60 Hours work on an individual topic with written and oral presentation
- 30 Hours private studies
- 30 Hours in-classroom work

Contents of teaching:

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Qualification-goals/Competencies:

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Grading through:

- contributions to the discussion

Requires:

- Computational Complexity (CS4003)
- Algorithmics (CS4000)

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:

- :

Language:

- English, except in case of only German-speaking participants

CS3052-KP04, CS3052 - Programming Languages and Type Systems (ProgLan14)

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

Course of study, specific field and term:

- Bachelor Computer Science 2019 (optional subject), major subject informatics, Arbitrary semester
- Bachelor Computer Science 2019 (optional subject), Canonical Specialization Web and Data Science, 3rd semester
- Bachelor Computer Science 2019 (compulsory), Canonical Specialization SSE, 3rd semester
- Bachelor Media Informatics 2020 (optional subject), computer science, 5th or 6th semester
- Bachelor Media Informatics 2014 (optional subject), computer science, 5th or 6th semester
- Bachelor Computer Science 2016 (optional subject), major subject informatics, Arbitrary semester
- Bachelor Computer Science 2016 (compulsory), Canonical Specialization SSE, 3rd semester
- Bachelor Computer Science 2012 (optional subject), central topics of computer science, 5th or 6th semester
- Bachelor Computer Science 2012 (compulsory), specialization field IT security and safety, 4th semester
- Master Computer Science 2012 (compulsory), advanced curriculum programming, 2nd or 3rd semester
- Bachelor IT-Security 2016 (optional subject), computer science, Arbitrary semester
- Bachelor CLS 2010 (optional suject), computer science, 5th or 6th semester
- Bachelor Computer Science 2014 (optional subject), central topics of computer science, 5th semester
- Bachelor Computer Science 2014 (compulsory), specialization field IT security and safety, 5th semester

Classes and lectures:

- Progamming Languages and Type Systems (lecture, 2 SWS)
- Progamming Languages and Type Systems (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 syntacic 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.
- The can evaluate possible programming languages for an application.

Grading through:

- Written or oral exam as announced by the examiner

Requires:

- Linear Algebra and Discrete Structures 1 (MA1000-KP08, MA1000)
- Algorithms and Data Structures (CS1001-KP08, CS1001)
- Introduction to Programming (CS1000-KP10, CS1000SJ14)

Responsible for this module:

- Prof. Dr. Martin Leucker

Teacher:

- Institute of Software Technology and Programming Languages

- Dr. Annette Stümpel
- Prof. Dr. Martin Leucker

Literature:

- K.C. Louden: Programming Languages: Principles and Practice - Course Technology 2011
- J.C. Mitchell: Concepts in Programming Languages - Cambridge University Press 2003
- T.W. Pratt, M.V. Zelkowitz: Programming Languages: Design and Implementation - Prentice Hall 2000
- R.W. Sebesta: Concepts of Programming Languages - Pearson Education 2012
- R. Sethi: Programming Languages: Concepts and Constructs - Addison-Wesley 2003
- D.A. Watt: Programming Language Design Concepts - John Wiley & Sons 2004
- G. Winskel: The Formal Semantics of Programming Languages - MIT Press 1993

Language:

- German and English skills required

Notes:

Admission requirements for taking the module:
- None (the competencies of the modules listed under

CS4131 - Programming Methodology (MethoPrg)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), advanced curriculum programming, 2nd or 3rd semester

Classes and lectures:

- Programming Methodology (lecture, 2 SWS)
- Programming Methodology (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Programming as a development process
- Transforming specifications into functional algorithms
- Improvement of functional algorithms
- Transforming functional algorithms into imperative programs
- Improvement of imperative programs
- Data structure refinement
- Introduction of pointers and linked data structures
- Transition to machine-oriented control- and data strcutures
- Methods for object-oriented programming
- Techniques for abstraction and modularization
- Advances programming techniques

Qualification-goals/Competencies:

- Understanding the basic methods of programming
- Understanding major abstraction levels of programming
- Proficiency in programming algorithms with adequate language elements
- Gaining deeper insight into the interplay between control and data structures
- Familiarity with frequently used concepts for abstraction and modularization

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr. Martin Leucker

Teacher:

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

Literature:

- :
- :
- :
- :

Language:

- English, except in case of only German-speaking participants

CS4132 - Functional Programming (FunktPr)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), advanced curriculum programming, 2nd or 3rd semester

Classes and lectures:

- Functional Programming (lecture, 2 SWS)
- Functional Programming (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Overview on functional programming languages
- Elements of functional programming
- Recursive data structures
- Properties of functional programs
- Transformation of functional programs
- Abstraction and functional modules
- Evaluation of functional programs
- Implementation of functional programs
- Applications of functional programming
- Functional input and output
- Lambda calculus and higher order functions

Qualification-goals/Competencies:

- Knowing a functional programming language (SML, Haskell)
- Familiarity with methods for functional programming
- Knowing important execution models of functional languages
- Ability to design well structured functional programs for complex tasks
- Understanding the relations between functional and imperative programming

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr. Martin Leucker

Teacher:

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

Literature:

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Language:

- English, except in case of only German-speaking participants

CS4133 - Logic Programming (LogikPr)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), advanced curriculum programming, 2nd or 3rd semester

Classes and lectures:

- Logic Programming (lecture, 2 SWS)
- Logic Programming (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Logic as a programming language
- Introduction to logic programming
- Predicate logic resolution
- Foundations of logic programming
- Data structures for logic programming
- Methods of logic progamming
- Applications of logic programming
- Extensions of logic progamming

Qualification-goals/Competencies:

- Kowledge of a logic programming language
- Understanding the foundations of logic programming
- Abitlity to design logic programs in a systematic way
- Knowing the application areas of logic programming
- Understanding the execution model of logic programs

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr. Martin Leucker

Teacher:

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

Literature:

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Language:

- English, except in case of only German-speaking participants

CS4135 - Programming Parallel and Distributed Systems (PPVS)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), advanced curriculum programming, 2nd or 3rd semester

Classes and lectures:

- Programming Parallel and Distributed Systems (lecture, 2 SWS)
- Programming Parallel and Distributed Systems (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Motivation of parallel and distributed processing
- Parallel hardware architectures
- Foundations of parallel programming
- Multithreaded programming
- Programming with compiler directives
- Synchronisation and mutual exclusion
- Explicit communication through message passing
- Data parallel programming
- Analytical modelling
- Performance and evaluation

Qualification-goals/Competencies:

- Kowledge of parallel computer architectures
- Ability to design parallel and distributed software
- Experience in programming parallel and distributed systems
- Ability to use programming environmentsfor parallel and distributed programming
- Ability to evaluate sequential and parallel implementations of a program

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr. Martin Leucker

Teacher:

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

Literature:

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Language:

- English, except in case of only German-speaking participants

CS5198 - Programming Lab (PrProgr)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4 (Typ B)

Course of study, specific field and term:

- Master Computer Science 2012 (compulsory), advanced curriculum programming, 2nd or 3rd semester

Classes and lectures:

- Programming Lab (programming project, 3 SWS)

Workload:

- 75 Hours group work
- 45 Hours in-classroom work

Contents of teaching:

- Implementing a model programming language with functional, parallel and/or object-oriented language elements

Qualification-goals/Competencies:

- Enhancing programming skills
- Undertanding advanced implementation techniques
- Ability to abstract from concrete programming languages

Grading through:

- documentation

Responsible for this module:

- Prof. Dr. Martin Leucker

Teacher:

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

Language:

- English, except in case of only German-speaking participants

CS4019 - Theory of distributed systems (TVertSys)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), advanced curriculum distributed information systems, 2nd or 3rd semester

Classes and lectures:

- Theory of Distributed Systems (lecture with exercises, 3 SWS)

Workload:

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

Contents of teaching:

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Qualification-goals/Competencies:

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Grading through:

- Oral examination

Requires:

- Algorithmics (CS4000)

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:

- :
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Language:

- English, except in case of only German-speaking participants

CS4199 - Projektpraktikum Verteilte Informationssysteme (PrVertfS)

Duration:	Turnus of offer:	Credit points:
1 Semester	irregularly	4 (Typ B)

Course of study, specific field and term:

- Master Computer Science 2012 (compulsory), advanced curriculum distributed information systems, 2nd or 3rd semester

Classes and lectures:

- Projektpraktikum Verteilte Informationssysteme (practical course, 4 SWS)

Workload:

- 65 Hours private studies
- 45 Hours in-classroom work
- 10 Hours written report

Contents of teaching:

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Qualification-goals/Competencies:

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Grading through:

- programming project

Responsible for this module:

- Prof. Dr. Stefan Fischer

Teacher:

- Institute of Telematics
- Institute of Information Systems

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

Language:

- offered only in German

CS5153-KP04, CS5153 - Wireless Sensor Networks (DlSensorN)

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

Course of study, specific field and term:

- Master Media Informatics 2020 (optional subject), computer science, Arbitrary semester
- Master Medical Informatics 2014 (optional subject), computer science, 1st or 2nd semester
- Master Computer Science 2012 (optional subject), specialization field IT security and safety, 3rd semester
- Master Computer Science 2012 (optional subject), advanced curriculum parallel and distributed system architecutres, 2nd or 3rd semester
- Master Computer Science 2012 (optional subject), advanced curriculum organic computing, 2nd or 3rd semester

Classes and lectures:

- Wireless Sensor Networks (lecture, 2 SWS)
- Wireless Sensor Networks (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Basics of Sensor Networks
- Architecture of Sensor Nodes and of Sensor Networks
- Identities and addressing
- Wireless communication
- Data management and topology control
- Time Synchronization
- Localization
- Energy harvesting
- Applications

Qualification-goals/Competencies:

- The students are able to present the potential, benefits and limitations of sensor networks.
- They are able to cope with analysis, design, and evaluation of protocols in sensor networks.
- They are able to interpret and pursue current research activities for sensor networks.

