Hochschule Karlsruhe

Faculty for Computer Science and Business Information Systems

Module manual

Course of studies Computer Science (Master), ER 6

Summer semester 2025

Module Computer Science (Master), ER 6

Module Concepts and Designs of interactive Systems	
Internal number	INFM110MI
Coordinator	Prof. Thomas Hinz
Scope	7.0 ECTS points, 6.0 Contact hours
Placement	All semesters
Pre-requisites with regard to content	none
Pre-requisites according to the examination regulations	none
Competences	Students learn theoretical knowledge of designing interactive systems and put their knowledge into practice in constructing prototypes. With knowledge of design principles and concepts they are able to solve design problems. They gain practical experiences on innovative natural user interfaces and interaction in public space and can develop new forms of human-machine interfaces.
Exams	Individual exams
Lecture Design of Interactions	
Internal number	INFM111MI
Lecturer	Prof. Thomas Hinz
Scope	2.0 ECTS points, 2.0 Contact hours 60 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German
Content	The students learn a variety of methods and strategies for designing interactive systems and how to apply them. They are able to identify and solve problems in the design of corresponding systems. They deal with the cultural context of interactions and engage in critical reflection about the history of interaction design.

Recommended reading	Script, Literature: - R. Klanten, S. Ehmann, F. Schulze: "Visual Storytelling: Inspiring a New Visual Language", 2011, ISBN-13: 978-3899553758 - R. Klanten, L. Feireiss: "A Touch of Code: Interactive Installations and Experiences", 2011, ISBN-13: 978-3899553314 - J. Sauter, S. Jaschko, J. Ängeslevä: ART+COM: "Medien, Räume und Installationen", 2011, ISBN-13: 978-3899553864 - J. Pannafino: Interdisciplinary Interaction Design: "A Visual Guide to Basic Theories, Models and Ideas for Thinking and Designing for Interactive Web Design and Digital Device Experiences", 2012, ISBN-13: 978-0982634813 - H.-D. Hellige: "Mensch-Computer-Interface: Zur Geschichte und Zukunft der Computerbedienung", 2008, ISBN-13: 978-3899425642 - J. Schenk, G. Rigole: "Mensch-Maschine-Kommunikation: Grundlagen von sprach- und bildbasierten Benutzerschnittstellen", 2010, ISBN-13: 978-3642054563 - R. Dorau: "Emotionales Interaktionsdesign Gesten und Mimik interaktiver Systeme, 2011, ISBN-13: 978-3642031007 - D. Wigdor, D. Wixon: "Brave NUI World: Designing Natural User Interfaces for Touch and Gesture", 2011, ISBN-13: 978-0123822314
Exams	Concept 1 Semester (graded)
Comments	Participation at tuition, in class group work and discussion.

Lecture Interactive Systems Exercise

Internal number	INFM112MI
Lecturer	Prof. Thomas Hinz
Scope	5.0 ECTS points, 4.0 Contact hours 150 Stunden gesamt, davon 60 Stunden Kontaktstudium.
Type/mode	Exercise
Language of instruction	German
Content	The participants apply their theoretical understanding of the conception and design of interactive systems. They design and develop prototypes of interactive systems. The students experiment with innovative forms of human-computer interfaces and their possibilities. They are capable of presenting their results convincingly using multimodal tools, as well as justify them in a methodical and theoretically grounded manner.
Recommended reading	- J. Hunt: "Talk to Me: Design and the Communication between People and Objects", 2011, ASIN: B009XR1NSY - D. Roberts: "Making Things Move: Die Welt bewegen", 2011, ISBN-13: 978-3868991390 - T. Igor, P. Stefan: "Making Things Talk: Die Welt hören, sehen, fühlen", 2012, ISBN-13: 978-3868991628 - G. Borenstein: "Making Things See: 3D vision with Kinect, Processing, Arduino, and MakerBot", 2012, ISBN-13: 978-1449307073 - D. Schmalstieg, T. Höllerer: "Augmented Reality", 2016, ISBN-13 978-0-321-88357-5
Exams	Exercise 1 Semester (not graded)

Comments	- Teamworking - Experiments on design and prototyping - Presentation and discussion of the results

Module Intelligent Systems	
Internal number	INFM110ML
Coordinator	Prof. Dr.-Ing. Astrid Laubenheimer
Scope	7.0 ECTS points, 6.0 Contact hours
Placement	All semesters
Pre-requisites with regard to content	none
Pre-requisites according to the examination regulations	none
Competences	
Exams	Individual exams
Lecture Unsupervised Learning	
Internal number	INFM111ML
Lecturers	Prof. Dr. Dennis Janka Prof. Dr.-Ing. Astrid Laubenheimer
Scope	4.0 ECTS points, 4.0 Contact hours 120 Stunden gesamt, davon 60 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German
Content	
Recommended reading	
Exams	Written/verbal Exam 90/20 Min. (graded)
Comments	
Lecture Intelligent Systems Exercise	
Internal number	INFM112ML
Lecturers	Prof. Dr.-Ing. Astrid Laubenheimer Prof. Dr. Norbert Link
Scope	3.0 ECTS points, 2.0 Contact hours 90 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Exercise
Language of instruction	German
Content	
Recommended reading	
Exams	Exercise 1 Semester (not graded)
Comments	

