Hochschule Karlsruhe

Faculty for Computer Science and Business Information Systems

Module manual

Course of studies Computer Science (Master), ER 8

Winter semester 2024/2025

Module Computer Science (Master), ER 8

Module Interaction Design	
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	3.0 ECTS points, 2.0 Contact hours 90 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	Verbal Exam/Concept 20/1 Min./Semester (graded)
Comments	Participation at tuition, in class group work and discussion.

Lecture Interaction Design Exercise

Internal number	INFM112MI
Lecturer	Prof. Thomas Hinz
Scope	4.0 ECTS points, 4.0 Contact hours 120 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 Machine learning	
Internal number	INFM110ML
Coordinator	Prof. Dr. Dennis Janka
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 Machine learning	
Internal number	INFM111ML
Lecturers	Prof. Dr. Christine Preisach Prof. Dr. Dennis Janka
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 120/20 Min. (graded)
Comments	
Lecture Machine learning Exercise	
Internal number	INFM112ML
Lecturers	Prof. Dr. Dennis Janka Prof. Dr. Christine Preisach
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 (graded)
Comments	

Module Software Architectures	
Internal number	INFM110SE
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	The students learn how to design and evaluate the architecture of large software systems. This includes, in addition to the logical organization of functions and procedures, the specific decomposition into components and connectors as well as the selection and evaluation of appropriate frameworks.
Exams	Individual exams
Lecture Software Architectures	
Internal number	INFM111SE
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	In the first part of the lecture central modeling techniques for the design of components are developed. In the second part of the lecture well known architectural patterns and concepts are examined. Students learn to identify their structures, properties, and characteristics, to understand and recognize these structures as patterns. The third part of the lecture focuses on module-level architecture. Using various scenarios and examples, the use of different patterns is demonstrated and evaluated in the respective context.

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	Written/verbal Exam 60/20 Min. (graded)
Comments	The lecture will take the form of seminars with exercises.
Lecture Parallel Programming	
Internal number	INFM112SE
Lecturer	Dipl.-Ing. Christian Meder
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	
Lecture Software Architectures Laboratory	
Internal number	INFM113SE
Lecturer	Prof. Dr. Carsten Sinz
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	
Recommended reading	
Exams	Exercise 1 Semester (not graded)
Comments	

Module Smart Interaction	
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 Smart 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	Verbal Exam/Concept 20/1 Min./Semester (graded)
Comments	

Lecture Smart 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 Data Science	
Internal number	INFM120ML
Coordinator	Prof. Dr. Reimar Hofmann
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	Written/verbal Exam 120/20 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 Optimization	
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 Optimization Exercise	
Internal number	INFM122ML
Lecturer	Prof. Dr.-Ing. Astrid Laubenheimer
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 (graded)
Comments	

Module Programming language concepts	
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	Students will get to know various types of programming languages and their underlying concepts as well as optimization methods to efficiently execute programs. Via practical exercises students are exposed to different styles of programming in several programming languages. They are able to judge the usefullness and effectiveness of various programming concepts.
Exams	Individual exams
Lecture Programming paradigms	
Internal number	INFM121SE
Lecturer	Prof. Dr. Martin Sulzmann
Scope	3.0 ECTS points, 3.0 Contact hours 90 Stunden gesamt, davon 45 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	Exercise 1 Semester (graded)
Comments	Prerequisites: Experience in a programming language. Mix of lectures (2/3) and practical exercies (1/3)

Lecture Program Optimization Laboratory

Internal number	INFM122E
Lecturer	Prof. Dr. Christian Pape
Scope	4.0 ECTS points, 3.0 Contact hours 120 Stunden gesamt, davon 45 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.

