CARL VON OSSIETZKY universität OLDENBURG

Department für INFORMATIK

Study Program

Engineering of Socio-Technical Systems (M.Sc.)

Module Descriptions

Carl von Ossietzky University Oldenburg

Stand: 06.02.2017

Table of Contents – Engineering of Socio-Technical Systems (M.Sc.)

Core Curriculum - Fundamental Competences in Computer Science and Psychology

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Engineering of STS	*Kategorie:* - Mastermodul *Degree award:* - Master
Emphases: HCI, embBCI, SE	*Sections:*
Module reference number/Title: - inf960 Fundamental Competences in Computing Science I: Signals and Dynamical Systems	
Duration: 1 semester *Cycle:* once a year *Type of module:* compulsory *Level:* BC (base competence) *This module should be taken in* 1st semester	*Type of program:* V (2 semester hours), Ü (2 semester hours) *Language:* German *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Martin Georg Fränzle, Prof. Dr. Andreas Hein
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:*
Objective of the module / skills: *Professional competences:* The students: - Name the concepts of signal and image processing in technical systems - Name the methods/algorithms of preprocessing, filtering, classification, interpretation and visualisation of signals and pictures - Select algorithms appropriately - Evaluate the effectiveness of algorithms - Design algorithms and processing chains and evaluate their quality *Methodological competences:* The students: - Get used to specific subjects of signal and image processing *Social competences:* The students: - Present solutions for specific questions in signal and image processing *Self-competences:* The students: - Reflect their solutions by using methods learned in this course	
Content of the module:	

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

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

Comments:
-

Weblink:
-

Prerequisites for admission:
-

Helpful previous knowledge:
Modul math040 Analysis II b: Differenzialgleichung mehrerer Variablen

Associated with the module(s):
-

Maximum number of students / selection criteria:
unlimited

Types of examinations:
Hands-on exercises and written or oral exam

Examination periods:
At the end of the semester

Registration procedure:
Stud.IP

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Engineering of STS	*Kategorie:* - Mastermodul *Degree award:* - Master
Emphases: HCI, embBCI, SE	*Sections:* -
Module reference number/Title: ## - inf961 Fundamental Competences in Computing Science II: Mathematics	
Duration: 1 semester *Cycle:* once a year *Type of module:* *Level:* BC (base competences) *This module should be taken in* 1st semester	*Type of program:* V (3 semester hours), Ü (1 semester hours) *Language:* German *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Heinz-Georg Quebbemann, Prof. Dr. Florian Heß, Prof. Dr. Andrea Stein, Dr. Sandra Stein, Prof. Dr. Martin Fränzle
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:*

Objective of the module / skills:
The courses provides an introduction to the fundamental methods of mathematical formalisation and proof, as well as to the central concepts of graph theory, elementary number theory, and algebra. The selection of topics is based on their particular relevance to computer science and related disciplines

Professional competences:
The students:
The students get acquainted with the formalisms and reasoning underlying modern mathematics, and they are able to apply these to concrete problems. They understand the central concepts and methods of graph theory, elementary number theory, and algebra relevant to computer science and related disciplines

Methodological competences:
The students are able to apply fundamental methods of mathematical formalisation and reasoning to concrete problems. They are able to retrieve the verdicts originating from such formal reasoning and to interpret them in terms of the original, informal problem description. students:

Social competences:
The students:
The students are able to explain mathematical formalisations to each other and to discuss their justification

Self-competences:
The students:
The students are able to reflect appropriateness of their fomalisation and verification attempts

Content of the module: Propositional logic; methods of mathematical proof; sets, relations, and functions; combinatorics; graphs and their applications; natural and integer numbers and their residue classes; groups and sime-groups. The module consists of a lecture and an exercise part.	
Suggested reading: B. Kreußler und G. Pfister: Mathematik für Informatiker, Springer-Verlag 2009 (available online from the university library)	
Comments: - *Weblink:* - *Prerequisites for admission:* -	*Helpful previous knowledge:* - *Associated with the module(s):*
Maximum number of students / selection criteria: *Types of examinations:* written exam or oral exam *Examination periods:* At the end of the lecture periods *Registration procedure:* Stud.IP	

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Engineering of STS	*Kategorie:* - Mastermodul *Degree award:* - Master
Emphases: HCI, embBCI, SE	*Sections:* -
Module reference number/Title: **- inf962 Fundamental Competences in Computing Science III: Algorithms and Computational Problem Solving**	
Duration: 1 semester *Cycle:* once a year *Type of module:* *Level:* BC (base competences) *This module should be taken in* 1st semester	*Type of program:* V (3 semester hours), Ü (1 semester hours)965 *Language:* German *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Martin Fränzle	*Person responsible for this module:* Teachers of the Department for Computing Sciences
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:*
Objective of the module / skills: The students acquire a thorough understanding of the fundamental methods of computer science in general and the use of algorithms for computational problem solving in particular. They learn how structure problems, model problems and solutions, and develop and implement computational solutions. *Professional competences:* The students understand concepts for representing information computationally, they know pertinent data structures and algorithms and can argue about their complexity, and they are acquainted with formal concepts like automata and formal languages as a means of modeling *Methodological competences:* The students are able to analyze problems from their application domain, to conceive computational solutions, and to estimate the effort involved in their realization and execution. They are able to evaluate alternative computational representations of data and problems and to draw informed conclusions for subsequent decisions in design and implementation *Social competences:* The students: The students are able to present and discuss their solutions in an interdisciplinary team *Self-competences:* The students are able to critically reflect fundamental design decisions in algorithms and data structures	
Content of the module:	

<table>
<tr><td colspan="2">Computer representation of information; formal languages, grammar and automata; basic data structures; algorithms and complexity; programming in the small</td></tr>
<tr><td colspan="2">Suggested reading:</td></tr>
<tr><td>Comments:
-

Weblink:
-

Prerequisites for admission:
-</td><td>Helpful previous knowledge:
Knowledge of a programming language may be helpful, but is not required

Associated with the module(s):</td></tr>
<tr><td colspan="2">Maximum number of students / selection criteria:

Types of examinations: Hands-on exercises and written exam or Hands-on exercises and oral exam
Examination periods: At the end of the lecture periods

Registration procedure: Stud.IP</td></tr>
</table>

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Engineering of STS	*Kategorie:* - Mastermodul *Degree award:* - Master
Emphases: HCI, embBCI, SE	*Sections:* -
Module reference number/Title: - inf970 Fundamental Competences in Psychology I: Psychology	
Duration: 1 semester *Cycle:* once a year *Type of module:* mandatory *Level:* BC (base curriculum) *This module should be taken in* 1st semester	*Type of program:* V (2 semester hours), Ü (2 semester hours) *Language:* German *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Christoph Herrmann
Alternative person(s) responsible for this module: The Teachers of the module	*Examiner(s):* The Teachers of the module
Objective of the module / skills: *Professional competences:* The students: - will acquire basic knowledge in Psychology *Methodological competences:* The students: - learn methods and theories of Psychology *Social competences:* The students: - will learn to work together in small groups - will communicate scientific theories *Self-competences:* The students: - will learn to apply their knowledge in other, more specific Psychology courses	
Content of the module: The module consists of a lecture and an exercise part: Lecture: The lecture will be based on the textbook by Atkinson & Hilgards. It will introduce the students to topics of General Psychology (learning & memory, perception, language, emotion), Social Psychology, Psychological Disorders, and Individual Psychology. Exercises: To be written by Prof. Hein	

Suggested reading: Atkinson & Hilgards: Introduction to Psychology, CENGAGE, 2014.	
Comments: - *Weblink:* - *Prerequisites for admission:* -	*Helpful previous knowledge:* - *Associated with the module(s):*
Maximum number of students / selection criteria: unlimited *Types of examinations:* Written exam *Examination periods:* During the last lecture appointment *Registration procedure:* StudIP and examination management	

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Engineering of STS	*Kategorie:* - Mastermodul *Degree award:* - Master
Emphases: HCI, embBCI, SE	*Sections:* -
Module reference number/Title: - inf971 Fundamental Competences in Psychology II: Introduction to Neurobiology	
Duration: 1 semester *Cycle:* once a year *Type of module:* mandatory *Level:* BC (base-curriculum) *This module should be taken in* 1st semester	*Type of program:* V (2 semester hours) S (2 semester hours) *Language:* German *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Christiane Thiel
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:* -
Objective of the module / skills: Introduction to basic concepts of neurobiolgical foundations of sensory, motor and cognitive functions *Professional competences:* The students will be able to understand basic concepts of neurobiological foundations of cognition and present these to fellow students of different backgrounds: *Methodological competences:* The students will learn to present and discuss scientific findings *Social competences:* The students will learn to interact in a group *Self-competences:* The students will be able to assess their own knowledge and understanding in the context of an interedisciplinary group	
Content of the module: The lecture includes the neuroanatomy of different sensory systems such as vision and audition. motor systems and higher cognitive functions. The seminar will focus on lecture topics based on the book chapters. These contents will be acquired in group work.	
Suggested reading: Purves D, Augustine GJ, Fitzpatrick D, Hall WC, LaMantia AS, McNamara JO, White LE (2012) Neuroscience. Palgrave Macmillan	
Comments:	*Helpful previous knowledge:*

This is part of a neurobiology module offered for biology students - *Weblink:* - *Prerequisites for admission:* -	*Associated with the module(s):*
Maximum number of students / selection criteria: 15 *Types of examinations:* written exam *Examination periods:* March *Registration procedure:* Stud.IP	

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Engineering of STS	*Kategorie:* - Mastermodul *Degree award:* - Master
Emphases: HCI, embBCI, SE	*Sections:* -
Module reference number/Title: **- inf972 Fundamental Competences in Psychology III: Experiments and Studies**	
Duration: 1 semester *Cycle:* once a year *Type of module:* mandatory *Level:* BC (base curriculum) *This module should be taken in* 1st semester	*Type of program:* V (2 semester hours), Ü (2 semester hours) *Language:* English *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Susanne Boll
Alternative person(s) responsible for this module: The Teachers of the module	*Examiner(s):* The Teachers of the module

Objective of the module / skills:
Professional competences:
The students:

- see Content of the module

Methodological competences:
The students are introduced into the design, implementation and also the analysis and interpretation of experiments.

Social competences:

Self-competences::
The students have knowledge of the tools and methods used for experiment design and evaluation. They are able to chose the right methods for their specific experiment. They are able to design and run experiments.

Content of the module:
Introduction into experimental psychology

- Variables, dependent and independent variables
- Formulating Hypotheses / Hypothesis testing
- Correlation and Cause
- Quantitative and qualitative methods
- Surveys, Experiments, Observational Studies

Experiment design / Study designs

- Between-Subjects Experiments
- Within-Subjects Experiments
- Randomized Control Trials

- Practical Considerations
- Complex Research Designs
- Single-Subject Research
- Lab studies vw. Studies in the wild
- Single factor vs. multifactor designs

Participants
- Recruiting participants
- Participants sampling
- Randomization
- Power Calculation

Tools
- SoSci Survey for online survery
- Statistic Tools

Analysis
- Descriptive Statistics
- Descriptive statistics and Correlation coefficients
- Statistical analysis of the data
- Internal and external validity

Ethics
- Institutional Review Boards
- Informed Consent

The module consists of a lecture and an exercise part:
Lecture: Theoretical introduction into the concepts and scientific methods of experiment design.

Exercises: Deepening the understanding of the experiments by planning and carrying out a survey and an experimental study in teams over the course of the term.

Suggested reading:

Das psychologische Experiment, Eine Einführung, Osswald Huber, 2005
How to Design and Report Experiments, Andy Field, sage 2003
Research Methods in HCI, Jonathan Lazar, Jinjuan Heidi Feng, Harry Hochheiser, John Wiley and Sons Ltd, 2009
Allgemeine Psychologie, Müsseler, Jochen, Berlin ; Heidelberg: Springer, 2017

Comments: - *Weblink:* - *Prerequisites for admission:* -	*Helpful previous knowledge:* - *Associated with the module(s):*

Maximum number of students / selection criteria:
Types of examinations: practical work and oral exam
Examination periods: at the end of the lecture period
Registration procedure: Stud.IP

Core Curriculum - Foundations of Socio-Technical System Engineering (STS Eng.)

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Engineering of STS	*Kategorie:* - Mastermodul *Degree award:* - Master
Emphases: HCI, embBCI, SE	*Sections:* -
Module reference number/Title: - inf965 Foundations of STS Eng.: Systems Engineering	
Duration: 1 semester *Cycle:* once a year *Type of module:* mandatory *Level:* BC (base curriculum) *This module should be taken in* 1st semester	*Type of program:* V (2semester hours), Ü (2 Semester hours) *Language:* English *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Axel Hahn, Prof. Dr. Martin Fränzle
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:* -
Objective of the module / skills: *Professional competences:* Designing and maintaining complex artefacts are a mayor challenge of engineering for decades. System Engineering is an approach to handle this complexity. By completing this module, the students are aware of the challenges of complexity. They know how systems engineering can address these while designing complex but reliable, dependable and safe products. A major cornerstone is to know the concept of a system and to describe it using appropriate modelling techniques. The student starts think in systems as an aggregation of components systems that may again be a component of an aggregated system up to the concepts of systems of systems. They are able to understand the effects of single components attributes on the system as a hole including humans a elements of complex systems. *Methodological competences:* The students are able to apply system-engineering methodologies and methods to understand requirements, to design, implement and test systems. *Professional competences:* Usage of engineering tools will provide practical experience. *Social competences:* They are aware of the role complex systems play in our society and got and understanding of complexity management as a *Self-competences:s* in engineering.	