Module Theory of efficient algorithms	
Internal number	INFM110SE
Coordinator	Prof. Dr. Heiko Körner
Scope	7.0 ECTS points, 5.0 Contact hours
Placement	All semesters
Pre-requisites with regard to content	none
Pre-requisites according to the examination regulations	none
Competences	The module deals with the design of efficient algorithms in theory and practice. Students learn proof techniques for graph-theoretical problems in order to show the correctness of algorithms with exact logical conclusions. To the end, they analyze runtimes of procedures and apply suitable analysis techniques. Using the example of numerical problems such as the interpolation and approximation of mathematical models, students also independently design solution methods and then implement them. The iteration methods are implemented by the students for specific technical problems and parallelized for use on modern high-performance computers. After completing the module, students will be able to analyze and evaluate algorithms theoretically, but also to apply modeling and simulation methods for the computer-aided design of process sequences in practice.
Exams	Written Exam 90 Min. (graded)
Lecture Graph Algorithms	
Internal number	INFM111SE.a
Lecturer	Prof. Dr. Heiko Körner
Scope	3.0 ECTS points, 2.0 Contact hours 90 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German
Content	This couse gives an overview of some basic graph algorithms and their applications. The students learn to apply further algorithms and how to implement them. Furthermore, techniques for proving the correctness and complexity of algorithms are thoroughly studied. After a brief theoretical introduction to graphs some fundamental algorithms like depth first search and breadth first search are presented. Other algorithms deal with the detection of strongly connected components, topological sorting and the calculation of shortest paths. Efficient tests concerning the existence of circuits in a graph are also discussed. For this course some basic knowledge of programming and the safe handling of the O-calculus are necessary. Furthermore, the participant is assumed to be familiar with inductive proofs. Both topics are handled in an appendix of the lecture notes.

Recommended reading	The substance of the lecture will be discussed at the blackboard. Lecture notes containing the complete material are also available. Lecture notes, exercises and their solutions are available online. Literature: T. H. Cormen, C. E. Leiserson, R. L. Rivest, C. Stein: Introduction to Algorithms. MIT Press, 2001, ISBN 0-262-03293-7.
Exams	Module exam
Comments	Classical lecture. Several exercises deepen the field of study and are discussed in the classroom if desired.
Lecture Modeling and Simulation	
Internal number	INFM111SE.b
Lecturer	Prof. Dr. Britta Nestler
Scope	2.0 ECTS points, 2.0 Contact hours 60 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German
Content	
Recommended reading	
Exams	Module exam
Comments	
Lecture Modeling and Simulation Exercise	
Internal number	INFM112SE
Lecturer	Prof. Dr. Britta Nestler
Scope	2.0 ECTS points, 1.0 Contact hours 60 Stunden gesamt, davon 15 Stunden Kontaktstudium.
Type/mode	Exercise
Language of instruction	German
Content	
Recommended reading	
Exams	Exercise 1 Semester (not graded)
Comments	

Module New Module	
Internal number	INFM120MI
Coordinator	Prof. Dr. Matthias Wölfel
Scope	7.0 ECTS points, 6.0 Contact hours
Placement	All semesters
Pre-requisites with regard to content	none
Pre-requisites according to the examination regulations	none
Competences	
Exams	Individual exams
Lecture Perception based Interaction	
Internal number	INFM121MI
Lecturer	Prof. Dr. Matthias Wölfel
Scope	3.0 ECTS points, 3.0 Contact hours 90 Stunden gesamt, davon 45 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German
Content	Nowadays machines are already capable of communicating with human beings in a "natural" fashion through the existence of capabilities to understand natural language, recognise hand writing, and for interpreting gestures. However, they are also capable of extending human perception through augmenting situations with additional knowledge ("augmented reality"), i.e. the depiction of information is contextualised according to the situation as perceived by the machine. Examples of this are smartphones and tablets (voice-control, face recognition, "goggle", music recognition), vehicles (driver assistance systems), video game consoles (movement interpretation), but also in work-related contexts (surgery, human-robot-cooperation). The lecture covers the foundations of voice- and gesture recognition, the sensing and recognition of objects in the environment, as well as information presentation. Sample applications (e.g. using the Kinect sensor) allow students to gain deeper understanding of the covered material. Topics include: - system performance of perception-based interaction - sensor systems for the recognition of the environment (sound, video, 3d, touch, acceleration and rotation) - Recognition (object recognition in video and 3d, speech- and behaviour recognition) - interaction models (augmented reality, situation graphs)
Recommended reading	
Exams	Concept 1 Semester (graded)
Comments	
Lecture Perception based Interaction Exercise	

Internal number	INFM122MI
Lecturer	Prof. Dr. Matthias Wölfel
Scope	4.0 ECTS points, 3.0 Contact hours 120 Stunden gesamt, davon 45 Stunden Kontaktstudium.
Type/mode	Exercise
Language of instruction	German
Content	
Recommended reading	
Exams	Exercise 1 Semester (not graded)
Comments	

Module New Module	
Internal number	INFM120ML
Coordinator	Prof. Dr. Reimar Hofmann
Scope	7.0 ECTS points, 5.0 Contact hours
Placement	All semesters
Pre-requisites with regard to content	none
Pre-requisites according to the examination regulations	none
Competences	
Exams	Written Exam 90 Min. (graded)
Lecture Data Science	
Internal number	INFM121ML.a
Lecturer	Prof. Dr. Reimar Hofmann
Scope	2.0 ECTS points, 2.0 Contact hours 60 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German
Content	
Recommended reading	
Exams	Module exam
Comments	
Lecture Optimisation	
Internal number	INFM121ML.b
Lecturer	Prof. Dr.-Ing. Astrid Laubenheimer
Scope	2.0 ECTS points, 2.0 Contact hours 60 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German
Content	
Recommended reading	
Exams	Module exam
Comments	
Lecture Optimisation Exercise	
Internal number	INFM122ML
Lecturer	Prof. Dr.-Ing. Astrid Laubenheimer
Scope	3.0 ECTS points, 1.0 Contact hours 90 Stunden gesamt, davon 15 Stunden Kontaktstudium.