Grading through:

- Oral examination

Responsible for this module:

- Prof. Dr.-Ing. Mladen Berekovic

Teacher:

- Institute of Computer Engineering
- Dr. rer. nat. Javad Ghofrani

Literature:

- H. Karl, A. Willig: Protocols and Architectures of Wireless Sensor Networks - Wiley, 2005
- F. Zhao, L. Guibas: Wireless Sensor Networks - Morgan Kaufmann, 2004
- B.-C. Renner: Sustained Operation of Sensor Nodes with Energy Harvesters and Supercapacitors - Books on Demand 2013

Language:

- offered only in English

Notes:

Admission requirements for taking the module:
- None

Admission requirements for participation in module examination(s):
- Successful completion of exercise assignments as specified at the beginning of the semester

Module Exam(s):
- CS5153-L1: Wireless Sensor Networks, oral exam, 100% of the module grade

CS5192 - Practical Parallel and Distributed System Architectures (PrPVS)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4 (Typ B)

Course of study, specific field and term:

- Master Computer Science 2012 (compulsory), advanced curriculum parallel and distributed system architecutres, 2nd or 3rd semester

Classes and lectures:

- Practical Parallel and Distributed System Architectures (programming project, 3 SWS)

Workload:

- 65 Hours private studies
- 45 Hours group work
- 10 Hours written report

Contents of teaching:

- Solution of an application problem with parallel / distributed systems in teamwork

Qualification-goals/Competencies:

- In-depth understanding of the functionality and practical application of parallel and distributed system architectures
- Capability to use parallel and distributed systems for typical application problems in teamwork
- Ability for documentation and presentation of project results

Grading through:

- documentation

Requires:

- Distributed Systems (CS4150)

Responsible for this module:

- Prof. Dr. Stefan Fischer

Teacher:

- Institute of Telematics
- Institute of Computer Engineering

- Prof. Dr.-Ing. Mladen Berekovic
- Prof. Dr. Stefan Fischer

Language:

- offered only in German

CS5154 - Swarm Intelligence (SwarmIntel)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), advanced curriculum organic computing, 2nd or 3rd semester

Classes and lectures:

- Swarm Intelligence (lecture, 2 SWS)
- Swarm Intelligence (exercise, 1 SWS)

Workload:

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

Contents of teaching:

Qualification-goals/Competencies:

Grading through:

- programming project

Responsible for this module:

- Prof. Dr.-Ing. Mladen Berekovic

Teacher:

- Institute of Computer Engineering
- Prof. Dr. rer. nat. Walter Raasch

Literature:

- Eric Bonabeau, Marco Dorigo, Guy Theraulaz: Swarm Intelligence: From Natural to Artificial Systems - Oxford: OUP 1999

Language:

- offered only in German

CS5175 - Seminar Organic Computing (SemOrgComp)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4 (Typ B)

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), advanced curriculum organic computing, 2nd or 3rd semester

Classes and lectures:

- Organic Computing (seminar, 2 SWS)

Workload:

- 60 Hours private studies
- 30 Hours in-classroom work
- 20 Hours written report
- 10 Hours oral presentation (including preparation)

Contents of teaching:

- Selected advanced topics in Organic Computing

Qualification-goals/Competencies:

- The students can master basic scientific methodology.
- They can familiarize themselves with a scientific topic on their own.
- They can summarize a scientific topic in written form.
- They can give an intelligible and concise oral presentation of a current research topic.
- ie haben die Kommunikationskompetenz, ein aktuelles Forschungsthema in einer Fragerunde zu diskutieren.

Grading through:

- Oral presentation and written report

Responsible for this module:

- Prof. Dr.-Ing. Thilo Pionteck (Nachfolger NN)
- Prof. Dr.-Ing. Erhardt Barth
- Prof. Dr. Stefan Fischer
- Prof. Dr. rer. nat. Thomas Martinetz

Teacher:

- Institute for Neuro- and Bioinformatics
- Institute of Telematics
- Institute of Computer Engineering

- Prof. Dr.-Ing. Thilo Pionteck (Nachfolger NN)
- Prof. Dr. rer. nat. Thomas Martinetz
- Prof. Dr. Stefan Fischer
- Prof. Dr.-Ing. Erhardt Barth

Language:

- offered only in English

CS5197 - Practical Course Organic Computing (PrOrganicC)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4 (Typ B)

Course of study, specific field and term:

- Master Computer Science 2012 (compulsory), advanced curriculum organic computing, 2nd or 3rd semester

Classes and lectures:

- Practical Course Organic Computing (practical course, 3 SWS)

Workload:

- 90 Hours group work
- 30 Hours in-classroom work

Contents of teaching:

- In-Door Monitoring with Sensor Networks
- Swarm Behaviour of Autonomos Robots
- Image Recognition using concepts of OC

Qualification-goals/Competencies:

- Detailed Knowledge of Methods of Organic Computing by applying
- Practical Experience with Programming and Evalutation of Learned Concepts of OC
-

Grading through:

- continuous, successful participation in practical course, >80%

Responsible for this module:

- Prof. Dr.-Ing. Thilo Pionteck (Nachfolger NN)

Teacher:

- Institute of Telematics
- Institute of Computer Engineering
- Institute for Neuro- and Bioinformatics

- Prof. Dr.-Ing. Thilo Pionteck (Nachfolger NN)

Literature:

- :

Language:

- offered only in German

CS5193 - Practical Intelligent Embedded Systems (PrIntelES)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4 (Typ B)

Course of study, specific field and term:

- Master Computer Science 2012 (compulsory), advanced curriculum intelligent embedded systems, 2nd or 3rd semester

Classes and lectures:

- Practical Intelligent Emedded Systems (practical course, 3 SWS)

Workload:

- 65 Hours private studies
- 45 Hours group work
- 10 Hours written report

Contents of teaching:

- Realiziation of intelligent embedded systems for typical application scenarios in teamwork

Qualification-goals/Competencies:

- Students have gained in-depth knowledge about intelligent embedded systems and their practical applications.
- They are able to realize intelligent embedded systems in teamwork.
- They are able to document and present project results.

Grading through:

- documentation

Requires:

- Real-Time Systems (CS4160)

Responsible for this module:

- Prof. Dr. rer. nat. Thorsten Buzug
- Prof. Dr.-Ing. Mladen Berekovic
- Prof. Dr.-Ing. Alfred Mertins

Teacher:

- Institute of Medical Engineering
- Institute for Signal Processing
- Institute of Computer Engineering

- Prof. Dr. rer. nat. Thorsten Buzug
- Prof. Dr.-Ing. Alfred Mertins
- Prof. Dr.-Ing. Mladen Berekovic

Language:

- offered only in German

CS5194 - Practical Project in Signal and Image Processing (PrBildSigv)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4 (Typ B)

Course of study, specific field and term:

- Master Computer Science 2012 (compulsory), advanced curriculum signal and image processing, 2nd or 3rd semester

Classes and lectures:

- iRoom (practical course, 3 SWS)

Workload:

- 60 Hours group work
- 40 Hours private studies
- 20 Hours written report

Contents of teaching:

- Planning and realization of typical signal processing applications in a team

Qualification-goals/Competencies:

- Students will have comprehensive knowledge of using signal and image processing algorithms in practice.
- They are able to realize signal processing systems in teamwork and in a self-directed manner.
- They have the communication competency to document and present project results.

