Universität Rostock

Traditio et Innovatio

Module Handbook

Master Computer Science International

Unofficial translation of the german module handbook.

Please note that only the german version is legally binding.

This page is intentionally left blank.

Content

This page is intentionally left blank.

Advanced Artificial Intelligence: Artificial Neural Networks

Category	Content
Name of Module in German	Weiterführende Themen der Künstlichen Intelligenz: Künstliche Neuronale Netze
Credit Points	6
Responsible for the Module	IEF/IN/VAC/Mobile Multimediale Informationssysteme
Contact	Prof. Dr.-Ing. Thomas Kirste / Dr. rer. nat. Sebastian Bader
Language	English
Admission Restriction	None
Level of Module	Master – advanced
Mandatory Prerequisites	None
Recommended Prerequisites	Knowledge of • signal processing • programming in Python • machine learning • artificial intelligence
Related Curricula	M.Sc. Computer Science International M.Sc. Informatik M.Sc. Wirtschaftsinformatik
Duration of Module	1 semester
Start / Regular Cycle	Summer semester, irregularly
Learning and Qualification Objectives	Artificial neural networks (ANNs) play an important role for many modern AI systems. In some application areas they even outperform humans on selected tasks. Based on interconnected simple computational units (neurons) complex behavior emerges. Training algorithms can be used to fine-tune the internal parameters of a network based on available training data. The module covers the mathematical foundations as well as practical aspects. The students will learn how to solve a given classification or regression problem using state of the art neural architectures. Technical: • Foundations and theory of artificial neural networks • Simple perceptrons • Feed-forward neural networks • Recurrent neural networks • Hopfield networks • Selected deep architectures • Self-explanation capabilities of neural networks Methodical: • Competence to select an appropriate neural architecture and a corresponding training algorithm • Competence to select and fine-tune hyperparameters Social: • Competence to work together in groups • Ability to discuss complex problem statements

	• Ability to evaluate the performance and generalization capabilities of a given neural network • Assessment of reliability and self-explanation capabilities
Teaching Content	• Biological and physical foundations of artificial neural networks • Perceptron and delta rule • Feed-forward networks and backpropagation • Hopfield networks and Hebbian learning • Deep neural networks • Self-explanation of neural networks • Reliability and generalization capabilities of neural networks
Literature	Preparatory: • R. Rojas. *Neural Networks – A systematic Introduction*. Springer (Berlin), 1996. • A. Géron. *Hands-on Machine Learning with Scikit-Learn & Tensorflow*. O'Reilly 2017 • I. Goodfellow, Y. Bengio, A. Courville. Deep Learning. MIT Press 2016 Accompanying: Will be announced in the lecture.
Associated Courses	Integrated Course 4 semester hours Total 4 semester hours
Learning Methods	• Lecture with slides and whiteboard presentation, • Interactive discussion during lectures and tutorial sessions • working in groups, solving exercises, • implementation of examples, self-study
Student Workload	Attendance Time 60 hours Preparation and Follow Up Work 30 hours Structured Self-Study 20 hours Exercises 30 hours Practice 0 hours Preparation of Exam and Exam 40 hours Total 180 hours
Exam Prerequisites	None
Examinations	Oral or written exam (announcement at latest in 2nd week of semester)
Standard Examination Date	cf. SPSO
Evaluation	cf. SPSO
Notes	None
Module Number	

Applications of Enterprise Modeling (AEM)

Category	Content
Name of Module in German	Anwendungen der Unternehmensmodellierung
Credit Points	6
Responsible for the Module	IEF/IIN/Wirtschaftsinformatik
Contact	Prof. Dr.-Ing. Kurt Sandkuhl
Language	German, English
Admission Restriction	None
Level of Module	Master course - basic
Mandatory Prerequisites	None
Recommended Prerequisites	Basic knowledge in enterprise modeling or business process modeling
Related Curricula	M.Sc. Computer Science International M.Sc. Informatik M.Sc. Wirtschaftsinformatik
Duration of Module	1 semester
Start / Regular Cycle	Summer semester, irregularly
Learning and Qualification Objectives	The students will gain advanced knowledge in goals, approaches, methods and technologies of enterprise modeling in businesses and public administration. The course covers the following application fields of enterprise modeling: • Knowledge of modeling methods plus notations and tools • Knowledge of standards and frameworks • Abilities for analysis and usage of an enterprise model • Understanding of quality aspects of enterprise models
Teaching Content	The course covers the following for selected areas of enterprise modeling: • Methods of modeling, including notations, tools and procedures • Analysis of enterprise models • Quality aspects of enterprise modeling • Frameworks and standards
Literature	Literature for preparing for the module: Chapters 1 to 9 of the following book: Sandkuhl, K.; Stirna, J.; Persson, A.; Wißotzki, M. (2014) Enterprise Modeling: Tackling Business Challenges with the 4EM Method (The Enterprise Engineering Series). Springer Verlag, Berlin Heidelberg. ISBN 978-3662437247. Literature used in the module: Chapters 10 to 16 of the following book: Sandkuhl, K.; Stirna, J.; Persson, A.; Wißotzki, M. (2014) Enterprise Modeling: Tackling Business Challenges with the 4EM Method (The Enterprise Engineering Series). Springer Verlag, Berlin Heidelberg. ISBN 978-3662437247. Additional literature: see current bibliography of the course
Associated Courses	Integrated Course 4 semester hours Total 4 semester hours
Learning Methods	Lecture with slides and whiteboard presentation,

	literature work, structured individual study, group work, discussion, presentations	
Student Workload	Attendance Time	56 hours
	Preparation and Follow Up Work	28 hours
	Structured Self-Study	32 hours
	Exercises	8 hours
	Practice	8 hours
	Preparation of Exam and Exam	48 hours
	Total	180 hours
Exam Prerequisites	None	
Examinations	1. Examination: Written assignment (15 pages) addressing a selected topic in enterprise modeling applications - accounts for 66,6% of the final grade 2. Examination: Colloquium (20 minutes) – accounts for 33,4% of the final grade.	
Standard Examination Date	cf. SPSO	
Evaluation	cf. SPSO	
Notes	None	
Module Number	1151170	

Big Data Processing (BDP)

Category	Content
Name of Module in German	Big Data Processing
Credit Points	6
Responsible for the Module	IEF/IN/IFI/Datenbank- und Informationssysteme
Contact	Dr.-Ing. Holger Meyer, Prof. Dr. Andreas Heuer
Language	English
Admission Restriction	None
Level of Module	Master – basic
Mandatory Prerequisites	None
Recommended Prerequisites	Basic knowledge of database systems
Related Curricula	M.Sc. Computer Science International M.Sc. Informatik
Duration of Module	1 semester
Start / Regular Cycle	Summer semester, irregularly
Learning and Qualification Objectives	Big Data Processing will focus on the following topics: • Distributed and parallel databases: Data that was previously stored centrally is distributed horizontally and vertically to various computer nodes. The effects on design principles, transaction procedures, lock protocols and query optimization are explained. • Parallel analysis of large amounts of data: Processing principles for the parallel analysis of distributed data are discussed, such as map/reduce and frameworks for data flow programming. Furthermore, it will be discussed how such analyses can be processed in a data-efficient and thus privacy-aware manner by means of vertical distribution of the algorithms. • Data stream processing: When processing sensor data on the Internet of Things or in large-scale scientific experiments, new data is generated every second that has to be processed. Conventional database technologies are not suitable in such an environment. The lecture discusses concepts of streaming data management, which can filter, compress and analyze data streams. Technical: • Knowledge of the essential terms, techniques and approaches in a research field of database technology Methodical: • Application of the typical methods for solving problems in a relevant research field of database technology • Ability to classify practical or applied facts into the basic concepts and methods of database technology Self and Social: • Competence to work together in groups • Ability to discuss complex problem statements in a relevant