Type/mode	Exercise
Language of instruction	German
Content	
Recommended reading	
Exams	Exercise 1 Semester (not graded)
Comments	

Module Concepts of Programming Languages	
Internal number	INFM120SE
Coordinator	Prof. Dr. Martin Sulzmann
Scope	7.0 ECTS points, 6.0 Contact hours
Placement	All semesters
Pre-requisites with regard to content	none
Pre-requisites according to the examination regulations	none
Competences	Programming languages are the most basic tool of programmers. This course covers the basics of the theory of programming languages, its applications to widely used languages today, and trends in the field that are likely to help define the programming languages of tomorrow. After this course, students will have an understanding of a wide range of programming language concepts and will be able to quickly adapt to emerging new programming languages. A mix of written as well as practical exercises will help students to get an understanding of different styles of programming in several programming languages. Content. Various styles of programming with a focus on functional programming: data types and pattern matching higher-order functions polymorphic types Different flavors of polymorphism: subtyping (structual and nominal) generics, overloading Program correctness: static verification methods testing methods such as QuickCheck There is no final exam. Evaluation is based on quizzes, midterms and several smaller projects that are carried out during the semester.
Exams	Written Exam 90 Min. (graded)
Lecture Programming Paradigms	
Internal number	INFM121SE.a
Lecturer	Prof. Dr. Martin Sulzmann
Scope	2.0 ECTS points, 2.0 Contact hours 60 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Lecture

Language of instruction	German
Content	Students of this course - obtain an overview of the history of programming languages, - get to know the various styles of programming (paradigms), - explore their commonalities and differences, - get hands on experiences by solving practical problems. List of topics covered includes: - Historical Overview - Procedural languages Block structure Parameter Passing - Object-oriented languages Subtyping Inheritance Overloading - Functional languages Lambda calculus Higher-order functions Algebraic data types and pattern matching - Type systems Deduction (-> Prolog / logic programming) Typinference Polymorphism Static Analysis - Concurrent and distributed programming The Actor model Software Transactional Memory
Recommended reading	- Lecture notes and slides - Exercises - Textbook: Concepts in Programming Languages von John C. Mitchell
Exams	Module exam
Comments	Prerequisites: Experience in a programming language. Mix of lectures (2/3) and practical exercies (1/3)
Lecture Program optimisation	
Internal number	INFM121SE.b
Lecturer	Prof. Dr. Christian Pape
Scope	1.0 ECTS points, 1.0 Contact hours 30 Stunden gesamt, davon 15 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German
Content	
Recommended reading	
Exams	Module exam
Comments	
Lecture Program Optimization Laboratory	
Internal number	INFM122E
Lecturer	Prof. Dr. Christian Pape
Scope	2.0 ECTS points, 2.0 Contact hours 60 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Exercise
Language of instruction	German

Content	The students of this course have to - implement complex algorithms with a procedural or object-oriented programming language, - optimize the implementation with specific techniques like CPU-cache optimization or the pardigm of hybridization, - measure and analyze the time and memory consumption of the implemenation, - compare algorithms with respect to different test scenarios, and - documenting and discuss the final results. The computer science problems of this course change from time to time. Typical problems include: - Fast multiplication of polynomials and numbers, - geometric algorithms, or - graph algorithms.
Recommended reading	The exercises and supplementary materials are available electronically (HTML, PDF, partial programms).
Exams	Exercise 1 Semester (not graded)
Comments	Prerequisites: Deep practical knowledge of a procedural or object-oriented programming language like C, C++, C#, or Java. Implementation and testing of basic algorithms in the field of search, graphs and sorting problems. Format: Practical Assignment in a computer laboratory with small introductional parts as a lecture. Support: Individual support by the teachers in the computer lab. Contact outside laboratory time via e-mail or during the hours of the lecturers.
Lecture Programming paradigms exercise	
Internal number	INFM123E
Lecturer	Prof. Dr. Martin Sulzmann
Scope	2.0 ECTS points, 1.0 Contact hours 60 Stunden gesamt, davon 15 Stunden Kontaktstudium.
Type/mode	Exercise
Language of instruction	German
Content	
Recommended reading	
Exams	Exercise 1 Semester (not graded)
Comments	

Module New Module	
Internal number	INFM210MI
Coordinator	Prof. Daniel Schwarz
Scope	7.0 ECTS points, 5.0 Contact hours
Placement	All semesters
Pre-requisites with regard to content	none
Pre-requisites according to the examination regulations	none
Competences	
Exams	Individual exams
Lecture Game Design + Development	
Internal number	INFM211MI
Lecturer	Prof. Daniel Schwarz
Scope	3.0 ECTS points, 2.0 Contact hours 90 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German
Content	
Recommended reading	
Exams	Concept 1 Semester (graded)
Comments	
Lecture Game Design + Development Exercise	
Internal number	INFM212MI
Lecturer	Prof. Daniel Schwarz
Scope	4.0 ECTS points, 3.0 Contact hours 120 Stunden gesamt, davon 45 Stunden Kontaktstudium.
Type/mode	Exercise
Language of instruction	German
Content	
Recommended reading	
Exams	Exercise 1 Semester (not graded)
Comments	

Module New Module	
Internal number	INFM210ML
Coordinator	Prof. Dr. Patrick Baier
Scope	7.0 ECTS points, 6.0 Contact hours
Placement	All semesters
Pre-requisites with regard to content	Intelligent Systems
Pre-requisites according to the examination regulations	none
Competences	
Exams	Individual exams
Lecture Artificial intelligence	
Internal number	INFM211ML
Lecturers	Prof. Dr. Patrick Baier Prof. Dr. Jannik Strötgen
Scope	3.0 ECTS points, 2.0 Contact hours 90 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German
Content	
Recommended reading	
Exams	Written/verbal Exam 90/20 Min. (graded)
Comments	
Lecture Artificial intelligence Exercise	
Internal number	INFM212ML
Lecturers	M.Sc. Anna Weißhaar Prof. Dr. Patrick Baier
Scope	4.0 ECTS points, 4.0 Contact hours 120 Stunden gesamt, davon 60 Stunden Kontaktstudium.
Type/mode	Exercise
Language of instruction	German
Content	
Recommended reading	
Exams	Concept 1 Semester (not graded)
Comments	