Module Game Design	
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	
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	Verbal Exam/Concept 20/1 Min./Semester (graded)
Comments	
Lecture Game Design 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 Artificial Intelligence	
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	Machine learning
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	This lecture introduces current developments and research in the field of artificial intelligence and deep learning. To start with, the foundations of neural networks are shortly repeated to be able to understand the following algorithms that are mainly based on deep learning. Different architectures are introduced, like "Convolutional Neural Networks", "Recurrent Neural Networks" and "LSTMs", and their application in the context of "Computer Vision", "Natural Language Processing" and "Reinforcement Learning" are presented. The outline of the lecture is as follows: - Neural networks and deep learning - CNNs - Object detection, image segmentation - Transfer learning - Sequential models (RNNs, LSTMs, GRUs) - Language models, word embeddings, neural machine translation - Attention mechanism and transformer models - Reinforcement Learning: Basics, Q-learning, DQNs, Alpha Go - Autoencoders and GANs
Recommended reading	
Exams	Written/verbal Exam 60/20 Min. (graded)

Comments	
Lecture Artificial Intelligence Exercise	
Internal number	INFM212ML
Lecturer	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	This lab implements the theoretical foundations from the lecture into practical tasks. For this, tasks from the following three domains are tackled: * Computer Vision * Natural Language Processing * Reinforcement Learning
Recommended reading	
Exams	Exercise 1 Semester (graded)
Comments	Requirements: - Basic knowledge in Python - Basic knowledge in Machine Learning

Module Theory of efficient algorithms	
Internal number	INFM210SE
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/verbal Exam 120/20 Min. (graded)
Lecture Graph Algorithms	
Internal number	INFM211SE.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 SAT Solving	
Internal number	INFM211SE.a
Lecturer	Prof. Dr. Carsten Sinz
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 SAT Solving Exercise	
Internal number	INFM212SE
Lecturer	Prof. Dr. Carsten Sinz
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 Special chapters Media Informatics	
Internal number	INFM220MI
Coordinator	Prof. Dr. Matthias Wölfel
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 Special chapters Media Informatics	
Internal number	INFM221MI
Lecturers	Prof. Daniel Schwarz Prof. Thomas Hinz Dr. Tim Schlippe Prof. Dr. Matthias Wölfel
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. Thomas Hinz Prof. Daniel Schwarz 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 Special chapters KI	
Internal number	INFM220ML
Coordinator	Prof. Dr. Patrick Baier
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/verbal Exam 120/20 Min. (graded)
Lecture Special chapters KI 1	
Internal number	INFM221ML
Lecturer	Dr. Patrick Baier
Scope	4.0 ECTS points, 3.0 Contact hours 120 Stunden gesamt, davon 45 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German
Content	
Recommended reading	
Exams	Written/verbal Exam 60/20 Min. (graded)
Comments	
Lecture Special chapters KI 2	
Internal number	INFM222ML
Lecturer	Dr. Patrick Baier
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 60/20 Min. (graded)
Comments	
Lecture New Lecture	
Internal number	INFM223ML
Lecturer	Dr. Patrick Baier
Scope	4.0 ECTS points, 3.0 Contact hours 120 Stunden gesamt, davon 45 Stunden Kontaktstudium.

Type/mode	Lecture
Language of instruction	German
Content	
Recommended reading	
Exams	Module exam
Comments	
Lecture New Lecture	
Internal number	INFM224ML
Lecturer	Dr. Patrick Baier
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	Module exam
Comments	

Module Special chapters on software engineering	
Internal number	INFM220SE
Coordinator	Prof. Dr. Dirk Hoffmann
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 Coding Theory	
Internal number	INFM221SE
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	Written/verbal Exam 60/20 Min./Semester (graded)
Comments	Lecture
Lecture Modeling and Simulation	
Internal number	INFM222SE
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	Written/verbal Exam 60/20 Min./Semester (graded)
Comments	
Lecture Modeling and Simulation Exercise	
Internal number	INFM222SE

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 Mobile and Distributed Systems	
Internal number	INFM230SE
Coordinator	Prof. Dr. Oliver Waldhorst
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	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/verbal Exam 120/20 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	Within the course "mobile systems" the students learn the basics and concepts of mobile computing. The first part of the course introduces the problems and challenges, which one has to solve in mobile computing. The course focuses on mobility support on higher levels. Different variants of client-server architectures are compared, and treated in principle. Also caching strategies, transaction models, and concurrency control concepts are discussed. In the second part the basics of wireless communication and cellular networks are established. Beside the different variants of medium access, infrastructure and services of global cell phone standards (GSM, UMTS, LTE) are discussed, as well as their potential for mobile applications.