	field of research of database technology
Teaching Content	• Distributed Databases • Distributed Design • Distributed Query Processing • Distributed Transactions • Parallel Databases • Parallel Query Processing • Data Distribution Techniques • NoSQL-Sharding • MapReduce: Applications from Big Data Analytics • Systems NoSQL, Hadoop, Spark • Replication and Consistency • Cloud Databases • Stream Processing • Stream Databases and Stream Query Processing
Literature	Preparatory: • Heuer, Saake, Sattler: Datenbanken – Implementierungstechniken, 4.Auflage, MITP, 2019; Chapters 1 to 13 • Garcia-Molina, Ullman, Widom: Database Systems – The Complete Book, 2nd Edition, Pearson International, 2009, Chapters 13 to 19 • Elmasri, Navathe: Fundamentals of Database Systems, 7th Edition, Pearson Global Ed., 2017, Chapters 16 to 22 Accompanying: • M. Tamer Oszu, Patrick Valduriez: Principles of Distributed Database Systems, Third Edition, Springer, 2011. • Erhard Rahm, Gunter Saake, Kai-Uwe Sattler: Verteiltes und Paralleles Datenmanagement – Von verteilten Datenbanken zu Big Data und Cloud. Springer Vieweg, 2015.
Associated Courses	Integrated Course 4 semester hours Total 4 semester hours
Learning Methods	Lecture with slides and whiteboard presentation, working in groups, solving exercises, discussion, implementation of examples, self-study
Student Workload	Attendance Time 60 hours Preparation and Follow Up Work 30 hours Structured Self-Study 20 hours Exercises 30 hours Practice 0 hours Preparation of Exam and Exam 40 hours Total 180 hours
Exam Prerequisites	None
Examinations	Oral or written exam (announcement at latest in 2nd week of semester)
Standard Examination Date	cf. SPSO
Evaluation	cf. SPSO
Notes	None
Module Number	

Cloud Computing (CC)

Category	Content
Name of Module in German	Cloud Computing
Credit Points	6
Responsible for the Module	IEF/IN/IFI/Architektur von Anwendungssystemen
Contact	Prof. Dr.-Ing. habil. Gero Mühl
Language	English
Admission Restriction	None
Level of Module	Master - basic
Mandatory Prerequisites	None
Recommended Prerequisites	Basic knowledge of distributed systems
Related Curricula	M.Sc. Computer Science International M.Sc. Informationstechnik / Technische Informatik M.Sc. Wirtschaftsinformatik
Duration of Module	1 semester
Start / Regular Cycle	Winter semester, irregularly
Learning and Qualification Objectives	Cloud computing is a new paradigm for distributed systems that allows to flexibly use hard- and software components over a network such as the Internet. It is, for example, possible to deal with load peaks of applications that run in the cloud by dynamically scaling compute, memory, and network resources at runtime, while still paying only for the actually used resources. Cloud computing does not only change the development and the architecture of future application systems, but also the related business processes and models. The lecture gives an overview of the concepts and architectures in the area of cloud computing and deals with different cloud-based approaches. Underlying technologies, such as virtualization and map reduce, are introduced and their role in the cloud architecture is discussed. Programming models for the cloud and current developments are also considered. Technical: • Understanding of the architectures and concepts in the area of cloud computing • Knowing the complex interaction of virtual machine monitors and virtual machines • Getting an insight into how to realize dependable and performant systems Methodical: • Competence to analyze complex problems and to solve them by the help of cloud computing Social: • Competence to work together in groups • Ability to discuss complex problem statements

	Self: • Becoming aware of the complexity of distributed systems • Knowing the chances and risks of cloud computing	
Teaching Content	• Overview of cloud computing • Infrastructure as a Service (IaaS) • Platform as a Service (PaaS) • Virtualization • Storage • Dependability • Performance Modeling • Map Reduce	
Literature	Preparatory: A. S. Tanenbaum and M. van Steen. *Distributed Systems: Principles and Paradigms*. Creative Space Independent Publishing Platform (3rd Edition), 2016. Accompanying: Will be announced in the lecture.	
Associated Courses	Integrated Course Total	4 semester hours 4 semester hours
Learning Methods	Lecture with slides and whiteboard presentation, working in groups, solving exercises, discussion, implementation of examples, self-study	
Student Workload	Attendance Time Preparation and Follow Up Work Structured Self-Study Exercises Practice Preparation of Exam and Exam Total	60 hours 30 hours 20 hours 30 hours 0 hours 40 hours 180 hours
Exam Prerequisites	None	
Examinations	Oral or written exam (announcement at latest in 2nd week of semester)	
Standard Examination Date	cf. SPSO	
Evaluation	cf. SPSO	
Notes	None	
Module Number		

Cognitive Systems

Category	Content
Name of Module in German	Cybersecurity
Credit Points	6
Responsible for the Module	IEF/IN/IFI/Praktische Informatik
Contact	Prof. Dr. Alke Martens
Language	English
Admission Restriction	None
Level of Module	Master – basic
Mandatory Prerequisites	None
Recommended Prerequisites	None
Related Curricula	M.Sc. Computer Science International M.Sc. Informatik M.Sc. Wirtschaftsinformatik B.Sc. Medizinische Informationstechnik
Duration of Module	1 Semester
Start / Regular Cycle	Summer semester, irregularly
Learning and Qualification Objectives	Goal of this lecture is to mediate the basic knowledge from the field of Cognitive Science. After participating this lecture, students should be able to make a relation between the fundamental insights in psychological Cognitive Science and current research in Computer Science, e.g. in Artificial Intelligence. Students should be able to describe ways of human information processing and to map those to the ways of information processing in the computer. They can describe basic models of Cognitive Science and are able to develop simple cognitive models on their own. They are able to develop knowledge models for computers.
Teaching Content	Cognitive Science has its roots in psychology, linguistic, philosophy and in computer science. Nowadays, quite a lot information processing or knowledge processing models are funded on psychological insights from the field of Cognitive Science. In this lecture, we will give an introduction to the broad field of Cognitive Science, covering aspects of human cognition and how these aspects have been used for computer models of cognition. We learn about psychological and medical basics and follow the path to artificial intelligence (AI). Models for information processing and knowledge elicitation will be introduced and investigated. The examples used in this lecture are related to current trends in AI research, same as to expert systems development, which is a rather traditional field in modeling cognition.
Literature	More literature will be announced in the lecture. Eysenck, M.W. Cognitive Psychology: A Student's Handbook, Taylor & Francis, 2015 Anderson, J.R. Cognitive Psychology and its Implications, Worth, 2014
Associated Courses	Lecture 3 semester hours Exercises 1 semester hours Total 4 semester hours

Learning Methods	Lecture with slides and whiteboard presentation, working in groups, solving exercises, interactive discussion, implementation of examples, self-study	
Student Workload	Attendance Time	60 hours
	Preparation and Follow Up Work	30 hours
	Structured Self-Study	20 hours
	Project tasks	30 hours
	Preparation of Exam and Exam	40 hours
	Total	180 hours
Exam Prerequisites	None	
Examinations	Oral exam or written exam (announcement at latest in 2nd week of semester)	
Standard Examination Date	cf. SPSO	
Evaluation	cf. SPSO	
Notes	None	
Module Number		

Computer Vision (CV)