Grading through:

- programming project

Requires:

- Signal processing (CS3100-KP04)
- Image processing (CS3203)

Responsible for this module:

- Prof. Dr.-Ing. Alfred Mertins

Teacher:

- Institute for Signal Processing
- Prof. Dr.-Ing. Alfred Mertins
- MitarbeiterInnen des Instituts

Language:

- offered only in German

Notes:

Prerequisites for attending the module:
- None

Prerequisites for the exam:
- None

CS4180-KP04, CS4180 - Security in Networks and Distributed Systems (SicherNet)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Bachelor Medical Informatics 2014 (optional subject), computer science, 5th or 6th semester
- Bachelor Computer Science 2014 (optional subject), central topics of computer science, 6th semester
- Bachelor Computer Science 2014 (compulsory), specialization field IT security and safety, 4th semester
- Bachelor Computer Science 2012 (compulsory), specialization field IT security and safety, 6th semester
- Master Computer Science 2012 (optional subject), advanced curriculum security, 2nd or 3rd semester
- Master Computer Science 2012 (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 formals 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:

- William Stallings: Cryptography and Network Security: Principles and Practice - Prentice Hall, 2013

- William Stallings, Lawrie Brown: Computer Security: Principles and Practice - Prentice Hall, 2014

Language:

- offered only in German

CS5015 - Seminar Security (SemSicher)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4 (Typ B)

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), specialization field IT security and safety, 3rd semester
- Master Computer Science 2012 (optional subject), advanced curriculum security, 2nd or 3rd semester

Classes and lectures:

- Seminar Security (seminar, 2 SWS)

Workload:

- 90 Hours work on an individual topic with written and oral presentation
- 30 Hours in-classroom work

Contents of teaching:

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Qualification-goals/Competencies:

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Grading through:

- Oral presentation and written report

Responsible for this module:

- Prof. Dr. Rüdiger Reischuk

Teacher:

- Institute of Computer Engineering
- Institute of Telematics
- Institute for Theoretical Computer Science

- Prof. Dr. Maciej Liskiewicz
- Prof. Dr. Stefan Fischer
- Prof. Dr.-Ing. Mladen Berekovic

Literature:

- :

Language:

- English, except in case of only German-speaking participants

CS4157 - Mainframes: Architecture and Programming (Mainframes)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), advanced curriculum enterprise IT, 2nd or 3rd semester

Classes and lectures:

- Mainframes: Archtecture and Programming (lecture, 2 SWS)
- Mainframes: Archtecture and Programming (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Introduction into Mainframe Architectures
- Introduction into z/OS
- Application Programming in z/OS
- System Programming in z/OS
- Application Programs on Mainframes

Qualification-goals/Competencies:

- The students are familiar with the mainframe architecture.
- They know the most important characteristics and ways of usage of the operating system z/OS.
- They are able to program simple system and application programs.
- They know the most important application programs on mainframes, such as databases or web application servers.

Grading through:

- written exam

Responsible for this module:

- Prof. Dr. Stefan Fischer

Teacher:

- Institute of Telematics
- Prof. Dr. Stefan Fischer

Literature:

- :

Language:

- offered only in German

CS5152 - SOA Technologies (SOA)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), advanced curriculum enterprise IT, 2nd or 3rd semester

Classes and lectures:

- SOA Technologies (lecture, 2 SWS)
- SOA Technologies (exercise, 1 SWS)

Workload:

- 45 Hours in-classroom work
- 45 Hours private studies
- 30 Hours exam preparation

Contents of teaching:

- SOA Overview
- Service-oriented organization
- Basics of Web Services
- Basic infrastructures for Web Services
- Business Process Execution Language (BPEL)
- Transactions
- Security
- SOA in the context of sensor networks
- Alternative implementation technologies
- SOA in medical technologies

Qualification-goals/Competencies:

- The students can explain die most important architectures for business applications in the Internet.
- They are familiar with the paradigm of service orientation.
- They are able to analyze a business application with repsect to their realizability with SOA technologies.
- They can design and implement business applications based on web service technologies.

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:

- I. Melzer et.al.: Service-Orientierte Architekturen mit Web Services - Spektrum-Verlag 2010
- J. Dunkel, A. Eberhart, S. Fischer, C. Kleiner, A. Koschel: Enterprise SOA - Hanser-Verlag 2008

Language:

- offered only in German

CS5191 - Seminar Enterprise IT (SemEnterIT)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4 (Typ B)

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), advanced curriculum enterprise IT, 2nd or 3rd semester

Classes and lectures:

- Seminar Enterprise IT (seminar, 2 SWS)

Workload:

- 60 Hours private studies
- 30 Hours written report
- 20 Hours in-classroom work
- 10 Hours oral presentation (including preparation)

Contents of teaching:

- Current topics from the field of enterprise applications

Qualification-goals/Competencies:

- The students know and understand current problems in the field of enterprise applications.
- They are able to prepare and give scientific talks and they are able to write scientific summaries of existing papers and books.

Grading through:

- term paper

Responsible for this module:

- Prof. Dr. Stefan Fischer

Teacher:

- Institute of Information Systems
- Institute of Telematics

- Prof. Dr. Stefan Fischer

Literature:

- : Current scientific work

Language:

- English, except in case of only German-speaking participants

CS5196 - Projektpraktikum Enterprise IT (PrEnterpIT)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4 (Typ B)

Course of study, specific field and term:

- Master Computer Science 2012 (compulsory), advanced curriculum enterprise IT, 2nd or 3rd semester

Classes and lectures:

- Projektpraktikum Enterprise IT (practical course, 3 SWS)

Workload:

- 75 Hours group work
- 45 Hours in-classroom work

Contents of teaching:

- Team-based solution of a major programming assignment from the area of enterprise software, starting from requirements analysis and leading to the actual deployment. Typically, solutions will be SOA- or N-Tier-based.

Qualification-goals/Competencies:

- After the course, the participants will be able to design, implement, and deploy complex diustributed applications based on current middleware technologies such as J2EE or MS .Net.
- They have a good idea on how to tranfer the acquired knowledge to larger projects.
- They are able to assess the differences of the diverse platforms and have learned how to selct the best platform for a specific task.

Grading through:

- programming project

Responsible for this module:

- Prof. Dr. Stefan Fischer

Teacher:

- Institute of Information Systems
- Institute of Telematics

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

Language:

- offered only in German

MA4030-KP08, MA4030 - Optimization (Opti)

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

Course of study, specific field and term:

- Minor in Teaching Mathematics, Bachelor of Arts 2023 (compulsory), mathematics, 8th semester
- Bachelor CLS 2023 (compulsory), mathematics, 4th semester
- Master Auditory Technology 2022 (optional subject), mathematics, 2nd semester
- Master MES 2020 (optional subject), mathematics / natural sciences, Arbitrary semester
- Bachelor Computer Science 2019 (optional subject), Extended optional subjects, Arbitrary semester
- Master Robotics and Autonomous Systems 2019 (optional subject), Additionally recognized elective module, Arbitrary semester
- Minor in Teaching Mathematics, Bachelor of Arts 2017 (compulsory), mathematics, 8th semester
- Master Auditory Technology 2017 (optional subject), mathematics, 1st or 2nd semester
- Bachelor Computer Science 2016 (optional subject), advanced curriculum, Arbitrary semester
- Bachelor CLS 2016 (compulsory), mathematics, 4th semester
- Master MES 2014 (optional subject), mathematics / natural sciences, Arbitrary semester
- Master MES 2011 (optional subject), mathematics, 2nd semester
- Master Computer Science 2012 (optional subject), advanced curriculum numerical image processing, 2nd or 3rd semester
- Bachelor MES 2011 (optional subject), medical engineering science, 6th semester
- Master Computer Science 2012 (optional subject), advanced curriculum analysis, 2nd or 3rd semester
- Bachelor CLS 2010 (compulsory), mathematics, 4th semester

Classes and lectures:

- Optimization (lecture, 4 SWS)
- Optimization (exercise, 2 SWS)

Workload:

- 130 Hours private studies and exercises
- 90 Hours in-classroom work
- 20 Hours exam preparation

Contents of teaching:

- Linear optimization (simplex method)
- Unconstrained nonlinear optimization (gradient descent, conjugate gradients, Newton method, Quasi-Newton methods, globalization)
- Equality- and inquality-constrained nonlinear optimization (Lagrange multipliers, active set methods)
- Stochastic methods for machine learning

Qualification-goals/Competencies:

- Students can model real-life problems as optimization problems.
- They understand central optimization techniques.
- They can explain central optimization techniques.
- They can compare and assess central optimization techniques.
- They can implement central optimization techniques.
- They can assess numerical results.
- They can select suitable optimization techniques for practical problems.
- Interdisciplinary qualifications:
- Students can transfer theoretical concepts into practical solutions.
- They are experienced in implementation.
- They can think abstractly about practical problems.