Recommended reading	Slides, textbooks, and other literature: - Schiller, J. Mobile Communications - Addison-Wesley, 2000. - Walke, B., Althoff M. P. und Seidenberg, P. UMTS - Ein Kurs - Schlembach, 2002. - Pitoura, E and Samaras, G. Data Management for Mobile Computing - Kluwer, 1998. - Roth, J. Mobile Computing: Grundlagen, Technik, Konzepte - dpunkt.verlag, 2002. - Höpfner, H., Türker, C. und König-Ries, B. Mobile Datenbanken und Informationssysteme - dpunkt.verlag, 2005 - Fuchß, Th. Mobile Computing: Grundlagen und Konzepte für mobile Anwendungen - München: Hanser Fachbuchverlag, 2009.
Exams	Module exam
Comments	The lecture will take the form of seminars with exercises.

Lecture Distributed Systems

Internal number	INFM231SE
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	Building on an assumed understanding of the basic principles and paradigms of distributed systems, this Master's course deals with case studies of current application areas. The selection of covered contents varies. On the one hand, practically significant (industry-relevant) areas are considered. On the other hand, current trends from research and development are addressed. Currently, the course focuses on the topic of internet computing. In this course, students gain a comprehensive understanding of the infrastructure and technologies that underpin today's Internet computing. They will develop a solid understanding of distributed system architectures and web technologies that are essential for navigating the complex landscape of modern IT environments. By exploring current paradigms such as cloud computing and the Internet of Things (IoT), students will be able to evaluate and utilize these technologies in a variety of professional contexts. In addition, by exploring emerging technologies such as distributed ledger technologies and fog computing, students will be prepared to develop innovative contributions in the field of Internet computing. The course aims to enhance their analytical skills and enable them to critically evaluate the integration and potential of Internet-based technologies in shaping individual, organizational and societal practices. In addition, students will enhance their research and inquiry skills through engagement with a variety of learning resources, including examples, further reading and comprehension questions in the accompanying textbook.

Recommended reading	Lecture Notes: - Sunyaev, Ali. 2020. Internet Computing: Principles of Distributed Systems and Emerging Internet-Based Technologies. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-34957-8. An extensive bibliography and specific recommendations for further reading will be presented during the course.
Exams	Module exam
Comments	Independent work units concern the follow-up of the course content and the exam preparation.

Lecture Distributed Systems Laboratory

Internal number	INFM232SE
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 lab provides practical insights into the construction of distributed information systems. Current paradigms are taken up and extended principles are dealt with in the context of realistic use cases. The specific tasks are based on current topics in industrial research and development. It therefore varies from semester to semester. The practical implementation is carried out using modern industry-relevant platforms and frameworks. Currently, the lab covers a project to migrate a monolithic information system following the microservice architectural style. It utilizes technologies like UML and Domain Driven Design, REST-based Microservices with Spring/Spring-Boot, a Microservice-Platforms with Docker and Kubernetes as well as Service Meshes based on Istio. Through participation in this lab class, students will gain hands-on experience in designing, developing, and deploying distributed information systems, particularly through the lens of converting monolithic architectures into microservices. They will become proficient in using a suite of modern, industry-standard tools and technologies, including UML for modeling, Domain-Driven Design for structuring systems, Spring and Spring Boot for creating REST-based microservices, and Docker and Kubernetes for containerization and orchestration. Furthermore, the application of Istio for managing service meshes will equip students with the skills necessary for optimizing the communication and operation of microservices in complex systems. This practical experience will prepare students for current and future challenges in industrial research and development.

Recommended reading	- S. Newman, "Microservices - Konzeption und Design", mitp, 2015 - E. Wolf, Das Microservices-Praxisbuch: Grundlagen, Konzepte und Rezepte, dpunkt, 2018, - B. Rumpe , Modellierung mit UML, Xpert.press, 2011 - V. Vernon, Domain-Driven Design kompakt, dpunkt, 2017 - E. Wolf, 2016, Microservices - Grundlagen flexibler Softwarearchitekturen, dpunkt, 2016 - E. Wolf, H. Prinz, Service Mesh – The New Infrastructure for Microservices, innoQ, 2020, http://leanpub.com/service-mesh-primer More literature is presented each semester according to the task. This also includes online tutorials based on a selection of current frameworks and libraries.
Exams	Laboratory Work 1 Semester (not graded)
Comments	Basic knowledge in the areas of web and component-based distributed systems as well as web and database programming in Java is required. The course includes 50% supervised attendance time (2 SWS) and 50% independent work. Proof of performance is provided by presentation and defense of the solution.