Category	Content
Name of Module in German	Computer Vision
Credit Points	6
Responsible for the Module	IEF/IN/VAC/Visual Computing
Contact	Prof. Dr. sc. techn. Oliver Staadt
Language	English
Admission Restriction	None
Level of Module	Master - basic
Mandatory Prerequisites	None
Recommended Prerequisites	Basic knowledge of computer graphics; linear algebra and vector calculus
Related Curricula	M.Sc. Computer Science International M.Sc. Informationstechnik / Technische Informatik M.Sc. Mathematik M.Sc. Computational Science and Engineering 27.02.2018 M.Sc. Computational Science and Engineering 28.09.2016 M.Sc. Mathematik 15.07.2019 M.Sc. Mathematik 26.09.2018 M.Sc. Mathematik 27.05.2015 M.Sc. Visual Computing 28.09.2016
Duration of Module	1 semester
Start / Regular Cycle	Winter semester
Learning and Qualification Objectives	Technical: • Comprehensive and in-depth knowledge in the field of computer vision Methodical: • Specialization of the individual method portfolio in the field of computer vision Social: • Ability to discuss complex problem statements Self: • Specialization according to individual job expectations
Teaching Content	• Image Formation • Image Processing • Feature Detection and Matching • Image Stitching • Computational Photography • Stereo Correspondence • 3D Recognition • Image-based Rendering Further topics result from the further development of the subject area and from new research perspectives.
Literature	D. Forsyth, *Computer vision: A modern approach,* 2nd ed. Boston: Pearson, 2012. Accompanying: Will be announced in the lecture.

Associated Courses	Lecture	3 semester hours
	Projects	1 semester hours
	Total	4 semester hours
Learning Methods	Lecture with slides and whiteboard presentation, discussion, implementation of examples, self-study	
Student Workload	Attendance Time	60 hours
	Preparation and Follow Up Work	0 hours
	Structured Self-Study	100 hours
	Exercises	0 hours
	Practice	0 hours
	Preparation of Exam and Exam	20 hours
	Total	180 hours
Exam Prerequisites	None	
Examinations	Oral or written exam (announcement at latest in 2nd week of semester)	
Standard Examination Date	cf. SPSO	
Evaluation	cf. SPSO	
Notes	None	
Module Number	1151030	

Contemporary Topics in Business Information Systems (CBIS)

Category	Content	
Name of Module in German	Aktuelle Themen der Wirtschaftsinformatik	
Credit Points	6	
Responsible for the Module	IEF/IIN/Wirtschaftsinformatik	
Contact	Prof. Dr.-Ing. Kurt Sandkuhl, Prof. Dr. Michael Fellmann, Dr. Birger Lantow	
Language	German, English	
Admission Restriction	None	
Level of Module	Master course – basic	
Mandatory Prerequisites	None	
Recommended Prerequisites	Basic knowledge in research methodologies	
Related Curricula	M.Sc. Computer Science International M.Sc. Informatik M.Sc. Wirtschaftsinformatik	
Duration of Module	2 semesters	
Start / Regular Cycle	Every semester	
Learning and Qualification Objectives	Students acquire knowledge of current methodological, technological or application-oriented developments in business information systems with relevance for industry, service providers and public institutions. Students can describe the causes and effects of these developments and evaluate the associated innovations and possible use cases. Social implications of contemporary developments and ethical aspects are discussed. Students can independently analyze current issues and present their results in a structured way in written and oral form.	
Teaching Content	At the beginning, individual questions on selected current developments in business information systems will be presented in an overview in order to familiarize students with them. Details and concretization of the underlying methods, technologies or applications are then worked out by the students in small groups and discussed in the module. The individual contents are indicated at the beginning of each semester.	
Literature	Literature for preparing for the module: none Literature used in the module: Due to the dynamic nature of the course, the literature changes depending on the contemporary topics discussed in the semester	
Associated Courses	Integrated Course	4 semester hours
	Total	4 semester hours
Learning Methods	Literature work, structured individual study, group work, discussion, presentations, lectures with slides and whiteboard presentation,	
Student Workload	Attendance Time	56 hours
	Preparation and Follow Up Work	28 hours
	Structured Self-Study	32 hours
	Exercises	0 hours
	Practice	0 hours
	Preparation of Exam and Exam	64 hours
	Total	180 hours
Exam Prerequisites	None	

Examinations	1. Examination: Written assignment (15 pages) addressing a selected topic in enterprise modeling applications - accounts for 50% of the final grade 2. Examination: Colloquium (20 minutes) – accounts for 50% of the final grade.
Standard Examination Date	cf. SPSO
Evaluation	cf. SPSO
Notes	None
Module Number	1151140

Cybersecurity

Category	Content
Name of Module in German	Cybersecurity
Credit Points	6
Responsible for the Module	IEF/IN/IFI/Informations- und Kommunikationsdienste
Contact	Prof. Dr. Clemens Cap
Language	English
Admission Restriction	None
Level of Module	Master – basic
Mandatory Prerequisites	None
Recommended Prerequisites	None
Related Curricula	M.Sc. Computer Science International M.Sc. Informatik M.Sc. Wirtschaftsinformatik
Duration of Module	1 Semester
Start / Regular Cycle	Summer semester, irregularly
Learning and Qualification Objectives	Knowledge and skills in the area of data and information security, in cryptographic and organizational procedures to secure computing systems and networks; ability to analyze the security level of IT systems, including technical, social and organizational aspects
Teaching Content	• Security analysis • Access control • Authentication • Anonymous communication • Symmetric and asymmetric encryption • Digital signatures • Biometric authentication • Zero knowledge protocols • Security models • Social engineering • Current security incidents • Blockchain technology • Emergency procedures • Additional topics as necessary by the fast development in the area
Literature	Script and literature list in the lecture.
Associated Courses	Lecture 3 semester hours Exercises 1 semester hours Total 4 semester hours
Learning Methods	Lecture with slides and whiteboard presentation, working in groups, solving exercises, discussion, implementation of examples, self-study
Student Workload	Attendance Time 60 hours Preparation and Follow Up Work 30 hours Structured Self-Study 20 hours Project tasks 30 hours Preparation of Exam and Exam 40 hours Total 180 hours
Exam Prerequisites	Solution of project tasks and presentation of the solution

	(number and conditions for passing announced in second week of the lecture)
Examinations	Oral exam (20 min) or written exam (120 min) (announcement at latest in 2nd week of semester)
Standard Examination Date	cf. SPSO
Evaluation	cf. SPSO
Notes	None
Module Number	

Data-Driven Simulation (DDS)

Category	Content
Name of Module in German	Datengetriebene Simulation
Credit Points	6
Responsible for the Module	IEF/IN/VAC/Modellierung und Simulation von Informatik-Systemen
Contact	Prof. Dr. rer.nat. habil. Adelinde Uhrmacher
Language	English
Admission Restriction	None
Level of Module	Master – basic
Mandatory Prerequisites	None
Recommended Prerequisites	Basic knowledge of modeling and simulation, basics of statistics
Related Curricula	M.Sc. Computer Science International M.Sc. Informatik M.Sc. Wirtschaftsinformatik M.Sc. Visual and Analytic Computing
Duration of Module	1 semester
Start / Regular Cycle	Winter semester, irregularly
Learning and Qualification Objectives	Data play a central role in modeling and simulation. To analyze, calibrate, and validate a simulation model, a multitude of different simulation experiments can be executed which rely on diverse data. At the same time, these simulation experiments may reveal important information about the data. The lecture gives an overview of experiment design methods, data analysis methods, as well as different types of simulation experiments, including sensitivity analysis, statistical model checking, optimization, parameter estimation and uncertainty quantification. Workflow and provenance methods support the replicability of simulation studies and the assessment of simulation products. Technical: • Understanding the concepts in the area of DDS • Knowing methods and techniques for data driven applications and simulation studies • Learning methods that support reproducibility of science • Getting an insight into standards and products in the area of DDS Methodical: • Competence to analyze complex problems and in developing suitable solutions using DDS methods Social: • Competence to work together in groups • Ability to understand, and discuss complex problems • Challenges in reproducible sciences