Module Software Architectures	
Internal number	INFM210SE
Coordinator	Prof. Dr. Thomas Fuchß
Scope	7.0 ECTS points, 6.0 Contact hours
Placement	All semesters
Pre-requisites with regard to content	none
Pre-requisites according to the examination regulations	none
Competences	On successful completion of the module, students will be able to independently design, develop and critically evaluate the architecture of large-scale software systems. They will be able to decompose software into components and connectors, select and evaluate appropriate frameworks, and logically organise functionalities and workflows. Students will be able to plan and design parallel and concurrent processes and integrate them into architectures tailored to different application domains. In addition, they will have developed their technical, social and personal skills, as well as their communication and self-management skills, and will be able to apply them effectively in the context of large-scale software projects.
Exams	Individual exams
Lecture Software Architectures	
Internal number	INFM211SE
Lecturer	Prof. Dr. Thomas Fuchß
Scope	2.0 ECTS points, 2.0 Contact hours 60 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German

Content	The "Software Architectures" course provides advanced knowledge and skills in the development and analysis of modern software architectures. In the first part of the lecture, relevant process models are reviewed, and approaches for agile architecture development are introduced. Students explore and compare various view models, deepen their understanding of modeling techniques for components and connectors, and expand their knowledge of design methods. The course emphasizes the use of scenarios for describing and evaluating non-functional requirements. The second part focuses on fundamental architectural patterns, such as layered architecture, hexagonal architecture, onion architecture, blackboard, pipes-and-filters, and event-driven architecture. Students learn to identify, understand, and apply these patterns while exploring their role in typical middleware concepts. The lecture demonstrates how these architectural templates provide pathways to organizing flexible and evolutionary systems. The third part addresses architecture at the module level. Using practical scenarios and examples, the application of patterns for the business layer is presented and analyzed in context. The course aims to equip students with a comprehensive understanding of designing and evaluating modular software architectures.
Recommended reading	- Avgeriou, P; et. al (editors): Relating Software Requirements and Architectures. Springer, 2011. - Clements, P.; Bass, L. and Kazman, R.: Software Architecture in Practice, 2. ed. Addison-Wesley, 2003. - Fowler, M.: Patterns of Enterprise Application Architecture. Addison-Wesley, 2003. - Goll, J. und Dausmann, M.:Architektur- und Entwurfsmuster der Softwaretechnik. Springer Vieweg, 2013. - Gorton, Ian: Essential Software Architecture, 2. ed. Springer, 2011. - Larman, Craig: Applying UML and Patterns : An Introduction to Object-Oriented Analysis and Design and Iterative Development, 3. ed. Prentice Hall, 2004. - Lilienthal, Carola: Sustainable software architecture: analyze and reduce technical debt. dpunkt.verlag, 2019. - Buschmann, Frank: A System of Patterns (POSA V.1). John Wiley & Sons. 1996 - Schmidt, Douglas C.: Patterns for Concurrent and Networked Objects (POSA V.2). John Wiley & Sons, 2000. - Sommerville, Ian: Software Engineering, 9. Auflage. Pearson Studium, 2012. - Vogel, O.; Arnold, I.; Chughtai, A. and Kehrer, T.: Software Architecture: A Comprehensive Framework and Guide for Practitioners. Springer, 2011. - Vogel, O.; et. al: Software-Architektur: Grundlagen – Konzepte – Praxis, 2. Auflage. Spektrum, 2009.
Exams	Verbal Exam 20 Min. (graded)
Comments	The lecture will take the form of seminars with exercises and presentations.
Lecture Parallel Programming	
Internal number	INFM212SE

Lecturer	Dipl.-Ing. Christian Meder
Scope	3.0 ECTS points, 2.0 Contact hours 90 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Laboratory Course
Language of instruction	German
Content	The "Parallel Programming Lab" provides practical knowledge of concurrent programming and its application across various modern technologies and systems. In the first part of the course, students revisit and deepen their understanding of the fundamentals of concurrent programming. Through hands-on exercises using Java and the Java Development Kit (JDK), they learn how to efficiently design concurrent processes and address challenges such as race conditions and deadlocks. In the second part, the course explores practical applications of concurrent programming through concise introductions to various technologies and platforms, including: - Concurrency in operating systems, e.g., Linux - Concurrency on mobile platforms, e.g., Android - Map/Reduce and the Hadoop ecosystem - Concurrency in web applications - Concurrency in modern programming languages like Go and Rust - Reactive Extensions (Rx) and their use cases - Cloud, cluster, and distributed systems - Microservice architectures - Deep learning and concurrency By combining theoretical insights with practical exercises, students gain the skills to understand, implement, and advance concurrent programming in diverse technical contexts.
Recommended reading	- Brian Goetz, "Java Concurrency in Practice" - Online Tutorials The literature for the second part changes every semester.
Exams	Exercise 1 Semester (not graded)
Comments	Passing the lab will be assessed by completing the exercises independently. In the second part of the lab, various new methods and concepts will be presented and discussed.
Lecture Software Architectures Laboratory	
Internal number	INFM213SE
Lecturer	M.Sc. Aladdin Özenir
Scope	2.0 ECTS points, 2.0 Contact hours 60 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Laboratory Course
Language of instruction	German