Content of the module: The module consists of a lecture and an exercise part: Lecture: Introduction to the concepts of systems, methodologies and methods of systems engineering. As special emphasis is put on the usage of SYSML as an modelling approach. Exercises: Own design experiences by using engineering methods and tools.	
Suggested reading: Tim Weilkiens, Systems Engineering with SysML/UML: Modeling, Analysis, Design, MK/OMG Press, 2011	
Comments: - *Weblink:* - *Prerequisites for admission:* Basics of engineering methods	*Helpful previous knowledge:* - *Associated with the module(s):*
Maximum number of students / selection criteria: unlimited *Types of examinations:* Portfolio *Examination periods:* at the end of the lecture period *Registration procedure:* Stud.IP	

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Engineering of STS	*Kategorie:* - Mastermodul - Master
Emphases: HCI, embBCI, SE	*Sections:* -
Module reference number/Title: - inf966 Foundations of STS Eng.: Statistics and Programming	
Duration: 1 semester *Cycle:* once a year *Type of module:* mandatory *Level:* BC (base curriculum) *This module should be taken in* 1st semester	*Type of program:* V (3 semester hours), Ü (1 semester hours) *Language:* German *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Antje Timmer, Prof. Dr.-Ing Andreas Hein
Alternative person(s) responsible for this module: The teachers of the module	*Examiner(s):* The teachers of the module

Objective of the module / skills:
Professional competences:
The students learn:
To plan, program and interpret statistical data evaluation via programming.

Methodological competences:
The students:
- understand the main statistical methods and their practical use through application
- can evaluate statistical methods regarding the qualities and their limits
- learn the use of statistical software in application scenarios
- can implement programms via a programming language
- know how to program statistical data analyses

Social competences:
The students gain experience in interdisciplinary work.

Self-competences:
The students gain experiences in
- Pursuing goals: Thinking, problem solving and acting
- Ability to analyze and evaluate the effects and relevance of datasets for specific research questions

Content of the module:
The module consists of a lecture and an exercise part:
Lecture: Introduction to the concepts and methods for computer supported statistically data evaluation. Special emphasis are put on statstically methodoly as well as on a basic understanding of programming languages.

1. Fundamental Computerscience Concepts in regard to the handling of imperative programming languages including:
   - variable types and variable handling

- typical code structures (such as "while / for loops" or "if-then else" statements)
- data-handling and computation approaches

2. Fundamental static methodoloy such as:
   - estimating parameters through the method of maximum likelihood
   - confidence intervals and classical significance testing
   - classical regression analysis
   - modern advancements in regression analysis

Exercises: Stepwise practical or paperbased use of the learned concepts, methods and tools.

Suggested reading:

Comments: - *Weblink:* - *Prerequisites for admission:* -	*Helpful previous knowledge:* - *Associated with the module(s):*

Maximum number of students / selection criteria: 32

Types of examinations: Written or oral exam

Examination periods: At the end of the lecture period

Registration procedure: Stud.IP

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Engineering of STS	*Kategorie:* - Mastermodul *Degree award:* - Master
Emphases: HCI, embBCI, SE	*Sections:* -

- inf963 Foundations of STS Eng.: Cognitive Processes

Duration: 1 semester *Cycle:* once a year *Type of module:* mandatory *Level:* BC (basis curriculum) *This module should be taken in* 1st semester	*Type of program:* V (3 semester hours), S (1 semester hours) *Language:* English *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Martin Fränzle
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:*

Objective of the module / skills:
The module aims to provide an overview of theories of cognitives processes.
Part 1 will be a lecture on neurocognition. Students will first acquire a general understanding of the brain mechanisms of different cognitive functions and the methods used to study these functions:

- Brain and cognition, methods of cognitive neuroscience
- Attention, learning and memory
- Emotional and social behaviour
- Language, executive functions

Part 2 will be a lecture on neurophysiology. Students will acquire specific knowledge about neurophysiology and neuroanatomy, learn the fundamental concepts of multi-channel EEG analysis, and acquire hands-on skills in using EEGLAB, an open-source software toolbox for advanced EEG analysis.
Competencies:
Understanding of basic concepts of biomedical signal processing; using EEG analysis tools interactively and independently; understanding the complete chain of EEG analysis steps, from data import to the illustration of results; ability to use open source tools for EEG analysis; application of theoretical knowledge to practical problems of physiology.

Part 3 will be a seminar on cognitive engineering.
Students will be introduced to methods, tools, and techniques (MTTs) to evaluate and predict human performance in small use cases in different domains (Aviation, Air Traffic Control, Automotive, Maritime, or Healthcare). Each student is expected to study and apply the MTT based on material and software provided and present and discuss the modeling approach and the results achieved with the other participants and experts in the seminar.

Professional competences:
The students:

- Neuropsychological / neurophysiological knowledge

Methodological competences:

The students:

- interdisciplinary knowledge & thinking

Social competences:

The students:

- Written and oral presentation and discussion of scientific and technical results with others.

Self-competences:

The students:

- Reading, understanding, summarizing and critically evaluating scientific texts/literature

Content of the module:

Suggested reading:

Part 1 neurocognition:
Ward (2015) The Student's Guide to Cognitive Neuroscience, Psychology Press

Part 2 neurophysiology:
Kandel et al. (2000). Principles of Neural Science, McGraw-Hill
Luck, S.J. (2005). An Introduction to the ERP Technique, The MIT Press
Van Drongelen, W. (2006). Signal Processing for Neuroscientists, Academic Press

Part 3 cognitive engineering:
Paternò, F (2000). Model-Based Design and Evaluation of Interactive Applications
Anderson, Matessa & Lebiere (1997). ACT-R: A Theory of Higher Level Cognition and its Relation to Visual Attention. In: Human Computer Interaction
Wickens & Hollands (2012). Engineering Psychology & Human Performance
Vicente, K (2002).Ecological interface design: progress and challenges. In: Human Factors
Vicente, K (1999).Cognitive Work Analysis: Toward Safe, Productive, and Healthy Computer-Based Work
Card, Moran & Newell (1983). The Psychology of Human-Computer Interaction

Comments:

The module will be offered in winter terms and should be completed within one semester. Both parts will run in parallel.

Weblink:

-

Prerequisites for admission:

-

Helpful previous knowledge:

-

Associated with the module(s):

Maximum number of students / selection criteria:

Types of examinations:

Written exam. A bonus system will be employed.

Examination periods: At the End of the lecture period

Registration procedure: Stud. IP

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Engineering of STS	*Kategorie:* - Mastermodul *Degree award:* - Master
Emphases: HCI, embBCI, SE	*Sections:* -

- inf964 Foundations of STS Eng.: Psychology and Philosophy of Technology

Duration: 1 semester *Cycle:* once a year *Type of module:* compulsory elective *Level:* BC (basic curriculum) *This module should be taken in* 1st semester	*Type of program:* V (2 semester hours) S (2semester hours) *Language:* English *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Rainer Röhrig
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:*

Objective of the module / skills:

The module aims to provide an overview of theories of (Neuro)Cognitive Psychology with potential for application, concepts for technology assessments and ethical principals and their applicability for the field of (Neuro)Cognitive Psychology. In addition to these learning aims, they will experience chances and limitations of technology assessments. Thus, it will cover core concepts of cognitive psychology, their neuronal basis, basic knowledge of neuroimaging and data analysis techniques. Special emphasis will be put on research aiming at complex real-world settings and translation of basic science in to practice. Examples of successful transfers will be analyzed. Parts 1 (lecture) and
2 (seminar) will run in parallel. The lecture provides the theoretical basis. In the seminar the material is consolidated by examples from the literature will be presented and critically analyzed and discussed
Competencies: and

Professional competences:

The students

- Should have a repertoire of cognitive psychology concepts relevant for real world situations
- should be able to familiarize themselves with important ethical concepts, are able to explain them, and transmit them on scenarios of the technology assessment
- should know and be able to explain different forms and concepts of technology assessments (Expert, participatory, constructive, discursive Technology Assessment, Health Technology Assessment (HTA)
- should be able to reflect the collingride dilemma
-

Methodological competences:

The students:

- should be able to transfer the learned theoretical concepts into practical contexts
- should be able to perform an systematic literature review

- should be able to evaluate potential issues arising in the process of translation
- should be able to do an risk-benefit analysis and cost-benefit analysis of given examples
- should know and can explain empirical methods for technology assessment
- Methodological considerations: Generalization, validity of theories and research methods

Social competences:

The students:

- should be able to argue on different point of views based on different

Self-competences:

The students:

- should be able to reflect their own attitudes and able to explain them using ethical principles
- Pursuing goals: Thinking, problem solving and acting

Content of the module:

The module consists of a lecture and an exercise part:

Lecture:

- Neurocognitive Psychology with emphasis in real world context
- Ethical Principals an Concepts
- Forms and Concepts of Technology Assessment
- Chances and Limitations of Technology Assessment

General: Presentation as well as critical evaluation and discussion of scientific literature, application of research methods, transfer of scientific paradigms (concepts and methods) to real-world situations.

Seminar:

The students write a thesis for a given technological innovation. In this, various concepts of ethical assessment and technology assessment are to be applied. The Innovation is to be discussed critically from different perspectives. Advantages against disadvantages, benefits against damage, opportunities against dangers, self-interest against common public interest are to be weighed.

Suggested reading:

Part 1: Psychology of Technology

• Esgate, A. (2004) An Introduction to Applied Cognitive Psychology, Psychology Press
• Sternberg, RJ and Sternberg, K. (2011) Cognitive Psychology, Wadsworth
• Ward (2010) The Student's Guide to Cognitive Neuroscience, Psychology Press

Comments:

The module will be offered in summer terms and should be completed within one semester. Both parts will run in parallel.

Weblink:

Prerequisites for admission:

Helpful previous knowledge:

-

Associated with the module(s):

Maximum number of students / selection criteria: unlimited

Types of examinations: Portfolio

Examination periods: at the end of the lecture period

Registration procedure: Stud.IP

Accentuation modules

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Informatik	*Kategorie:* - Mastermodule *Degree award:* - Master
Emphases: HCI, embBCI	*Sections:* - Praktische Informatik
Module reference number/Title: - inf100 Human Computer Interaction	
Duration: 1 semester *Cycle:* once a year *Type of module:* optional compulsory *Level:* AS (advanced curriculum) *This module should be taken in* 2nd semester	*Type of program:* V (2 semester hours), P (2 semester hours) *Language:* German *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Michael Sonnenschein, Prof. Dr. Andreas Hein	*Person responsible for this module:* Prof. Dr. Susanne Boll-Westermann
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:*
Objective of the module / skills: *Professional competences:* The students: - Name the human-computer interaction core principles - Characterise the basic elements of the human-centered design of interactive systems *Methodological competences:* The students: - Comprehend context of use and user requirements of human-machine interfaces - Design, develop and evaluate human-machine interfaces - Conduct experiments with their prototypes *Social competences:* The students: - Implement human-computer interfaces in practical hands-on projects in teams - Evaluate human-machine interfaces with potential users - Develop and present solutions for Human-Computer Interaction related problems - Integrate technical and factual comments into own results	
Content of the module: The module introduces the field of human-computer interfaces and their historical context. Moreover, it shows motivating examples of human-computer interaction. The module covers the core principles of human-computer interaction. In detail, the module deals with the design concepts of interactive systems: context of use, requirements and task analysis,	

human perception capabilities, design process, usability, prototyping and evaluation. During the practical project a concrete human-computer interface will be designed, developed and evaluated according to this concept.

Suggested reading:
- Alan Dix, Jane Finlay, Gegory Abowd, Russel Beale, Human Computer Interaction Person, 2004.
- Markus Dahm, Grundlagen der Mensch Computer-Interaktion. Pearson, 2006
- Literature in the reserve shelf in the university bibliography. Link list in Stud.IP.

Comments:
-

Weblink:
medien.informatik.uni-oldenburg.de/lehre

Prerequisites for admission:
-

Helpful previous knowledge:
Basic programming skills

Associated with the module(s):
-

Maximum number of students / selection criteria: unlimited

Types of examinations:
Practical group project which progress has to be presented regularly during the tutorials. Oral exam on the topics of the lecture. Practical project and oral exam count 50% each to the final grade. Both practical project and oral exam have to be passed individually.

Examination periods:
The completed practical projects will be presented on a single project day, which will take place at the end of the lecture period. The oral exam takes place within the last two weeks of the lecture period. If necessary, re-examinations will take place at the end of the term. Find out more about the schedule on the websites of the department and in Stud.IP.

Registration procedure:
Stud.IP

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Engineering of STS	*Kategorie:* - Mastermodul *Degree award:* - Master
Emphases: HCI	*Sections:* Applied Computing Sciences
Module reference number/Title: - inf131 Advanced Topics in Human Computer Interaction	
Duration: 1 semester *Cycle:* semi-annual *Type of module:* mandatory *Level:* AC (accentuation module) *This module should be taken in* 1st semester	*Type of program* VL (2 semester hours) P (2 semester hours) *Language:* english *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Martin Fränzle	*Person responsible for this module:* Susanne Boll
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:*

Objective of the module/skills:

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

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

Professional competences:
The students:

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

Methodological competences:
The students:

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

Social competences:
The students:

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

Self-competences:
The students:

- Be comfortable tackling original research questions
- Aptitude in conceptualizing and running both qualitative and quantitative HCI experiments
- Ability to summarize, analyze, and critique published (peer-review) research papers

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

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

Structure of the Module:

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

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

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

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

Suggested reading:
The Computer for the 21st Century, Mark Weiser, Scientific American, September 1991, pp. 94 - 104.
Bush, V. (1945). As We May Think. Atlantic Monthly.
Design of Everyday Things, Chapters 1 to 7
Greenberg, S. and Buxton, B. (2008). Usability Evaluation Considered Harmful (Some of the Time). Proceedings of the ACM Conference on Human Factors in Computing Systems (CHI 2008), 111-120.
Olsen, D.R. (2007). Evaluating User Interface Systems Research. Proceedings of the ACM Symposium on User Interface Software and Techno

Comments:	*Helpful previous knowledge:*
-	Interaktive Systeme
Weblink:	*Associated with the module(s):*

- *Prerequisites for admission:* Mensch-Maschine-Interaktion (Human Computer Interaction)	Interaktive Systeme

Maximum number of students / selection criteria: *24*

Types of examinations: *Project and oral exams*

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

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

Grading:
Your grade will be calculated as follows:

Scored Items	%
Final	40
Assignments A01–03	30
Mini HCI research project	20

Examination periods: At the end of the lecture period

Registration procedure: Stud. IP

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Engineering of STS	*Kategorie:* - Mastermodul *Degree award:* - Master
Emphases: HCI	*Sections:* -
Module reference number/Title: **- inf174 Special Topics in "Media Informatics and Multimedia Systems" I**	
Duration: 1 semester *Cycle:* irregulary *Type of module:* compulsory elective *Level:* AS (advanced curriculum) *This module should be taken in* 1st semester 2nd semester, 3rd semester	*Type of program:* V (2 semester hours) , Ü (2 semester hours) *2 courses out of V, S, Ü, P, P* *Language:* German *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Michael Sonnenschein Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Susanne Boll
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module -

Objective of the module / skills:
This module integrates current developments in the field in adequate study courses.