	Self: • Becoming aware of the complexity of simulation studies and the challenge of conducting valid and reproducible simulation studies
Teaching Content	• Input and output analysis for stochastic models • Work smarter not harder: experiment design methods • Specifying simulation models and simulation experiments: a case for domain-specific languages • Optimization: more than hill climbing • What impact has a parameter: sensitivity analysis • Making hypotheses explicit: the virtue of statistical model checking • Bayes: statistical parameter estimation and uncertainty quantification • Credibility crises of simulation: workflow approaches and provenance • Applications: epidemiological applications, manufacturing systems
Literature	*Simulation Modeling and Analysis*, fifth edition Averill M. Law, Ph.D. McGraw-Hill, 2015, 804 pages Further literature will be announced during the lecture.
Associated Courses	Lecture 3 semester hour(s) Exercise 1 semester hour(s) Total 4 semester hour(s)
Learning Methods	Lecture with slides and whiteboard presentation, working in groups, solving exercises, discussion, implementation of examples, self-study
Student Workload	Attendance Time 60 hours Preparation and Follow Up Work 30 hours Structured Self-Study 20 hours Exercises 30 hours Practice 0 hours Preparation of Exam and Exam 40 hours Total 180 hours
Exam Prerequisites	Yes - announcement at latest in 2nd week of semester
Examinations	Oral or written exam (announcement at latest in 2nd week of semester)
Standard Examination Date	cf. SPSO
Evaluation	cf. SPSO
Notes	None
Module Number	

Data Warehouses, Business Intelligence und Data Mining

Category	Content
Name of Module in German	Data Warehouses, Business Intelligence und Data Mining
Credit Points	6
Responsible for the Module	IEF/IN/IFI
Contact	apl. Prof. Dr.-Ing. habil. Meike Klettke
Language	English or German
Admission Restriction	None
Level of Module	Master - basic
Mandatory Prerequisites	None
Recommended Prerequisites	Basic knowledge of database management systems
Related Curricula	M.Sc. Computer Science International M.Sc. Informatik M.Sc. Wirtschaftsinformatik
Duration of Module	1 semester
Start / Regular Cycle	Summer semester, irregularly
Learning and Qualification Objectives	In this lecture, students learn to plan, build and use Business Intelligence applications, namely data warehouse technology and data mining techniques. In Business Intelligence applications, heterogeneous datasets are integrated into Data Warehouses and used for management decisions in companies and organizations. The module introduces the basics of Data Warehouses, explains the underlying multidimensional data model, introduces different storage variants and shows how OLAP requests on Warehouse data can be formulated and executed. The ETL process for extracting and transforming data from different source databases (e.g. relational, semi structured, and NoSQL) into the multidimensional data structure of Data Warehouses is presented. Selected Data Mining methods are introduced and their implementation on raw data and on top of Data Warehouse is explained. Several application scenarios describe the interaction of the Data Warehouse components and the Data Mining method.
Teaching Content	Business Intelligence: • Application fields • Aims • Technology for BI Data Warehouses: • Multidimensional data model • Design of Data Warehouses • Relational storage (star schema, snowflake schema, full-fact, galaxy) • Multidimensional stores • Column Stores vs. Row Stores • OLAP queries, SQL extensions for Data Warehouses • Multidimensional queries (mdx) • ETL (Extraction, Transformation, Load) • Application Fields and examples

	• Data Integration • Schema and Data integration • Mapping tools Data Mining: • Association Rules • Clustering Methods • Algorithms for Classification • Case-based Reasoning • Data Mining methods of Text analysis	
Literature	Accompanying: • Han, Kamber: Data Mining. Concepts and Techniques Concepts and Techniques, Morgan Kaufmann Series in Data Management Systems, 2012 • W. H. Inmon: Building the Data Warehouse, John Wiley & Sons, 4. edition, 2005 • Abadi/Boncz/Harizopoulos: Column-Oriented Database Systems, Tutorial, VLDB 2009 • Fatemeh Nargesian, Erkang Zhu, Renée J. Miller, Ken Pu, Patricia C. Arocena, Data Lake Management: Challenges and Opportunities, Tutorial VLDB 2019	
Associated Courses	Integrated Course Total	4 semester hours 4 semester hours
Learning Methods	Lecture with slides and whiteboard presentation, working in groups, self-study	
Student Workload	Attendance Time Preparation and Follow Up Work Structured Self-Study Exercises Practice Preparation of Exam and Exam Total	56 hours 56 hours 40 hours 0 hours 0 hours 28 hours 180 hours
Exam Prerequisites	None	
Examinations	Oral or written exam (announcement at latest in 2nd week of semester)	
Standard Examination Date	cf. SPSO	
Evaluation	cf. SPSO	
Notes	None	
Module Number		

Event-Driven Architectures (EDA)

Category	Content
Name of Module in German	Ereignisgetriebene Architekturen
Credit Points	6
Responsible for the Module	IEF/IN/IFI/Architektur von Anwendungssystemen
Contact	Prof. Dr.-Ing. habil. Gero Mühl
Language	English
Admission Restriction	None
Level of Module	Master - basic
Mandatory Prerequisites	None
Recommended Prerequisites	Basic knowledge of distributed systems
Related Curricula	M.Sc. Computer Science International M.Sc. Informatik M.Sc. Wirtschaftsinformatik
Duration of Module	1 semester
Start / Regular Cycle	Summer semester, irregularly
Learning and Qualification Objectives	An event-driven architecture (EDA) is an architectural pattern that is based on the detection, distribution, and processing of events. EDAs loosely couple the components of a distributed system making large and complex systems manageable. Historically, EDAs were used, e.g., in the area of graphical user interfaces. However, due to their advantageous characteristics, they are now applied in many application areas ranging from sensor networks, over embedded systems to the orchestration of complex business processes in agile business environments. Students get to know events as a mean to structure distributed systems as well as the basic ideas, principles, and concepts of event-driven software architectures. They get a practical insight into the technological foundations as well as into the application and implementation of event-driven architectural patterns. Technical: • Understanding the concepts in the area of EDAs • Knowing methods and techniques to realize applications and to integrate applications using an EDA • Getting an insight into standards and products in the area of EDAs Methodical: • Competence to analyze complex problems and to solve them by the help of an EDA Social: • Competence to work together in groups • Ability to discuss complex problem statements

	Self: • Becoming aware of the complexity of distributed systems • Knowing the chances and risks of EDAs	
Teaching Content	• Foundations • Publish/Subscribe • Filtering Algorithms • Matching Algorithms • Content-based Routing • Models and Correctness • Adaptivity • Multicast Communication • Software-Defined Networking • Complex Event Processing • Stream Processing • Case Studies: Snoop, Esper, SQL Match-Recognize • Standards: JMS, AMQP, DDS	
Literature	Preparatory: A. S. Tanenbaum and M. van Steen. *Distributed Systems: Principles and Paradigms*. Creative Space Independent Publishing Platform (3rd Edition), 2016. Accompanying: Will be announced in the lecture.	
Associated Courses	Integrated Course	4 semester hours
	Total	4 semester hours
Learning Methods	Lecture with slides and whiteboard presentation, working in groups, solving exercises, discussion, implementation of examples, self-study	
Student Workload	Attendance Time	60 hours
	Preparation and Follow Up Work	30 hours
	Structured Self-Study	20 hours
	Exercises	30 hours
	Practice	0 hours
	Preparation of Exam and Exam	40 hours
	Total	180 hours
Exam Prerequisites	None	
Examinations	Oral or written exam (announcement at latest in 2nd week of semester)	
Standard Examination Date	cf. SPSO	
Evaluation	cf. SPSO	
Notes	None	
Module Number		