Grading through:

- Written or oral exam as announced by the examiner

Is requisite for:

- Non-smooth Optimization and Analysis (MA5035-KP05)

Requires:

- Linear Algebra and Discrete Structures 2 (MA1500-KP08, MA1500)
- Analysis 2 (MA2500-KP09)
- Analysis 2 (MA2500-KP04, MA2500)

Responsible for this module:

- Prof. Dr. rer. nat. Jan Modersitzki

Teacher:

- Institute of Mathematics and Image Computing

- Prof. Dr. rer. nat. Jan Modersitzki
- Prof. Dr. rer. nat. Jan Lellmann

Literature:

- J. Nocedal, S. Wright: Numerical Optimization - Springer
- F. Jarre: Optimierung - Springer
- C. Geiger: Theorie und Numerik restringierter Optimierungsaufgaben - Springer

Language:

- offered only in German

Notes:

Prerequisites for attending the module:
- None (Familiarity with the topics of the required modules is assumed, but the modules are not a formal prerequisite for attending the course).

Prerequisites for the exam:
- Examination prerequisites can be defined at the beginning of the semester. If preliminary work is defined, it must have been completed and positively evaluated before the first examination.

Examination:
- MA4030-L1: Optimization, written examination (90 min) or oral examination (30 min) as decided by examiner, 100 % of final mark

MA4500-KP04, MA4500 - Mathematical Methods in Image Processing (MatheBildv)

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

Course of study, specific field and term:

- Master MES 2020 (optional subject), mathematics / natural sciences, Arbitrary semester
- Master Medical Informatics 2019 (optional subject), medical image processing, 1st or 2nd semester
- Master Medical Informatics 2014 (optional subject), medical image processing, 1st or 2nd semester
- Master MES 2014 (optional subject), mathematics / natural sciences, 1st or 3rd semester
- Master MES 2011 (optional subject), mathematics, 1st or 3rd semester
- Master Computer Science 2012 (optional subject), advanced curriculum imaging systems, 2nd or 3rd semester
- Master MES 2011 (advanced curriculum), imaging systems, signal and image processing, 1st or 3rd semester
- Master Computer Science 2012 (compulsory), advanced curriculum numerical image processing, 2nd or 3rd semester
- Master CLS 2010 (compulsory), mathematics, 1st or 3rd semester

Classes and lectures:

- Mathematics in Image Processing (lecture, 2 SWS)
- Mathematics in Image Processing (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Image processing
- Digital images
- Operators in the spatial domain
- Operators in the Fourier domain
- Deblurring
- Total variation
- Segmentation
- Level-set methods

Qualification-goals/Competencies:

- Students have a solid mathematical understanding of typical image processing methods.
- They can compare and assess typical mathematical image processing methods.
- They can derive typical mathematical methods for image processing.
- They understand fundamental operators in image processing.
- They understand fundamental discretization techniques.
- They understand typical numerical methods for image processing.
- They are able to implement fundamental numerical methods for image processing.
- Interdisciplinary qualifications:
- Students have advanced skills in modeling.
- They can translate theoretical concepts into practical solutions.
- They are experienced in implementation.
- They can think abstractly about practical problems.

Grading through:

- Written or oral exam as announced by the examiner

Is requisite for:

- Calculus of Variations and Partial Differential Equations (MA5034-KP04, MA5034)

Requires:

- Linear Algebra and Discrete Structures 2 (MA1500-KP08, MA1500)
- Analysis 2 (MA2500-KP04, MA2500)

Responsible for this module:

- Prof. Dr. rer. nat. Jan Modersitzki

Teacher:

- Institute of Mathematics and Image Computing

- Prof. Dr. rer. nat. Jan Modersitzki
- Prof. Dr. rer. nat. Jan Lellmann

Literature:

- Gonzales/Woods: Digital Image Processing - Prentice Hall, 2007
- Russ: The Image Processing Handbook - CRC Press, 2011
- Handels: Medizinische Bildverarbeitung - Vieweg+Teubner, 2009

Language:

- German and English skills required

Notes:

Prerequisites for attending the module:
- None (The competences of the required modules are required for this module, but the modules are not a prerequisite for admission).

Prerequisites for the exam:
- Preliminary examinations can be determined at the beginning of the semester. If preliminary work has been defined, it must have been completed and positively assessed before the initial examination.

MA5030-KP04, MA5030 - Image Registration (Bildregist)

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

Course of study, specific field and term:

- Master MES 2020 (optional subject), mathematics / natural sciences, Arbitrary semester
- Master Medical Informatics 2019 (optional subject), medical image processing, 1st or 2nd semester
- Master Medical Informatics 2014 (optional subject), medical image processing, 1st or 2nd semester
- Master MES 2014 (optional subject), mathematics / natural sciences, 1st semester
- Master Computer Science 2012 (optional subject), advanced curriculum imaging systems, 2nd or 3rd semester
- Master MES 2011 (optional subject), mathematics, 1st or 3rd semester
- Master MES 2011 (advanced curriculum), imaging systems, signal and image processing, 1st or 3rd semester
- Master CLS 2010 (optional subject), mathematics, 1st or 3rd semester
- Master Computer Science 2012 (optional subject), advanced curriculum numerical image processing, 2nd or 3rd semester

Classes and lectures:

- Image Registration (lecture, 2 SWS)
- Image Registration (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Introduction and basic principles
- Interpolation
- Deformation models
- Landmark-based registration
- Parametric registration
- Non-parametric registration and regularization strategies

Qualification-goals/Competencies:

- Students know the fundamental concepts in image registration.
- They are able to translate concrete problems into suitable models.
- They have experience with parametric and non-parametric registration problems.
- Interdisciplinary qualifications:
- Students have advanced skills in modeling.
- They can translate theoretical concepts into practical solutions.
- They are experienced in implementation.
- They can think abstractly about practical problems.

Grading through:

- Written or oral exam as announced by the examiner

Requires:

- Linear Algebra and Discrete Structures 2 (MA1500-KP08, MA1500)
- Analysis 2 (MA2500-KP04, MA2500)

Responsible for this module:

- Prof. Dr. rer. nat. Jan Modersitzki

Teacher:

- Institute of Mathematics and Image Computing
- Prof. Dr. Martin Leucker
- Prof. Dr. rer. nat. Jan Modersitzki

Literature:

- Goshtasby: 2D and 3D Image Registration - Wiley 2005
- Modersitzki: Numerical Methods for Image Registration - Oxford University Press 2004
- Modersitzki: FAIR: Flexible Algorithms for Image Registration - SIAM 2009

- Rohr: Landmark-Based Image Analysis - Kluwer 2001

Language:

- German and English skills required

Notes:

Prerequisites for attending the module:
- None (The competences of the required modules are required for this module, but the modules are not a prerequisite for admission).

Prerequisites for the exam:
- Preliminary examinations can be determined at the beginning of the semester. If preliminary work has been defined, it must have been completed and positively assessed before the initial examination.

MA5032-KP04, MA5032 - Numerical Methods for Image Computing (NumerikBV)

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

Course of study, specific field and term:

- Master MES 2020 (optional subject), mathematics / natural sciences, Arbitrary semester
- Master Medical Informatics 2019 (optional subject), medical image processing, 1st or 2nd semester
- Master MES 2014 (optional subject), mathematics / natural sciences, Arbitrary semester
- Master Medical Informatics 2014 (optional subject), medical image processing, 1st or 2nd semester
- Master MES 2011 (optional subject), advanced curriculum imaging systems, 2nd or 4th semester
- Master Computer Science 2012 (optional subject), advanced curriculum numerical image processing, 2nd or 3rd semester
- Master CLS 2010 (optional subject), mathematics, 2nd or 4th semester

Classes and lectures:

- Numerical Methods for Image Computing (lecture, 2 SWS)
- Numerical Methods for Image Computing (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Imaging process an imaging modalities
- Grids and image representation
- Operators in spatial and frequency domain
- Discrete Fourier Transform/FFT und Anwendungen
- JPEG
- Poisson equation and finite differences discretization
- Splitting methods
- Multigrid methods

Qualification-goals/Competencies:

- The students are familiar with fundamental numerical concepts in image computing.
- They have experience in realizing practical solutions.
- They can implement numerical algorithms on a computer.
- They understand selected methods for solving large linear systems.
- They can implement selected methods for solving large linear systems.
- Interdisciplinary qualifications:
- Students have advanced skills in modeling.
- They can translate theoretical concepts into practical solutions.
- They are experienced in implementation.
- They can think abstractly about practical problems.

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr. rer. nat. Jan Modersitzki

Teacher:

- Institute of Mathematics and Image Computing
- Prof. Dr. rer. nat. Jan Modersitzki
- Prof. Dr. rer. nat. Jan Lellmann

Language:

- German and English skills required

Notes:

Prerequisites for attending the module:
- None (Familiarity with the topics of the required modules is assumed, but the modules are not a formal prerequisite for attending the course).

Prerequisites for the exam:
- Preliminary examinations can be determined at the beginning of the semester. If preliminary work has been defined, it must have been completed and positively assessed before the first examination.