*Professional competences:*s
The students:
Define and contrast a computer science part, in which they are specialised, in detail or evaluate computer science in general

- Recognise and evaluate applied techniques and methods of their subject and are aware of their limits
- Identify, structure and solve problems/tasks, also in new or developing subject areas
- Apply state of the art and innovative methods to solve problems, if necessary from other disciplines
- Are aware of the current limits and contribute to the development of computer science research and technology
- Discuss and evaluate recent computer science developments

Methodological competences:s
The students:

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

Social competences:s
The students:

- Support team process by their abilities

Self-competences:s
The students:

- Pursue the overall and special computer science development critically
- Implement innovative professional activities effectively and independently

Content of the module: According to the assigned course	
Suggested reading:	
Comments: - *Weblink:* - *Prerequisites for admission:* -	*Helpful previous knowledge:* - *Associated with the module(s):*
Maximum number of students / selection criteria: unlimited *Types of examinations:* Portfolio or presentation or oral exam *Examination periods:* At the end of the lecture period *Registration procedure:* Examination Office or Stud.IP	

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:*	*Kategorie:* - *Degree award:* -
Emphases: HCI	*Sections:* -
Module reference number/Title: ## - inf175 Special Topics in 'Media Informatics and Multimedia Systems' II	
Duration: 1 semester *Cycle:* irregulary *Type of module:* compulsory elective *Level:* AS (advanced curriculum)*This module should be taken in* 2nd semester 3rd semester	*Type of program:* V (2 semester hours), Ü (2 semester hours) *2 courses out of V, S, Ü, P, P* *Language:* German *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Michael Sonnenschein Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Susanne Boll-Westermann
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module

Objective of the module / skills:
This module integrates current developments in the field in adequate study courses.

Professional competences:s
The students:

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

Methodological competences:s
The students:

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

Social competences:s
The students:

- Support team process by their abilities

Self-competences:
The students:

• Pursue the overall and special computer science development critically • Implement innovative professional activities effectively and independently	
Content of the module: According to the assigned course	
Suggested reading: According to the assigned course	
Comments: - *Weblink:* - *Prerequisites for admission:* -	*Helpful previous knowledge:* - *Associated with the module(s):*
Maximum number of students / selection criteria: *unlimited* *Types of examinations:* Exercises or presentation or oral exam *Examination periods:* At the end of the lecture period *Registration procedure:* Examination Office or Stud.IP	

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Informatik	*Kategorie:* - Mastermodule *Degree award:* - Master
Emphases: embBCI, SE	*Sections:* - Technische Informatik
Module reference number/Title: - inf300 Hybrid Systems	
Duration: 1 semester *Cycle:* once a year *Type of module:* optional compulsory *Level:* AS (advanced curriculum) *This module should be taken in* 1st semester or 2nd semester	*Type of program:* V (3 semester hours), Ü (1 semester hours) *Language:* English *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Andreas Hein, Prof. Dr. Michael Sonnenschein, Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Martin Georg Fränzle
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:*

Objective of the module / skills:

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

Professional competences:

The students:

- Characterise formal models of cyber-physical systems: hybrid automata, hybrid state transition systems
- Name domain-specific system requirements: safety, stability, robustness
- Name analysis methods: symbolic state-space exploration, abstraction and abstraction refinement, generalized Lyapunov-Methods
- Use state-of-the-art analysis tools
- Select and apply adequate modelling and analysis methods for concrete application scenarios
- Apply methods to reduce large state spaces and reduce infinite-state systems by abstraction
- Know the de-facto industry standards for system modelling and are able to apply the corresponding modelling framewortks and tools

Methodological competences:

The students:

- Model heterogeneous dynamical systems with adequate modelling and design tools, in particular Simulink/Stateflow
- Transfer modelling and analysis methods to other heterogeneous domains, e.g. socio-technical systems

Social competences:
The students:
- Work in teams
- Solve complex modelling, design, and analysis tasks in teams

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

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

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

Suggested reading:
- Luca P Carloni, Roberto Passerone, Allesandro Pinto & Alberto L Sangiovanni-Vincentelli: Languages and Tools for Hybrid System design. World Scientific, 2006.
- Wassim M. Haddad, VijaySekhar Chellaboina & Sergey G. Nersesov: Impulsive and Hybrid Dynamical Systems: Stability, Dissipativity, and Control. Princeton University Press, 2006
- Daniel Liberzon: Switching in Systems and Control. Birkhauser, 2003
- Michael Huth, Mark Ryan: Logic in Computer Science: Modelling and Reasoning About Systems. Cambridge University Press, 2004.
- Christel Baier, Joost-Pieter Katoen: Principles of Model Checking. MIT Press, 2008.

Comments:
-

Weblink:
-

Prerequisites for admission:
-

Helpful previous knowledge:
A BSc. in CS or knowledge of ordinary differential equations.

Associated with the module(s):
-

Maximum number of students / selection criteria:
unlimited

Types of examinations:
Semester project including written work and final presentation

Examination periods:
At the end of the lecture period

Registration procedure:
Stud.IP

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften	*Kategorie:* - Mastermodule *Degree award:*

Department für Informatik *Subject:* Informatik	- Master
Emphases: HCI, embBCI, SE	*Sections:* - Technische Informatik
Module reference number/Title: ## - inf301 Machine-oriented Systems Engineering	
Duration: 1 semester *Cycle:* seimi-aual *Type of module:* compulsory elective *Level:* AS (advanced curriculum) *This module should be taken in* 1st semester	*Type of program:* V (2 semester hours), P (2 semester hours) *Language:* German *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Andreas Hein, Prof. Dr. Michael Sonnenschein, Prof. Dr. Martin Fränzle	*Person responsible for this module:* Dr. Alfred Mikschl, Prof. Dr. Werner Damm
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the modul*:*
Objective of the module / skills: The module provides practical relevance to the design of digital embedded systems. *Professional competences:* The students: - characterise the structure of microprocessor systems - name control aspects of time sensitive external components - program efficient embedded systems *Methodological competences:* The students: - use specifications from electrical components data sheets *Social competences:* The students: - work in a team - discuss solutions	
Content of the module: Embedded systems support complex feedback problems, control problems and data processing tasks. They have an important value creation potential for telecommunications, production management, transport and electronics. The functionality of embedded systems is realized by the integration of processors, special hardware and software. The embedded systems design is influenced by the heterogeneity of system architectures, the complexity of systems and technical and economic requirements. This module gives an initial review of computer architectures. After that embedded systems are introduced by a specific microprocessor. Furthermore, external hardware will be connected to the microprocessor. Besides this, the design of circuit boards will be discussed. The students will design,	

<table>
<tr><td colspan="2">develop and implement a circuit layout with CAD and programd this embedded system with a Flash-eprom.</td></tr>
<tr><td colspan="2">Suggested reading:
Lecturers notes, hardware manuals and data sheets, and development tool manuals</td></tr>
<tr><td>Comments:
-

Weblink:
-

Prerequisites for admission:
-</td><td>Helpful previous knowledge:
„Eingebettete Systeme I and II“and successful completion of the module „Praktikum Technische Informatik“

Associated with the module(s):
-</td></tr>
<tr><td colspan="2">Maximum number of students / selection criteria:
unlimited

Types of examinations:
Portfolio (Design, development and implementation of embedded systems, colloquium)

Examination periods:
At the end of the lecture period

Registration procedure:
StudIP</td></tr>
</table>

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Informatik	*Kategorie:* - Mastermodule *Degree award:* - Master
Emphases: HCI, embBCI, SE	*Sections:* - Technische Informatik
Module reference number/Title: ## - inf303 Fuzzy-Control and Artificial Neural Networks	
Duration: 1 semester *Cycle:* once a year *Type of module:* compulsory elective *Level:* AS (advanced curriculum) *This module should be taken in* 2nd semester	*Type of program:* V (3 semester hours), Ü (1 semester hours) *Language:* Englisch *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Michael Sonnenschein, Prof. Dr. Andreas Hein, Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Sergej Fatikow
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:* Prof. Dr. Sergej Fatikow

Objective of the module / skills:

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

Professional competences:

The students:
- Recognise control problems in robotics and automation technology,
- Name principles of fuzzy logic and ANN and their practical applications,
- Compare conventional and advanced control methods,
- Characterise the combination of fuzzy logic and ANN in control systems

Methodological competences:

The students:
- Will acquire knowledge of the tools, methods and applications in fuzzy logic and ANN
- Deepen their knowledge for the practical use of the given methods
- Can use common software tools for design and application of fuzzy logic and ANN

Social competence

The students:
- Gain experience in interdisciplinary work
- Are integrated into the recent research work

- Work together in small teams to solve problems
- Discuss and present developed control solutions in front of an audience within the tutorial

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

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

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

Empfohlen:
- Bothe, H.-H.: Neuro-Fuzzy-Methoden, Springer, 1998
- Braun, Feulner, Malaka: Praktikum Neuronale Netze, Springer, 1997
- Kahlert, J.: Fuzzy Control für Ingenieure, Vieweg, Braunschweig Wiesbaden, 1995
- Nauck, D., Klawonn, F. und Kruse, R.: Neuronale Netze und Fuzzy-Systeme, Vieweg, 1994
- Zell, A.: Simulation Neuronaler Netze, Addison-Wesley / Oldenbourg Verlag, Bonn, 1996

Gute Sekundärliteratur:
- Altrock, M. O. R.: Fuzzy Logic, R. Oldenbourg Verlag, 1993
- Bekey, A. and Goldberg, K.Y. (Eds.): Neural Networks in Robotics, Kluwer Academic, 1996
- Berns, K. und Kolb, T.: Neuronale Netze für technische Anwendungen, Springer, 1994
- Bothe, H.-H.: Fuzzy Logic, Springer, 1993
- Bunke, H., Kandel, A. (eds.): Neuro-Fuzzy Pattern Recognition, World Scientific Publ., 2000
- Kahlert, J. und Hubert, F.: Fuzzy-Logik und Fuzzy-Control, Vieweg, 1993
- Kim, Y.H. and Lewis, F.L.: High-Level Feedback Control with Neural Networks, World Scientific, 1998
- Kratzer, K.P.: Neuronale Netze, Carl Hanser, 1993
- Lämmel, U. und Cleve, J.: Künstliche Intelligenz (neuronale Netze), Fachbuchverlag Leipzig, 2001
- Lawrence, J.: Neuronale Netze, Systhema Verlag, München, 1992
- Omidvar, O. and van der Smagt, P. (eds.): Neural Networks for Robotics, Academic Press, 1997
- Patterson, D.W.: Künstliche neuronale Netze, Prentice Hall, 1996
- Pham, D.T. and Liu, X.: Neural Networks for Identification, Prediction and Control, Springer,

1997
- Rigoll, G.: Neuronale Netze, Expert Verlag, Renningen-Malmsheim, 1994
- Ritter, H., Martinetz, Th. und Schulten, K.: Neuronale Netze, Addison-Wesley, 1991
- Schulte, U.: Einführung in Fuzzy-Logik, Franzis-Verlag, München, 1993
- Tizhoosh, H.R.: Fuzzy-Bildverarbeitung, Springer, 1998
- von Altrock, C.: Fuzzy Logic: Technologie, Oldenbourg, 1993
- White, D. and Sofge, D. (Eds.): Handbook of Intelligent Control, Van Nostrand Reinhold, New York, 1992
- Zakharian, S. Ladewig-Riebler, P. und Thoer, St.: Neuronale Netze für Ingenieure, Vieweg, Wiesbaden, 1998
- Zalzala, A. and Morris, A. (Eds.): Neural Networks for Robotic Control, Ellis Horwood, London, 1996
- Zimmermann H.-J. (Hrsg.): Datenanalyse, VDI-Verlag, 1995
- Zimmermann, H.-J. (Hrsg.): Neuro + Fuzzy: Technologien und Anwendungen, VDI-Verlag, 1995
- Zimmermann, H.-J. und von Altrock, C. (Hrsg.): Fuzzy Logic: Anwendungen, Oldenbourg, 1994

Comments: - *Weblink:* - *Prerequisites for admission:* -	*Helpful previous knowledge:* - Control engineering *Associated with the module(s):* -

Maximum number of students / selection criteria:
unlimited

Types of examinations:
Hands-on-exercises and oral Exam

Examination periods:
At the end of the lecture period until the beginning of the next semester

Registration procedure:
StudIP

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Informatik	*Kategorie:* - Mastermodule *Degree award:* - Master
Emphases: HCI, embBCI, SE	*Sections:* - Technische Informatik
Module reference number/Title: - inf305 Medical Technology	
Duration: 1 semester *Cycle:* once a year *Type of module:* compulsory elective *Level:* AS (advanced curriculum) *This module should be taken in* 3rd semester	*Type of program:* V (3 semester hours), Ü (1 semester hours) *Language:* German *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Andreas Hein, Prof. Dr. Michael Sonnenschein, Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Andreas Hein
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:* -
Objective of the module / skills: *Professional competences:* The students: - Describe medical diagnosis and therapy methods - Understand the core concepts of computer-assisted medical interventions - Are aware of the basic concepts and legal conditions of the development of medical devices - Define the character of medical devices' software parts and implement them - Assess the complex interaction of medical products and patients - Get familiar with the development of medical products within a short period of time *Methodological competences:* The students: - Recognise the interdisciplinary challenges and accordingly exchange information with other disciplines *Social competences:* The students: - Present solutions for specific questions *Self-competences:* The students: - reflect their solutions by using methods learned in this course	
Content of the module: - Medical areas and areas of application - Basic requirements for medical systems (hygiene, MPG, technical security, materials) - Medical systems: - Functional diagnostics (ECG, EMG, EEG)	

- Imaging systems (CT, MRI, ultrasound, PET, SPECT)
- Therapy equipment (Laser, RF, Microtherapy)
- Signal processing / monitoring (cardiovascular, hemodynamic, respiratory, metabolic, cerebral)
- Medical Informatics (HIS, DICOM, Telemedicine, VR, image processing).