Field-specific Seminar Information Systems

Category	Content
Name of Module in German	Gebietsseminar Informationssysteme
Credit Points	6
Responsible for the Module	IEF/IN/INF/Architektur von Anwendungssystemen
Contact	Prof. Dr.-Ing. habil. Gero Mühl
Language	English
Admission Restriction	None
Level of Module	Master – advanced
Mandatory Prerequisites	None
Recommended Prerequisites	Successful participation of modules in the specialization area of complex systems with at least 12 Credit Points
Related Curricula	M.Sc. Computer Science International M.Sc. Informatik
Duration of Module	1 semester
Start / Regular Cycle	every semester
Learning and Qualification Objectives	The students work on topics covering several modules of the specialization area of complex systems by writing a paper and giving a talk. The goal is to make connections between the individual topics and to enhance especially the competence to transfer knowledge and methods. The module also prepares the students for their master thesis and deals with the topics of good scientific practice and plagiarism. Technical: • Dealing with several aspects of complex systems • Recognizing interconnections between different areas Methodical: • Finding and reading relevant scientific literature • Knowing strategies and concepts for writing a paper and giving a talk • Ability to deal with research topics independently • Empowering the students to give a scientific talk as well as to write a scientific paper • Dealing correctly with citations and avoiding plagiarism • Knowing the rules of good scientific practice Social: • Ability to contribute to complex discussions • Enabling students to critically discuss scientific talks Self: • Awareness for the effects that complex systems have on the modern society • Knowing the opportunities and limits of complex systems • Improving the ability to be criticized • Increasing the expressive skills in speaking and writing • Self-confidence and competent appearance

Teaching Content	Different specific topics in the specialization area of complex systems	
Literature	Accompanying: Will be announced in the lecture.	
Associated Courses	Seminar	2 semester hours
	Total	2 semester hours
Learning Methods	Lecture with slides and whiteboard presentation, literature research, self-study, giving talks, preparing papers, discussion	
Student Workload	Attendance Time	30 hours
	Preparation and Follow Up Work	0 hours
	Structured Self-Study	60 hours
	Exercises	0 hours
	Practice	0 hours
	Preparation of Exam and Exam	90 hours
	Total	180 hours
Exam Prerequisites	None	
Examinations	Presentation (30 minutes) and written paper (10 pages)	
Standard Examination Date	cf. SPSO	
Evaluation	cf. SPSO	
Notes	None	
Module Number		

Field-specific Seminar Complex Systems

Category	Content
Name of Module in German	Gebietsseminar Komplexe Systeme
Credit Points	6
Responsible for the Module	IEF/IN/IFIVAC/Architektur von Anwendungssystemen
Contact	Prof. Dr.-Ing. habil. Gero Mühl
Language	English
Admission Restriction	None
Level of Module	Master – advanced
Mandatory Prerequisites	None
Recommended Prerequisites	Successful participation of modules in the specialization area of complex systems with at least 12 Credit Points
Related Curricula	M.Sc. Computer Science International M.Sc. Informatik
Duration of Module	1 semester
Start / Regular Cycle	Every semester
Learning and Qualification Objectives	The students work on topics covering several modules of the specialization area of complex systems by writing a paper and giving a talk. The goal is to make connections between the individual topics and to enhance especially the competence to transfer knowledge and methods. The module also prepares the students for their master thesis and deals with the topics of good scientific practice and plagiarism. Technical: • Dealing with several aspects of complex systems • Recognizing interconnections between different areas Methodical: • Finding and reading relevant scientific literature • Knowing strategies and concepts for writing a paper and giving a talk • Ability to deal with research topics independently • Empowering the students to give a scientific talk as well as to write a scientific paper • Dealing correctly with citations and avoiding plagiarism • Knowing the rules of good scientific practice Social: • Ability to contribute to complex discussions • Enabling students to critically discuss scientific talks Self: • Awareness for the effects that complex systems have on the modern society • Knowing the opportunities and limits of complex systems • Improving the ability to be criticized • Increasing the expressive skills in speaking and writing • Self-confidence and competent appearance

Teaching Content	Different specific topics in the specialization area of complex systems	
Literature	Accompanying: Will be announced in the lecture.	
Associated Courses	Seminar	2 semester hours
	Total	2 semester hours
Learning Methods	Lecture with slides and whiteboard presentation, literature research, self-study, giving talks, preparing papers, discussion	
Student Workload	Attendance Time	30 hours
	Preparation and Follow Up Work	0 hours
	Structured Self-Study	60 hours
	Exercises	0 hours
	Practice	0 hours
	Preparation of Exam and Exam	90 hours
	Total	180 hours
Exam Prerequisites	None	
Examinations	Presentation (30 minutes) and written paper (10 pages)	
Standard Examination Date	cf. SPSO	
Evaluation	cf. SPSO	
Notes	None	
Module Number		

Hardware/Software Co-Design

Category	Content	
Name of Module in German	Hardware/Software Co-Design	
Credit Points	6	
Responsible for the Module	IEF/IMD/Eingebettete Systeme	
Contact	Prof. Dr.-Ing. habil. Christian Haubelt	
Language	English	
Admission Restriction	None	
Level of Module	Master – specializing	
Mandatory Prerequisites	None	
Recommended Prerequisites	None	
Related Curricula	M.Sc. Computer Science International M.Sc. Electrical Engineering 20.04.2018	
Duration of Module	1 semester	
Start / Regular Cycle	Summer semester, regularly	
Learning and Qualification Objectives	Ability to rate hardware/software co-design methods with respect to their efficiency and performance, and apply and extend them. Ability to rate the performance and efficiency of modern system architectures Ability to rate, apply and extend design methodologies for embedded multi-processor systems with respect to performance and limitations	
Teaching Content	Embedded systems are optimized with respect to multiple and often conflicting design goals while simultaneously underlying stringent constraints, e.g., area, costs, performance, and energy consumption. The design of such complex systems results in several new problems. In particular, 1) the selection of processors, memories, and communication resources; 2) the hardware/software partitioning of the specification; 3) the automatic synthesis of interfaces and communication resources; 4) the verification. In this module the following topics are covered: Overview and comparison of architectures for MPSoCs (Multi-Processor System on Chip) and NoCs (Network on Chip) Methodologies for the design of multi-processor systems: Hardware/software partitioning / task distribution, Quality estimation methods, Performance analysis Communication synthesis: Types of communication, Synchronization, Synthesis, Design space exploration Verification and virtual prototyping	
Literature	None	
Associated Courses	Tutorial	2 semester hours
	Lecture	2 semester hours
	Total	4 semester hours
Learning Methods	None	

Student Workload	Attendance Time	60 hours
	Preparation and Follow Up Work	40 hours
	Structured Self-Study	42 hours
	Exercises	0 hours
	Practice	0 hours
	Preparation of Exam and Exam	42 hours
	Total	184 hours
Exam Prerequisites	None	
Examinations	Written exam (90 min)	
Standard Examination Date	cf. SPSO	
Evaluation	cf. SPSO	
Notes	None	
Module Number	1351610	