Content	
Recommended reading	
Exams	Exercise 1 Semester (not graded)
Comments	

Module Semantic Web Technologies	
Internal number	INFM130
Coordinator	Prof. Dr. Peter Henning
Scope	6.0 ECTS points, 4.0 Contact hours
Placement	1st Semester
Pre-requisites with regard to content	none
Pre-requisites according to the examination regulations	none
Competences	The succesful handling of the large data volume available in a globalized information infrastructure necessitates its semantic annotation, i.e. data has to be accompanied by meta data that denotes its meaning. XML techniques, in particular the transformation of data according to XSLT style sheets are at the core of these modern concepts. Students acquire abstract and concrete knowledge about XML basics (XML concepts, DTD, Namespaces and DOM) as well as about XSLT basics (XPath, simple transformations, principles of functional programming with XSLT). Students know advanced XML topics (XML Schema, XLink/XPointer), and have dealt with various XSLT applications. Students have abstract and concrete knowledge about the Resource Description Framework RDF, its extension into RDFS and OWL; they know how to write and visualize simple ontologies. Students know machine based reasoning tools and principles of knowledge description, they have performed several reasoning tasks. Students know paradigms of learning and have been introduced to models of thinking and reasoning. The course therefore contributes to the two dimensions technical knowledge and leadership skills. Since it is held in English, participants also improve their key skills.
Exams	Individual exams

Lecture Semantic Web Technologies	
Internal number	INFM131
Lecturer	Prof. Dr. Peter Henning
Scope	3.0 ECTS points, 2.0 Contact hours 90 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	English

Content	- XML Basics: Documents and document types, their definition and structure (DTD, Namespaces and Schema) - XSLT Basics: XPath, simple transformations, principles of functional programming with XSLT - XML Schema definitions, XLink, XPointer The Resource Description Framework RDF. Application to simple semantic views on data, extension into RDFS and description of simple ontologies. Modeling of knowledge using OWL. Machine based reasoning. Science theory, formal logic and models of thinking.
Recommended reading	Prerequisites: Participants should have basic knowledge of descriptive languages (XML applications), at least should have practical knowledge of Web programming. Participants should have sufficient knowledge of technical English Format Participation necessary in two classroom hours per week, electronic tests and essay writing on selected topics, theoretical self-study on semantic technologies. Counseling Questions during course hours, electronic learning management system ILIAS, weekly online chat in ILIAS, 24 x 7 offline discussion in ILIAS Forum, eMail Powerpoint transparencies, electronic whiteboard notes as PDF, eLearning courses on XML, XSLT, SMIL, additional electronic material for reading and self-assessment. References Geroimenko, V., Chen, C.: Visualizing Information Using SVG and X3D. XML Based Technologies for the XML Based Web (Springer 2004) ISBN 978-1852337902 Geroimenko, V., Chen, C.: Visualizing the Semantic Web. XML-Based Internet and Information Visualization (Springer 2005) ISBN 978-1852339760 Antoniou, G., van Harmelen, F.: A Semantic Web Primer. Cooperative Information Systems (The MIT Press 2004), ISBN 0262012103 Eisenberg, J.: SVG Essentials (O'Reilly 2002) ISBN 978-0596002237 Bulterman,D., Rutledge, L.: Smil 2.0: Interactive Multimedia for Web and Mobile Devices (Springer 2004) ISBN 354020234 Henning, P.A.: Taschenbuch Multimedia (Hanser 2007), ISBN 978-3446409712
Exams	Written Exam 90 Min. (graded)
Comments	

Lecture Semantic Web Technologies Laboratory

Internal number	INFM132
Lecturer	Prof. Dr. Peter Henning
Scope	3.0 ECTS points, 2.0 Contact hours 90 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Laboratory Course
Language of instruction	English

Content	Topics covered by practical lab problems include: - XML Basics: Document Type Definition and XML Schema definitions. - Advanced XML techniques: Document Object Model and XPath addressing in documents. The transformation of documents using XSLT. Functional programming in XSLT. - Visualization using XML: SVG and GraphML applied to semantically rich XML documents - Resource Description Framework RDF: Creation of RDF documents, transformation of RDF into XML Schema definition - RDFS, OWL: Basics of ontologies and their application - Machine based reasoning and logical problem solution
Recommended reading	Prerequisites: Students should be participants of the "SemanticWeb Technologies" course, at least should have theoretical knowledge of the topics covered. Format: Participation in 2 lab hours per week in small groups of 2-3 students, practical self-study and XML programming. Deliverables: Successful completion (upload to ILIAS in time) of 80% of the lab problems. Counseling: Personal counseling during lab hours, electronic learning managment system ILIAS, weekly online chat in ILIAS, 24 x 7 offline discussion in ILIAS forum, eMail References eLearning content and Books mentioned as course material for browsing, XML Editor oXygen in media::lab, Internet research during lab hours
Exams	Exercise 1 Semester (not graded)
Comments	

Module Management Competence	
Internal number	INFM140
Coordinator	Prof. Dr. rer. pol. Mathias Philipp
Scope	7.0 ECTS points, 6.0 Contact hours
Placement	1st Semester
Pre-requisites with regard to content	none
Pre-requisites according to the examination regulations	none
Competences	In this module the students acquire advanced skills to lead projects with budget and personnel responsibility. Special consideration will be the management of computer science departments or data centers. They are both key skills, as well as practical knowledge in their application in accordance with the standards. There are both key skills as well as the practical implementation of skills in accordance to best practice standards.
Exams	Written Exam 120 Min. (graded)
Lecture IT Project Management	
Internal number	INFM141.a
Lecturer	Prof. Dr. Uwe Haneke
Scope	3.0 ECTS points, 2.0 Contact hours 90 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	English
Content	- Agile project management - Requirements specification in IT-projects - Special aspects of network planning in IT-projects - Risk management - Keeping informed: reporting systems in IT-projects - Quality management
Recommended reading	
Exams	Module exam
Comments	
Lecture IT Entrepreneurship	
Internal number	INFM141.b
Lecturer	Prof. Dr. rer. pol. Mathias Philipp
Scope	2.0 ECTS points, 2.0 Contact hours 60 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German