Suggested reading:
essential:
- Kramme, R.: Medizintechnik. Verfahren, Systeme und Informationssysteme. Springer Verlag, 2002 (2. Auflage).
- Lecture slides

recommended:
- Lehmann, Th.; Oberschelp, W.; Pelikan, E.; Pepges, R.: Bildverarbeitung in der Medizin. Springer Verlag, 1997.
- Dugas, M.; Schmidt, K.: Medizinische Informatik und Bioinformatik. Springer Verlag, 2003.

secondary literature:
- Taylor, R.H. et al.: Computer-Integrated Surgery. Technology and clinical Applikations. MIT Press, Cambridge, MA, 1996.

Comments:
-

Weblink:
-

Prerequisites for admission:
-

Helpful previous knowledge:
Signal- und Bildverarbeitung, Regelungstechnik

Associated with the module(s):
-

Maximum number of students / selection criteria:
unlimited

Types of examinations:
Portfolio: Hands-on exercises, report, and written or oral exam

Examination periods:
At the end of the lecture period

Registration procedure:
StudIP

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Informatik	*Kategorie:* - Mastermodule *Degree award:* - Master
Emphases: HCI, embBCI, SE	*Sections:* - Technische Informatik
Module reference number/Title: - inf307 Robotics	
Duration: 1 semester *Cycle:* once a year *Type of module:* compulsory elective *Level:* AC (Accentuation module) *This module should be taken in* 2nd semester	*Type of program:* V (3 semester hours), Ü (1 semester hours) *Language:* German *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Andreas Hein, Prof. Dr. Michael Sonnenschein, Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Andreas Hein
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:* -
Objective of the module / skills: *Professional competences:* The students: - Name and know the functions and applications of robot systems - Characterise the basic concepts to program robot systems - Differentiate between the interaction of mechanical, electrical and software components *Methodological competences:* The students: - Define characteristics and components of robot systems for a specific application - Design and implement robot system sub-components - Design and parameterise simple control structures - Plan the application of robot systems and derive the requirements - Model electrical and mechanical systems - Develop and realise simple robot systems *Social competences:* The students: - Solve robot systems problems in team work *Self-competences:* The students: - Reflect their solutions in reference to robot system methods	

Content of the module:
- Integration in production plants / aims / subsystems
- Architectures / classifications (classification of robots)
- Robot components + Computer systems for programming
  - PA-10
  - Lego Mindstorms
- Basics of kinematics	

    - Coordinate transformation, homogeneous coordinates, Coordinate transitions
    - Kinematic equation systems, transformation of vectors
- Kinematic
    - Joint types (manipulators) / Wheels, TCP
    - Denavit-Hartenberg-Transformation
    - Forward calculation
    - Backward calculation
- Sensors
    - General properties of sensors, parameter
    - Simple optical position sensors
    - Inductive-, capacitive- und ultrasonic-sensors
    - Distance sensors (laser scanner, triangulation sensors)
    - Force sensors
    - Sensor data preparation
- Planing / Regulation
    - Overall regulation approach, terms, process- and control functions, PID-controller
    - Planning concepts and approaches (On-Line, Off-Line), planning processes, construction and path planning
- Actuators

Suggested reading:

essential: lecture nodes

recommended:

Lüth, T.: Technische Multi-Agenten-Syteme. Hanser-Verlag, 1998.
Siegert, H.-J.; Bocionek, S.: Programmierung intelligenter Roboter. Springer Verlag, 1996.
Craig, J.J.: Introduction to Robotics: Mechanics and Control. Prentice Hall, 1989.
Juckenack, D.: Handbuch der Sensortechnik: Messen mechanischer Größen. Verlag moderne Industrie, Landsberg/Lech, 1989.
Jiang, X.; Bunke, H.: Dreidimensionales Computersehen (Gewinnung und Analyse von Tiefenbildern), Springer Verlag, 1997.

sekundar literature:

Hommel, G.; Heiß, H.: Roboterkinematik. Bericht 1990-15 an der TU-Berlin.
Muir, P.F.; Neuman, C.P.: Kinematic Modeling of Wheeled Mobile Robots. Journal of Robotic Sytemes, 4(2) 281-340, 1987.

Comments:
-

Weblink:
-

Prerequisites for admission: -

Helpful previous knowledge:
-

Associated with the module(s):
-

Maximum number of students / selection criteria:
unlimited

Types of examinations:
Portfolio: Hands-on exercises, report, and written or oral exam

Examination periods:
at the end of the lecture period

Registration procedure:
Stud.IP

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Informatik	*Kategorie:* - Mastermodule *Degree award:* - Master
Emphases: HCI, embBCI, SE	*Sections:* - Technische Informatik
Module reference number/Title: - inf308 Microrobotics II	
Duration: 1 semester *Cycle:* once a year *Type of module:* compulsory elective *Level:* MM (master module) *This module should be taken in* 2nd semester	*Type of program:* V (3 semester hours), Ü (1 semester hours) *Language:* German *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Andreas Hein, Prof. Dr. Michael Sonnenschein, Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Sergej Fatikow
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:*

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

Professional competences:
The students:
- Name and recognise the basic concepts of nanotechnology, in particular, micro- and nanorobotics approaches
- Differentiate the development, control and application of micro- and nanorobotics systems
- Implement and design application-specific mirco- and nanorobotics systems

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

Social competences:
The students:
- Work in a team

Self-competences:
The students:

- Reflect their problem-solving behaviour and use hands-on experience to develop, control and application of microrobotics

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

Suggested reading:
- Lecture notes (can be obtained in our secretariat, A1-3-303)
- Fatikow, Sergej (Ed.): Automated Nanohandling by Microrobots, Springer, London, 2008

Comments:
-

Weblink:
-

Prerequisites for admission:
Module "Microrobotics and Microsystem Technology"

Helpful previous knowledge:
-

Associated with the module(s):
-

Maximum number of students / selection criteria:
unlimited

Types of examinations:
oral Exam and exercises

Examination periods:
At the end of the lecture period

Registration procedure:
Stud.IP

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Informatik	*Kategorie:* - Mastermodule *Degree award:* - Master
Emphases: embBCI, SE	*Sections:* -
Module reference number/Title: ## - inf311 Low Energy Systems Design	
Duration: 1 semester *Cycle:* once a year *Type of module:* compulsory elective *Level:* AS (advanced curriculum) *This module should be taken in* 1st semester	*Type of program:* V (3 semester hours), Ü (1 semester hours) *Language:* German *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Andreas Hein, Prof. Dr. Michael Sonnenschein, Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Wolfgang Nebel
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:* -
Objective of the module / skills: This module introduces the estimation of power dissipation and optimisation. *Professional competences:* The students: - Discuss the fundamental problems of power dissipation - Characterise the requirements-driven design process of embedded systems - Name power loss analysis and optimization methods - Design embedded systems with common design and analysis tools - Design power-optimized embedded systems *Methodological competences:* The students: - Model systems with a hardware description language - Analyze and model hardware components - Perform multi-dimensional optimization of systems *Social competences:* The students: - Implement solutions of given problems in teams - Discuss their outcomes appropriately *Self-competences:* The students: - Acknowledge the limits of their ability to cope with pressure during the modeling process of systems	
Content of the module: According to Moore's Law the number of integratable transistors on a computer chip doubles every	

two years. In addition, new circuits are getting faster and faster. This leads not only to an increased functionality of a system, but it also increases the electrical power consumption.

This electrical power consumption is problematic from two different points of view: Firstly, the electrical power must be supplied. Secondly, the resulting heat has to dissipate from the system. An increased power consumption always causes lower battery life and higher energy costs. The heat generation reduces the reliability and life of integrated circuits. The cooling (ceramic housings, cooling elements, fans, etc.) increases the system's costs.
Today the development of heat, caused by power dissipation, needs to be considered during the embedded system design process. This knowledge takes the system's reliability and operation costs into account.

This module introduces the estimation of power dissipation and optimisation.

Suggested reading:

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

Comments:
-

Weblink:
-

Prerequisites for admission:
-

Helpful previous knowledge:
- inf200 Grundlagen der Technische Informatik,
- inf201 Technische Informatik,
- inf203 Eingebettete Systeme I+,
- inf204 Eingebettete Systeme II

Associated with the module(s):

Maximum number of students / selection criteria:
unlimited

Types of examinations:
hands-on exercises and oral exam

Examination periods:
at the end of the lecture period

Registration procedure:
Stud.IP

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Engineering of STS	*Kategorie:* - Mastermodule *Degree award:* - Master
Emphases: HCI	*Sections:* -
Module reference number/Title: ## - inf330 Embedded Systems (M)	
Duration: 1 semester *Cycle:* anuzal *Type of module:* compulsory *Level:* AC (Accentuation) *This module should be taken in*	*Type of program:* V (2 semester hours), Ü (2 semester hours) *Language:* German *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Werner Damm, Prof. Dr.-Ing. Wolfgang Nebel, Prof. Dr. Martin Fränzle
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:* -

Objective of the module / skills:
This module provides an introduction to the design of digital embedded systems

Professional competences:
The students:
- *Name functional and non-functional requirements to specify embedded systems*
- *Discuss design space and associated embedded systems design methods*
- *Name control and feedback control systems' core concepts*
- *Characterise the fundamental digital signal processing algorithms*

Methodological competences:
The students:
- Design and develop embedded feedback control systems with modelling tools
- Implement an embedded hardware-/software system according to a given specification
- Analyze various specification languages according to different properties

Social competences:
The students:
- Implement solutions to given problems in teams
- Present results of computer science problems to groups
- Organize themselves as a team to solve a larger problem using project management methods

Self-competences:
The students:
- Acknoledge the limits of their ability to cope with pressure during the implementation process of systems
- Solve excercises self-responsibly

Content of the module:

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

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

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

Suggested reading:

Slides and

- Harel, D.: STATECHARTS: A Visual Formalism for Complex Systems. Science of Computer Programming, 8, North-Holland, 1987, page(231-274)
- Harel D.: Naamad, A. The STATEMATE Semantics of Statecharts. ACM Trans. Software Engineering Methods, Oct 1996
- Harel, D.; Politi, M.: Modeling Reactive Systems with Statecharts: The Statemate Approach
- Josef Hoffmann: Matlab und Simulink: Beispielorientierte Einführung in die Simulation dynamischer Systeme, Addison-Wesley, 1998, ISBN 3-8273-1077-6
- Staunstrup, J., Wolf, W. (eds.): Hardware/Software Co-Design: Principles and Practice. Kluwer Academic Publishers, 1997, ISBN 0-7923-8013-4, chapters 1, 2, (3), 4, 6, (7), (8-10)
- U. Reimers. Digitale Fernsehtechnik. 2. Aufl., Springer, 1997, ISBN 3-540-60945-8

Secundary literature:

- Debardelaben, J.A.; Gadient, A.J.: Incorporating Cost Modeling in Embedded-System Design. IEEE Design & Test, vol 13, no. 3, 1997
- De Micheli, G.; Sami, M.: Hardware-Software Co-Design. Kluwer, 1996, ISBN 0-7923-3883-9
- Gajski, D.; Vahid, F.; Narayan, S.; Gong, J.: Specification and Design of Embedded Systems. Prentice Hall, 1994, ISBN 0-13-150731-1
- T. Painter, A. Spanias. Perceptual Coding of Digital Audio. Proceedings of the IEEE, vol 88, no 4, April 2000.
- U. Freyer. DVB - Digitales Fernsehen. Verlag Technik, 1997, ISBN 3-341-01192-7
- B. Friedrichs. Kanalcodierung: Grundlagen und Anwendungen in modernen Kommunikationssystemen. Springer, 1995, ISBN 3-540-58232-0
- G.C. Clark. Error-correction coding for digital communications. 3rd printing, Plenum Press, 1988, ISBN 0-306-40615-2
- Artikelserie zum MPEG-2-Standard 3/94 - 10/94 und das Tutorial "Digitale Bildcodierung" 1/92 - 1/93, beides in "Fernseh- und Kinotechnik" (BIS: Z elt ZA 1536)

Comments:	*Helpful previous knowledge:*
- This module is compulsory for students who are	- Grundlagen der technischen Informatik

specialising in "Eingebettete Systeme und Mikrorobotik". *Weblink:* - *Prerequisites for admission:* -	- Technische Informatik *Associated with the module(s):* In the module "Eingebettete Systeme II" additonal relevant topics such as design processes, HW/SW-Partitioning, High-Level-Synthesis and Hardware discription languages are discussed. The modules Eingebettete Systeme I und II offer cross-references to the module "Rechnerarchitektur", "Realzeitbetriebssysteme" and semantic orientated modules of theoretical computer science. It is possible to enhance the knowledge of embedded systems design by attending the modules "System Level Design" and "Low energy System Design".
Maximum number of students / selection criteria: unlimited *Types of examinations:* Written or oral exam *Examination periods:* At the end of the semester period *Registration procedure:* Stud.IP	

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Engineering of STS	*Kategorie:* - Mastermodule *Degree award:* - Master
Emphases: embBCI	*Sections:* -
Module reference number/Title: ## - inf331 Automated and Connected Driving	
Duration: 1 semester *Cycle:* once a year *Type of module:* mandatory *Level:* AC (Accentuation) *This module should be taken in*	*Type of program:* V (3 semester hours), Ü (1 semester hours) *Language:* German *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Frank Köster
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:*

Objective of the module / skills:
This module introduces the principles of automated driving.