HCI and Interaction Design

Category	Content
Name of Module in German	Mensch-Computer-Interaktion und Interaktionsdesign
Credit Points	6
Responsible for the Module	IEF/IN/IFI/Softwaretechnik
Contact	Dr.-Ing. Anke Dittmar
Language	English
Admission Restriction	None
Level of Module	Master - basic
Mandatory Prerequisites	None
Recommended Prerequisites	None
Related Curricula	M.Sc. Computer Science International M.Sc. Informatik M.Sc. Wirtschaftsinformatik M.Sc. Visual Computing M.Sc. Computational Engineering M.Sc. Electrical Engineering M.Sc. Informationstechnik/Technische Informatik
Duration of Module	1 semester
Start / Regular Cycle	Winter semester, irregularly
Learning and Qualification Objectives	"The increasing importance of designing spaces for human communication and interaction will lead to expansion in those aspects of computing that are focused on people, rather than machinery. The methods, skills, and techniques concerning these human aspects are generally foreign to those of mainstream computer science, and it is likely that they will detach (at least partially) from their historical roots to create a new field of 'interaction design'" (T. Winograd, 1997). Technical and methodical: • Understanding essential concepts in the field of HCI and interaction design, • Knowing methods and techniques to design and evaluate interactive systems and to investigate digital artefact use, • Understand design problems from multiple perspectives, develop and assess alternative solutions, • Understand iterative development with multidisciplinary teams, integration of different design approaches. Social: • Competence to work together in groups and to face complex design problems, • Ability to discuss cognitive, cultural, and social aspects of technological change, • Ability to apply different design approaches (e.g., human-centered design). Self: • Becoming aware of the complexity of human-computer interaction and interaction design.

	• Skills in applying methods and techniques to design and understand the use of digital artefacts. • Ability to conduct research.
Teaching Content	Selected topics from Human-Computer Interaction (HCI): • Experiments in HCI • Empirical studies of artefact use • Modeling in HCI • Usability, User Experience • Theoretical Frameworks • Design approaches (e.g., User-Centered Design, Meta-Design) • Techniques and methods in Interactions Design (e.g., ideation, sketching, prototyping, personas, scenarios, model-based techniques) • Design theories • Current research topics
Literature	• Alan Dix, Janet E. Finlay, Gregory D. Abowd, and Russell Beale. Human-Computer Interaction (3rd Edition). Prentice-Hall, Inc., 2003. • Paul Cairns and Anna L. Cox, editors. Research Methods for Human-Computer Interaction. Cambridge University Press, 2008. • J. Olson, W. Kellogg (eds). Ways of Knowing in HCI. Springer, 2014. • Saffer, D. (2009). Designing for Interaction. New Riders. • Benyon, D. (2014). Designing Interactive Systems – A comprehensiveguide toHCI, UX and interaction design. Third Edition, Pearson. • Buxton, B. (2007). Sketching User Experiences. Morgan Kaufmann. • Moggridge, B. (2007). Designing Interactions. MIT Press. Accompanying: Will be announced in the lecture.
Associated Courses	Integrated Course 4 semester hours Total 4 semester hours
Learning Methods	Lecture with slides and whiteboard presentation, working in groups, solving exercises, discussion, implementation of examples, self-study
Student Workload	Attendance Time 60 hours Preparation and Follow Up Work 30 hours Structured Self-Study 20 hours Exercises 20 hours Practice 0 hours Preparation of Exam and Exam 50 hours Total 180 hours
Exam Prerequisites	None
Examinations	Part 1 (66% of the grade): Oral exam (20 minutes) or written exam (120 minutes), announcement at latest in 2nd week of semester Part 2 (33% of the grade): Report (about 10 pages)

Standard Examination Date	cf. SPSO
Evaluation	cf. SPSO
Notes	None
Module Number	

Models for Business Processes and Services

Category	Content
Name of Module in German	Modelle for Geschäftsprozesse und Services
Credit Points	6
Responsible for the Module	IEF/IN/IFI/Theoretical Computer Science
Contact	Prof. Dr. rer. nat. habil. Karsten Wolf
Language	English
Admission Restriction	None
Level of Module	Master - basic
Mandatory Prerequisites	None
Recommended Prerequisites	None
Related Curricula	M.Sc. Computer Science International M.Sc. Wirtschaftsinformatik 20.08.2018 M.Sc. Wirtschaftsinformatik 22.03.2016
Duration of Module	1 semester
Start / Regular Cycle	Summer semester
Learning and Qualification Objectives	Technical: • To know popular modeling and execution languages for business processes and services • To know techniques for synthesis, analysis, composition, and mediation of processes and services • Typical phenomena of complex systems (e.g. state explosion, concurrency) and techniques for mastering complexity (modeling, modularization, computer aided analysis, mining) Methodical: • To understand modeling and analysis as approaches for mastering complex • Ability to select and to apply suitable modeling and analysis tools for supporting the modeling process Social: • Motivation to transfer formal methods into the business world • Ability to communicate across subjects • Social, ethical, and legal aspects in the technical support of human interaction Self: • Ability to structure complex tasks
Teaching Content	Processes: • Semiformal modeling languages • Formal Modeling • Qualitative analysis (soundness) • Quantitative analysis (modeling and analyzing timed and stochastic systems) • Flexibility • Process Mining

	• Conformance Checking • Artefact centric Modeling Services: • Modeling and execution languages • Composition, Choreographies • Formal Modeling of service behavior • Basic algorithms for service behavior: correctness, mediation, substitutability, Test case generation	
Literature	Accompanying: Will be announced in the lecture.	
Lectures	Lecture	3 semester hours
	Practical Work	1 semester hour
	Total	4 semester hours
Learning Methods	Lecture with slides and whiteboard presentation	
Student Workload	Attendance Time	60 hours
	Preparation and Follow Up Work	0 hours
	Structured Self-Study	60 hours
	Exercises	0 hours
	Practice	40 hours
	Preparation of Exam and Exam	20 hours
	Total	180 hours
Exam Prerequisites	None	
Examinations	Oral exam (20 minutes) or written exam (120 minutes) to be announced before the end of the second week of lectures.	
Standard Examination Date	cf. SPSO	
Evaluation	cf. SPSO	
Notes	None	
Module Number	1150960	

Network Security

Category	Content
Name of Module in German	Netzwerksicherheit
Credit Points	6
Responsible for the Module	IEF/IN/IFI/Informations- und Kommunikationsdienste
Contact	Dr.-Ing. Thomas Mundt
Language	English
Admission Restriction	None
Level of Module	Master - specializing
Mandatory Prerequisites	None
Recommended Prerequisites	Basic knowledge about networks, security mechanisms such as authorization, authentication, encryption and digital signatures
Related Curricula	M.Sc. Computer Science International M.Sc. Informatik M.Sc. Informationstechnik / Technische Informatik
Duration of Module	1 Semester
Start / Regular Cycle	Winter Semester, irregularly
Learning and Qualification Objectives	Technically: • The participants are able to configure and operate a computer system secured against attacks via a network. • They know the generally available tools and can understand conceptually and operate them professionally. • They can recognize and defeat attacks. Methodically: • Participants can develop a security concept. • Participants can understand scientific reports about new attacks and attack vectors and draw conclusions for the improvement of the own security concept. • They are able to train other people in the basics of network security and instruct them in the safe and secure use of the system.
Teaching Content	The lecture deals with various technical and organizational aspects of network security. Technical aspects are devices like firewalls, systems for detecting intrusions, proxies, VPNs etc., which are installed and maintained to increase security. The organizational aspects are defined and to be observed work guidelines for people, which are also to increase security. • Introduction: protection goals, taxonomy of possible attacks, identification of general risks, basics of security and technical components for defence • Technical aspects: Firewalls, intrusion detection systems, proxies, virtual private networks (VPNs), public key infrastructure (PKI), network device security, computer security, network forensics • Organizational aspects: Security processes, policy and security design, policy development and application, assessment, human aspects and social engineering, policy enforcement, disaster recovery and continuity planning, certification