Examination:
- MA5032-L1: Numerical Methods for Image Computing, written examination (90min) or oral examination (30min) as decided by examiner, 100% of final mark

MA5034-KP04, MA5034 - Calculus of Variations and Partial Differential Equations (VariPDE)

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

Course of study, specific field and term:

- Master MES 2020 (optional subject), mathematics / natural sciences, Arbitrary semester
- Master Medical Informatics 2019 (optional subject), medical image processing, 1st or 2nd semester
- Master MES 2014 (optional subject), mathematics / natural sciences, Arbitrary semester
- Bachelor CLS 2010 (optional subject), mathematics, 4th or 6th semester
- Master Medical Informatics 2014 (optional subject), medical image processing, 1st or 2nd semester
- Master MES 2011 (optional subject), mathematics, 2nd or 4th semester
- Master Computer Science 2012 (optional subject), advanced curriculum numerical image processing, 2nd or 3rd semester
- Master MES 2011 (advanced curriculum), imaging systems, signal and image processing, 2nd or 4th semester
- Master CLS 2010 (optional subject), mathematics, 2nd or 4th semester

Classes and lectures:

- Calculus of Variations and Partial Differential Equations (lecture, 2 SWS)
- Calculus of Variations and Partial Differential Equations (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Motivation and application examples
- Functional-analytic foundations
- Direct methods in the calculus of variations
- The dual space, weak convergence, Sobolev spaces
- Optimality conditions
- Classification of partial differential equations and typical PDEs
- Fundamental solutions, maximum principle
- Finite elements for elliptical partial differential equations

Qualification-goals/Competencies:

- Students understand variational modeling.
- They are able to formulate basic physical problems in a variational setting.
- They understand the connections between variational methods and partial differential equations.
- They can derive optimality conditions for energy functionals.
- They understand the mathematical theory behind selected variational problems.
- They can implement selected fundamental variational problems.
- They can formulate selected practical problems in the variational setting.
- Interdisciplinary qualifications:
- Students have advanced skills in modeling.
- They can translate theoretical concepts into practical solutions.
- They are experienced in implementation.
- They can think abstractly about practical problems.

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr. rer. nat. Jan Modersitzki

Teacher:

- Institute of Mathematics and Image Computing
- Prof. Dr. rer. nat. Jan Modersitzki
- Prof. Dr. rer. nat. Jan Lellmann

Literature:

- Vogel: Computational Methods for Inverse Methods - SIAM
- Aubert, Kornprobst: Mathematical Problems in Image Processing: Partial Differential Equations and the Calculus of Variations - Springer
- Scherzer, Grasmair, Grossauer, Haltmeier, Lenzen: Variational Methods in Imaging - Springer

Language:

- German and English skills required

Notes:

Prerequisites for attending the module:
- None (Familiarity with the topics of the required modules is assumed, but the modules are not a formal prerequisite for attending the course).

Prerequisites for the exam:
- Preliminary examinations can be determined at the beginning of the semester. If preliminary work has been defined, it must have been completed and positively assessed before the first examination.

Examination:
- MA5034-L1: Calculus of Variations and Partial Differential Equations, written examination (90min) or oral examination (30min) as decided by examiner, 100% of final mark

MA4040-KP04, MA4040 - Numerics 2 (Num2)

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

Course of study, specific field and term:

- Bachelor MES 2020 (optional subject), mathematics / natural sciences, 3rd semester at the earliest
- Bachelor MES 2014 (optional subject), mathematics / natural sciences, 4th or 6th semester
- Bachelor MES 2011 (optional subject), medical engineering science, 6th semester
- Master Computer Science 2012 (optional subject), advanced curriculum analysis, 2nd or 3rd semester
- Minor in Teaching Mathematics, Master of Education 2023 (compulsory), mathematics, 2nd semester

Classes and lectures:

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

Workload:

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

Contents of teaching:

- Polynomial interpolation
- Hermite interpolation
- Approximation
- Numerical quadrature

Qualification-goals/Competencies:

- Students know basic numerical techniques.
- They can transform a continuous problem into a discrete one.
- They can handle both stable and robust numerical algorithms competently.
- They can competently work on practical tasks.

Grading through:

- written exam

Requires:

- Numerics 1 (MA3110-KP04, MA3110)
- Linear Algebra and Discrete Structures 2 (MA1500-KP08, MA1500)
- Linear Algebra and Discrete Structures 1 (MA1000-KP08, MA1000)
- Analysis 2 (MA2500-KP04, MA2500)
- Analysis 1 (MA2000-KP08, MA2000)

Responsible for this module:

- Prof. Dr. rer. nat. Andreas Rößler

Teacher:

- Institute for Mathematics
- Prof. Dr. rer. nat. Andreas Rößler

Literature:

- M. Bollhöfer, V. Mehrmann: Numerische Mathematik - Vieweg (2004)
- P. Deuflhard, A. Hohmann: Numerische Mathematik I
- P. Deuflhard, F. Bornemann: Numerische Mathematik II - 3. Auflage, De Gruyter (2008)
- M. Hanke-Bourgeois: Grundlagen der Numerischen Mathematik und des Wissenschaftlichen Rechnens - 3. Aufl., Teubner (2009)
- H. R. Schwarz, N. Köckler: Numerische Mathematik - 6. Auflage, Teubner (2006)
- J. Stoer: Numerische Mathematik I - 10. Auflage, Springer (2007)
- J. Stoer, R. Bulirsch: Numerische Mathematik II - 5. Auflage, Springer (2005)
- A. M. Quarteroni, R. Sacco, F. Salieri: Numerical Mathematics - 2. Auflage, Springer (2006)

Language:

- offered only in German

Notes:

The lecture is identical to that in module MA4040-MML/Numerics 2

Prerequisites for attending the module:
- None (The competences of the required modules are required for this module, but the modules are not a prerequisite for admission).

Prerequisites for the exam:
- Preliminary examinations can be determined at the beginning of the semester. If preliminary work has been defined, it must have been completed and positively assessed before the initial examination.

MA4330-KP04, MA4330 - Biosignal analysis (BioSA)

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

Course of study, specific field and term:

- Master MES 2020 (optional subject), mathematics / natural sciences, Arbitrary semester
- Master MES 2014 (optional subject), mathematics / natural sciences, Arbitrary semester
- Master MES 2011 (optional subject), mathematics, 2nd semester
- Master Computer Science 2012 (compulsory), advanced curriculum analysis, 2nd semester
- Master CLS 2010 (compulsory), mathematics, 2nd semester

Classes and lectures:

- Biosignal analysis (lecture, 2 SWS)
- Biosignal analysis (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Hilbert spaces
- Fourier series and Fourier transformation
- generalized functions
- discrete wavelet tranformation
- least square techniques
- application to biological and medical data

Qualification-goals/Competencies:

- Students have deepened knowledges of the mathematical background of signal analysis
- They master different methodsof one-dimensional signal analysis
- They have practical skills in the application of these methods
- They have skills in working with Mathematica or MatLab

Grading through:

- written exam
- Exercises

Requires:

- Analysis 2 (MA2500-KP04, MA2500)

Responsible for this module:

- Nachfolge von Prof. Dr. rer. nat. Karsten Keller

Teacher:

- Institute for Mathematics
- Nachfolge von Prof. Dr. rer. nat. Karsten Keller
- Prof. Dr. rer. nat. Jürgen Prestin

Literature:

- S. Mallat: A wavelet tour of signal processing - Academic Press, 1998
- A. N. Kolmogorov, S.V. Fomin: Reelle Funktionen und Funktionalanalysis - Deutscher Verlag der Wissenschaften 1975

Language:

- offered only in German

Notes:

Prerequisites for attending the module:
- None (The competences of the required modules are required for this module, but the modules are not a prerequisite for admission).

Prerequisites for the exam:
- Preliminary examinations can be determined at the beginning of the semester. If preliminary work has been defined, it must have been completed and positively assessed before the initial examination.