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

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

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

Self-competences:

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

Content of the module:
- levels of automated driving (eg. SAE-Level)
- levels of connected driving
- core-domains of automated vehicles
- sense, plan, and act in the context of automated and connected vehicles
- transition between different levels of automation
- selected connected vehicle functions
- selected automated vehicle functions
- human factors and socio-technical systems
- vehicle architectures

Suggested reading:
- Maurer, M., Gerdes, J.C., Lenz, B., Winner, H. (Eds.) (2015). Autonomes Fahren (Technische, rechtliche und gesellschaftliche Aspekte), Springer (Open Access)
- Braess, H.-H., Seiffert, U. (Eds.) (2012). Handbuch Kraftfahrzeugtechnik, Vieweg.

Comments:
-

Weblink:
-

Prerequisites for admission:
-

Helpful previous knowledge:
- inf201 Technische Informatik,
- inf203 Eingebettete Systeme I+,
- inf204 Eingebettete Systeme II

Associated with the module(s):

Maximum number of students / selection criteria: unlimited
Types of examinations: Practical work and oral exam

Examination periods: at the end of the lecture period

Registration procedure: Stud.IP

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Engineering of STS	*Kategorie:* - Mastermodule *Degree award:* - Master
Emphases: embBCI	*Sections:* -
Module reference number/Title: ## - inf332 Practice Robotics	
Duration: 1 semester *Cycle:* once a year *Type of module:* mandatory *Level:* AC (Accentuation module) *This module should be taken in* 3rd seester	*Type of program:* V (3 semester hours), Ü (1 semester hours) *Language:* German *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Andreas Hein
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:*

Objective of the module / skills:
Professional competences:
The students learn:
- Programming of robots (mobile or stationary)
- Implementation of elementary operations
- Integration of operations into a small application scenario

Methodological competences:
The students learn:
- Systematic development process with team members
- Systematic evaluation of the application

Social competences:
The students learn:
- Project management
- Team work
- Team work

Self-competences:
The students:
- Time management
- Autodidactic work (literature search, technical specs, related work)

Content of the module:
In diesem Modul werden spezielle Themen aus dem Gebiet der Robotik angeboten. Weitere Informationen finden Sie direkt in der zugeordneten Veranstaltung
Students will define the project/application scenario of the robots by their own.
The module consists of a lecture and an exercise part:
Lecture: 2-3 lectures for introduction onto the module and introduction into the Robot Operation

System (ROS) Exercises:	
Suggested reading:	
Comments: - *Weblink:* - *Prerequisites for admission:* -	*Helpful previous knowledge:* - *Associated with the module(s):*
Maximum number of students / selection criteria: *Types of examinations:* Demonstration and written documentation *Examination periods:* At the end of the lecture period *Registration procedure:* Stud.IP	

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Engineering of STS	*Kategorie:* - Mastermodule *Degree award:* - Master
Emphases: embBCI	*Sections:*
Module reference number/Title: - inf333 Sensor Technology in the Automotive Domain	
Duration: 1 semester *Cycle:* once a year *Type of module:* mandatory *Level:* AC (Accentuation module) *This module should be taken in* 2nd semester	*Type of program:* V (3 semester hours), Ü (1 semester hours) *Language:* German *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the programme: Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Frank Köster
Alternative person(s) responsible for this module: Teachers of the Modul	*Examiner(s):* Teachers of the Modul

Objective of the module / skills:
This module introduces the principles of sensors and sensor-systems as well as data-fusion in the automotive doemain.

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

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

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

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

Content of the module:
- Sensor-technologies
- Data fusion (multi-level fusion)
- Kalman-Filter
- In-vehicle data-processing
- Car2cx-technologies (ITS G5 and 5G)
- Multi-sensor and multi-lvel fusion architectures

Suggested reading:
- Maurer, M., Gerdes, J.C., Lenz, B., Winner, H. (Eds.) (2015). Autonomes Fahren (Technische, rechtliche und gesellschaftliche Aspekte), Springer (Open Access)
- Tille, T. (2016). Automobil-Sensorik: Ausgewählte Sensorprinzipien und deren automobile Anwendung. Springer.

Comments: - *Weblink:* - *Prerequisites for admission:* -	*Comments:* - *Weblink:* - *Prerequisites for admission:* -

Maximum number of students / selection criteria:
unlimited

Types of examinations:
Practical work and oral exam

Examination periods:
at the end of the lecture period

Registration procedure:
Stud.IP

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Informatik	*Kategorie:* - Mastermodule *Degree award:* - Master
Emphases: embBCI, SE	*Sections:* - Technische Informatik
Module reference number/Title: ## - inf334 System Level Design	
Duration: 1 semester *Cycle:* once a year *Type of module:* compulsory elective *Level:* AS (advanced curriculum) *This module should be taken in* 1st semester	*Type of program:* V (3 semester hours), Ü (1 semester hours) *Language:* German *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Andreas Hein, Prof. Dr. Michael Sonnenschein, Prof. Dr. Martin Fränzle	*Person responsible for this module:* Dr. Kim Grüttner
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:*

Objective of the module / skills:
Professional competences:
The students:
- Ability to describe and analyze system components and architectures using system level description languages SpecC and SystemC
- Capabilities for partitioning and parallelizing of applications

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

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

Self-competences:
The students:
- presentation skills
- reflect their solutions by using methods learned in this course

Content of the module:

The ever-increasing integration densities of integrated circuits enable the implementation of increasingly powerful and complex systems. This can be on the one hand the integration of several sub-components on the same chip (system-on-chip) or on the other hand the implementation of more powerful algorithms. However, traditional design techniques are hardly able to cope with the increasing complexity of today's embedded systems. Therefore, in research and practice efforts through new methods and tools, there is a significant increase in productivity in the design process, thus closing the so-called "design productivity gap". This is achieved, for example, by a stronger abstraction, in which the behavior of components is described only at the algorithmic level and is automatically translated into hardware or software implementations by high-level synthesis techniques. The final system implementation is achieved by means of a structured refinement and exploration processes. Throughout this refinement flow, system properties (for example, timing, energy consumption, chip area and costs) are estimated on each abstraction level and guide the designer in the iterative decision process. By means of techniques such as virtual prototyping, entire systems can be simulated and verified on each refinement layer, even without the availability of a full implementation for all system components.

This module builds on the modules Embedded Systems I and II, deepens the knowledge acquired there for the design of hardware/software systems and expands them with current methods and tools. With SystemC, a language is presented that is already widely used in industry and research for the design and verification of hardware/software systems and supports several abstraction levels from clock cycle accurate hardware description, over transaction level models to process based functional specifications.

Suggested reading:

Main textbooks:

- D. Gajski, S. Abdi, A. Gerstlauer, G. Schirner, Embedded System Design: Modeling, Synthesis, Verification, Springer, 2009 (“orange book”)
- D. C. Black, J. Donovan, B. Bunton, A. Keist, SystemC: From The Ground Up, Second Edition, Springer 2010 (“red book”)

Optional books:

- F. Vahid, T. Givargis, Embedded System Design: A Unified Hardware/Software Introduction, Wiley, John & Sons, 2001 (“blue book”). Background about embedded systems in general
- A. Gerstlauer, R. Doemer, J. Peng, D. Gajski, System Design: A Practical Guide with SpecC, Kluwer, 2001 (“yellow book”). Practical, example-driven introduction using SpecC

Additional reading material posted on Stud.IP

Comments: -

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

Prerequisites for admission:
-

Helpful previous knowledge:

- inf200 Grundlagen der Technische Informatik,
- inf201 Technische Informatik,
- inf203 Eingebettete Systeme I,
- inf204 Eingebettete Systeme II

Associated with the module(s):

Maximum number of students / selection criteria:
unlimited

Types of examinations:
hands-on exercises and oral exam

Examination periods:
at the end of the lecture period

Registration procedure:
Stud.IP

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Informatik	*Kategorie:* - Mastermodule *Degree award:* - Master
Emphases: embBCI	*Sections:* - Technische Informatik
Module reference number/Title: - inf335 Strategy Synthesis	
Duration: 1 semester *Cycle:* once a year *Type of module:* optional compulsory *Level:* AS (advanced curriculum) *This module should be taken in* 1st semester or 2nd semester	*Type of program:* V (3 semester hours), Ü (1 semester hours) *Language:* English *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Andreas Hein, Prof. Dr. Michael Sonnenschein, Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Werner Damm
Alternative person(s) responsible for this module: The teachers of the module	*Examiner(s):* The teachers of the module

Objective of the module / skills:

To learn fundamental techniques in strategy synthesis as foundation for high-level control strategies in highly autonomous systems

Professional competences:

The students:

- understand the concepts of open, reactive systems and can explain their relevance
- can provide formal model of open reactive systems and their relevance for system design
- understand the concept of world models as internal representation of a systems environment
- understand and can explain the concept of strategies, and relate this to system design
- understand the relevance of information flow in distributed system
- understand the relevance of choosing the periphery of world models
- can formalize system requirements in temporal logic
- understand the relevance of assumptions in system design

Methodological competences:

The students:

- methods for synthesis of winning strategies in closed systems
- methods for synthesizing remorse-free strategies in open systems
- methods for determining the perimeter of world models
- methods for cooperative strategy synthesis

Social competences:

The students:

- Work in teams
- Solve complex modelling, design, and synthesis tasks in teams

Self-competences:

The students:

- Reflect their actions and respect the scope of methods for strategy synthesis

Content of the module:

The module gives an introduction to the synthesis of control strategies for highly autonomous systems. We first introduce classical game theory and present algorithms for synthesizing strategies for reactive system. We extend this to open systems, and analyze conditions, under which synthesis for distributed systems is decidable. We introduce remorse-free strategies and present compositional approaches to synthesis of remorse-free strategies. We analyze under what conditions world models allow for optimal remorse free strategies. We provide algorithms for computing weakest assumptions on the system environments under which winning strategies exist. We extend this to cooperative strategy synthesis, where multiple players cooperate in achieving jointly the system objectives. We illustrate these concepts with examples from autonomous driving.

Suggested reading:

- Werner Damm and Bernd Finkbeiner. **Automatic compositional synthesis of distributed systems**. In Cliff Jones, Pekka Pihlajasaari, and Jun Sun, editors, *FM 2014: Formal Methods*, volume 8442 of *Lecture Notes in Computer Science*, pages 179-193. Springer International Publishing, 2014.
- Bernd Finkbeiner and Leander Tentrup. **Detecting unrealizable specifications of distributed systems**. In Erika Ábrahám and Klaus Havelund, editors, *Tools and Algorithms for the Construction and Analysis of Systems - 20th International Conference, TACAS 2014, Held as Part of the European Joint Conferences on Theory and Practice of Software, ETAPS 2014, Grenoble, France, April 5-13, 2014. Proceedings*, volume 8413 of *Lecture Notes in Computer Science*, pages 78-92. Springer, 2014.
- Rayna Dimitrova and Bernd Finkbeiner. **Counterexample-guided synthesis of observation predicates**. In Marcin Jurdzinski and Dejan Nickovic, editors, *Formal Modeling and Analysis of Timed Systems - 10th International Conference, FORMATS 2012, London, UK, September 18-20, 2012. Proceedings*, volume 7595 of *Lecture Notes in Computer Science*, pages 107-122. Springer, 2012.
- Werner Damm and Bernd Finkbeiner. **Does it pay to extend the perimeter of a world model?**. In Michael Butler and Wolfram Schulte, editors, *Proceedings of the 17th International Symposium on Formal Methods*, volume 6664 of *Lecture Notes in Computer Science*, pages 12-26. Springer-Verlag, June 2011.
- Bernd Finkbeiner and Sven Schewe. **Coordination logic**. In Anuj Dawar and Helmut Veith, editors, *Computer Science Logic, 24th International Workshop, CSL 2010, 19th Annual Conference of the European Association for Computer Science Logic (EACSL), Brno, Czech Republic, August 23-27, 2010. Proceedings*, volume 6247 of *Lecture Notes in Computer Science (LNCS)*, pages 305-319. Springer-Verlag, 2010.

Comments:

-

Weblink:

-

Prerequisites for admission:

-

Helpful previous knowledge:

A BSc. in CS with a specialisation equivalent to "embedded systems and microrobotics" or corresponding knowledge from the MSc: The lecture assumes familiarity with the modelling and analysis of reactive systems.

Associated with the module(s): -

Maximum number of students / selection criteria:

unlimited

Types of examinations: Written or oral exam

Examination periods: At the end of the lecture period

Registration procedure: Stud.IP

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Informatik	*Kategorie:* - Mastermodule *Degree award:* - Master
Emphases: HCI, embBCI, SE	*Sections:*
Module reference number/Title: - inf336 Application Area Automotive	
Duration: 1 semester *Cycle:* once a year *Type of module:* mandatory *Level:* MM (Master Module) *This module should be taken in* 2nd semester	*Type of program:* V (3 semester hours), Ü (1 semester hours) *Language:* German *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the programme: Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Frank Köster
Alternative person(s) responsible for this module: Teachers of the Modul	*Examiner(s):* Teachers of the Modul

Objective of the module / skills:
This module introduces the application area Automotive.