Literature	Literature will be announced at the first event and throughout the lecture.	
Associated Courses	Lecture	3 semester hours
	Exercise	1 semester hour
	Total	4 semester hours
Learning Methods	Lecture with slides and whiteboard presentation, working in groups, solving exercises, discussion, implementation of examples, self-study	
Student Workload	Attendance Time	60 hours
	Preparation and Follow Up Work	0 hours
	Structured Self-Study	60 hours
	Exercises	15 hours
	Practice	0 hours
	Preparation of Exam and Exam	45 hours
	Total	180 hours
Exam Prerequisites	None	
Examinations	Oral or written exam (announcement at latest in 2nd week of semester)	
Standard Examination Date	cf. SPSO	
Evaluation	cf. SPSO	
Notes	None	
Module Number		

Project Master Computer Science International

Category	Content
Name of Module in German	Projekt Master Computer Science International
Credit Points	12
Responsible for the Module	IEF/IN/VAC/Modellierung und Simulation von Informatik-Systemen
Contact	Prof. Dr.-rer.nat.habil. Adelinde Uhrmacher
Language	English
Admission Restriction	20 participants for each offered project
Level of Module	Master – specializing
Mandatory Prerequisites	None
Recommended Prerequisites	Successful participation of lectures of both specializations (together more than 12 CP)
Related Curricula	M.Sc. Computer Science International
Duration of Module	1 Semester
Start / Regular Cycle	Every semester
Learning and Qualification Objectives	A programming project is at the core of this module. Software solutions shall be designed for concrete problems that fit to the specialization Complex Systems or to the specialization Information Systems respectively. The problem formulation shall enable students to apply methods and competences gained in other lectures. This will further increase the students' competence to transfer knowledge and methods as well as to develop and realize solutions for concrete problems. Technical: • Independent specification, development, realization, as well as documentation of a software system Methodical: • Project management • Software engineering • Experiences with state of the art programming environments Social: • Competence to work together in groups Self: • Awareness of the complexity of software projects • Confident and competent appearance
Teaching Content	• Independent specification, design, realization and documentation of a software system to solve a concrete problem
Literature	None
Associated Courses	Integrated Course 2 semester hours Total 2 semester hours
Learning Methods	Project

Student Workload	Attendance Time	30 hours
	Preparation and Follow Up Work	0 hours
	Structured Self-Study	90 hours
	Exercises	0 hours
	Practice	150 hours
	Preparation of Exam and Exam	90 hours
	Total	360 hours
Exam Prerequisites	None	
Examinations	Project	
Standard Examination Date	cf. SPSO	
Evaluation	cf. SPSO	
Notes	None	
Module Number		

Recent Developments in Computer Science

Category	Content
Name of Module in German	Neueste Entwicklungen in der Informatik
Credit Points	6
Responsible for the Module	IEF/IN/IFI/Theoretical Computer Science
Contact	Prof. Dr. rer. nat. habil. Karsten Wolf
Language	English and German lectures offered
Admission Restriction	None
Level of Module	Master – advanced
Mandatory Prerequisites	None
Recommended Prerequisites	None
Related Curricula	M.Sc. Computer Science International M.Sc. Informatik
Duration of Module	1 semester
Start / Regular Cycle	Every semester
Learning and Qualification Objectives	Technical: • Exploration of a topic that is new, receives high attention or is otherwise relevant but not included in the standard Methodical: • Ability to explore a new topic in a mostly unstructured learning environment Social: • To adapt to innovative teaching formats • To establish and critically reflect relations between technical developments and recent developments in society Self: • Preparation for lifelong learning
Teaching Content	Lecturers and students jointly explore a topic that is not otherwise included in the curriculum
Literature	Accompanying: Will be announced in the lecture.
Lectures	Integrated Lecture 3 semester hours Total 3 semester hours
Learning Methods	Individual literature research, group discussion
Student Workload	Attendance Time 45 hours Preparation and Follow Up Work 0 hours Structured Self-Study 90 hours Exercises 0 hours Practice 0 hours Preparation of Exam and Exam 45 hours Total 180 hours
Exam Prerequisites	Successful execution of a project
Examinations	Presentation (30 minutes) – with written elaboration (10 pages per group member)
Standard Examination Date	cf. SPSO
Evaluation	cf. SPSO
Notes	None
Module Number	

Requirements Engineering

Category	Content
Name of Module in German	Anforderungsanalyse
Credit Points	6
Responsible for the Module	IEF/IN/IFI/Softwaretechnik
Contact	Dr.-Ing. Anke Dittmar
Language	English
Admission Restriction	None
Level of Module	Master – basic
Mandatory Prerequisites	None
Recommended Prerequisites	None
Related Curricula	M.Sc. Computer Science International M.Sc. Informatik M.Sc. Wirtschaftsinformatik M.Sc. Visual Computing M.Sc. Computational Engineering M.Sc. Electrical Engineering M.Sc. Informationstechnik/Technische Informatik
Duration of Module	1 Semester
Start / Regular Cycle	Summer Semester, unregularly
Learning and Qualification Objectives	Requirements Engineering (RE) “is often treated as a time-consuming, bureaucratic and contractual process. This attitude is changing as RE is increasingly recognized as a critically important activity in any systems engineering process” (Nuseibeh & Easterbrook, 2000). Technical and methodological: • Students are enabled to use notations for describing functional requirements (e.g., task models, use cases) and non-functional requirements (e.g., soft goal interdependency graph) and to evaluate existing models. • Ability to use specific methods for eliciting, analyzing, discussing, and specifying requirements Social: • Ability to collaborate in multidisciplinary groups • Ability to develop and discuss requirements documents with stakeholders • Consideration of ethical aspects in software development Self: • Skills in using knowledge elicitation methods and specification methods, becoming aware of the challenges in requirements engineering, knowledge enhancement according to personal professional goals.
Teaching Content	Selected topics from: • Requirements elicitation and analysis • Specification of functional requirements (goal models, use cases, task models, feature models, scenario-based approaches, formal specification of requirements) • Handling of non-functional requirements

	• Processes and frameworks • Views and their consistency • Management and validation of requirements • Current research topics
Literature	• T.Gilb: Towards the Engineering of Requirements. Requirements Engineering (1997) 2:165-169 • Sommerville: Software Engineering. 10th ed., Pearson, 2015 • A. van Lamsweerde: Requirements Engineering –From System Goals to UML Models to Software Specifications. Wiley, 2009 • B. Nuseibeh, S. Easterbrook: Requirements Engineering: A Roadmap. In: A. C. W. Finkelstein (ed) The Future of Software Engineering. (Companion volume to the proceedings of the 22nd International Conference on Software Engineering, ICSE'00). IEEE Computer Society Press, 2000 Accompanying: Will be announced in the lecture.

Associated Courses	Integrated Course	4 semester hours
	Total	4 semester hours
Learning Methods	Lecture with slides and whiteboard presentation, working in groups, solving exercises, discussion, implementation of examples, self-study	
Student Workload	Attendance Time	60 hours
	Preparation and Follow Up Work	30 hours
	Structured Self-Study	20 hours
	Exercises	20 hours
	Practice	0 hours
	Preparation of Exam and Exam	50 hours
	Total	180 hours
Exam Prerequisites	None	
Examinations	Part 1 (66% of the grade): Oral exam (20 minutes) or written exam (120 minutes), announcement at latest in 2nd week of semester Part 2 (33% of the grade): Report (about 10 pages)	
Standard Examination Date	cf. SPSO	
Evaluation	cf. SPSO	
Notes	None	
Module Number		

Research Areas in Computer Science

Category	Content
Name of Module in German	Forschungsthemen der Informatik
Credit Points	6
Responsible for the Module	IEF/IN/IFI/Theoretical Computer Science
Contact	Prof. Dr. rer. nat. habil. Karsten Wolf
Language	English
Admission Restriction	None
Level of Module	Master – basic
Mandatory Prerequisites	None
Recommended Prerequisites	None
Related Curricula	M.Sc. Computer Science International
Duration of Module	1 semester
Start / Regular Cycle	Winter semester, irregularly
Learning and Qualification Objectives	Technical: • Overview of research areas in computer science • Categorization of research topics in the overall context of computer science Methodical: • Understanding for different methodological cultures within computer science • Ability to act in various areas of computer science Social: • Ability to engage in broad discourse in computer science Self: • Getting in touch with the teaching staff • Assistance of selection of own specialization
Teaching Content	• Lecturers present their individual research topics
Literature	Accompanying: Will be announced in the lecture.
Lectures	Lecture 2 semester hours Total 2 semester hours
Learning Methods	Lecture with slides and whiteboard presentation
Student Workload	Attendance Time 30 hours Preparation and Follow Up Work 0 hours Structured Self-Study 60 hours Exercises 0 hours Practice 0 hours Preparation of Exam and Exam 90 hours Total 180 hours
Exam Prerequisites	None
Examinations	Homework- 20 pages (in summary), covering two different topics
Standard Examination Date	cf. SPSO
Evaluation	cf. SPSO
Notes	None
Module Number	

Selected Topics in Embedded Systems Design

Category	Content	
Name of Module in German	Selected Topics in Embedded Systems Design	
Credit Points	6	
Responsible for the Module	IEF/IMD/Eingebettete Systeme	
Contact	Prof. Dr.-Ing. habil. Christian Haubelt	
Language	English	
Admission Restriction	None	
Level of Module	Master – specializing	
Mandatory Prerequisites	None	
Recommended Prerequisites	None	
Related Curricula	M.Sc. Computer Science International M.Sc. Informationstechnik / Technische Informatik M.Sc. Electrical Engineering 20.04.2018 M.Sc. Elektrotechnik 04.07.2019	
Duration of Module	1 semester	
Start / Regular Cycle	Winter semester, regularly	
Learning and Qualification Objectives	With the successful completion of this module, the student will be aware of current trends and developments in the domain of embedded systems and has gathered forward-looking knowledge in this field. Repetition, Understanding, Application, Analysis: Architectures of embedded systems, design methodologies for embedded systems, verification methods for embedded systems Self: Self-reliance and personal responsibility	
Teaching Content	Modern developments and trends in the domain of embedded systems permanently result in a multitude of novel and interesting topics. Within this module, such topics are addressed. The objective of this module lies in picking up new ideas and concepts in the embedded systems domain. Hence, leading edge research topics in the scope of the Chair of Embedded Systems can be taught, discussed and rated. A particular focus is on embedded systems architectures, design methods for embedded systems, and verification methods for embedded systems. The precise topic of the module will be defined at start of term.	
Literature	None	
Associated Courses	Tutorial	1 semester hours
	Lecture	3 semester hours
	Total	4 semester hours
Learning Methods	Active listening and taking notes, consultation	
Student Workload	Attendance Time	60 hours
	Preparation and Follow Up Work	40 hours
	Structured Self-Study	40 hours
	Exercises	0 hours
	Practice	0 hours
	Preparation of Exam and Exam	40 hours
	Total	180 hours
Exam Prerequisites	None	

Examinations	Oral or written exam (announcement at latest in 2nd week of semester)
Standard Examination Date	cf. SPSO
Evaluation	cf. SPSO
Notes	None
Module Number	1351710

Systems Biology

Category	Content
Name of Module in German	Systembiologie
Credit Points	6
Responsible for the Module	IEF/IN/IFI/Systembiologie
Contact	Prof. Dr. Olaf Wolkenhauer
Language	English
Admission Restriction	None
Level of Module	Master - specializing
Mandatory Prerequisites	None
Recommended Prerequisites	Basic understanding of mathematical modelling
Related Curricula	M.Sc. Computer Science International M.Sc. Informatik M.Sc. Informationstechnik / Technische Informatik M.Sc. Medizinische Biotechnologie 10.09.2018 M.Sc. Medizinische Biotechnologie 27.05.2015
Duration of Module	1 semester
Start / Regular Cycle	Winter semester
Learning and Qualification Objectives	The student will be enabled to identify and work on research questions related to biotechnological and biomedical applications that require mathematical modelling.
Teaching Content	• Modelling and Simulation of dynamical systems • Analysis of biochemical reaction networks • Analysis of large signaling networks • Integration of experimental data and models • Workflows in Systems Biology
Literature	Accompanying: Will be announced in the lecture.
Associated Courses	Lecture 3 semester hours Exercises (mandatory attendance) 1 semester hours Total 4 semester hours
Learning Methods	Lecture with slides and whiteboard presentation, working in groups, solving exercises, self-study
Student Workload	Attendance Time 56 hours Preparation and Follow Up Work 28 hours Structured Self-Study 26 hours Exercises 30 hours Practice 0 hours Preparation of Exam and Exam 40 hours Total 180 hours
Exam Prerequisites	Attendance is mandatory for the exercises
Examinations	Oral or written exam (announcement at latest in 2nd week of semester)
Standard Examination Date	cf. SPSO
Evaluation	cf. SPSO
Notes	None
Module Number	1151120

Web 2.0

Category	Content
Name of Module in German	Web 2.0
Credit Points	6
Responsible for the Module	IEF/IN/IFI/Informations- und Kommunikationsdienste
Contact	Prof. Dr. Clemens Cap
Language	German, English
Admission Restriction	None
Level of Module	Master – basic
Mandatory Prerequisites	None
Recommended Prerequisites	None
Related Curricula	M.Sc. Computer Science International M.Sc. Informatik M.Sc. Wirtschaftsinformatik
Duration of Module	1 Semester
Start / Regular Cycle	Summer semester, irregularly
Learning and Qualification Objectives	Evaluation of the application areas and strengths of Web 2.0 technologies; analysis of business concepts from idea to implementation, knowledge of the pertinent technological methods; programming concepts, techniques and languages
Teaching Content	• JavaScript • HTML, JSON • NoSQL • Asynchronous programming techniques • Business models in the internet • Structure and dynamics of social networks and their implications on the economic dynamics of the web • Security aspects of the web • Bitcoin, smart contracts and applications of blockchain technology • Social implications of Web 2.0 technology • Mobile web applications • Frameworks and design methods • Additional topics as necessary by the fast development in the area
Literature	Script and literature list in the lecture
Associated Courses	Lecture 3 semester hours Exercises 1 semester hours
Learning Methods	Lecture with slides and whiteboard presentation, working in groups, solving exercises, discussion, implementation of examples, self-study
Student Workload	Attendance Time 60 hours Preparation and Follow Up Work 30 hours Structured Self-Study 20 hours Project tasks 30 hours Preparation of Exam and Exam 40 hours Total 180 hours
Exam Prerequisites	Solution of project tasks and presentation of the solution (number and conditions for passing announced in second week of the lecture)

Examinations	Oral exam (20 min) or written exam (120 min) (announcement at latest in 2nd week of semester)
Standard Examination Date	cf. SPSO
Evaluation	cf. SPSO
Notes	None
Module Number	