MA4410 - Approximation Theory (Approx)

Duration:	Turnus of offer:	Credit points:
1 Semester	irregularly	4

Course of study, specific field and term:

- Bachelor CLS 2010 (optional subject), mathematics, 5th or 6th semester
- Master Computer Science 2012 (optional subject), advanced curriculum analysis, 2nd or 3rd semester
- Master CLS 2010 (optional subject), mathematics, Arbitrary semester

Classes and lectures:

- Approximation theory (lecture, 2 SWS)
- Approximation theory (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Fundamentals of functional analysis
- Best approximation
- Linear methods, trigonometric kernels
- Theorems of Jackson and Bernstein
- Moduli of continuity
- Singular integrals
- Theorem of Banach--Steinhaus
- Interpolation methods
- Stability inequalities

Qualification-goals/Competencies:

- Learning the basic principles of approximation theory
- Understanding the relationship between order of convergence and smoothness
- Knowledge of the basic approximation methods

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr. rer. nat. Jürgen Prestin

Teacher:

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

Literature:

- P. L. Butzer, R. J. Nessel: Fourier Analysis and Approximation - Birkhäuser Verlag 1971
- A. Schönhage: Approximationstheorie - de Gruyter 1971

Language:

- English, except in case of only German-speaking participants

MA4430 - Approximation on Spheres (ApproxSph)

Duration:	Turnus of offer:	Credit points:
1 Semester	irregularly	4

Course of study, specific field and term:

- Bachelor CLS 2010 (optional subject), mathematics, 5th or 6th semester
- Master Computer Science 2012 (optional subject), advanced curriculum analysis, 2nd or 3rd semester
- Master CLS 2010 (optional subject), mathematics, Arbitrary semester

Classes and lectures:

- Approximation on spheres (lecture, 2 SWS)
- Approximation on spheres (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Polynomial systems on spheres
- Approximation methods
- Fast algorithms
- Scattered data

Qualification-goals/Competencies:

- Learning the basic principles of approximation theory on spheres
- Understanding the function systems on spheres
- Knowledge of the basic approximation methods on spheres

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr. rer. nat. Jürgen Prestin

Teacher:

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

Literature:

- V. Michel: Lectures on Constructive Approximation - Fourier, Spline, and Wavelet Methods on the Real Line, the Sphere, and the Ball - Birkhäuser Verlag, Boston, 2013
- W. Freeden, T. Gervens, and M. Schreiner: Constructive Approximation on the Sphere (With Applica- tions to Geomathematics) - Oxford Science Publication, Clarendon Press, 1998

Language:

- English, except in case of only German-speaking participants

MA4510 - Wavelet Theory (Wavelet)

Duration:	Turnus of offer:	Credit points:
1 Semester	irregularly	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), advanced curriculum analysis, 2nd or 3rd semester
- Master CLS 2010 (optional subject), mathematics, Arbitrary semester

Classes and lectures:

- Wavelet Theory (lecture, 2 SWS)
- Wavelet Theory (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Haar system
- discrete Haar transformation
- orthonormal wavelet bases
- Multiresolution Analysis
- algorithms for reconstruction and decomposition
- multivariate generalizations

Qualification-goals/Competencies:

- Kenntnis der Grundlagen der Waveletanalysis
- Verständnis von Anwendungen in der Signalanalyse,
- Arbeiten mit Wavelettoolboxen

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr. rer. nat. Jürgen Prestin

Teacher:

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

Literature:

- :
- :

Language:

- offered only in German

MA4340 - Selected methods of bioinformatics (StatBioinf)

Duration:	Turnus of offer:	Credit points:
1 Semester	irregularly	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), advanced curriculum stochastics, 2nd or 3rd semester

Classes and lectures:

- Selected methods of bioinformatics (lecture, 2 SWS)
- Selected methods of bioinformatics (exercise, 1 SWS)

Workload:

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

Contents of teaching:

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Qualification-goals/Competencies:

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Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr. rer. nat. Andreas Ziegler

Teacher:

- Institute of Medical Biometry and Statistics
- Prof. Dr. rer. nat. Andreas Ziegler
- Prof. Dr. rer. biol. hum. Inke König

Literature:

- :

Language:

- offered only in German

MA4610-KP04, MA4610 - Stochastic processes and modeling (StochPrzMd)

Duration:	Turnus of offer:	Credit points:
1 Semester	normally each year in the winter semester	4

Course of study, specific field and term:

- Master MES 2020 (optional subject), mathematics / natural sciences, Arbitrary semester
- Master MES 2014 (optional subject), mathematics / natural sciences, 1st or 2nd semester
- Master Computer Science 2012 (optional subject), advanced curriculum stochastics, 2nd or 3rd semester
- Master CLS 2010 (compulsory), mathematics, 1st or 3rd semester

Classes and lectures:

- Stochastic processes and modeling (lecture, 2 SWS)
- Stochastic processes and modeling (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Conditional expectation
- Stochastic processes
- Filtrations
- Martingales
- Brownian motion

Qualification-goals/Competencies:

- Students can name stochastic processes on the basis of selected process classes and explain their properties.
- They have deepened the stochastic way of thinking and can explain the evidence of the lecture.
- They can explain and apply basic ideas and concepts of stochastic analysis.

Grading through:

- written exam

Requires:

- Stochastics 2 (MA4020-MML)
- Stochastics 1 (MA2510-KP04, MA2510)

Responsible for this module:

- Prof. Dr. rer. nat. Andreas Rößler

Teacher:

- Institute for Mathematics
- Prof. Dr. rer. nat. Andreas Rößler

Literature:

- :
- :
- Ioannis Karatzas, Steven E. Shreve: Brownian Motion and Stochastic Calculus - Springer Verlag, 2nd edition, 1991

Language:

- German and English skills required

Notes:

Prerequisites for attending the module:
- None (The competences of the required modules are required for this module, but the modules are not a prerequisite for admission).

Prerequisites for the exam:
- Preliminary examinations can be determined at the beginning of the semester. If preliminary work has been defined, it must have been completed and positively assessed before the initial examination.

MA5610 - Selected stochastic processes (StochPrz2)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Bachelor CLS 2010 (optional suject), mathematics, 6th semester
- Master CLS 2010 (optional subject), mathematics, 2nd or 4th semester
- Master Computer Science 2012 (optional subject), advanced curriculum stochastics, 2nd or 3rd semester

Classes and lectures:

- Selected stochastic processes (lecture, 2 SWS)
- Selected stochastic processes (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- branching processes
- Poisson process
- birth-and-death processes
- reneval processes
- Brownian and fractional Brownian motion
- life science applications

Qualification-goals/Competencies:

- Mastering some important classes of stochastic processes and understanding possible applications

Grading through:

- Oral examination

Requires:

- Stochastics 2 (MA4020-KP04, MA4020)

Responsible for this module:

- Prof. Dr. rer. nat. Andreas Ziegler
- Nachfolge von Prof. Dr. rer. nat. Karsten Keller

Teacher:

- Institute of Medical Biometry and Statistics
- Institute for Mathematics

- Nachfolge von Prof. Dr. rer. nat. Karsten Keller
- Prof. Dr. rer. nat. Andreas Ziegler

Literature:

- R. Durrett: Probability: Theory and Examples - 3rd. edition, Thomson, 2005
- S. Karlin und H.M. Taylor: A First Course in Stochastic Processes - 2rd. edition, Academic Press, 1975

Language:

- offered only in German

MA5620 - Selected statistical models (StatModell)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), advanced curriculum stochastics, 2nd or 3rd semester

Classes and lectures:

- Selected statistical models (lecture, 2 SWS)
- Selected statistical models (exercise, 1 SWS)

Workload:

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

Contents of teaching:

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Qualification-goals/Competencies:

-

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr. rer. nat. Andreas Ziegler

Teacher:

- Institute of Medical Biometry and Statistics
- Institute for Mathematics

- Prof. Dr. rer. nat. Andreas Ziegler

Literature:

- :

Language:

- English, except in case of only German-speaking participants

CS4000 - Algorithmics (ALG)

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

Course of study, specific field and term:

- Master CLS 2010 (optional subject), computer science, 1st or 3rd semester
- Master Computer Science 2012 (compulsory), computer science mandatory courses, 1st semester

Classes and lectures:

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

Workload:

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

Contents of teaching:

- satisfiability and constraint satisfaction problems
- randomized search
- discrete optimization problems, linear programming
- Las-Vegas- and Monte-Carlo-algorithms
- complexity analysis of algorithmic problems
- approximation algorithms
- heuristic search

Qualification-goals/Competencies:

- ability to model real problems in an algorithmic manner
- ability to design efficient algorithms for complex problems
- good practice in applying basic algorithmic techniques
- skill in analyzing algorithms, in particular with respect to corrrectness and complexity

Grading through:

- Viva Voce or test

Is requisite for:

- Seminar Algorithmics and Complexity Theory (CS5099)
- Advanced Algorithmics and Data Structures (CS4008)
- Computer Algebra (CS4018)

Requires:

- Theoretical Computer Science (CS2000-KP08, CS2000)
- Algorithm Design (CS3000-KP04, CS3000)

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:

- Aho, Hopcroft, Ullman: Design and Analysis of Computer Algorithms - Addison Wesley, 1978
- Motwani, Raghavan: Randomized Algorithms - Cambridge University Press, 2000
- Mitzenmacher, Upfal: Probability and Computing - Cambridge University Press, 2005
- Kreher, Stinson: Combinatorial Algorithms - CRC Press, 1999
- Williamson, Shmoys: The Design of Approximation Algorithms - Cambridge University Press, 2011

Language:

- offered only in German

CS4005 - Algorithmic Learning and Data Mining (AlgLernDM)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (compulsory), computer science mandatory courses, 2nd semester

Classes and lectures:

- Algorithmic Learning and Data Mining (lecture with exercises, 3 SWS)

Workload:

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

Contents of teaching:

- Concept learning
- Learning in the limit
- PAC-Learning
- Decision tree learning
- Naive Bayes Classifier
- Instance based learning
- Searching algorithms in Data Mining

Qualification-goals/Competencies:

- Understanding of learning models
- Knowledge and understanding of basic machine learning methods
- Knowledge of the basic methods in data mining
- Ability to apply machine learning and data mining methods to real-life problems

Grading through:

- Written or oral exam as announced by the examiner

Requires:

- Algorithmics (CS4000)

Responsible for this module:

- Prof. Dr. Maciej Liskiewicz

Teacher:

- Institute for Theoretical Computer Science

- Prof. Dr. Rüdiger Reischuk
- Prof. Dr. Maciej Liskiewicz

Literature:

- M.J. Kearns, V.V. Vazirani: An Introduction to Computational Learning Theory - MIT Press, 1997
- T.M. Mitchell: Machine Learning - WCB McGraw-Hill, 1997
- D. Hand, H.Mannila, P. Smyth: Principles of Data Mining - MIT Press, 2001
- J. Han, M. Kamber: Data Mining - Morgan Kaufmann 2001

Language:

- English, except in case of only German-speaking participants

CS4020 - Specification and Modelling (SpezMod)

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

Course of study, specific field and term:

- Master CLS 2010 (optional subject), computer science, Arbitrary semester
- Master Computer Science 2012 (compulsory), computer science mandatory courses, 1st semester

Classes and lectures:

- Specification and Modelling (lecture, 2 SWS)
- Specification and Modelling (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Introduction to modelling and specification
- Modelling concepts (data, streams, traces, diagrams, tables)
- Modelling software components (state, behaviour, structure, interface)
- Modelling concurrency
- Algebraic specification
- Composing, refining, analysing and transforming specifications and models
- Specification languages and tools for specification and modelling

Qualification-goals/Competencies:

- The students can argue on the importance of specifications and models for software development.
- Sie können wichtige Spezifikations- und Modellierungstechniken charakterisieren, anwenden, anpassen und erweitern.
- They can model and specify simple software/hardware system in an adequate way.
- They can describe a system from different views and on different levels of abstraction.
- They can apply specifications and modelsin software development.

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr. Martin Leucker

Teacher:

- Institute of Software Technology and Programming Languages

- Dr. Annette Stümpel
- Prof. Dr. Martin Leucker

Literature:

- V.S. Alagar, K. Periyasamy: Specification of Software Systems - Springer 2011
- M. Broy, K. Stølen: Specification and Development of Interactive Systems - Springer 2001
- J. Loeckx, H.-D. Ehrich, M. Wolf: Specification of Abstract Data Types - John Wiley & Sons 1997
- D. Bjorner: Software Enginneering 1-3 - Springer 2006
- U. Kastens, H. Kleine Büning: Modellierung - Grundlagen und formale Methoden - Hanser 2005

Language:

- German and English skills required

CS4150 - Distributed Systems (VertSys)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (compulsory), computer science mandatory courses, 1st semester

Classes and lectures:

- Verteilte Systeme (lecture, 2 SWS)
- Verteilte Systeme (exercise, 1 SWS)

Workload:

- 40 Hours private studies
- 30 Hours e-learning
- 30 Hours in-classroom work
- 20 Hours exam preparation

Contents of teaching:

- Introduction and motivation
- Protocols and layered models
- Message representations
- Realization of network services
- Communication mechanisms
- Addresses, names and directory services
- Synchronisation
- Replication and consistency
- Fault tolerance
- Distributed transactions
- Security

Qualification-goals/Competencies:

- The participants will accquire a deep understanding for problems to be solved in distributed systems, such as synchronization, error handling, naming etc.
- They know the most important services in distributed systems such as name service, distributed file systems etc.
- They are able to program simple distributed applications and systems themselves.
- They know the most important algorithms in distributed systems, for instance for time synchronization, for leader election, or for mutual exclsuion.
- They have a good feeling for when it makes sense to use distributed instead of centralized systems.
- They have a good feeling for what kind of solutions could best be used for what kind of problems in distributed Internet applications.

Grading through:

- written exam

Responsible for this module:

- Prof. Dr. Stefan Fischer

Teacher:

- Institute for Theoretical Computer Science
- Institute of Telematics

- Prof. Dr. Stefan Fischer
- Prof. Dr. Rüdiger Reischuk

Literature:

- A. Tanenbaum, M. van Steen: Distributed Systems: Principles and Paradigms - Prentice Hall 2006
- G. Coulouris, J. Dollimore, T. Kindberg, G. Blair: Distributed Systems - Concepts and Design - Addison Wesley 2011
- A. Tanenbaum, D.J. Wetherall: Computer Networks - Prentice Hall 2011
- R. Cahn: Wide Area Network Design - Morgan Kaufmann 1998
- M. G. Gouda: Elements of Network Protocol Design - John Wiley 1998
- N. Lynch: Distributed Algorithms - Morgan Kaufmann 1996
- W. Reisig: Elements of Distributed Algorithms - Springer 1998

Language:

- offered only in German

CS4160 - Real-Time Systems (Echtzeit)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (compulsory), computer science mandatory courses, 1st semester

Classes and lectures:

- Real-Time Systems (lecture, 2 SWS)
- Real-Time Systems (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Fundamentals of real-time processing
- Hardware platforms
- Process interface
- Real-time communications systems
- Real-time programming
- Real-time operating systems
- Real-time middleware
- Fault-tolerant real-time systems
- Application examples

Qualification-goals/Competencies:

- Students have developed an understanding of the fundamental problems of real-time processing (e.g. hard, soft real-time) and the corresponding approaches for their solution
- They know the most important hardware and software components of real-time systems
- They have basic knowledge about fault tolerance techniques for reliable and safe real-time systems for critical applications
- They know typical application examples and are able to judge which methods are applicable in which areas
- They are able to design and implement real-time systems

Grading through:

- written exam

Responsible for this module:

- Prof. Dr.-Ing. Mladen Berekovic

Teacher:

- Institute of Computer Engineering
- Prof. Dr.-Ing. Mladen Berekovic

Literature:

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Language:

- offered only in English

Notes:

Only CS4160-KP06 Real-Time Systems is now offered for 6 credits.

CS4220 - Statistical Pattern Recognition (SME)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master MES 2011 (optional subject), mathematics, 1st semester
- Master CLS 2010 (compulsory), mathematics, 1st or 3rd semester
- Master MES 2011 (advanced curriculum), imaging systems, signal and image processing, 1st semester
- Master Computer Science 2012 (compulsory), computer science mandatory courses, 1st semester

Classes and lectures:

- Pattern Recognition (lecture, 2 SWS)
- Pattern Recognition (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Introduction to probability theory
- Principles of feature extraction and pattern recognition
- Bayes decision theory
- Discriminance functions
- Neyman-Pearson test
- Receiver Operating Characteristic
- Parametric and nonparametric density estimation
- kNN classifiers
- Linear classifiers
- Support vector machines and kernel trick
- Random Forest
- Neural Nets
- Feature reduction and feature transforms
- Validation of classifiers
- Selected application scenarios: acoustic scene classification for the selection of hearing-aid algorithms, acoustic event recognition, attention classification based on EEG data, speaker and emotion recognition

Qualification-goals/Competencies:

- Students are able to describe the main elements of feature extraction and pattern recognition.
- They are able to explain the basic elements of statistical modeling.
- They are able to use feature extraction, feature reduction and pattern classification techniques in practice.

Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr.-Ing. Alfred Mertins

Teacher:

- Institute for Signal Processing
- Prof. Dr.-Ing. Alfred Mertins

Literature:

- R. O. Duda, P. E. Hart, D. G. Storck: Pattern Classification - New York: Wiley

Language:

- offered only in German

Notes:

Prerequisites for attending the module:
- None

Prerequisites for the exam:
- Successful completion of homework assignments during the semester (at least 50% of max. points).

Modul exam:
- CS4220-L1:Pattern Recognition, written exam, 90 Min, 100% of modul grade

New modul CS4220-KP04 Pattern Recognition

CS4230 - Human-Computer-Interaction (MCI)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (compulsory), computer science mandatory courses, 1st semester

Classes and lectures:

- Human-Computer-Interaction (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 of the topic area
- Norms and legal foundations
- Human information processing and processes of actions
- Models for human-computer systems and interactive media
- Input/Output devices and interaction technologies
- User-centered development process and special groups of users
- Usability Engineering
- System paradigms and corresponding system examples
- Evaluation and impact analyzes
- Innovative concepts and systems

Qualification-goals/Competencies:

- The students know the principles and methods of the context-, task- and user-centered development of interactive systems.
- They have basic knowledge about human information processing and can introduce it into the design process.
- They know the basic models of interactive systems und can apply them for their analysis and evaluation.
- They have the ability to analyze and review interative systems based on criteria.

Grading through:

- written exam

Responsible for this module:

- Prof. Dr.-Ing. Nicole Jochems

Teacher:

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

Literature:

- M. Herczeg: Software-Ergonomie - München: Oldenbourg 2009
- M. Herczeg: Interaktionsdesign - München: Oldenbourg, 2006
- D. Norman: The Design of Everyday Things - Cambridge, MA: Basic Books, 1988
- B. Shneiderman, C. Plaisant: Designing the User Interface - Reading, MA: Addison-Wesley, 2005
- J. Preece et al.: Human-Computer Interaction - Addison Wesley, 1994
- Dix et al.: Human-Computer Interaction - Prentice Hall, 2003
- Schlick et. al.: Arbeitswissenschaft - Springer, 2010
- E.B. Goldstein: Wahrnehmungspsychologie - Springer, 2002
- A. Sears, J.A. Jacko: The Human-Computer Interaction Handbook - Lawrence Erlbaum Associates, 2012
- C. Stephanidis: User Interfaces for All - Laurence Erlbaum Associates, 2001

Language:

- offered only in German

Notes:

Studierende mit Anwendungsfach Medieninformatik können das Modul Mensch-Computer-Interaktion durch ein anderes Modul aus dem Wahlpflichtbereich Medieninformatik ersetzen.

Das Modul wird ab WS 2014/15 durch CS3010 abgelöst.

CS3205-KP04, CS3205 - Computer Graphics (CompGrafik)

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

Course of study, specific field and term:

- Bachelor Computer Science 2019 (optional subject), major subject informatics, Arbitrary semester
- Bachelor MES 2020 (optional subject), computer science / electrical engineering, 3rd semester at the earliest
- Bachelor Media Informatics 2020 (compulsory), media informatics, 6th semester
- Bachelor Robotics and Autonomous Systems 2020 (optional subject), computer science, 5th or 6th semester
- Bachelor Medical Informatics 2019 (optional subject), computer science, 4th to 6th semester
- Bachelor Computer Science 2016 (optional subject), major subject informatics, Arbitrary semester
- Bachelor Robotics and Autonomous Systems 2016 (optional subject), computer science, 5th or 6th semester
- Bachelor IT-Security 2016 (optional subject), computer science, Arbitrary semester
- Bachelor Medical Informatics 2014 (optional subject), computer science, 5th or 6th semester
- Bachelor MES 2014 (optional subject), computer science / electrical engineering, 4th or 6th semester
- Bachelor Media Informatics 2014 (compulsory), media informatics, 6th semester
- Bachelor Computer Science 2014 (optional subject), central topics of computer science, 5th or 6th semester
- Bachelor Medical Informatics 2011 (optional subject), computer science, 4th to 6th semester
- Master Computer Science 2012 (optional subject), advanced curriculum imaging systems, 2nd or 3rd semester
- Bachelor CLS 2010 (optional subject), mathematics, 6th semester
- Bachelor Computer Science 2012 (optional subject), central topics of computer science, 5th or 6th semester
- Master CLS 2010 (optional subject), mathematics, 2nd semester
- Bachelor Computer Science 2012 (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:

- Geometric transformations in 2D and 3D
- Homogeneous coordinates
- Transformations between Cartesian coordinate systems
- Planar and perspective projections
- Polygonal models
- Illumination models and shading methods
- Texture Mapping
- Culling and clipping
- Hidden line and surface removal
- Raster graphics algorithms
- Ray tracing
- Shadows, reflections and transparency
- Basics of graphics programming with OpenGL and GLSL

Qualification-goals/Competencies:

- Students know the basic concepts, algorithms and methods in computer graphics
- They are able to implement and apply principle algorithms
- They are able to explain the learned techniques and to assess their possibilities and limitations

Grading through:

- written exam

Requires:

- Linear Algebra and Discrete Structures 2 (MA1500-KP08, MA1500)
- Linear Algebra and Discrete Structures 1 (MA1000-KP08, 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

Notes:

Admission requirements for taking the module:
- None (the competences of the modules listed under "requires" are needed for this module, but are not a formal prerequisite)

Admission requirements for participation in module examination(s):
- Successful completion of exercise slips and programming projects as specified at the beginning of the semester

Module exam(s):
- CS3205-L1: Computer Graphics, written exam, 90 min, 100 % of module grade

ME3520 - Projektpraktikum Bildgebung (PrBildgeb)

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

Course of study, specific field and term:

- Master Computer Science 2012 (compulsory), advanced curriculum imaging systems, 2nd or 3rd semester

Classes and lectures:

- Projektpraktikum Bildgebende Verfahren (project work, 2 SWS)

Workload:

- 60 Hours group work
- 40 Hours private studies
- 20 Hours written report

Contents of teaching:

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Qualification-goals/Competencies:

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Grading through:

- contributions to the discussion

Responsible for this module:

- Prof. Dr. rer. nat. Thorsten Buzug

Teacher:

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

Literature:

- :

Language:

- offered only in German

ME4020 - Imaging Systems 2 (BildgbSys2)

Duration:	Turnus of offer:	Credit points:	Max. group size:
1 Semester	each winter semester	4	99

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), advanced curriculum imaging systems, 2nd or 3rd semester
- Master CLS 2010 (compulsory), computational life science / imaging, 2nd semester

Classes and lectures:

- Imaging Systems 2 (lecture, 2 SWS)
- Imaging Systems 2 (exercise, 1 SWS)

Workload:

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

Contents of teaching:

- Physical fundamentals of magnetic resonance imaging: nuclear magnetic resonance, relaxation mechanisms, principles of position encodingprinciples of spatial encoding, relaxation)
- Construction of basic imaging sequences, weighting
- Concept of k-space
- Coherence pathways
- Hardware components of a clinical MR system
- Possible sources of hazard for patients
- Influence of measurement parameters on signal-to-noise ratio
- Causes of image artefacts

Qualification-goals/Competencies:

- The students can explain the physical principles of NMR and MRI.
- They can explain the idea behind important imaging sequences, using a pulse sequence diagram.
- They can recognise the causes of important image artefacts.
- They can list advantages and disadvantages of MRT, compared to other imaging techniques.
- They can list possible sources of hazard for patients, explain their causes and point out strategies for avoiding these.

Grading through:

- Oral examination

Responsible for this module:

- Prof. Dr. rer. nat. Martin Koch

Teacher:

- Institute of Medical Engineering
- Prof. Dr. rer. nat. Martin Koch

Literature:

- Liang, Z.-P., Lauterbur, P. C.: Principles of Magnetic Resonance Imaging: A Signal Processing Perspective - IEEE Press, New York 2000

Language:

- German and English skills required

Notes:

In summer semester 2015 this course is replaced by ME4413 Nuklear Imaging for MML students.

CS5910 - Processes for Fault Tolerance (Toleranz)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), specialization field IT security and safety, 2nd or 3rd semester

Classes and lectures:

- Processes for Fault Tolerance (lecture, 2 SWS)
- Processes for Fault Tolerance (exercise, 1 SWS)

Workload:

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

Contents of teaching:

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Qualification-goals/Competencies:

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Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr.-Ing. Mladen Berekovic

Teacher:

- Institute of Computer Engineering
- Prof. Dr.-Ing. Mladen Berekovic

Literature:

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Language:

- offered only in German

CS5930 - Security in Digital Economy (SiDigiWirt)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), specialization field IT security and safety, 2nd or 3rd semester

Classes and lectures:

- Security in Digital Economy (seminar-style lectures, 3 SWS)

Workload:

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

Contents of teaching:

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Qualification-goals/Competencies:

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Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr. Rüdiger Reischuk

Teacher:

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Literature:

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Language:

- German and English skills required

CS5940 - Biometrical Systems (BiometSys)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), specialization field IT security and safety, 2nd or 3rd semester

Classes and lectures:

- Biometrical Systems (lecture, 2 SWS)
- Biometrical Systems (exercise, 1 SWS)

Workload:

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

Contents of teaching:

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Qualification-goals/Competencies:

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Grading through:

- Written or oral exam as announced by the examiner

Responsible for this module:

- Prof. Dr.-Ing. Erhardt Barth

Teacher:

- Institute for Neuro- and Bioinformatics
- Prof. Dr.-Ing. Erhardt Barth

Literature:

- :
- :
- :

Language:

- offered only in German

CS5950 - Computer Forensics (Forensik)

Duration:	Turnus of offer:	Credit points:
1 Semester	not available anymore	4

Course of study, specific field and term:

- Master Computer Science 2012 (optional subject), specialization field IT security and safety, 2nd or 3rd semester

Classes and lectures:

- Computer Forensics (seminar-style lectures, 3 SWS)

Workload:

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

Contents of teaching:

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Qualification-goals/Competencies:

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Grading through:

- Oral examination

Responsible for this module:

- Prof. Dr. Rüdiger Reischuk

Teacher:

-
- Institute for Theoretical Computer Science

Literature:

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Language:

- German and English skills required