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

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

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

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

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

Suggested reading:
- Maurer, M., Gerdes, J.C., Lenz, B., Winner, H. (Eds.) (2015). Autonomes Fahren (Technische, rechtliche und gesellschaftliche Aspekte), Springer (Open Access).
- Braess, H.-H., Seiffert, U. (Eds.) (2012). Handbuch Kraftfahrzeugtechnik, Vieweg.
- Tille, T. (2016). Automobil-Sensorik: Ausgewählte Sensorprinzipien und deren automobile Anwendung. Springer.
- Treiber, M., Kesting, A. (2010). Verkehrsdynamik und -simulation (Daten, Modelle und Anwendungen der Verkehrsflussdynamik), Springer.

Comments: - *Weblink:* - *Prerequisites for admission:* -	*Comments:* - *Weblink:* - *Prerequisites for admission:* -

Maximum number of students / selection criteria:
unlimited

Types of examinations:
Practical work and oral exam

Examination periods:
at the end of the lecture period

Registration procedure:
Stud.IP

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Engineering of STS	*Kategorie:* - Mastermodule *Degree award:* - Master
Emphases: embBCI, SE	*Sections:* -
Module reference number/Title: ## - inf338 Design of Autonomous Systems	
Duration: 1 semester *Cycle:* once a year *Type of module:* mandatory *Level:* AC (Accentuation module) *This module should be taken in* 1st semester	*Type of program:* V (3 semester hours), Ü (1 semester hours) *Language:* German *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Martin Fränzle
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:*
Objective of the module / skills: *Professional competences:* The students are enabled to analyze and build autonomous systems. *Methodological competences:* The students know examples of existing autonomous systems, understand the elements involved in their architectural design and the rationale behind decomposing the problem into obligations for the respective system components. The module furthermore enables the students to analyze existing architectures for autonomous systems with respect to their performance and safety. The students learn how to decompose a problem of designing an autonomous system into an architecture, are able to derive design obligations for its components, and can structure a pertinent safety case. They understand the software and hardware components necessary for achieving system autonomy and are able to design or instantiate these. *Social competences:* The students acquire hands-on experience in designing components for autonomous systems in small teams and present the underlying theory, their particular design decisions, and their personal evaluation to fellow students. *Self-competences:* The students can judge adequacy of their methodological skills for designing particular autonomous solutions. They are able to assess the safety impact of such a solution and are therefore able to develop a personal ethical stance towards its realization.	
Content of the module: The module consists of a lecture and an exercise part: Lecture: Exercises:	
Suggested reading:	

Comments: - *Weblink:* - *Prerequisites for admission:* -	*Helpful previous knowledge:* - *Associated with the module(s):*
Maximum number of students / selection criteria: - *Types of examinations:* Presentation *Examination periods:* Second half of semester *Registration procedure:* Stud. IP	

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Informatik	*Kategorie:* - Mastermodule *Degree award:* - Master
Emphases: SE	*Sections:* - Theoretische Informatik
Module reference number/Title: ## - inf454 Communicating and Mobile Systems	
Duration: 1 semester *Cycle:* irregularly *Type of module:* compulsory elective *Level:* AS (advanced curriculum) *This module should be taken in* 1st semester und/oder 3rd semester	*Type of program:* V (3 semester hours), Ü (1 semester hours) *Language:* German *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Michael Sonnenschein, Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Ernst-Rüdiger Olderog
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:* -

Objective of the module / skills:
Introduction to Milner's Calculus of Communicating Systems (CCS) and the pi-Calculus.

Professional competences:
The students:
- Know the theory of the operational semantics of CCS and the pi-calculus
- Perform equivalence proofs using simulations and bisimulations
- Specify communicating and mobile systems with CCS and the pi-calculus

Methodological competences:
The students:
- Learn about different views on mobility
- Recognize equivalences as formal means for system correctness

Social competences:
The students:
- Work together in small groups to solve problems
- Present their solutions to groups of other students

Self-competences:
The students:
- Learn persistence in pursuing difficult tasks
- Learn precision in specifying problems

Content of the module:
Communication is one of the basic concepts of computer science. It occurs between computers in a network as well as between components of a computer. The focus of the course is on Robin Milner's

pi;-calculus. It enables a new modelling of communication, taking the location of the communication into account.

The pi-calculus can describe the change of data in a computer as well as the sending of messages or even programs along networks like the internet. It is also possible to describe reconfigurable networks. This will be shown using the examples of mobile phones, schedulers, automatic vending machines, data structures, communication protocols, and objects in object-oriented programming. All these applications are backed by the theory of the pi;-calculus, which is based on operational semantics and a concept of behavioural equivalence.
The theory will be explained in a step-by-step manner.

Topics:
- different views on mobility
- transition systems with simulations and bisimulations
- Milner's Calculus of Communicating Systems (CCS) and Milner's picalculus for mobile systems, both with operational semantics, structural congruence, strong equivalence and observational equivalence, relationship between reactions and transitions, solvability of recursive equations
- formal specification of examples of communicating and mobile systems using CCS and thepi-calculus
- proof of strong equivalence and observational equivalence of given processes
- specification of dynamic data structures in the pi-calculus

Suggested reading:
Robin Milner. Communicating and Mobile Systems: The pi-calculus.
Cambridge University Press, 1999.
Robin Milner. Communication and Concurrency. Prentice Hall, 1989.
D. Sangiorgi and D. Walker. The pi-calculus: A Theory of Mobile Systems.
Cambridge University Press, 2001.

Comments:
-

Weblink:
-

Prerequisites for admission:
-

Helpful previous knowledge:
Theoretical Computer ScienceII

Associated with the module(s):
-

Maximum number of students / selection criteria:
unlimited

Types of examinations:
written exam or oral exam

Examination periods:
at the end of the lecture period

Registration procedure:
Stud.IP

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Informatik	*Kategorie:* - Mastermodule *Degree award:* - Master
Emphases: embBCI, SE	*Sections:* - Theoretische Informatik
Module reference number/Title: ## - inf456 Real-Time Systems	
Duration: 1 semester *Cycle:* irregularly *Type of module:* supplemental/professionalization *Level:* AS (advanced curriculum) *This module should be taken in* 1st semester	*Type of program:* V (3 semester hours), Ü (1 semester hours) *Language:* German *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Andreas Hein, Prof. Dr. Michael Sonnenschein, Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Ernst-Rüdiger Olderog
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:* -

Objective of the module / skills:
Introduction to formal methods of the specification and verification of time sensitive systems and their combinations.

Professional competences:
The students:
- Learn about different models of time and real-time properties
- Specify and verify real-time systems
- Model real-time systems using Timed Automata and PLC-Automata
- Apply the model checker UPPAAL for the verification of real-time properties
- Specify real-time systems using the Duration Calculus
- Learn about decidability and undecidability results for real-time systems

Methodological competences:
The students:
- Recognize logic and automata as adequate forms for describing real-time systems

Social competences:
The students:
- Work together in small groups to solve problems
- Present their solutions to groups of other students

Self-competences:
The students:
- Learn persistence in pursuing difficult tasks
- Learn precision in specifying problems

Content of the module:
Examples of time-critical systems are railway control systems, robots, or even gas burners. It is essential for these systems to comply with certain timing conditions. For example, the control of a railway crossing must close the gates not later than 4 seconds after the sensors have reported an approaching train. If the gates are open, they should stay that way for at least 15 seconds to allow for a safe crossing of vehicles.
Different specification methods have been developed to describe such timing conditions.

The Duration Calculus developed by Zhou Chaochen in 1991 is one attractive method. It is a logic combined with a calculus, in which the duration of states can be described. The course will introduce the Duration Calculus and will explain its application by means of examples. As further specification method Timed Automata introduced by Alur & Dill in 1994 will be presented. After the specification of real-time system requirements, the verification of programs implementing these requirements will follow. The specification methods of the Duration Calculus and Timed Automata are used to describe the real-time behavior of these programs. The correctness is then proven on the basis of these behavioural descriptions.

Topics:
- discrete and continuous model of time
- logics and automata models for the specification of real-time systems (predicate logic, Duration Calculus, Timed CTL, Timed Automata, PLC-Automata)
- decidability and undecidability results for real-time systems
- model checker UPPAAL for Timed Automata
- formal specification of real-time systems using Duration Calculus as well as Timed Automata and PLC-Automata
- verification of concrete Timed Automata using the model checker UPPAAL,
- transformation of Duration Calculus for discrete time into regular languages
- implementability of real-time systems on PLC-like hardware

Suggested reading:
essential:
- E.-R. Olderog, H. Dierks: Real-Time Systems: Formal Specification and Automatic Verification, Cambridge University Press, 2008

recommended:
- C. Heitmeyer and D. Madrioli, editors. Formal Methods for Real-Time Computin, Wiley, 1996.
- M. Joseph, editor. Real-time Systems -- Specification, Verification and Analysis, Prentice Hall, 1996 (http://docencia.etsit.urjc.es/moodle/file.php/31/documentos/RTSbook.pdf).

Comments: -
Weblink: -
Prerequisites for admission: -

Helpful previous knowledge:
Theoret. Comp. Science I and II

Associated with the module(s): -

Maximum number of students / selection criteria:
unlimited

Types of examinations:
exercises and written or oral exam

Examination periods:
at the end of the lecture period

Registration procedure:
Stud.IP

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Engineering of STS	*Kategorie:* - Mastermodule *Degree award:* - Master
Emphases: embBCI, SE	*Sections:* -
Module reference number/Title: - inf460 Security	
Duration: 1 semester *Cycle:* once a year *Type of module:* optional *Level:* Mastermodule *This module should be taken in* 1st semester	*Type of program:* S or V (2 semester hours) *Language:* English (or German) *Attainable credit points:* 3,00 CP *Workload:* 90 hours *Required attendance:* 28 hours
Person responsible for the program: Prof. Dr. Martin Fränzle	*Person responsible for this module:* PD Dr. Sibylle Fröschle
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:*

Objective of the module / skills:
The goal of this module is to provide a foundation in computer and network security.

Professional competences:
The students:
- are aware of the threats posed by cyber attacks to computer and network systems
- understand the basic principles and mechanisms to protect a system against these threats
- are able to apply this knowledge to assess the risk of cyber attacks to a given system as well as to develop and evaluate countermeasures against them

Methodological competences:
The students:
- carry out a threat and risk assessment
- formulate security requirements for a given system
- identify and apply standard security solutions to meet them
(These are examples, the exact skills depend on the focus chosen by the student.)

Social competences:
The students:
- are able to master a new topic by self-study and interaction with experts and peers
- are able to explain principles and applications of computer security to experts and non-experts
- are able to expertly discuss security risks and incidents

Self-competences:
The students:
- follow up and critically assess current developments in computer security including security incidents
- are security aware in their own behaviour, in their assessment of the systems they work with, and those they develop

Content of the module:
This module provides a broad and comprehensive knowledge in computer security. The topics cover threat analysis and attack trees, essential cryptographic tools, user authentication, access control, malware, intrusion detection and prevention, denial-of-service attacks and defences, software security and trusted systems, and network security.

Students without prior knowledge in computer security focus on basic principles such as listed above. Students with prior knowledge in computer security can deepen their knowledge by studying real-world examples such as the SSL/TLS protocol. Typically, they will illustrate their topic by discussing a security incident reported in the public domain security news.

Suggested reading:
Computer Security, Principles and Practice by William Stallings and Lawrie Brown, 3rd Edition, Pearson 2015
Security Engineering by Ross Anderson, 2nd Edition, 2008

Comments:
-

Weblink:
- access from http://vhome.offis.de/sibyllef

Prerequisites for admission:
-

Helpful previous knowledge:
- Basic knowledge in security

Associated with the module(s):
Security of Cyber-Physical Systems

Maximum number of students / selection criteria: no constraints

Types of examinations: presentation and paper, oral exam, or exam (depending on the number of students)

Examination periods: will be specified in class

Registration procedure: Stud.IP

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Engineering of STS	*Kategorie:* - Mastermodule *Degree award:* - Master
Emphases: SE	*Sections:* -
Module reference number/Title: - inf461 Security of Cyber-Physical Systems	
Duration: 1 semester *Cycle:* once a year *Type of module:* optional *Level:* Master *This module should be taken in* > 2nd semester	*Type of program:* S or V (2 semester hours) *Language:* German *Attainable credit points:* 3,00 CP *Workload:* 90 hours *Required attendance:* 28 hours
Person responsible for the program:	*Person responsible for this module:* PD Dr. Sibylle Fröschle
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:*

Objective of the module / skills:
Professional competences:
The students:
- are aware of the threats posed by cyber attacks to cyber-physical systems
- understand security solutions specific to CPS
- know examples of security architectures of CPS
- are able to apply this knowledge to assess the risk of cyber attacks to a given CPS as well as to develop a conceptual systems security architecture for it

Methodological competences:
The students:
- carry out a threat and risk assessment for a given CPS
- formulate security requirements for a given CPS
- develop a systems security architecture for a given CPS to meet them
(These are examples, the exact skills depend on the focus chosen by the student.)