Module Management Competence	
Internal number	INFM140
Coordinator	Prof. Dr. rer. pol. Mathias Philipp
Scope	5.0 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 module consists of the parts "IT Project Management" and "IT Entrepreneurship". In the IT Project Management course, students are enabled to plan and, if necessary, implement development projects in SWE. To this end, students are familiarized with various industry-specific requirements, methods, process models and tools. The course is held in English. The objective is to prepare students for international IT projects.
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	The lecture will focus on practice oriented project management and highlight special topics like risk or quality management within the context of project management in order to enable students to plan and implement SWE projects - IT-Project Management Process Models - Agile project management - Design Thinking - Requirements specification in IT-projects - Frameworks for scaling agile projects - Risk management - Reporting systems in IT-projects - Process Models for AI and ML projects
Recommended reading	PowerPoint slides, exercise-sheets, case-studies, selected literature on the topic
Exams	Module exam
Comments	Lecture with exercises and case studies
Lecture ITEntrepreneurship	

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.

Module Project-based scientific work under supervision 1	
Internal number	INFM150
Coordinator	Prof. Dr. Thomas Fuchß
Scope	5.0 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	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	Verbal Exam 20 Min. (graded)
Lecture Project work 1	
Internal number	INFM151
Lecturer	Alle Professoren
Scope	5.0 ECTS points, 4.0 Contact hours 150 Stunden gesamt, davon 60 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 Philosophy of science and ethics	
Internal number	INFM130
Coordinator	Prof. Dr. Thomas Morgenstern
Scope	5.0 ECTS points, 3.0 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 Philosophy of Science for Computer Science	
Internal number	INFM131
Lecturer	Prof. Dr. Thomas Morgenstern
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/Hands-on Work 60/20/11 Min./Min./Semester (graded)
Comments	
Lecture Ethics for computer science	
Internal number	INFM132
Lecturer	Prof. Dr. phil. Ziad Mahayni
Scope	2.0 ECTS points, 1.0 Contact hours 60 Stunden gesamt, davon 15 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German
Content	
Recommended reading	
Exams	Written/verbal Exam/Hands-on Work 60/20/1 Min./Min./Semester (graded)
Comments	

Module Project-based scientific work under supervision 2	
Internal number	INFM240
Coordinator	Prof. Dr. Thomas Fuchß
Scope	5.0 ECTS points, 4.0 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	Verbal Exam 20 Min. (graded)
Lecture Project work 2	
Internal number	INFM241
Lecturer	Alle Professoren
Scope	5.0 ECTS points, 4.0 Contact hours 150 Stunden gesamt, davon 60 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 Advanced seminar	
Internal number	INFM250
Coordinator	Prof. Dr.-Ing. Holger Vogelsang
Scope	5.0 ECTS points, 4.0 Contact hours
Placement	2nd Semester
Pre-requisites with regard to content	none
Pre-requisites according to the examination regulations	none
Competences	
Exams	Verbal Exam 20 Min. (graded)
Lecture Seminar with presentation	
Internal number	INFM251
Lecturer	Prof. Dr.-Ing. Holger Vogelsang
Scope	5.0 ECTS points, 4.0 Contact hours 150 Stunden gesamt, davon 60 Stunden Kontaktstudium.
Type/mode	Thesis
Language of instruction	German
Content	
Recommended reading	
Exams	Presentation 1 Semester (graded)
Comments	

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. In particular, within a Master's Thesis the student has to reacher deeper and more completely into his or her field of work, than within a Bachelor's Thesis. Moreover, the Master's Thesis has to contain an abstraction of the field of work that is consistent with a scientific attitude.
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 and knowledge of the subject. They structure the task, compile the necessary resources and work on the problem according to a timetable. They are then able to present the results of their work.
Recommended reading	
Exams	Master Thesis 6 Months (graded)
Comments	All work will be individual work and will include basic literature research, system analysis, coding, documentation, and oral presentation.
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	