Content	Die Vorlesung gliedert sich in die lebenszyklus orientierten Kapitel: - Grundlagen Entrepreneurship - Geschäftsmodell, Geschäftsplanung und unterneherische Handlungsstrategien - Gründungsprozess, Rechtsformen und Rechtsformenvergleich - Businessplan und Finanzierungsarten - Wachstumsmanagement und Unternehmensentwicklung - Unternehmensverkauf Die Studenten sollen unternehmerische Denken und Handeln von der Entwicklung einer Geschäftsidee über die Gründung eines Unternehmens bis zum Verkauf erlernen.
Recommended reading	Lecture material completely on eLearning platform ILIAS and as pdf documents available, blackboard notes for interactive development of central problem positions, LARS-promoted web based training tool for specific preparations and rework of the lectures with multiple choice questions for every process). All together about 160 questions. List of Acronyms and Glossary of Terms, MindMaps for all processes and the complete lecture.
Exams	Module exam
Comments	Teilnahme am seminaristischen Unterricht. Übungen zum Erstellung eines Geschäftsplans, steuerrechtlich korrekten Fakturierung und Auswah der richtigen Gesellschaftsform.

Lecture Leadership Training

Internal number	INFM142
Lecturer	Dipl. Inform. Klaus-Dieter Hüttel
Scope	2.0 ECTS points, 2.0 Contact hours 60 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Project Lecture
Language of instruction	German
Content	
Recommended reading	
Exams	Exercise 1 Semester (not graded)
Comments	

Module Student Research Project 1	
Internal number	INFM150
Coordinator	Prof. Dr. Thomas Fuchß
Scope	4.0 ECTS points, 3.0 Contact hours
Placement	1st Semester
Pre-requisites with regard to content	none
Pre-requisites according to the examination regulations	none
Competences	In this module, students acquire skills in scientific and/or project based work under close guidance by a professor. The scientific problem or application project is studied continuously throughout the whole term.
Exams	Individual exams
Lecture Project based scientific Project 1	
Internal number	INFM151
Lecturer	Alle Professoren
Scope	4.0 ECTS points, 3.0 Contact hours 120 Stunden gesamt, davon 45 Stunden Kontaktstudium.
Type/mode	Hands-on Experience
Language of instruction	German
Content	Problems and projects may be opened by every faculty member, they are advertized on the message board at the beginning of the term. Scientific research problems usually are at the leading edge of computer science research and may be carried out in cooperation with research institutions. Application projects are of particular relevance for the industrial practice and may be carried out in cooperation with an industrial partner.
Recommended reading	According to project requirements.
Exams	Hands-on Work 1 Semester (graded)
Comments	Prerequisites According to project requirements. Format Presence time and group discussion 30 %, self study 70 %. Oral exam 30 Minutes Counseling In general, a weekly project session involving the whole team is scheduled. The counseling amounts to at least one hour per week and student.

Module New Module	
Internal number	INFM220MI
Coordinator	Prof. Dr. Matthias Wölfel
Scope	7.0 ECTS points, 5.0 Contact hours
Placement	2nd Semester
Pre-requisites with regard to content	none
Pre-requisites according to the examination regulations	none
Competences	
Exams	Individual exams
Lecture Special chapters Media Informatics	
Internal number	INFM221MI
Lecturers	Prof. Dr. Matthias Wölfel Dr. Tim Schlippe Prof. Thomas Hinz Prof. Daniel Schwarz
Scope	3.0 ECTS points, 2.0 Contact hours 90 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German
Content	
Recommended reading	
Exams	Verbal Exam/Concept 20/1 Min./Semester (graded)
Comments	
Lecture Special chapters Media Informatics Exercise	
Internal number	INFM222MI
Lecturers	Prof. Dr. Matthias Wölfel Prof. Thomas Hinz Prof. Daniel Schwarz
Scope	4.0 ECTS points, 3.0 Contact hours 120 Stunden gesamt, davon 45 Stunden Kontaktstudium.
Type/mode	Exercise
Language of instruction	German
Content	
Recommended reading	
Exams	Exercise 1 Semester (not graded)
Comments	

Module New Module	
Internal number	INFM220ML
Coordinator	Prof. Dr. Frank Schaefer
Scope	7.0 ECTS points, 5.0 Contact hours
Placement	2nd Semester
Pre-requisites with regard to content	none
Pre-requisites according to the examination regulations	none
Competences	
Exams	Written/verbal Exam 120/20 Min. (graded)
Lecture Applied Cryptography	
Internal number	INFM221ML.a
Lecturer	Prof. Dr. Frank Schaefer
Scope	2.0 ECTS points, 2.0 Contact hours 60 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German
Content	In the course the main cryptographic algorithms are presented. Blockciphers (DES, AES), Modes of Operation (ECB, CBC, Countermode), Hash functions, MACs, public key algorithms (RSA, Diffie-Helman, ElGamal) are covered by the lectures. Then we will look at and analyze applications in IT-security, which use cryptography: E/mail-security (eg. PGP, S-MIME), web-security (SSL), network-security (IP-Sec), authentication mechanisms.
Recommended reading	Claudia Eckert: IT-Sicherheit. Konzepte - Verfahren - Protokolle, München, Oldenbourg Wissenschaftsverlag, 2013, 8. Auflage, ISBN 978-3-486-58270-3.
Exams	Module exam
Comments	The course consist of lectures (around 2/3) and exercises (around 1/3). In the exercises the mathematical techniques introduced in the lecture will be trained.
Lecture Coding Theory	
Internal number	INFM221ML.b
Lecturer	Prof. Dr. Dirk Hoffmann
Scope	3.0 ECTS points, 2.0 Contact hours 90 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German

Content	This course teaches foundations about codes and codings as well as basic algorithms for source coding, channel coding and line coding. The lecture focuses on the following topics: information and coding theory, data compression, error detecting and correcting codes, limits of data transmission.
Recommended reading	Slides, blackboard, exercise sheets
Exams	Module exam
Comments	Lecture
Lecture Applied Cryptography Exercise	
Internal number	INFM222ML.a
Lecturer	Prof. Dr. Frank Schaefer
Scope	2.0 ECTS points, 1.0 Contact hours 60 Stunden gesamt, davon 15 Stunden Kontaktstudium.
Type/mode	Thesis
Language of instruction	German
Content	
Recommended reading	
Exams	Exercise 1 Semester (not graded)
Comments	

Module Secure Systems	
Internal number	INFM220SE
Coordinator	Prof. Dr. Frank Schaefer
Scope	7.0 ECTS points, 5.0 Contact hours
Placement	2nd Semester
Pre-requisites with regard to content	none
Pre-requisites according to the examination regulations	none
Competences	Understanding of the basic techniques used in applied cryptography and modern coding theory
Exams	Written/verbal Exam 120/20 Min. (graded)
Lecture Applied Cryptography	
Internal number	INFM221SE.a
Lecturer	Prof. Dr. Frank Schaefer
Scope	2.0 ECTS points, 2.0 Contact hours 60 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German
Content	In the course the main cryptographic algorithms are presented. Blockciphers (DES, AES), Modes of Operation (ECB, CBC, Countermode), Hash functions, MACs, public key algorithms (RSA, Diffie-Helman, ElGamal) are covered by the lectures. Then we will look at and analyze applications in IT-security, which use cryptography: E/mail-security (eg. PGP, S-MIME), web-security (SSL), network-security (IP-Sec), authentication mechanisms.
Recommended reading	Claudia Eckert: IT-Sicherheit. Konzepte - Verfahren - Protokolle, München, Oldenbourg Wissenschaftsverlag, 2013, 8. Auflage, ISBN 978-3-486-58270-3.
Exams	Module exam
Comments	The course consist of lectures (around 2/3) and exercises (around 1/3). In the exercises the mathematical techniques introduced in the lecture will be trained.
Lecture Coding Theory	
Internal number	INFM221SE.b
Lecturer	Prof. Dr. Dirk Hoffmann
Scope	3.0 ECTS points, 2.0 Contact hours 90 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German

Content	This course teaches foundations about codes and codings as well as basic algorithms for source coding, channel coding and line coding. The lecture focuses on the following topics: information and coding theory, data compression, error detecting and correcting codes, limits of data transmission.
Recommended reading	Slides, blackboard, exercise sheets
Exams	Module exam
Comments	Lecture
Lecture Applied Cryptography Exercise	
Internal number	INFM222SE
Lecturer	Prof. Dr. Frank Schaefer
Scope	2.0 ECTS points, 1.0 Contact hours 60 Stunden gesamt, davon 15 Stunden Kontaktstudium.
Type/mode	Thesis
Language of instruction	German
Content	
Recommended reading	
Exams	Exercise 1 Semester (not graded)
Comments	

Module Mobile and Distributed Systems	
Internal number	INFM230
Coordinator	Prof. Dr. Oliver Waldhorst
Scope	7.0 ECTS points, 6.0 Contact hours
Placement	2nd Semester
Pre-requisites with regard to content	none
Pre-requisites according to the examination regulations	none
Competences	This module enables the students to understand and conceptualize mobile and distributed system architectures. They use and understand the terminology of components, layers, interfaces and standards. Students have command of functional as well as non-functional requirements upon the system and software architecture. Distribution, integration and the interaction of different technologies are also understood.
Exams	Written Exam 120 Min. (graded)
Lecture Mobile Systems	
Internal number	INFM231.a
Lecturer	Prof. Dr. Oliver Waldhorst
Scope	2.0 ECTS points, 2.0 Contact hours 60 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German

Content	In this course, students acquire a basic understanding of the challenges and technologies in the field of mobile communication systems. After completing the lecture, they will be able to explain basic principles of wireless and mobile communication and analyze and evaluate specific technologies such as mobility models, mobile ad hoc networks (MANETs), delay tolerant networks (DTNs) and mobile TCP. In addition, they are able to identify problems in the field of mobile systems and apply suitable solutions in practical scenarios. The lecture covers the following topics: · Fundamentals of mobile systems: Challenges posed by mobility, wireless communication and networks. · Mobility models: simulation and analysis of individual and group-based mobility. · Mobile ad hoc networks (MANETs): Self-organizing networks, routing protocols and use cases. · Delay-tolerant networks (DTNs): Communication with intermittent connectivity and "store-carry-forward" mechanisms. · Mobile TCP: Adaptation and optimization of the Transmission Control Protocol for mobile and wireless networks. The lecture is taught in a flipped classroom format. Students prepare for the live sessions independently with the help of lecture slides and explanatory videos. In the classroom sessions, content is deepened through case studies and exercises. Online tests are available for self-assessment, offering students feedback and the opportunity to consolidate what they have learned. The examination consists of a 60-minute written exam, which is part of the module exam "Mobile and Distributed Systems". The total workload is 60 hours, which is divided into 20 hours of attendance time in the live sessions, 20 hours of asynchronous learning with lecture slides and videos and 20 hours for exam preparation and follow-up work.
Recommended reading	- Slide collection and explanatory videos in the ILIAS system - James Kurose, Keith Ross: Computer Networking - A Top-Down Approach, 8th edition, Pearson, 2021 (Chapter 7). - Martin Sauter, Grundkurs Mobile Kommunikationssysteme, 8th edition, 2022 (available as an e-book via the KIT library) - Further information in ILIAS and in the lecture
Exams	Module exam
Comments	The lecture will take the form of seminars with exercises.