Social competences:
The students:
- are able to master a new topic by self-study and interaction with experts and peers
- are able to explain the significance and facets of security for CPS to experts and non-experts
- are able to expertly discuss security risks and incidents of CPS

Self-competences:
The students:
- follow up and critically assess current developments in the security of CPS including relevant security incidents
- are security aware and foster a security culture with respect to CPS and the resulting critical infrastructures

Content of the module:

Embedded systems in the energy, transportation, and health domains are currently undergoing a technological transition towards highly networked automated cyber-physical systems (CPS). Such systems are potentially vulnerable to cyber attacks, and these can have physical impact. This includes targeted sabotage of a plant (e.g. Stuxnet), large-scale sabotage of infrastructure to cause economic damage (e.g. attacks against energy grids), and indiscriminate attacks to cause civilian casualties (e.g. by compromise of transportation systems). In this module we investigate and discuss security principles, solutions, and architectures for CPS as well as real-life security incidents. The topics include distance bounding protocols, location tracking and counter-measures, safety and security engineering of CPS, security in the automotive and maritime domain including car hacking and vehicle-2-x communication, hacking in the medical domain, attacks against energy grids, Stuxnet, CPS and society: benefits, risks, acceptance.	
Suggested reading: Recent scientific papers and reports in the public domain news.	
Comments: - *Weblink:* - access from http://vhome.offis.de/sibyllef *Prerequisites for admission:* -	*Helpful previous knowledge:* - *Associated with the module(s):* Security
Maximum number of students / selection criteria: no constraints *Types of examinations:* presentation and written documentation, oral exam, or exam *Examination periods:* At the end of the lecture period *Registration procedure:* Stud.IP	

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Informatik	*Kategorie:* - Mastermodule *Degree award:* - Master
Emphases: HCI, embBCI, SE	*Section:* Applied Computing Science
Module reference number/Title: - inf522 Information Processing in Bio-Medical Research	
Duration: 1 Semester *Cycle:* anual *Type of module:* compulsory *Level:* AS Aktzentsetzung *This module should be taken in:* *2nd semester*	*Type of program:* V (2 semester hours) Ü (2 semester hours) *Language of program:* *German* *Attainable credit-points:* 6,00 KP *Workload:* *180 h* *Required attendance:* *56 h*
Person responsible for the program: Prof. Dr. Michael Sonnenschein, Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Rainer Röhrig
Examiners The teachers of the module	*Alternative person(s) responsible for this module* The teachers of the module

Objective of the module/skills:
The students are aware of the requirements of biomedical research information processing and technologies. They know, develop and evaluate apporaches.

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

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

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

Self-competences:
The students:

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

Content of the Module:

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

Suggested reading:

Comments: *Weblink:* *Prerequisites for admission:*	*Helpful previous knowledge:* *Associated with the module(s):*

Maximum number of students / selection criteria: 16
Type of examinations: written exam
Examination periods: At the end of the lecture period
Registration procedure: StudIP
Weblink for additional information:

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Informatik	*Kategorie:* - Mastermodule *Degree award:* - Master
Emphases: HCI, embBCI, SE	*Section:* Applied Computing Science
Module reference number/Title: - inf523 Medical Software Engineering	
Duration: 1 semester *Cycle:* anual *Type of module:* compulsory *Level:* AS Aktzentsetzung *This module should be taken in:* 2nd semester	*Type of program:* V (2 semester hours) Ü (2 semester hours) *Language of program:* *English* *Attainable credit-points:* 6,00 KP *Workload:* *180 h* *Required attendance:* *56 h*
Person responsible for the program: Prof. Dr. Michael Sonnenschein, Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Rainer Röhrig
Examiners The teachers of the module	*Alternative person(s) responsible for this module* The teachers of the module

Objective of the module/skills:
This Module provides the regulatory requirements of medical software. Focus is on software life cycle methods and approaches, the implementation of combined usability- and risk management processes as well as qualtiy management.

Professional competences:
The students:
- Know and use obligatory medical software requirements
- Know methods and approaches to develop security-critical medical software and implement them by example
- Know at least one medical application area and its specific professional, organisational and regulatory requirements

Methodological competences:
The students:
- Are able to apply risk management methods of socio-technical systems
- Are able to extend their knowledge of new application areas. They are able to handle the obstacles of normative frameworks and software development.

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

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

Content of the Module: *This module provides medical software development processes. The module deals with normative software requirements with the focus on patient privacy and quality management. Contents are the declaration of conformity based on medical product classes and software security classes. The software security is focused on software quality, tests and verification, validation as well as quality and risk management. The software life cycle provides security related systems and software as well as software architecture and different process models.*	
Suggested reading:	
Comments: *Weblink:* *Prerequisites for admission:*	*Helpful previous knowledge:* Medizin für Informatiker Programmierkenntnisse / Softwareentwicklung / Informationssysteme / Mensch Maschine Interaktion *Associated with the module(s):*
Maximum number of students / selection criteria: 16 *Type of examinations:* written exam *Examination periods:* At the end of the lecture period *Registration procedure:* StudIP *Weblink for additional information:*	

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Engineering of STS	*Kategorie:* - Mastermodule *Degree award:* - Master
Emphases: HCI	*Sections:* -
Module reference number/Title: **- inf532 Introduction to Cognitive Engineering**	
Duration: 1 semester *Cycle:* once a year *Type of module:* optional compulsory *Level:* AC (Accentuation modules) *This module should be taken in* 1st semester	*Type of program:* VL (2 semester hours) + Ü (2 semester hours) *Language:* German *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Martin Fränzle	*Person responsible for this module:* Dr. Sebastian Feuerstack
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module

Objective of the module / skills:

Professional competences:
The students:
- Understanding of state of the art methods, techniques and tools (MTTs) to describe, model and evaluate human performance in safety-critical systems.
- Basic understanding of cognitive modelling and state of the art cognitive architectures
- Application of MTTs for use cases applications in Automotive, ATC, Maritime, Healthcare and Energy.
- Understanding of model-based user interface engineering, which derives human machine interface designs based on models.

Methodological competences:
The students:
- Select and apply MTTs to predict human performance, in particular for:
    - task analysis, design and modeling,
    - modelling and prediction human visual attention while monitoring complex systems,
    - task performance and workload prediction based on cognitive architectures.

Social competences:
The students:

Self-competences:
The students:
- Solve analysis, design and modelling tasks
- Model-based thinking

Content of the module:
The module aims at students from computer science, engineering, and psychology that are interested

in getting and understanding into analyzing the impact of a human-machine interface to a human operator's performance and well-being.

Computer programming skills are not required, but an interest in applying computer programs to model human behavior as part of the practical exercise is expected.

The module consists of a lecture and an exercise part:

Lecture:
The module introduces the field of cognitive engineering, which is an emerging branch of human factors and ergonomics and places particular emphasis on the structured analysis of cognitive processes required of operators in safety-critical applications. The lecture puts specific emphasis on models and processes for task analysis (i.e. ConcurTaskTrees), visual attention (i.e. SEEV), human performance (i.e. modern GOMS variants) and also introduce cognitive modelling based on cognitive architectures, which implement psychological and physiological plausible models to explain and predict human performance (i.e. ACT-R and CASCaS). Besides these approaches that are mostly targeted to systematically evaluate interactive systems, we also spend time on introducing "constructive" design methods (i.e. based on ecological interface design) to optimize human machine interfaces so that they can be efficiently used and perceived.

Exercises:
Based on the examples (e.g. managing incoming flights at air traffic control, driving a car in complex overtaking scenarios or performing time critical interventions with robots in an operation theater) that we introduce in the lecture to explain and discuss the theoretical models of e.g. human attention, or human performance prediction, we aim at modeling these examples in the exercises in our lab to end up with concrete human performance predictions.

Suggested reading:
Each lecture covers usually a specific chapter of one of the following books or articles:
- Model-Based Design and Evaluation of Interactive Applications (Fabio Paternò)
- Introduction to ACT-R (John R. Anderson, Christian Lebiere)
- Engineering Psychology and Human Performance (Chris Wickens, Justin Hollands)
- Ecological interface design: Progress and challenges. Human Factors (Kim Vicente)
- Cognitive Work Analysis: Toward Safe, Productive, and Healthy Computer-Based Work (Kim Vicente)
- The psychology of Human Computer Interaction (Card, Moran, Newell)

Comments:
-

Weblink:
- http://www.humanics.eu

Prerequisites for admission:
-

Helpful previous knowledge:
Fundamental Competences in Psychology I
Fundamental Competences in Psychology III
Applied Cognitive Psychology
Human Computer Interaction

Associated with the module(s):
Application Area Automotive
Usability in Medicine

Maximum number of students / selection criteria: 20
Types of examinations: oral exam
Examination periods: At the end of the lecture period
Registration procedure: Stud.IP

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik Subject: Informatik	*Kategorie:* - Mastermodule *Degree award:* - Master
Emphases: embBCI, SE	*Sections:* - Angewandte Informatik
Module reference number/Title: - inf533 Probabilistic Modelling I	
Duration: 1 semester *Cycle:* once a year *Type of module:* compulsory elective *Level:* AS (advanced curriculum) *This module should be taken in* 1st semester	*Type of program:* S (2 semester hours) *Language:* German *Attainable credit points:* 3,00 CP *Workload:* 90 hours *Required attendance:* 28 hours
Person responsible for the program: Prof. Dr. Michael Sonnenschein, Prof. Dr. Andreas Hein, Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Claus Möbus
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:*
Objective of the module / skills: Probabilistic Bayesian models are generated with special tools (e.g. BUGS, JAGS, STAN) or programming languages (CHURCH, FIGARO, etc.). If they mimic cognitive processes of humans (e.g. pilots, drivers) or animals they could be used as assistance systems in technical systems like cars or robots. *Professional competences:* The students: - learn to map problem to model classes to come up with practical solutions *Methodological competences:* The students: - acquire basic skills in the design, implementation, and identification of probabilistic models with Bayesian methods - acquire knowledge about alternative non-Bayesian machine learning methods *Social competences:* The students: - learn to present and discuss probabilistic theories, methods, and models. *Self-competences:* The students: - reflect and evaluate chances and limitations of probabilistic approaches - learn to deliberate on machine-learning alternatives	
Content of the module: Theories, methods, and examples of Bayesian models with practical applications	
Suggested reading:	

Recent eBooks, eTutorials	
Comments: - *Weblink:* http://www.uni-oldenburg.de/en/computingscience/lcs/probabilistic-programming/ *Prerequisites for admission:* -	*Helpful previous knowledge:* Basic programming skills *Associated with the module(s):* inf534 Probabilistische Modellierung II
Maximum number of students / selection criteria: unlimited *Types of examinations:* Presentation *Examination periods:* - *Registration procedure:* -	

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Informatik	*Kategorie:* - Mastermodule *Degree award:* - Master
Emphases: embBCI	*Sections:* - Angewandte Informatik
Module reference number/Title: - inf536 Computational Intelligence II	
Duration: 1 semester *Cycle:* every 6 months *Type of module:* compulsory elective *Level:* AS (advanced curriculum) *This module should be taken in* 2nd semester und/oder 4th semester	*Type of program:* V (2 semester hours), Ü (2 semester hours) *Language:* German *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Michael Sonnenschein, Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Oliver Kramer
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:*
Objective of the module / skills: *Professional competences:* The students: - Recognise machine learning problems - Implement simple algorithms of machine learning - Critically discuss solutions and selection of methods - Deepen previous knowledge of analysis and linear algebra *Methodological competences:* The students: - Deepen programming skills - Apply modelling skills - Learn about the relation between problem class and method selection *Social competences:* The students: - Cooperatively implement content introduced in lecture - Evaluate own solutions and compare them with those of their peers *Self-competences:* The students: - Evaluate own skills w.r.t. peers - Realise personal limitations - Adapt own problem solving approaches w.r.t. required method competences	
Content of the module: Computational Intelligence comprises intelligent and adaptive methods for optimisation and learning.	

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

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

Suggested reading:
- BISHOP, C.M.: Pattern Recognition and Machine Learning. Springer 2007.
- HASTIE, T., TIBSHIRANI, R., FRIEDMAN, J.H.: The Elements of Statistical Learning, Springer 2009

Comments:
-

Weblink:
-

Prerequisites for admission:
-

Helpful previous knowledge:
- inf535 Computational Intelligence I
- Statistics

Associated with the module(s):
-

Maximum number of students / selection criteria:
unlimited

Types of examinations:
written or oral exam

Examination periods:
At the end of the semester

Registration procedure:
Stud.IP

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Informatik	*Kategorie:* - Mastermodule *Degree award:* - Master
Emphases: HCI, embBCI, SE	*Sections:* - Angewandte Informatik
Module reference number/Title: - inf537 Intelligent Systems	
Duration: 1 semester *Cycle:* once a year *Type of module:* compulsory elective *Level:* AS (advanced curriculum) *This module should be taken in* 1st semester und/oder 2nd semester	*Type of program:* V (2 semester hours), Ü (2 semester hours) *Language:* German *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Michael Sonnenschein, Prof. Dr. Jorge Marx Gomez, Prof. Dr. Martin Fränzle	*Person responsible for this module:* Apl. Prof. Dr.-Ing. Jürgen Sauer
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:* -
Objective of the module / skills: Objective of the module/skills: *Professional competences:* The students: - Name the structure of agent-based systems - Use problem-solving methods for complex problems - Characterise the application area of process planning - Evaluate the suitablilty of processes regarding to specific problems *Methodological competences:* The students: - Assign problem-solving methods to different problems *Social competences:* The students: - Implement selected methods in small teams *Self-competences:* The students: - Develop own solutions for given problems	
Content of the module: A lot of application areas use "intelligent" problem-solving methods. These are the main focus of this lecture. They will be illustrated by examples in order to enhance the students' problem-solving abilities. These inlcude	

- A brief introduction into AI
- Agent systems and
- Solution methods of AI like heuristics, meta-heuristics, soft computing methods.

To apply and foster the contents of the lecture, an intelligent planning system is implemented in practical exercises.

Suggested reading:

Suggested reading:
- Sauer, J.: Intelligente Ablaufplanung in lokalen und verteilten Anwendungsszenarien, Teubner, 2004
- Russel/Norvig: Künstliche Intelligenz, 3rd edition, Pearson, 2012
- Ghallab/ Nau/Traverso: Automated Planning, Morgan Kaufman, 2004

Comments: - *Weblink:* - *Prerequisites for admission:* -	*Helpful previous knowledge:* - *Associated with the module(s):* -

Maximum number of students / selection criteria: unlimited

Types of examinations: Practical tasks and written exam or oral exam

Examination periods: at the end of the semester

Registration procedure: Stud.IP

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Informatik	*Kategorie:* - Mastermodule *Degree award:* - Master
Emphases: HCI, embBCI, SE	*Sections:* - Angewandte Informatik
Module reference number/Title: ## - inf650 Transport Systems	
Duration: 1 semester *Cycle:* once a year *Type of module:* compulsory elective *Level:* AS (advanced curriculum) *This module should be taken in* 1st semester und/oder 2nd semester	*Type of program:* V (2 semester hours), Ü (2 semester hours) V+Ü *Language:* German *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Michael Sonnenschein, Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr.-Ing. Axel Hahn
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:* -

Objective of the module / skills:

Objective of the module/skills:

The Module Transport systems deals with planning and controlling systems of internal and external company logistics as well as public transport. It provides basic knowledge and recent research topics. The focus is on a resource orientated holistic view of company logistics as well as the planning of transport infrastructure.