Lecture Distributed Systems

Internal number	INFM231.b
Lecturer	Prof. Dr. Christian Zirpins
Scope	2.0 ECTS points, 2.0 Contact hours 60 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Lecture

Language of instruction	German
Content	The lecture provides the basic knowledge for the design of distributed information systems. The starting point form general system and software architecture issues, regardless of concrete technologies. Then follows a central theme of the concept of middleware. There is a distinction with regard to application, communication and message-oriented middleware made. As a first concrete technology and to clarify the knowledge learned will be dealt with Web services.
Recommended reading	- Hammerschall: Verteilte Informationssysteme (Pearson Studium, 2005 , ISBN 3- 8273 - 7096 -5) - Sebastian Abeck et al. "Verteilte Systeme und Anwendungen" - Ralf Reussner, Wilhelm Hasselbring"Handbuch derSoftware-Architektur"
Exams	Module exam
Comments	Seminaristic lecture, exercises

Lecture Distributed Systems Laboratory

Internal number	INFM232
Lecturer	Prof. Dr. Christian Zirpins
Scope	3.0 ECTS points, 2.0 Contact hours 90 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Laboratory Course
Language of instruction	German
Content	The model is defined jointly for the Distributed Systems Laboratory and the Graphical User Interfaces Laboratory. In this laboratory course, the work is focused on back end development, whereas front end and user interface are developed in the Graphical user Interfaces Laboratory. The concrete problem description is based on current industrial topics, therefore changes in each semester.
Recommended reading	Powerpoint transparencies, tutorial papers for frameworks
Exams	Laboratory Work 1 Semester (not graded)
Comments	Prerequisites Java Web and application components. Persistence layer and DBMS Format Presence time with supported teamwork in the laboratory 50 %, self-study 50 %. Oral exam and presentation. Counseling 2 hours guidance in the lab, introductory lecture, contact hours also according to individual schedule, eMail.

Module Student Research Project 2	
Internal number	INFM240
Coordinator	Prof. Dr. Thomas Fuchß
Scope	8.0 ECTS points, 5.0 Contact hours
Placement	2nd Semester
Pre-requisites with regard to content	none
Pre-requisites according to the examination regulations	none
Competences	This module is the continuation of the course "Scientific or project based work I". In this module, students study a scientific problem or application project continuously throughout the whole term. The project may be, but is not necessarily so, a continuation of the problem studied in the first part of the course. In parallel, the students prepare a scientific talk open to the faculty.
Exams	Individual exams
Lecture Project based scientific Project 1 2	
Internal number	INFM241
Lecturer	Alle Professoren
Scope	4.0 ECTS points, 3.0 Contact hours 120 Stunden gesamt, davon 45 Stunden Kontaktstudium.
Type/mode	Hands-on Experience
Language of instruction	German
Content	Problems and projects may be opened by every faculty member, they are advertized on the message board at the beginning of the term. Scientific research problems usually are at the leading edge of computer science research and may be carried out in cooperation with research institutions. Application projects are of particular relevance for the industrial practice and may be carried out in cooperation with an industrial partner.
Recommended reading	According to project requirements.
Exams	Hands-on Work 1 Semester (graded)
Comments	Prerequisites According to project requirements. Format Presence time and group discussion 30 %, self study 70 %. Oral exam 30 Minutes Counseling In general, a weekly project session involving the whole team is scheduled. The counseling amounts to at least one hour per week and student.
Lecture Seminar	
Internal number	INFM242
Lecturer	Alle Professoren
Scope	4.0 ECTS points, 2.0 Contact hours 120 Stunden gesamt, davon 30 Stunden Kontaktstudium.

Type/mode	Seminar
Language of instruction	German
Content	Each participant of the seminar creates under the guidance of a supervising faculty staff a written report in housework. The contents of the report should be computer science related. Based on the report suitable presentation techniques (slides, video sequences, programmed examples) are selected. Each participant individually presents his report followed by a discussion. The seminar topics are classified into thematic groups. Besides the technical problem the student has to learn how to do 'self-marketing'. The assessment of the student is based on the following criteria: degree of difficulty, quality of written preparation; didactically skillful presentation.
Recommended reading	Depends on the topic
Exams	Presentation 20 Min. (graded)
Comments	Meetings with the faculty supervisor; eventually experimental studies, literature refurbishment; presenting the work-out; defend the own presentation; active participation in discussing the presentations of others.

Module Thesis with Colloquium	
Internal number	INFM310
Coordinator	Prof. Dr. Heiko Körner
Scope	30.0 ECTS points, 0.0 Contact hours
Placement	3rd Semester
Pre-requisites with regard to content	none
Pre-requisites according to the examination regulations	none
Competences	The Master's Thesis is the final work of the Master's Program in computer science. It serves as a proof of the acquired skills by addressing and solving a scientic or application problem independently. In general, this is carried out in cooperation with a private company or a public research institution.
Exams	Individual exams
Lecture Thesis	
Internal number	INFM311
Lecturer	Alle Professoren
Scope	29.0 ECTS points, 0.0 Contact hours 870 Stunden gesamt, davon 0 Stunden Kontaktstudium.
Type/mode	Thesis
Language of instruction	German
Content	In the final thesis, students work independently on a practical problem or research task within a specified period of time using scientific methods. They structure the task, check dependencies, collect the necessary resources and work on the problem according to a timetable. The written thesis summarises the results in a didactically meaningful way and meets academic standards.
Recommended reading	Suitable for the task as agreed
Exams	Master Thesis 6 Months (graded)
Comments	
Lecture Thesis Defense	
Internal number	INFM312
Lecturer	Alle Professoren
Scope	1.0 ECTS points, 0.0 Contact hours 30 Stunden gesamt, davon 0 Stunden Kontaktstudium.
Type/mode	Colloquium
Language of instruction	German
Content	
Recommended reading	
Exams	Verbal Exam 30 Min. (not graded)

Comments	