Furthermore, trends such as autonomous vehicles and intelligent transport systems are discussed.

Professional competences:

The students:

- Name the basics of planning and controlling company logistics
- Assess transport systems of companies
- Name methods and approaches of computer aided transport systems and classify them
- Characterise software to plan complex logistics

Methodological competences:

The students:

- Display topics and concepts of transport systems
- Simulate transport and its systems with appropriate methods

Social competences:

The students:

- Work in groups
- Discuss their results appropriately

Self-competences:

The students:
- Realise their limits while working on a project containing aspects of modelling and implementation
- Question the presentation of their results

Content of the module:

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

Suggested reading:

Suggested reading:
Verkehrsdynamik und -simulation: Daten, Modelle und Anwendungen der Verkehrsflussdynamik von Martin Treiber und Arne Kesting von Springer, Berlin, 2010
Produktion und Logistik (Springer-Lehrbuch) von Hans-Otto Günther und Horst Tempelmeier von Springer, Berlin (Taschenbuch - Juni 2009)

Comments:
-

Weblink:
http://wi-ol.de

Prerequisites for admission:
-

Helpful previous knowledge:
Produktionsorientierte Wirtschaftsinformatik

Associated with the module(s):
-

Maximum number of students / selection criteria: unlimited

Types of examinations: Exercises and written exam

Examination periods: at the end of the lecture period

Registration procedure: Stud.IP

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Wirtschaftsinformatik	*Kategorie:* - Akzentsetzungsmodul Bereich Wirtschaftsinformatik *Degree award:* - Master
Emphases: SE	*Sections:* - Angewandte Informatik
Module reference number/Title: - inf657 Product Engineering	
Duration: 1 semester *Cycle:* once a year *Type of module:* compulsory elective *Level:* AS (advanced curriculum) *This module should be taken in* 2nd semester	*Type of program:* V (2 semester hours), Ü (2 semester hours) *Language:* German *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Michael Sonnenschein, Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr.-Ing. Axel Hahn
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:*

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

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

Methodological competences:
The students:
- Learn and try out project management concepts
- Learn and recognise the connections of different development concepts from different fields, e.g. mechanical engineering, control engineering, microelectronics and software engineering
- Develop own products with creativity techniques
- Schedule and organise the product development supported by project management techniques independently
- Learn the systematic refining of their own product idea with SysML
- Design and test products with state-of-the-art CAD-applications

Social competences:
The students:
- Impart their structure and mode of action to other people
- Develop their own products in small teams
- Present their solutions to groups
- Integrate criticism to their solutions
- Support other groups by giving appropriate criticism

Self-competences:
The students:
- Recognise and reflect their own limitations to get familiar and to plan a project in an unknown field (e.g. maritime construction/industries)

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

Suggested reading:
Ehrlenspiel (2003): Integrierte Produktentwicklung
Ophey (2005): Entwicklungsmanagement. Methoden in der Produktentwicklung.

Comments:
The lecture material contains English parts

Weblink:
-

Prerequisites for admission:
-

Helpful previous knowledge:
- Software Engineering (UML / SysML)
- Kreativitätstechniken
- Projektmanagement
- 3D Modellierung

Associated with the module(s):
-

Maximum number of students / selection criteria: unlimited

Types of examinations: written exam or oral exam, or written documentation or Presentation or Porfolio

Examination periods: At the end of the lecture period

Registration procedure: Stud.IP

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Engineering of STS	*Kategorie:* - Mastermodule *Degree award:* - Master
Emphases: HCI, embBCI, SE	*Sections:*
Module reference number/Title: ## - inf663 Application Area Maritime	
Duration: 1 semester *Cycle:* once a year *Type of module:* mandatory *Level:* BC (base curriculum) *This module should be taken in* 1st semester	*Type of program:* V (2 semester hours), S (2 semester hours) *Language:* English *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Axel Hahn
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:*

Objective of the module / skills:

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

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

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

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

Content of the module:

The module consists of a lecture and an exercise part: Lecture: - Maritime Transportation in global and local supply chains, Base concepts of ship handling and navigation, maritime system dynamics, bridge resource management, eNAvigation and high automation systems. Seminar: Covering aspects of maritime transportation	
Suggested reading: Bernhard Berking, Werner Huth (Herausgeber), Handbuch Nautik 1: Navigatorische Schiffsführung, Seehafen Verlag, 2010	
Comments: - *Weblink:* - *Prerequisites for admission:* -	*Helpful previous knowledge:* - *Associated with the module(s):*
Maximum number of students / selection criteria: *Types of examinations:* oral exam and documentation *Examination periods:* *Registration procedure:*	

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Engineering of STS	*Kategorie:* - Mastermodule *Degree award:* - Master
Emphases: embBCI	*Sections:* -
Module reference number/Title: - inf973 Psychological practicum fNIRS, EEG	
Duration: 1 semester *Cycle:* once a year *Type of module:* mandatory *Level:* AC (Accentuation module) *This module should be taken in* 1st semester	*Type of program:* P (4 semester hours) *Language:* English *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Jochem Rieger
Alternative person(s) responsible for this module: The Teachers of the module	*Examiner(s):* The Teachers of the module
Objective of the module / skills: *Professional competences:* The students: - will acquire Knowledge of planning, performing, and analysis of a neurocognitive study *Methodological competences:* The students: - learn to arrange a scientific report - be taught in the methods of psychophysiology, e.g. EEG, MEG, fMRI, or fNIRS *Social competences:* The students: - will work within a team *Self-competences:* The students: - will have to apply time management	
Content of the module: The module consists of a practical part. The students will obtain knowledge of literature search, comprehension of scientific texts. They will acquire skills in conducting experimental research.	
Suggested reading: - Luck, S.J. (2005) An Introduction to the ERP Technique. The MIT Press. - Grouard et al. (2010) From brain signals to adaptive interfaces: using fNIRS in HCI. In: Tan, Desney (ed.) Brain Computer Interfaces. Springer.	
	Helpful previous knowledge: -

	Associated with the module(s):
Maximum number of students / selection criteria: 6 *Types of examinations:* Presentation *Examination periods:* End of semester *Registration procedure:* StudIP and examination management	

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Engineering of STS	*Kategorie:* - Mastermodule *Degree award:* - Master
Emphases: embBCI	*Sections:* -
Module reference number/Title: - inf974 Human Computer Interaction and Brain Computer Interfacing	
Duration: 2 semester *Cycle:* once a year *Type of module:* compulsory elective *Level:* MM (master module) *This module should be taken in* 3rd Semester	*Type of program:* V (2 semester hours), TPS (2 semester hours) *Language: Englisch* *Attainable credit points:* 6,00 CP *Workload:* 180 hours *Required attendance:* 56 hours
Person responsible for the program: Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Jochem Rieger, Andreas Lüdtke
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:* -

Objective of the module / skills:
Professional competences:
The students:
-Human computer interaction (HCI) in its interdisciplinary requirements focusing on the perspective from neurocognitive psychology.
-Basic knowledge of Brain Computer Interfacing

Methodological competences:
The students:
-Will acquire basic knowledge of neuroimaging and data analysis techniques.
-Will acquire *Methodological competences:* required for deriving statistical models to link brain and cognition/behavior.
-Will acquire skills and knowledge to critically reflect basic science theories in naturalistic context.

Social competences:
Special social skills are not acquired

Self-competences:
The students will have knowledge of common experimental designs, data acquisition, and analysis methods and will have an insight of how to chose appropriate methods for their specific experiment. They are able to design and run a simple HCI/BCI experiment.

Content of the module:
The module consists of a lecture and an exercise part:
Lecture:
- Background and concepts of cognitive psychology relevant for human computer interaction
- Sensation, perception, action
- Data acquisition and processing methods for brain computer interfacing.

Suggested reading: • Dornhege et al. (2007) Toward Brain Machine Interfacing, The MIT-Press	
Comments: The module will start every summer term with part 1. Part 2 will be offered in the winter term. *Weblink:* - *Prerequisites for admission:* Enrolment in Master's program Neurocognitive Psychology or other programs related to the field (e.g. computer science, physics etc.).	*Helpful previous knowledge:* Knowledge in statistical data analysis techniques and/or programming (e.g. Module N) is desirable *Associated with the module(s):*
Maximum number of students / selection criteria: *Types of examinations:* Portfolio *Examination periods:* At the end of the lecture period *Registration procedure:* Stud.IP	

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Informatik	*Kategorie:* - Kernmodule *Degree award:* - Master
Emphases: SE	*Sections:* -
Module reference number/Title: - inf900 Project Group	
Duration: 2 semester *Cycle:* every 6 months *Type of module:* mandatory *Level:* AS (advanced curriculum) *This module should be taken in* 1st semester und/oder 2nd semester und/oder 3rd semester	*Type of program:* PG (8 semester hours) *Language:* German, English *Attainable credit points:* 24,00 CP *Workload:* 720 hours *Required attendance:* 112 hours
Person responsible for the program: Prof. Dr. Michael Sonnenschein, Prof. Dr. Andreas Hein, Prof. Dr. Jorge Marx Gomez, Prof. Dr. Martin Fränzle	*Person responsible for this module:* The module teachers
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:*

Objective of the module / skills:

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

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

Professional competences:

The students:
- Characterise and apply computer science basics (algorithms, data structures, programming, basics of practical, technical and theoretical computer science)
- Define und describe essential mathematical, logical and physical basics of computer science
- Define and illustrate the core disciplines of computer science (theoratical, practical and technical computer science)

Methodological competences:

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

Social competences:

The students:
- Integrate criticism into their own actions

- Respect team decisions
- Communicate with users and experts convincingly

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

Content of the module:
Cooperative development of a large-scale computer science project. This project general includes the (further) development of a hard or software system.

Suggested reading:
according to the assigned task

Comments: - *Weblink:* - *Prerequisites for admission:* -	*Helpful previous knowledge:* - *Associated with the module(s):* -

Maximum number of students / selection criteria: unlimited

Types of examinations: Active involvement, presentation, final report, project assessment

Examination periods:
-

Registration procedure: Stud.IP

Fakultät 2: Informatik, Wirtschafts- und Rechtswissenschaften Department für Informatik *Subject:* Wirtschaftsinformatik	*Kategorie:* - Mastermodule *Degree award:* - Master
Emphases SE	*Sections:* -
Modulkennziffer/Titel: - inf903 Research Project I	
Duration: 1 semester *Cycle:* *Type of module:* *Level:* *This module should be taken in*	*Type of program:* P *Language:* German, English *Attainable credit points:* 12 CP *Workload:* 360 *Required attendance:*
Person responsible for the program: Prof. Dr. Marx Gomez, Prof. Dr. Martin Fränzle	*Person responsible for this module:* Prof. Dr. Axel Hahn
Alternative person(s) responsible for this module: The teachers of the module	*Examiners(s):* The teachers of the module*:*

Ziele des Moduls/Kompetenzen:

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

Professional competences:s:

the students will extend their competences in the required technologies of the research area.

Methodological competences:s:

the students will extend their competences in scientific methodologies, methods, and tools regarding the research area.

Social competences:

Social competences are extended due to the integration in the working group of the supervisor of the work and include the presentation and discussion of the results within the working group.

Self competences:s:s

- Recognise their abilities and extend them purposefully
- Reflect their self-perception and actions with regard to professional, methodological and social aspects
- Develop and reflect self-developed hypothesis to theories independently
- Work in their field independently

Inhalte des Moduls:

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

Literatur:

Comments: - *Weblink:* - *Prerequisites for admission:* -	*Helpful previous knowledge:* - *Associated with the module(s):* -
Maximum number of students / selection criteria: unlimited *Types of examinations:* Project *Examination periods:* *Registration procedure:* Stud.IP	

Abschlussmodul

Faculty II Department of Computing Science *Fach:* 2.01 Informatik	*Studiengang/Abschluss:* Master Informatik
Emphases: HCI, embBCI, SE	*Section:* Practical Computing Science
Module reference number: - mam Masterabschlussmodul	
Duration: 1 semester *Cycle:* semi-annual *Type of module:* compulsory *Level:* Abschlussmodul *This module should be taken in:* *4th semester*	*Type of program: (Amount VL – Ü – Tut – SE – PG – P)* *MA+S* *Language of program: German* *Attainable credit-points:* 30,00 KP *Workload: 900 hours* *Required attendance: 28 hours*
Person responsible for the program: Prof. Dr. Marx Gomez, Prof. Dr. Michael Sonnenschein, Prof. Dr. Martin Fränzle	*Person responsible for this module:* Lecturers of the Department of Computer Science
Examiners Lecturers of the study program	*Alternative person(s) responsible for this module* Lecturers of the study program

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

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

Methodological competences:s:
The students:
- Identify and develop one or more solutions
- Evaluate and apply tools, technology and methods sophisticatedly

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

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

Self-competences:s:
The students:
- Pursue the overall and special computer science development critically
- Implement innovative professional activities effectively and independently

- Recognise their abilities and extend them purposefully
- Reflect their self-perception and actions with regard to professional, methodological and social aspects
- Develop and reflect self-developed hypothesis to theories independently
- Work in their field independently

Content of the Module: *The content of this module is an independent topic research. The research findings will be presented and discussed in a master's thesis colloquium.*

Suggested reading:

Comments: *Weblink:* *Prerequisites for admission:*	*Helpful previous knowledge:* *Associated with the module(s):*

Maximum number of students / selection criteria: unlimited
Type of examinations: *Master's thesis, presentation and discussion.*

Examination periods:

Registration procedure: Prüfungsamt
Weblink for additional information: