Hochschule Karlsruhe

Faculty for Computer Science and Business Information Systems

Module manual

Course of studies Computer Science (Bachelor), ER 5

Summer semester 2025

Module Computer Science (Bachelor), ER 5

Module Computer Science 1	
Internal number	INFB110
Coordinator	Prof. Dr. Christian Pape
Scope	8.0 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	The courses of this module teach the students fundamental programming and algorithmic skills. The students should be enabled to analyze small problems, find solutions to these problems, and develope them in the Java programming language.
Exams	Individual exams
Lecture Computer Science 1	
Internal number	INFB111
Lecturer	Prof. Dr. Christian Pape
Scope	5.0 ECTS points, 4.0 Contact hours 150 Stunden gesamt, davon 60 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German
Content	
Recommended reading	
Exams	Written Exam 120 Min. (graded)
Comments	
Lecture Computer Science 1 Laboratory	
Internal number	INFB112
Lecturer	Prof. Dr. Christian Pape
Scope	3.0 ECTS points, 2.0 Contact hours 90 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Exercise
Language of instruction	German
Content	The students turn small computer sciences problems into practice (design, implementation with Java, testing, debugging). The students are able to create their own homepage.
Recommended reading	
Exams	Exercise 1 Semester (not graded)
Comments	Practical assignment in a computer laboratory.

Module Computer Engineering 1	
Internal number	INFB120
Coordinator	Prof. Dr. Dirk Hoffmann
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	Students learn the basic concepts of computer engineering. They acquire the mathematical concepts of number representation and Boolean algebra, which are necessary for the analysis and design of hardware circuits. They learn how the common basic elements of digital technology are constructed and how these can be combined into complex combinational and sequential circuits. Furthermore, students will be able to explain the structure and functioning of common standard circuits, such as adders or shift registers. They will understand the basic concepts of the instruction set architecture of a processor and will be able to create simple assembly programs for a rudimentary model processor.
Exams	Written Exam 120 Min. (graded)
Lecture Computer Engineering 1	
Internal number	INFB121
Lecturers	Prof. Dr. Dirk Hoffmann Prof. Dr. Kurt Sutter
Scope	4.0 ECTS points, 4.0 Contact hours 120 Stunden gesamt, davon 60 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German
Content	Students acquire basic knowledge in the field of logic and circuit design. They learn how the functionality of a computer can be broken down into elementary operations, which are then physically realized in the form of logic gates. Students recognize how the desired functional components are designed from these, which require a minimum number of gates. This lays the foundation for corresponding CAE systems. The following topics are covered in detail: basic functioning of a computer; knowledge of the basic logical circuit blocks; technologies for realizing the basic components; knowledge of the most important electrical parameters; number and character representation in different codes; basics of Boolean algebra; methods of simplifying Boolean expressions; use of CAE software; designing combinational circuits; designing sequential circuits; designing synchronous circuits; flip-flops; counters and registers.
Recommended reading	Slides, blackboard, exercise sheets

Exams	Module exam
Comments	Lecture
Lecture Computer Engineering 1 Laboratory	
Internal number	INFB122
Lecturers	Prof. Dr. Kurt Sutter Prof. Dr. Dirk Hoffmann
Scope	3.0 ECTS points, 2.0 Contact hours 90 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Exercise
Language of instruction	German
Content	Alongside the lecture, students work through several exercises. The tasks come from the areas of number representation, Boolean algebra, circuit design and minimization, standard circuits and microcomputer architecture.
Recommended reading	Exercise sheets, blackbord
Exams	Exercise 1 Semester (not graded)
Comments	In-class exercises

Module Theoretical Computer Science 1	
Internal number	INFB130
Coordinator	Prof. Dr. Heiko Körner
Scope	4.0 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	Participants of this lecture will be in a position to recognize the fundamental limitations of today's computers when solving important problems. Hence, this course gives an intoduction to the basic areas of modern theoretical computer science. The Chomsky hierarchy helps the students to classify formal languages by their algorithmic complexity. Furthermore, the students use computational models (finite state automata, push-down automata) to represent today's computers and to understand their limits. Due to these limitations, several problems are shown to be unsolveable. Proving all these results requires precise mathematical and logical arguments, and the students are intensively trained to use them correctly.
Exams	Individual exams

Lecture Theoretical Computer Science 1	
Internal number	INFB131
Lecturer	Prof. Dr. Heiko Körner
Scope	4.0 ECTS points, 4.0 Contact hours 120 Stunden gesamt, davon 60 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German
Content	This course gives an introduction to the theory of formal languages. The Chomsky hierarchy will serve as a model to classify these languages by their computational complexity. Modern computers are represented by finite state automatons, showing theier principal limits. The students also learn how to apply several proof techniques. The lecture include the following areas of theoretical computer science: mathematical logic, formal languages, proof techniques, the O-calculus, finite automata, regular languages and expressions, the Chomsky hierarchy, the pumping lemma for regular and context-free languages and the minimization of finite automata by the theorem of Myhill-Nerode. Furthermore, the course covers pushdown automata, the CYK algorithm and closure properties of regular and context-free languages.

Recommended reading	The substance of the lecture will be discussed at the blackboard. Lecture notes containing the complete material are also available. Furthermore, there are sample solutions to all exercises. Literature: D. W. Hoffmann: Theoretische Informatik, 3. Auflage. Hanser, 2015. M. Sipser: Introduction to the Theory of Computation, 3rd edition. Cengage Learning, Inc., 2012.
Exams	Written Exam 90 Min. (graded)
Comments	This course will take place as a pure lecture. Numerous exercises deepen selected areas and will be discussed in tutorials.

Module Mathematics 1	
Internal number	INFB140
Coordinator	Prof. Dr.-Ing. Astrid Laubenheimer
Scope	8.0 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	Participants learn the mathematical basics from linear algebra, which are often used in computer science. These basics are specifially needed in computer graphics, robotic, cryptography.
Exams	Individual exams
Lecture Mathematics 1	
Internal number	INFB141
Lecturer	Prof. Dr. Frank Schaefer
Scope	5.0 ECTS points, 4.0 Contact hours 150 Stunden gesamt, davon 60 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German
Content	he participants should learn basic knowledge of mathematics and especially of linear algebra and acquire the methods to solve smaller mathematical tasks by themselves. In the part on linear algebra we will focus on knowledge needed in computer grafic and 3D simulations. Content of the lectures: Proof methods, relations, euqivalence relations, modulo-calculation, Euklid's algorithm, functions, operations, groups, rings, fields, polynomial rings, finite fields, interpolation, vector spaces, basis, dimension, linear equations, rank, Gauß-Jordan-algorithm, determinant, matrices, linear map, inverse matrices, rotation, translation, scaling, scalarproduct, norm, vectorproduct, orthogonal matrizen, eigenvalues, eigenvectors, homogeneous coordinates.
Recommended reading	Own writings from the blackboard, Exercises and summaries from the internet, Tutorials given by students, Textbook: Peter Stingl: Mathematik für Fachhochschulen, Hanser Verlag, 8. Auflage, 2009, ISBN-10: 3-446-42065-7
Exams	Written Exam 90 Min. (graded)
Comments	Lecture, Exercises, Summary of the solutions in the lecture, Tutorials for further assistance
Lecture Mathematics 1 Laboratory	
Internal number	INFB142
Lecturer	Prof. Dr. Frank Schaefer

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	Improving the knowledge of the related lectures, basics in computer-algebra systems, mathematical problem solving with computer assistance. With the help of the computer algebra system Maple different, applied mathematical questions from the fields of geometry, curves, interpolation and linear equations will be solved. Additionally we will look at functions, which can be represented by matrices.
Recommended reading	Short introduction will be given. Exercises distributed in the classes and also available on the internet.
Exams	Exercise 1 Semester (not graded)
Comments	Exercises in the labs with Maple (instructor will be present).

Module Language Competence	
Internal number	INFB150
Coordinator	Prof. Dr.-Ing. Holger Vogelsang
Scope	4.0 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 learning of a foreign language is an integral component of the in the course of studies communicated key qualification.
Exams	Individual exams
Lecture Foreign Languages	
Internal number	INFB151
Lecturer	Mehrere Dozenten
Scope	4.0 ECTS points, 4.0 Contact hours 120 Stunden gesamt, davon 60 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	English
Content	After a grading test students can deepen their English skills to three grades. The entry level requires the competence grade A2 (basic user) in the six-stage common European reference framework. The first two grades (English for advanced learners 1 and 2) engage besides a recapitulation of grammar mainly in issues of job-oriented common language and cultural studies, e.g. job application letters, descriptions of products and services, business telephone calls, progress of formal and informal conferences, presentations etc. The thus achieved grade complies with 173 points in the TOEFL (computer-based) or the competence grade B2 (independent user) of the European reference framework. In the following grade special language skills (English for science and technics) are leant: In business English the priority is on spoken language and small study groups. At the beginning of the semester each group founds its own company which advances dynamically during the course of the semester. At the same time vocabulary and phrasing in respect of topics like company structures, meetings, negotiation, marketing, production and sale, finances, comprehending of reports and presentations are gone through in order to make the attendees handle the language instruments to cope with each step of the simulation in English. The highlights of the course are a simulated exhibition, a hiring procedure and the group presentation. In technical English the priority is on the learning and practice of a technical basis vocabulary and typical expressions of technical communication.
Recommended reading	Literature depends on grade, PowerPoint presentations, execises, Videos, DVDs

Exams	Written Exam 90 Min. (graded)
Comments	Lecture participation, short talks, discussions

Module Computer Science 2	
Internal number	INFB210
Coordinator	Prof. Dr.-Ing. Holger Vogelsang
Scope	7.0 ECTS points, 6.0 Contact hours
Placement	2nd Semester
Pre-requisites with regard to content	Theoretical Computer Science 1, Computer Science 1
Pre-requisites according to the examination regulations	none
Competences	The students learn about basic algorithms and data structures. They can estimate in which situations specific and complex data types are used, how they work and how much time they take. They are able to prove the correctness of algorithms. In practical assignments the students are enabled to implement various algorithms and data structures.
Exams	Individual exams

Lecture Computer Science 2	
Internal number	INFB211
Lecturers	Dipl.-Ing. Christian Meder Prof. Dr.-Ing. Holger Vogelsang
Scope	4.0 ECTS points, 4.0 Contact hours 120 Stunden gesamt, davon 60 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German
Content	This lecture consists of four parts. The first one introduces basic concepts of object oriented programming on the basis of the programming language Java. The main issues are among other things: Language elements of Java, data abstraction and encapsulation, inheritance, polymormism, generic programming, error handling an runtime typ information. Based on these techniques an introduction in modeling of class diagrams with UML is made. Additional practical exercises with a standard IDE adeepen the knowledge. The second part introduces the development of mobile Apps with graphical user interfaces for Android. The third part of the lecture deals with some important data structures like lists, hashtables, tree and graphs and introduces basic algorithms to operate on them. The forth part introduces the modularization of applications with Spring.

Recommended reading	On the lecture homepage: PowerPoint presentation, program examples, script Books: - Christian Ullenboom, Java ist auch eine Insel, Galileo Computing - R. C. Martin, Clean Code, mitp - B. Lahres, G. Raýman, Objektorientierte Programmierung, Galileo Computing - G. Popp, Konfigurationsmanagement mit Subversion, Maven und Redmine, dpunkt - M. Jeckle, C. Rupp, J. Hahn, B. Zengler, S. Queins, UML 2 - glasklar, Hanser-Verlag - G. Saake, K. Sattler, Datenstrukturen und Algorithmen: Eine Einführung mit Java, dpunkt - O. Zeigermann: "JavaScript für JavaEntwickler", entwickler.press - D. Flanagan: "JavaScript - kurz & gut", O'Reilly - M. Haverbeke: "Eloquent JavaScript", kostenlos unter http://eloquentjavascript.net/ - JavaScript-Referenz: https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference
Exams	Written Exam 120 Min. (graded)
Comments	Preparation of lecture contents and exam

Lecture Computer Science 2 Laboratory

Internal number	INFB212
Lecturers	B.Sc. Manuel Vogel Dr. Martin Holzer Prof. Dr.-Ing. Holger Vogelsang
Scope	3.0 ECTS points, 2.0 Contact hours 90 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Exercise
Language of instruction	German
Content	The students solve Java and JavaScript exercises and model small applications using UML class diagrams.
Recommended reading	Script, compulsory and optional exercises on the homepage, solutions for optional exercises
Exams	Exercise 1 Semester (not graded)
Comments	Practical exercise with discussion of solutions

Module Software Laboratory	
Internal number	INFB220
Coordinator	Prof. Dr. Martin Sulzmann
Scope	5.0 ECTS points, 4.0 Contact hours
Placement	2nd Semester
Pre-requisites with regard to content	Computer Science 1
Pre-requisites according to the examination regulations	none
Competences	The students learn to apply the theoretical knowledge of "Informatik 2" using the programming language Java. They have design and implement projects with an increasing level of difficulty. The main topics are: - Practicing object oriented programming techniques - Preferring abstractions over concrete implementations - Modeling class and package diagrams before starting an implementation - Code quality assurance by writing automated tests - Teamwork
Exams	Individual exams
Lecture Software Laboratory	
Internal number	INFB221
Lecturers	Prof. Dr. Heiko Körner Prof. Dr. Christian Pape Prof. Dr. Martin Sulzmann
Scope	5.0 ECTS points, 4.0 Contact hours 150 Stunden gesamt, davon 60 Stunden Kontaktstudium.
Type/mode	Laboratory Course
Language of instruction	German
Content	The students implement projects with an increasing complexity in C++. They have to use generic classes, inheritance, polymorphism, abstract classes and interfaces and concepts for error handling and detection like exceptions and assertions. Additionally they will learn to use elements of the STL and to model the classes and their relationships with UML.
Recommended reading	On the homepage: Project description with a step-by-step instruction, Java script, optional exercise with solutions, books: - Ulrich Breymann, C++ - Einführung und professionelle Programmierung, Hanser-Verlag
Exams	Laboratory Work 1 Semester (not graded)
Comments	Laboratory work in small groups

Module Distributed Systems 1 and Theoretical Computer Science 2	
Internal number	INFB230
Coordinator	Prof. Dr. Heiko Körner
Scope	5.0 ECTS points, 4.0 Contact hours
Placement	2nd Semester
Pre-requisites with regard to content	Theoretical Computer Science 1, Computer Science 1
Pre-requisites according to the examination regulations	none
Competences	The students learn the theoretical foundations of computability and complexity theory. Certain undecidable problems are shown to be unsolvable with modern computers despite of their today's powerful hardware. Other intractable problems prove to be theoretically solvable, but with an unacceptable amount of computational time. Students also learn to identify as well as classify goals and problems of distributed systems. They sketch generic architectures, processes, communication as well as naming techniques and apply them to Web applications and services. Students distinguish software technologies for Web-based systems and evaluate their use cases.
Exams	Written Exam 120 Min. (graded)
Lecture Distributed Systems 1	
Internal number	INFB231.a
Lecturer	Prof. Dr. Christian Zirpins
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 course provides a practical introduction to the concepts and paradigms of distributed systems using the example of web technologies and application development on the web. This initially involves an introduction of the world wide web with basic protocols such as HTTP and other standards in the context of the Internet. After that an introduction to the design and construction of web applications is provided. This includes firstly the frontend development with HTML5, CSS3 as well as client-side JavaScript and secondly the backend development with server-side JavaScript on the Node.js platform. Interactions between frontend and backend follow modern REST/HTTP and AJAX techniques. In addition, mechanisms for personalization with cookies and sessions as well as to authenticate users are presented. The course closes with a detailed discussion of web application security. Upon completing this lecture class, students will acquire practical skills in the development and deployment of web applications, grounded in an understanding of distributed systems and web technologies. They will learn to proficiently use HTML5, CSS3, and JavaScript for frontend development, alongside server-side development with Node.js, enhancing their ability to create dynamic, full-stack web applications. Additionally, students will gain knowledge in implementing modern REST/HTTP and AJAX techniques for efficient frontend-backend communication, as well as in employing cookies, sessions, and authentication strategies for personalizing user experiences and ensuring application security. This comprehensive skill set will prepare students for a wide range of roles in web development and application design, equipping them with the necessary tools to address current and future challenges in the field.
Recommended reading	- Semmy Purewal, "Learning Web App Development", O'Reilly, 1. Auflage, 2014 - David Gourley, Brian Totty, "HTTP: The Definite Guide", O'Reilly, 2002 - Mark Pilgrim, "HTML5 Up and Running", O'Reilly, 2010 (Online: http://diveintohtml5.info) - Marijn Haverbeke, "Eloquent JavaScrip", No Starch Press, 2014 (Online: http://eloquentjavascript.net) - Peter Gasston, "The Book of CSS3 - A Developer's Guide to the Future of Web Design", 2nd Edition, No Starch Press, 2014 - Andy Budd, Emil Björklund, "CSS Mastery", Third Edition, Apress, 2016 (Online verfügbar im Hochschulnetz) - Ethan Brown, "Web development with Node and Express", O'Reilly, 2014 - Robert Prediger ; Ralph Winzinger, "Node.js : Professionell hochperformante Software entwickeln", Hanser, 2015 (Online verfügbar im Hochschulnetz) - Additional literature will be announced during the lecture
Exams	Module exam
Comments	In preparation for individual lecture units, the self-study of basic content is required by means of the accompanying literature (relevant chapters will be announced in the event). Further independent work concerns the follow-up of the lecture contents and the exam preparation.
Lecture Theoretical Computer Science 2	
Internal number	INFB231.b

Lecturer	Prof. Dr. Heiko Körner
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 course deals with the computational limits of modern computer systems, showing the undecidability and intractability of important problems. Several computational conceps like Turing machines and WHILE-programs are presented. Other topics include the Church-Turing thesis, the theory of NP-completeness and zero-knowledge-proofs. For this course some basics concerning theoretical computer science are required (regular languages, finite automata, O-calculus, etc.). This knowledge can be purchased in the lecture Theoretical Computer Science I.
Recommended reading	The substance of the lecture will be discussed at the blackboard. Lecture notes containing the complete material are also available. Furthermore, there are sample solutions to all exercises. Literature: D. W. Hoffmann: Theoretische Informatik, 3. Auflage. Hanser, 2015. M. Sipser: Introduction to the Theory of Computation, 3rd edition. Cengage Learning, Inc., 2012.
Exams	Module exam
Comments	This course will take place as a pure lecture. Numerous exercises deepen selected areas and will be discussed in tutorials.

Module Mathematics 2	
Internal number	INFB240
Coordinator	Prof. Dr.-Ing. Astrid Laubenheimer
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	
Exams	Written Exam 120 Min. (graded)
Lecture Analysis	
Internal number	INFB241.a
Lecturer	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	Module exam
Comments	
Lecture Statistics	
Internal number	INFB241.b
Lecturer	Prof. 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	The statistics lecture teaches skills in handling and analyzing empirical data, as well as an introduction to probability theory. Students learn to analyze and model data by seeing common statistical methods and models in action, which will enable them to apply static methods to evaluate data themselves. The contents of the lecture include: - Basic concepts of probability calculation - Probability distributions - Independence from random variables conditional probabilities - Excerpts from descriptive and inferential statistics.
Recommended reading	Teschl G. und Teschl S. Mathematik für Informatiker. Band 1 und Band 2. Springer Verlag. Zum Beispiel 3. Auflage 2010.
Exams	Module exam
Comments	

Module Computer Engineering 2	
Internal number	INFB250
Coordinator	Prof. Dr. Christian Langen
Scope	7.0 ECTS points, 6.0 Contact hours
Placement	2nd Semester
Pre-requisites with regard to content	Computer Engineering 1
Pre-requisites according to the examination regulations	none
Competences	The students are familiar with the foundations required for design of embedded systems. They know computer aided hardware design techniques. They are able to implement simple designs using the hardware design lanquage VHDL. Additionally, students are familiar with internal functions of typical processors. They are able to implement the hardware related software parts using the "C" programming languege including the use of typical peripherals. All knowledge gained is reinforced by practical work in the laboratory.
Exams	Individual exams
Lecture Computer Engineering 2	
Internal number	INFB251
Lecturer	Prof. Dr. Christian Langen
Scope	4.0 ECTS points, 4.0 Contact hours 120 Stunden gesamt, davon 60 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German
Content	The lecture will provide an overview of programmable logic. This will be followed by a description of the basic modular devices that comprise programmable logic. The students will particapate in an exercise which exposes them to the CAD for programmable logic. An introduction to the design language VHDL will be given. This will be expanded to provide background in parallel and sequential description modes used in VHDL. The remaining description modes (processes and structures) will also be discussed. On the processor side, the lecture will cover the following, basic processor hardware, processor architecture, addressing modes, instructions, memory mapping, peripherals and bit processing.
Recommended reading	Powerpoint slide, personal notes, web based exercises and the suggested solution (provided upon request).
Exams	Written Exam 90 Min. (graded)
Comments	The student will be required to come prepared to participate in the lecture and will be expected to be able to develop a summary upon completion of the lecture, all exercises provided for reinforcement will be required to be individual work.

Lecture Digital Technology Laboratory	
Internal number	INFB252
Lecturer	Prof. Dr. Christian Langen
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	Lab experiments will be conducted using: - Digital Circuits - Microcontrollers - Peripherals - Timers and Counters
Recommended reading	Exercises, equipment provided and various manuals and other support material.
Exams	Exercise 1 Semester (not graded)
Comments	All laboratory work will be group work. It will include the conduct of the experiment, demonstration of the required result and be prepared to answer questions on the work and the results. Groups are on their own and are required to come to the laboratory prepared to conduct the exercise. Each group will prepare a final documentation of the exercise.

Module System Software and System Programming	
Internal number	INFB310
Coordinator	Prof. Dr. Thomas Fuchß
Scope	9.0 ECTS points, 8.0 Contact hours
Placement	3rd Semester
Pre-requisites with regard to content	Computer Science 1, Computer Science 2, Software Laboratory, Theoretical Computer Science 1
Pre-requisites according to the examination regulations	none
Competences	Participants should know the design and implementation principles of modern operating systems. They should learn how to think in parallel structures and solve problems with the parallel programming paradigm.
Exams	Individual exams
Lecture System Software	
Internal number	INFB311
Lecturer	Prof. Dr. Thomas Fuchß
Scope	4.0 ECTS points, 4.0 Contact hours 120 Stunden gesamt, davon 60 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German

Content	The course "System Software" covers the fundamental tasks and functionalities of modern operating systems and enables students to apply these techniques independently and systematically in teams to solve system-level development tasks. The course is divided into four main thematic areas: Fundamentals, Process Management, and Scheduling: - Understanding the relationship between computer architecture and operating systems. - Principles of processor virtualization and limited direct execution. - Scheduling algorithms (e.g., Round-Robin, Shortes-Job-First). File Systems and Persistence: - Requirements and differences in HDDs and SSDs. - Structure and implementation of file systems. - Concepts of free-space management and crash consistency. Memory Virtualization: - Principles of memory segmentation and paging. - Management of page frames and allocation strategies. - Mechanisms for isolation and memory management. Concurrency: Processes and Threads: - Introduction to threads. - Synchronization mechanisms: Mutexes, semaphores, condition variables, monitors. - Patterns for parallel and concurrent programming. In addition, the specific challenges of each topic are discussed, along with common strategies for addressing them. Practical exercises complement the lectures to facilitate the application of theoretical concepts to realistic scenarios.
Recommended reading	Slides, videos, textbooks, and other literature: - Arpaci-Dusseau, Remzi H.; Arpaci-Dusseau, Andrea C. Operating Systems: Three Easy Pieces, (V. 1.10) Arpaci-Dusseau Books, 2023 - Tanenbaum, Andrew S.; Bos, H. Modern Operating Systems (4th Edition) – Pearson, 2014 - Stallings, W. Operating Systems: Internals and Design Principles (8th Edition) – Pearson, 2014
Exams	Written Exam 120 Min. (graded)
Comments	The lecture will take the form of seminars with exercises.

Lecture System Programming

Internal number	INFB312
Lecturer	Prof. Dr. Carsten Sinz
Scope	5.0 ECTS points, 4.0 Contact hours 150 Stunden gesamt, davon 60 Stunden Kontaktstudium.
Type/mode	Laboratory Course
Language of instruction	German

Content	The course is organized in three exercises, covering compiler construction and interprocess communication. Starting with a scanner, the students consolidate their skills in handling large dynamic data structures, pointers, and doing low level IO. The second exercise focuses on the development of a recursive descendent parser and a short introduction to semantic analysis and code generation. The third exercise is an introduction to the field of interprocess communication. Within the exercise, elementary techniques and concepts are trained: - generating processes / threads - terminating processes / threads - synchronizing processes / threads
Recommended reading	Slides and textbooks: - Eduard Glatz. Betriebssysteme: Grundlagen, Konzepte, Systemprogrammierung - dpunkt.verlag, 2010 - A.V. Aho, M.S. Lam, R. Sethi und J.D. Ullman. Compiler - Prinzipien, Techniken und Werkzeuge - 2nd Edition - München: Pearson Studium, 2008. - D. Grune et. al. Modern compiler design - Wiley, 2000. - Andrew S. Tanenbaum. Betriebssysteme, Entwurf und Realisierung Teil 1 - Hanser, 1990.
Exams	Laboratory Work 1 Semester (not graded)
Comments	Attended teamwork and three lectures.

Module Databases and Communication Networks 1	
Internal number	INFB330
Coordinator	Prof. Dr. Oliver Waldhorst
Scope	7.0 ECTS points, 6.0 Contact hours
Placement	3rd Semester
Pre-requisites with regard to content	Computer Science 1, Computer Science 2, Theoretical Computer Science 1
Pre-requisites according to the examination regulations	none
Competences	The module teaches the basics and practical skills in database systems and communication networks. Competence objectives in the field of databases: - Students can model, normalize and implement relational databases. - They are proficient in SQL (DDL, DML, DCL), transaction management, JDBC and OR mapping (Hibernate). - They develop database applications independently and integrate them into programming languages such as Java. - Teamwork and problem-solving skills are encouraged through practice-oriented projects. Competence goals in the area of communication networks: - Students understand the architecture and functionality of networks and analyze protocols such as HTTP, TCP, UDP, IPv4/IPv6. - They plan, configure and evaluate networks, including routing and subnetting. - They implement protocol functions and use tools for network analysis and fault diagnosis. - They are able to analyze and evaluate network performance indicators. The module promotes analytical thinking, practical problem-solving skills and teamwork and provides a foundation for topics such as network security and distributed systems.
Exams	Written Exam 120 Min. (graded)

Lecture Databases 1	
Internal number	INFB331.a
Lecturer	Prof. Dr.-Ing. Holger Vogelsang
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 covers the following topics: - Introduction to information systems - Basics of database systems - Database organization - Data models - Database schema - Architecture: 3-tier model, client-server architecture - Current SQL standard (queries, DDL, DML, in particular SQL:2003 with object-oriented extensions, NF2, window functions) - Transactions - JDBC - ER modeling - Mapping entities and relationships to relational data models - Normalization - OR mapping
Recommended reading	- Script - Example databases of the lecture for the common database systems - Exercises - Sample programs - Collection of old exams and their solutions - Edwin Schicker, "Datenbanken und SQL", Springer Vieweg, 2017, ISBN: 978-3834817327 - Gunter Saake, Kai-Uwe Sattler, "Datenbanken - Konzepte und Sprachen", mitp, 2013, ISBN: 978-3286694530
Exams	Module exam
Comments	

Lecture Communication Networks 1

Internal number	INFB331.b
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 expand their knowledge of communication networks, in particular by taking an in-depth look at the functionalities and challenges of the layers of the Internet protocol stack. After completing the course, they will be able to analyze, evaluate and practically apply advanced mechanisms and protocols in the application layer, transport layer, network layer and security layer. They will be able to identify complex network problems, combine specific solution modules and develop innovative solutions. The lecture covers the following topics: - Transmission of multimedia content in the application layer, e.g. Netflix and Skype, as well as the basics of secure communication such as TLS and secure email. - Transport layer mechanisms, including extensions to TCP such as SACK and CUBIC, as well as new protocols such as QUIC. - Network layer with addressing and routing concepts, including IPv6, Software Defined Networking (SDN) and IPsec. - Data link layer with a focus on VLANs, MPLS and data center networks. The lecture is taught in a flipped classroom format. Students prepare for the classroom sessions independently using lecture slides and explanatory videos. In these sessions, the topics are explored in greater depth through case studies and exercises. Online tests offer students the opportunity for self-assessment and to collect bonus points for the exam. The examination consists of a 60-minute written exam, which is part of the module exam "Databases and Communication Networks 2". The total workload is 75 hours, divided into 25 hours of attendance time, 25 hours of asynchronous learning and 25 hours for exam preparation and follow-up.
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 - Various Internet standards, see https://www.rfc-editor.org - Further information in the lecture
Exams	Module exam
Comments	

Lecture Databases 1 Laboratory

Internal number	INFB332
Lecturer	Prof. Dr.-Ing. Holger Vogelsang
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	Adatabase application for a flight reservation system is designed and prototypically implemented. This includes setting up a DB scheme, the design and testing of SQL queries, the use of transactions and transaction levels, as well as programming a seat reservation transaction with Java, JDBC and SQLJ-based on Oracle.

Recommended reading	Sample database, JUnit test cases, test-GUI; Textbooks: - "Grundlagen von Datenbanksystemen", Ausgabe Grundstudium (Taschenbuch) von Ramez Elmasri, Shamkant B. Navathe, Pearson, 2005, ISBN: 3827371538 - "Datenbanksysteme" von Alfons Kemper, Andre Eickler, Oldenbourg, 2006, ISBN: 3486576909 - "Datenbanken & Java. JDBC, SQLJ, ODMG und JDO" von Gunter Saake, Kai-Uwe Sattler, Dpunkt Verlag, 2003, ISBN: 3898642283
Exams	Exercise 1 Semester (not graded)
Comments	Supervised laboratory with final presentation on the computer, self-work, preparation and after working of lab sessions, prepare a reportof the laboratory tasks.

Module Man-Machine-Communication	
Internal number	INFB340
Coordinator	Prof. Dr. Ulrich Bröckl
Scope	4.0 ECTS points, 3.0 Contact hours
Placement	3rd Semester
Pre-requisites with regard to content	Computer Science 1
Pre-requisites according to the examination regulations	none
Competences	The main objective of the module is the ability of students to create effective, efficient and satisfactory end user interfaces. By means of periodic evening events they get basic understanding of association work, concretely the work of the Usability Professionals' Association (UPA).
Exams	Individual exams
Lecture Man-Machine-Communication Design	
Internal number	INFB341
Lecturer	Prof. Dr. Ulrich Bröckl
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	- "GUI Design Essentials " von Susan Weinschenk, Pamela Jamar, Sarah C. Yeo, Verlag John Wiley & Sons, 1997, ISBN: 0471175498
Exams	Written/verbal Exam 90 Min. (graded)
Comments	
Lecture Man-Machine-Communication Design	
Internal number	INFB342
Lecturer	B.Sc. Valeria Zitz
Scope	2.0 ECTS points, 1.0 Contact hours 60 Stunden gesamt, davon 15 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German
Content	An MMC-task which is standard practice is designed starting from task analysis up to the paper prototype. This prototype is subject - possibly over several iterations - of a usability test until the specified quality targets are reached.
Recommended reading	Script, eye-tracker and user monitoring space in the Usability Lab Textbooks: - "GUI Design Essentials " von Susan Weinschenk, Pamela Jamar, Sarah C. Yeo, Verlag John Wiley & Sons, 1997, ISBN: 0471175498

Exams	Homework 1 Semester (not graded)
Comments	Supervised group work with presentation and discussion; test the usability of the prototype, prepare a test report with proposals for improvements.

Module Antomation and Declarative Programming	
Internal number	INFB350
Coordinator	Prof. Dr. Norbert Link
Scope	6.0 ECTS points, 5.0 Contact hours
Placement	3rd Semester
Pre-requisites with regard to content	Computer Engineering 2
Pre-requisites according to the examination regulations	none
Competences	
Exams	Written Exam 120 Min. (graded)
Lecture Automation	
Internal number	INFB351.a
Lecturer	Prof. Dr. Norbert Link
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	- Rembold, U., Levi, P. : Realzeitsysteme zur Prozeßautomatisierung, Carl Hanser Verlag, München Wien, 1994 - MANN, H., SCHIFFELGEN, H., FRORIEP, R. : Einführung in die Regelungstechnik, Carl- Hanser Verlag, München, Wien, 2000 - Etschberger, K. (Hrsg) : CAN, Controller Area Network, Hanser-Verlag, München, 2001 - Tietze, U. , Schenk, Ch. : Halbleiter-Schaltungstechnik, Springer-Verlag, Berlin, 2005 - DATA LOGIC : Der Strichcode-Fibel, Firmenprospekt, 2008 - FINKENZELLER,K.: RFID-Handbuch, Hanser Verlag, München, Wien, 2006
Exams	Module exam
Comments	
Lecture Declarative Programming	
Internal number	INFB351.b
Lecturer	Prof. Dr. Christian Pape
Scope	2.0 ECTS points, 2.0 Contact hours 60 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	English
Content	
Recommended reading	

Exams	Module exam
Comments	
Lecture Automation Laboratory	
Internal number	INFB352
Lecturer	Dipl. Inf. (FH) Oktavian Gniot
Scope	2.0 ECTS points, 1.0 Contact hours 60 Stunden gesamt, davon 15 Stunden Kontaktstudium.
Type/mode	Laboratory Course
Language of instruction	German
Content	Practice of development processes for industrial, reactive systems with co-operating handling systems: modelling of system dynamics by means of state charts or Petri networks, implementation of the formal software models in PLC software (via AWL/FUP/KOP and STEP7-Graph), process visualisation on an control center PC (via WinCC), system communication via TCP/IP and real time channels, system co-operation.
Recommended reading	Lecture notes, task descriptions, project guidelines and FAQs, all accessible via the internet. Handbooks and relevant literature is available on site and for homework in the library.
Exams	Exercise 1 Semester (not graded)
Comments	Seminar-style teaching, practice, reporting

Module Business Administration	
Internal number	INFB360
Coordinator	Prof. Dr. Uwe Haneke
Scope	4.0 ECTS points, 4.0 Contact hours
Placement	3rd Semester
Pre-requisites with regard to content	none
Pre-requisites according to the examination regulations	none
Competences	
Exams	Individual exams
Lecture Business Administration	
Internal number	INFB361
Lecturer	Prof. Dr. Uwe Haneke
Scope	4.0 ECTS points, 4.0 Contact hours 120 Stunden gesamt, davon 60 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German
Content	Students are introduced to the fundamental concepts of general business administration. They learn about economic processes and interrelationships and become familiar with typical processes and requirements within companies. They are able to identify and outline the various areas of business administration. Using diferent tools and concepts, students can describe and analyze a company's situation. In addition, students are equipped to independently calculate and analyze key performance indicators that provide insights into a company's efficiency and effectiveness. In the Business Administration lecture, topics such as the economic environment (economics), business structures, organization, investment and financing, marketing, and accounting are covered in depth. This enables students to gain a comprehensive understanding of how a company operates and the resulting requirements.
Recommended reading	- Slides - Case studies - Exercises
Exams	Written Exam 90 Min. (graded)
Comments	

Module Internship Preparation and Roundup	
Internal number	INFB4P0
Coordinator	Prof. Dr. Heiko Körner
Scope	6.0 ECTS points, 4.0 Contact hours
Placement	4th Semester
Pre-requisites with regard to content	Computer Science 1
Pre-requisites according to the examination regulations	Vorstudium
Competences	After completing this module, students will be able to handle important work-related skills that are also relevant for the practical semester. They can use the Scrum process model to manage projects and work in corresponding Scrum teams. They master techniques for the professional creation of scientific documents, can prepare data in a targeted manner and visualise their findings in an appealing way using modern presentation tools.
Exams	Individual exams

Lecture Internship Preparation	
Internal number	INFB4P1
Lecturers	Dr. Martin Holzer B.Sc. Veit Richter
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 deals with the general handling of MS Office products and gives specifically an introduction to the main functions of MS-Excel. Topics include input methods, formulas, chart depictions and search functions. Basic knowledge about the programming in VBA are also taught. These methods will also be used for macro skripts in MS-Word. Afterwards, the students have learned how to solve typicals problems efficiently with these today's standard programs.
Recommended reading	Exercises, programs with solutions and online documentation.
Exams	Exercise 1 Week (not graded)
Comments	Practical assignment in a computer laboratory.

Lecture Internship Roundup	
Internal number	INFB4P2
Lecturers	Prof. Dr. Heiko Körner Dipl. WiInf. Lars Thoralf Thielemann
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 deals with the general handling of MS Office products and specifically provides an introduction to the most important functionalities of MS Excel. Students learn, for example, how to use input methods, formulae, diagrams and search functions. Basic knowledge of programming under VBA is also taught. These are then used to create macro scripts in MS Word. The focus is on the efficient use of MS Office products. Participating students are then able to quickly solve typical tasks.
Recommended reading	Lecture notes
Exams	Exercise 1 Week (not graded)
Comments	The course consists of a lecture (50%) and supervised practical exercises (50%).

Module Internship	
Internal number	INFB4PX0
Coordinator	Prof. Dr. Patrick Baier
Scope	24.0 ECTS points, 0.0 Contact hours
Placement	4th Semester
Pre-requisites with regard to content	none
Pre-requisites according to the examination regulations	Vorstudium
Competences	The internship is designed to deepen the previously acquired knowledge and skills by qualified collaboration in a larger project. The focus is on improving the technical competence and the development of social and personal skills. The student needs to assert himself as an independent member of the team. He becomes acquainted with new fields of duty and will become familiar with new tools. He learns to evolve himself and to assess his skills. The internship may be pursued in a company, in a research facility or an authority.
Exams	Individual exams
Lecture Internship	
Internal number	INFB4PX1
Lecturer	Dr. Patrick Baier
Scope	24.0 ECTS points, 0.0 Contact hours 720 Stunden gesamt, davon 0 Stunden Kontaktstudium.
Type/mode	On-the-job Training
Language of instruction	German
Content	
Recommended reading	
Exams	Hands-on Work 95 Days (not graded)
Comments	

Module Software Engineering and Distributed Systems 2	
Internal number	INFB510
Coordinator	Prof. Dr. Thomas Fuchß
Scope	8.0 ECTS points, 7.0 Contact hours
Placement	5th Semester
Pre-requisites with regard to content	Man-Machine-Communication, Internship, Distributed Systems 1 and Theoretical Computer Science 2, Computer Science 2, System Software and System Programming, Databases and Communication Networks 1
Pre-requisites according to the examination regulations	Vorstudium
Competences	Having successfully completed the module, students are able to work productively and independently on software projects of various sizes. They will be able to analyze and structure tasks as well as develop solutions independently, justify their decisions and document them in a comprehensible manner. They also explain general concepts of architectures, especially for distributed software systems, and apply them constructively. Students recognize the central requirements and challenges of such systems and develop suitable solutions. They will be able to explain concepts such as modularity, communication, fault tolerance and security and incorporate them constructively into the development of comprehensive software systems. They have further developed their technical, social and personal skills as well as their communication skills and self-management. They have learned to apply these new skills in the context of software projects.
Exams	Written Exam 120 Min. (graded)
Lecture Softwareengineering Laboratory	
Internal number	INFB511
Lecturer	Prof. Dr. Thomas Fuchß
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	In the Software Engineering Lab, students complete a full iterative software development process within a team. Starting with requirements analysis, they develop an analysis and design model and implement it in Java. Along the way, they actively engage with concepts such as use-case-driven development, architecture orientation, iterative and incremental approaches, and component-based software design. Through a concrete example project, students experience the practical application of these methods and learn to make independent design decisions while adhering to given requirements. The lab emphasizes teamwork and independent problem-solving, preparing participants to work effectively in agile development teams and address the challenges of complex software projects.

Recommended reading	Slides, videos, textbooks, and other literature: - Arlow, J.; Neustadt, I.: UML 2 and the Unified Process: Practical Object-Oriented Analysis and Design, 2. ed. - Addison-Wesley Professional, 2005. - Shimp, D. and Rawsthorne, D. Exploring Scrum: The Fundamentals – CreateSpace, 2011. - Jacobson, I.; Booch, G. and Rumbaugh, J.: The unified software development process - Reading, Mass.: Addison-Wesley, 1999. - Kim, G.; Humble, J.; Debois, P. und Willis, J.: Das DevOps-Handbuch: Teams, Tools und Infrastrukturen erfolgreich umgestalten - Heidelberg: O'Reilly; Heidelberg: dpunkt.verlag, 2017. - Larman, C.: Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development, 3. ed. - Upper Saddle River, NJ : Prentice Hall, 2004. - Larman, C. und Vodde, B.: Large-Scale Scrum: Scrum erfolgreich skalieren mit LeSS - Heidelberg: dpunkt.verlag, 2017. - Oestereich, B.: Developing Software with UML: Object-Oriented Analysis and Design in Practice 2. ed. - Addison-Wesley Professional, 2003. - Oestereich, B.: Analyse und Design mit UML 2.1: Objektorientierte Softwareentwicklung, 8. ed. - München; Wien : Oldenbourg, 2006 - OMG Object Management Group. Unified Modeling Language (OMG UML) Version 2.5.1 – OMG, 2017. - Seidl, M.; Scholz, M. and Huemer, C.: UML @ Classroom: An Introduction to Object-Oriented Modeling, Springer, 2015. - Schwaber, K. and Sutherland, J. The Scrum Guide: The Definitive Guide to Scrum – Scrumguides.org, 2020. - Sommerville, I.: Software Engineering, 10. Auflage - Pearson, 2018. - Wintersteiger, A.: Scrum: Schnelleinstieg, 4. Auflage - Frankfurt am Main: entwickler.press, 2018.
Exams	Exercise 1 Semester (not graded)
Comments	Attended teamwork
Lecture Distributed Systems 2	
Internal number	INFB512.a
Lecturer	Prof. Dr. Christian Zirpins
Scope	3.0 ECTS points, 3.0 Contact hours 90 Stunden gesamt, davon 45 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German

Content	The lecture conveys both fundamental and extended principles of distributed systems and illustrates these in practical form on the basis of concrete paradigms and technologies. The spectrum of principles covered includes fundamental aspects of the objectives and classes of distributed systems, as well as their architectures, processes, communications, and naming. Advanced principles include coordination, consistency and replication, fault tolerance and security. The covered principles are exemplified by various paradigms. Here, exemplary implementations of individual principles are presented. In addition, an introduction to the development of corresponding systems based on concrete software technologies is given. Upon completing this lecture class, students will achieve a comprehensive understanding of the principles underlying distributed systems, ranging from their fundamental objectives and architectures to advanced concepts such as coordination, consistency, replication, fault tolerance, and security. They will gain insights into the practical application of these principles through the examination of specific paradigms and technologies, enhancing their ability to analyze and design distributed systems. Moreover, the introduction to developing these systems using concrete software technologies will equip students with the practical skills necessary for implementing robust, efficient, and secure distributed systems in various computing environments.
Recommended reading	- Andrew S. Tannenbaum, Marten van Steen, "Verteilte Systeme, Prinzipien und Paradigmen", 2. aktualisierte Auflage, Pearson Studium, 2008, ISBN 978-3-8273-7293-2 - George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair, "Distributed Systems, Concepts and Design", Fifth Edition, Addison-Wesley, 2012, ISBN 978-0-13-214301-1 - Additional literature will be announced during the lecture
Exams	Module exam
Comments	Autonomous work includes pre- and post processing of lectures, exercises and exam preparation.
Lecture Software Engineering	
Internal number	INFB512.b
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 course "Software Engineering" builds on the practical experience students have gained during their internships and introduces techniques and methods for structured large-scale software development. The lecture begins with a review and consolidation of fundamental concepts such as objects, classes, associations, methods, inheritance, and polymorphism to ensure a solid understanding of the basics. It then focuses on the challenges of modern software development processes and structured approaches to address them effectively. Students learn how to integrate agile methodologies, such as Scrum, with established process models like the Unified Software Development Process to manage complex software projects. UML is introduced as a core modeling language to document development decisions and facilitate clear communication. Particular emphasis is placed on understanding the complexities of large-scale systems and applying structured methods and processes to address these challenges. Throughout the course, students develop the ability to work independently in agile environments, make informed development decisions, and document these decisions methodically. Theoretical concepts are complemented by practical examples that help bridge the gap between theory and real-world applications. In the associated lab, students apply the knowledge gained in the lecture to various example projects. They conduct the first iteration of a software development process, practicing teamwork, the use of agile methods, and professional documentation with UML.

Recommended reading	Slides, videos, textbooks, and other literature: - Arlow, J.; Neustadt, I.: UML 2 and the Unified Process: Practical Object-Oriented Analysis and Design, 2. ed. - Addison-Wesley Professional, 2005. - Shimp, D. and Rawsthorne, D. Exploring Scrum: The Fundamentals – CreateSpace, 2011. - Jacobson, I.; Booch, G. and Rumbaugh, J.: The unified software development process - Reading, Mass.: Addison-Wesley, 1999. - Kim, G.; Humble, J.; Debois, P. und Willis, J.: Das DevOps-Handbuch: Teams, Tools und Infrastrukturen erfolgreich umgestalten - Heidelberg: O'Reilly; Heidelberg: dpunkt.verlag, 2017. - Larman, C.: Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development, 3. ed. - Upper Saddle River, NJ : Prentice Hall, 2004. - Larman, C. und Vodde, B.: Large-Scale Scrum: Scrum erfolgreich skalieren mit LeSS - Heidelberg: dpunkt.verlag, 2017. - Oestereich, B.: Developing Software with UML: Object-Oriented Analysis and Design in Practice 2. ed. - Addison-Wesley Professional, 2003. - Oestereich, B.: Analyse und Design mit UML 2.1: Objektorientierte Softwareentwicklung, 8. ed. - München; Wien : Oldenbourg, 2006 - OMG Object Management Group. Unified Modeling Language (OMG UML) Version 2.5.1 – OMG, 2017. - Seidl, M.; Scholz, M. and Huemer, C.: UML @ Classroom: An Introduction to Object-Oriented Modeling, Springer, 2015. - Schwaber, K. and Sutherland, J. The Scrum Guide: The Definitive Guide to Scrum – Scrumguides.org, 2020. - Sommerville, I.: Software Engineering, 10. Auflage - Pearson, 2018. - Wintersteiger, A.: Scrum: Schnelleinstieg, 4. Auflage - Frankfurt am Main: entwickler.press, 2018.
Exams	Module exam
Comments	The lecture will take the form of seminars with exercises.

Module Databases and Communication Networks 2	
Internal number	INFB520
Coordinator	Prof. Dr. Zoltán Nochta
Scope	5.0 ECTS points, 4.0 Contact hours
Placement	5th Semester
Pre-requisites with regard to content	Databases and Communication Networks 1
Pre-requisites according to the examination regulations	Vorstudium
Competences	
Exams	Written Exam 120 Min. (graded)
Lecture Databases 2	
Internal number	INFB521.a
Lecturer	Prof. Dr. Zoltán Nochta
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	- "Datenbanksysteme" von Alfons Kemper, Andre Eickler - "Database Solutions" von Thomas Connolly, Carolyn Begg
Exams	Module exam
Comments	
Lecture Communication networks 2	
Internal number	INFB521.b
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 expand their knowledge of communication networks, in particular by taking an in-depth look at the functionalities and challenges of the layers of the Internet protocol stack. After completing the course, they will be able to analyze, evaluate and practically apply advanced mechanisms and protocols in the application layer, transport layer, network layer and security layer. They will be able to identify complex network problems, combine specific solution modules and develop innovative solutions. The lecture covers the following topics: - Transmission of multimedia content in the application layer, e.g. Netflix and Skype, as well as the basics of secure communication such as TLS and secure email. - Transport layer mechanisms, including extensions to TCP such as SACK and CUBIC, as well as new protocols such as QUIC. - Network layer with addressing and routing concepts, including IPv6, Software Defined Networking (SDN) and IPsec. - Data link layer with a focus on VLANs, MPLS and data center networks. The lecture is taught in a flipped classroom format. Students prepare for the classroom sessions independently using lecture slides and explanatory videos. In these sessions, the topics are explored in greater depth through case studies and exercises. Online tests offer students the opportunity for self-assessment and to collect bonus points for the exam. The examination consists of a 60-minute written exam, which is part of the module exam "Databases and Communication Networks 2". The total workload is 75 hours, divided into 25 hours of attendance time, 25 hours of asynchronous learning and 25 hours for exam preparation and follow-up.
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 - Various Internet standards, see https://www.rfc-editor.org - Further information in the lecture
Exams	Module exam
Comments	

Module Computer architecture and Autonomous Systems	
Internal number	INFB530
Coordinator	Prof. Dr. Martin Sulzmann
Scope	4.0 ECTS points, 4.0 Contact hours
Placement	5th Semester
Pre-requisites with regard to content	none
Pre-requisites according to the examination regulations	none
Competences	The realisation of technical systems is at the teaching core of this module. Two different basic concepts are addressed: Concepts for the software development of autonomous systems and the hardware concepts, which have to be employed to realise such systems. The module spans the corresponding space of system compositions with respect to hardware and software. The module builds upon the previous courses of computer engineering and software engineering. Therefore it can advance the students quite far conceptually as well as concerning the application fields. The focus is on the domain specific conceptual thinking, which supports the decision making competence of the graduatesfor therealisation ofsystems. The module also enables the graduates for further scientific activities in system development.
Exams	Written Exam 120 Min. (graded)

Lecture Autonomous Systems	
Internal number	INFB531.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 in this course - obtain an overview of methods for formal modelling and verification of autonomous/reactive systems, - get to know programming concepts to master highly concurrent/distributed systems.l Selection of topics covered: (1) Modeling and Verification - Statemachine models Mealy/Moore Communication statemachines Timed statemachines Harel Statecharts - Specification Reguar languages Temporal logic (CTL) - Modelchecking - Testcasegeneration via modelchecking - Run-Time Verification - Coverage criteria - UPPAAL (2) Concurrency and Synchronisation - Shared memory Threads and Locks Lock-free Algorithms Software Transactional Memory - Message-passing Foundations: CSP, Join Haskell, Go
Recommended reading	- Lecture notes and slides - Exercises - Selection of textbooks: Real World Haskell by Bryan O'Sullivan, Don Stewart, and John Goerzen Real-Time Systems and Programming Languages (Fourth Edition) Ada 2005, Real-Time Java and C/Real-Time POSIX by Alan Burns and Andy Wellings Principles of Model Checking Christel Baier and Joost-Pieter Katoen Real-Time UML: Developing Efficient Objects for Embedded Systems (2nd Edition)
Exams	Module exam
Comments	Mix of lecture and theoretical and practical exercises.
Lecture Computer architecture	
Internal number	INFB531.b
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	In the lecture we will deal with the most important principles of organization and design of microprocessors. Microprocessors are the central building blocks of practically all current computer systems, from smartphones to supercomputers and thus of the complete digital world. The focus of the lecture will be the programming of 64-bit ARMv8 processors and the logical design of processors with the help of Verilog. In addition to teaching the theoretical basics, great emphasis is placed on practical programming exercises. The following topics are covered: - Computer Abstractions and Technology - Instructions: Language of the Computer - Arithmetic for Computers - Performance Analysis - Logic Design with Verilog - The Processor - The Memory Hierarchy - Parallel Processors
Recommended reading	Computer Organization and Design : The Hardware/Software Interface , ARM Edition, D.A. Patterson, J.L. Hennessy, Elsevier Inc. 2017
Exams	Module exam
Comments	In general, the lectures start with a discussion of the exercises associated with the previous lecture. Afterwards we address new topics. Questions and feedback are always welcome!

Module Student Research Project	
Internal number	INFB540
Coordinator	Prof. Dr. Heiko Körner
Scope	6.0 ECTS points, 4.0 Contact hours
Placement	5th Semester
Pre-requisites with regard to content	none
Pre-requisites according to the examination regulations	none
Competences	Students will be able to independently apply the knowledge they have acquired in their previous studies to a complete task. They can analyse the problem, create a solution concept, find an implementation and implement it on their own. They can also write down their results observing scientific standards. They can also present their work in a short presentation and defend it in a subsequent discussion.
Exams	Individual exams
Lecture Student Research Projekt	
Internal number	INFB541
Lecturer	Alle Dozenten
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	A student research project deals with a topic in the field of software or hardware. The aim is to carry out a practical task, but work in the areas of evaluation or literature research is also possible. Students analyse the task and research which tools are best suited to solve it. They then use these accordingly. Comprehensive documentation must be prepared for the project work, covering all steps of the task and its completion (e.g. the exact problem definition, the concept, the implementation, operating instructions and more). A joint colloquium concludes the project work. The students show their results in a short presentation and then take part in a discussion. The project work is thus a preparation for the later final thesis, which the students will write according to very similar guidelines.
Recommended reading	Depending on the task
Exams	Homework 1 Semester (not graded)
Comments	
Lecture Student Research Projekt Colloquium	
Internal number	INFB542
Lecturer	Alle Dozenten

Scope	1.0 ECTS points, 0.0 Contact hours 30 Stunden gesamt, davon 0 Stunden Kontaktstudium.
Type/mode	Hands-on Experience
Language of instruction	German
Content	The colloquium marks the conclusion of the project work. Students present their results in a short presentation and then take part in a discussion. In doing so, they demonstrate that they are able to explain and defend the problem, the realisation of the work and the solution found in a short, concise form.
Recommended reading	
Exams	Verbal Exam 20 Min. (graded)
Comments	All work will be individual work and will include the presentation, discussion, defense of the work.

Module ERP Systems	
Internal number	INFB550
Coordinator	Prof. Dr. rer. pol. Mathias Philipp
Scope	7.0 ECTS points, 6.0 Contact hours
Placement	5th Semester
Pre-requisites with regard to content	Business Administration
Pre-requisites according to the examination regulations	Vorstudium
Competences	The students shall learn to think in business processes on the basis of integrated ERP systems. They should recognize the interdependence of operational functions, and thus deepen their basic economical knowledge about processes (horizontal integration). Further, the students recognize the need for vertical integration as a prerequisite for the development of ERP systems for management information systems. In addition the students learn architecture, design and development of ERP systems.
Exams	Written Exam 90 Min. (graded)
Lecture ERP Systems	
Internal number	INFB551.a
Lecturer	Prof. Dr. rer. pol. Mathias Philipp
Scope	3.0 ECTS points, 3.0 Contact hours 90 Stunden gesamt, davon 45 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German
Content	Contents: ERP basics, system integration, system architectures, and logistics: Distribution (SD), Materials Management (MM), Production Planning and Control (PP) as well as Financial Accounting (FI) and Controlling (CO). In addition, an overview is given to the software selection.
Recommended reading	Recommended reading: Lecture material completely as PowerPoint documents, blackboard notes for interactive development of central problem positions, a main textbook to ERP, a main textbook to SAP ECC 6.0.
Exams	Module exam
Comments	Kind of work: Lecture participation
Lecture IT Service Management	
Internal number	INFB551.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	The lecture covers the core processes of IT service management as well as methods for systematic planning, provision and support of IT services. For each process, the objectives, tasks, demarcation, mode of operation and the dependencies on the other processes are worked out. The students thus acquire the competence to know the relevant technical terms and to apply them in practical situations. The necessary roles and responsibilities are learned. The students understand how IT processes are represented in reference models. The lecture is based on the IT Infrastructure Library (ITIL), which is a generally accepted standard for the structure and operation of IT organizations.
Recommended reading	Lecture material as PowerPoint slides Blackboard notes for interactive development of core problems Numerous multiple-choice questions on each process in ILIAS
Exams	Module exam
Comments	

Lecture ERP Laboratory

Internal number	INFB552
Lecturer	Prof. Dr. rer. pol. Mathias Philipp
Scope	2.0 ECTS points, 1.0 Contact hours 60 Stunden gesamt, davon 15 Stunden Kontaktstudium.
Type/mode	Laboratory Course
Language of instruction	German
Content	The laboratory is linked to the lecture and serves to apply and deepen the lecture material. The following laboratory exercises are carried out: - SAP ERP navigation, case study to get to know the user interface and operation of the SAP system - Case study on order processing (SD module) to understand the implementation of business processes in complex ERP systems - Customizing case study on reorder point-oriented procurement planning to independently (under supervision) configure a procurement process in the system (company and process customizing) - Short programming task in ABAP to get to know the programming language. Independent processing of the case studies in an SAP ERP system individually or in a group of a maximum of two people. Software: SAP ECC 6.04, data basis: Global Bike Inc. Alternative to the laboratory: Introduction to the ABAP programming language. See I W918.
Recommended reading	Recommended reading: Extensive material for introduction to the topic as well as on each case study. Provisioning is about the blended learning and e-learning platform ILIAS.

Exams	Exercise 1 Semester (not graded)
Comments	Kind of work: Labor participation and preparation of laboratory results. Exercises and case studies from the curriculum GBI powered by t he SAP University Alliances community. Some case studies have been extended to more detailed tasks.

Module Embedded Software	
Internal number	INFB610
Coordinator	Prof. Dr. Dirk Hoffmann
Scope	5.0 ECTS points, 4.0 Contact hours
Placement	6th Semester
Pre-requisites with regard to content	Computer Science 1, Computer Science 2, Computer Engineering 1, Computer Engineering 2
Pre-requisites according to the examination regulations	Modul Internship
Competences	The lectures in this module impart advanced knowledge in the field of embedded systems. Students know the basic terms in the field of embedded systems and are able to differentiate between different types of real-time systems. With CAN bus, the students have become familiar with a typical communication medium and with CDMA technology, an important coding used, for example, in satellite communication. Students are able to implement typical programming tasks in the field of embedded systems in the C language. During the course, students learn how to use software tools that can be used to measure and optimize the program runtime of the software created.
Exams	Individual exams
Lecture Embedded Software	
Internal number	INFB611
Lecturer	Prof. Dr. Dirk Hoffmann
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 will be able to understand the fundamental concepts of software development for embedded real-time systems. In the context of this lecture, embedded systems are all computers controlled by software that are part of a larger system and whose primary function is not computing. Real-time systems also involve aspects of temporal behavior, i.e., they are systems that not only have to provide a correct answer, but also have to calculate the system answer within a predetermined and guaranteed period of time. In detail, topics from the following areas are covered: design and architecture of automotive control units, fundamentals of real-time programming, coding for data transmission, embedded C. The participants of the lecture apply their knowledge on the basis of exercises.
Recommended reading	Slides, blackboard, exercise sheets
Exams	Written Exam 90 Min. (graded)
Comments	Lecture
Lecture Embedded Software Laboratory	

Internal number	INFB612
Lecturer	Prof. Dr. Dirk Hoffmann
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	Students will be able to develop typical algorithms used in embedded systems in the C++ programming language. Students will develop a prototypical CDMA decoder that is able to extract the bits sent by GPS satellites from a composite signal.
Recommended reading	Software and hardware tools für designing automative ECUs
Exams	Exercise 1 Semester (not graded)
Comments	Practical work

Module Computer Graphics with Laboratory	
Internal number	INFB620
Coordinator	Prof. Dr. Christian Pape
Scope	4.0 ECTS points, 3.0 Contact hours
Placement	6th Semester
Pre-requisites with regard to content	Distributed Systems 1 and Theoretical Computer Science 2
Pre-requisites according to the examination regulations	Modul Internship
Competences	
Exams	Individual exams
Lecture Computer Graphics	
Internal number	INFB621
Lecturer	Prof. Dr. Christian Pape
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 to store, code and display two-dimensional graphics in the computer and external storage media. They will be able to apply their mathematical skills to simple areas of computer graphics, such as the use of coordinate systems, modeling three-dimensional objects with polygons, designing algorithms to calculate sections of geometric objects. The students learn about photorealistic image generation using ray tracing techniques. They can describe and implement homogeneous coordinates in object space and model space. OpenGL can be used in principle for practical programming.
Recommended reading	- Lecture notes - Steve Marschner, Peter Shirley. Fundamentals of Computer Graphics. O'Reilly. - John Vince. Mathematics for Computer Graphics. Springer. - Matt Pharr, Wenzel Jakob, Greg Humphreys. Physically based Rendering. https://pbrt.org/
Exams	Written Exam 90 Min. (graded)
Comments	
Lecture Computer Graphics Laboratory	

Internal number	INFB622
Lecturer	Prof. Dr. Christian Pape
Scope	2.0 ECTS points, 1.0 Contact hours 60 Stunden gesamt, davon 15 Stunden Kontaktstudium.
Type/mode	Laboratory Course
Language of instruction	German
Content	In the practical assignment, the knowledge of computer graphics imparted in the lecture will be deepened using the following practical tasks on the computer: 1. An existing arcade game implementation must be supplemented with its own 2D view component. A simple 2D API like SDL is used for this. 2. A rudimentary ray tracer based on given basic libraries is to be created. 3. The arcade game implementation is to be supplemented with a 3D view based on an API such as OpenGL or your own transformations. C++ is used as the implementation language.
Recommended reading	Detailled description of the assigments.
Exams	Exercise 1 Semester (not graded)
Comments	The solutions are presented and discussed with the supervisor in the exercises.

Module Communication Competence	
Internal number	INFB630
Coordinator	Prof. Dr. rer. pol. Mathias Philipp
Scope	7.0 ECTS points, 6.0 Contact hours
Placement	6th Semester
Pre-requisites with regard to content	Internship
Pre-requisites according to the examination regulations	Modul Internship
Competences	The student should learn how a common, computer science-related content will be refurbished for a specific group of audiants. Additionnally he should have learned how to give his presentation and defend it.
Exams	Individual exams
Lecture Seminar	
Internal number	INFB631
Lecturer	Alle Dozenten
Scope	6.0 ECTS points, 6.0 Contact hours 180 Stunden gesamt, davon 90 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	Homework 1 Semester (not 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.
Lecture Presentation	
Internal number	INFB632
Lecturer	Alle Dozenten
Scope	1.0 ECTS points, 0.0 Contact hours 30 Stunden gesamt, davon 0 Stunden Kontaktstudium.
Type/mode	Seminar

Language of instruction	German
Content	
Recommended reading	
Exams	Presentation 20 Min. (graded)
Comments	

Module Key Qualification	
Internal number	INFB640
Coordinator	Prof. Dr.-Ing. Holger Vogelsang
Scope	6.0 ECTS points, 6.0 Contact hours
Placement	6th Semester
Pre-requisites with regard to content	Language Competence
Pre-requisites according to the examination regulations	Modul Internship,<= 4; siehe § 43-I/b (7)
Competences	On successful completion of the module, students will be able to - behave appropriately towards people from other cultures in relation to the increasing globalisation of their work, - understand statements made by these people, - understand simple legal issues and contracts, - present the results of their own work in the form of a specialised presentation.
Exams	Individual exams
Lecture Intercultural Communication	
Internal number	INFB641
Lecturer	Prof. Dr. Andrea Cnyrim
Scope	2.0 ECTS points, 2.0 Contact hours 60 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	English
Content	Participants learn to understand intercultural competence as a strategic competitive factor and to organise their own actions in a culturally appropriate way: - Key aspects of intercultural communication (e.g. culturally determined norms, behaviours, values, verbal and non-verbal communication) with particular emphasis on differences between fact-oriented cultures such as Germany and relationship-oriented cultures such as China and India - Influence of different cultural standards on international business relationships (e.g. business initiation, negotiations, employee management, decision-making, conflict resolution, etc.) - Empirical studies (e.g. Geert Hofstede, Fons, Trompenaars etc.) - Case studies from different cultural areas (e.g. Germany, France, USA, Japan, China, India, etc.).
Recommended reading	
Exams	Exercise 1 Semester (not graded)
Comments	
Lecture Presentation techniques	
Internal number	INFB642

Lecturer	Prof. Dr. Michael Thiele
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	Verbal Exam 20 Min. (graded)
Comments	
Lecture Law	
Internal number	INFB643
Lecturer	RA Karin Raab
Scope	2.0 ECTS points, 2.0 Contact hours 60 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German
Content	- Introduction to the right - That "Bürgerliches Gesetzbuch” (BGB) - The "Handelsgesetzbuch” (HGB) - The judicial procedure
Recommended reading	
Exams	Written Exam 90 Min. (graded)
Comments	

Module Selected Chapters Computer Science 1	
Internal number	INFB650
Coordinator	Prof. Dr.-Ing. Holger Vogelsang
Scope	8.0 ECTS points, 8.0 Contact hours
Placement	6th Semester
Pre-requisites with regard to content	Internship, Internship Preparation and Roundup
Pre-requisites according to the examination regulations	§43 (3)
Competences	- Advanced Embedded Software - Business Intelligence - Graphical User Interfaces - Business Process Management - IT Consulting - Pattern Recognition - Network Security - Advanced ERP - Advanced Software Engineering
Exams	Individual exams
Lecture HKA-APP	
Internal number	I W155
Lecturers	M.Sc. Daniel Weisser Prof. Dr. Manfred Seifert
Scope	2.0 ECTS points, 2.0 Contact hours 60 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Hands-on Experience
Language of instruction	German
Content	HsKAmpus is intended to provide comprehensive functions for students of all faculties of the HsKA: - https://www.h-ka.de/hskampus/ - https://www.youtube.com/watch?v=OcyRZrwXzVM This primarily includes functions from the so-called. Online services based on the LSF server (events/schedule, facilities, people, student life), the QIS server (grade view) and other servers (canteen, KIT, KVV, ...). Other formats and functions are possible: - Creation or further development for Android, iOS, Windows, Web and our Broker/Server as well as the new Ersti-Hilfe - Provision in Google Play, Apple App Store, Microsoft Windows Store and as a web app - Marketing on various channels (website, FaceBook, Instagram, HsKA site, advertising material, ...) - User support - Communication at the university (campus day).

Recommended reading	http://www.hskampus.de https://www.facebook.com/hskampus https://www.instagram.com/hskampus/
Exams	Hands-on Work 1 Semester (graded)
Comments	

Lecture Graphical-geometric algorithms

Internal number	I W158
Lecturer	Prof. Dr. Christian Pape
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 90/20 Min. (graded)
Comments	

Lecture IT and media law

Internal number	I W159
Lecturers	RA Jeremias Held RA Josua Neudeck
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 Exam 90 Min. (graded)
Comments	

Lecture Augmented and Virtual Reality

Internal number	I W171
Lecturer	Prof. Dr. Matthias Wölfel
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 Exam 90 Min. (graded)
Comments	

Lecture Pattern Recognition	
Internal number	I W172
Lecturer	Prof. Dr. Norbert Link
Scope	2.0 ECTS points, 2.0 Contact hours 60 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German
Content	Risk minimisation Baysian decision theory Decision functions Perceptrons Linear machines Multi-Layer-Perceptrons k-Nearest-Neighbor classifiers Support vector machines Feature assessment via distance and separability measures Principal component analysis
Recommended reading	The matter is presented by means of animated slides and extensive derivations at the blackboard. The presentation is available on the internet. For further study four text books are recommended: - Pattern classification : a unified view of statistical and neural approaches / Jürgen SchürmannNew York [u.a.] : Wiley & Sons, 1996. - Pattern classification / Richard O. Duda ; Peter E. Hart ; David G. Stork. - 2. ed.New York ; Weinheim [u.a.] : Wiley, 2001. - Pattern recognition / Sergios Theodoridis and Konstantinos Koutroumbas. - 3. ed.Amsterdam ; Heidelberg[u.a.] : Elsevier Academic Press, 2006. - Learning with Kernels : support vector machines, regularization, optimization, and beyond / Bernhard Schölkopf ; Alexander J. SmolaCambridge, Mass. [u.a.] : MIT Press, 2002.
Exams	Written Exam 90 Min. (graded)
Comments	Class (including training) 50%, self-responsible work 50%

Lecture Business Intelligence	
Internal number	I W179
Lecturer	Prof. Dr. Uwe Haneke
Scope	2.0 ECTS points, 2.0 Contact hours 60 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German
Content	- Introduction and business-management background - The concept of data warehousing - Business Analytics and Balanced Scorecard (BSC) - CRM and Data Mining - Trends in Business Intelligence-Case studies

Recommended reading	
Exams	Written Exam 90 Min. (graded)
Comments	
Lecture ERP Special Chapters	
Internal number	I W182
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	Enterprise analysis, software choice, system integration, basics of customizing, small development task in ABAP in addition to an ABAP introduction, optional: project office: integrated project and service processing with SAP ECC 6.0
Recommended reading	Lecture material completely as pdf documents, blackboard notes for interactive development of central problem positions, extensive material for every case study.
Exams	Written Exam 90 Min. (graded)
Comments	Lecture, workshops, lab: Case study based participation in group oriented workshops about enterprise analysis, presentation of group results, independent implementation of the analysis results of into SAP by appropriate system customizing in the lab. Independent treatment of another lab task (e.g., ABAP course, case study project office)
Lecture IT Security	
Internal number	I W210
Lecturers	Dipl. Inform. (FH) Georg Magschok Dipl. Inform. (FH) Michael Fischer
Scope	2.0 ECTS points, 2.0 Contact hours 60 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German
Content	Technological and topological mechanisms for securingnetworks, attack patterns and defense mechanisms againstthem. Basics of, variants of and defense against maliciousssoftware. Analysis and judgement of security mechanismsand related activities. Excercies at the end of each semester provide practicalexperience in dealing with security topics.
Recommended reading	
Exams	Written Exam 90 Min. (graded)
Comments	Presentation with a lot of room for discussions andinteraction. Finalized by a hands-on session.
Lecture Robotics	
Internal number	I W232

Lecturer	Dr. Michael Haag
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 Exam 90 Min. (graded)
Comments	

Lecture Graphical User Interfaces

Internal number	I W332
Lecturer	Dipl.-Inf. Per Sterner
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 first deals with SWT/JFace and the Eclipse Rich Client Platform 4 (RCP), which uses SWT and JFace as its basis. The most important topics are the model-view-controller pattern, layout management and event handling using the observer pattern. Based upon this techniques advanced technologies like the separation of business logic and user interface code using data binding and dialog control are presented. Other topics are internationalization and multithreading in the context of user interfaces. The last part of the lecture shows the declarative construction of user interfaces and the application of the RCP framework.
Recommended reading	Books and Web sites: - Marc Teufel, "Eclipse 4", entwickler.press, Oktober 2012 - Lars Vogel, "Eclipse 4 Application Development", Mai 2012 - M. Marinilli, "Professional Java User Interfaces", Wiley & Sons, 2006 - R. Warner, R. Harris, "The Definite Guide to SWT and JFace", Apress, 2007 - M. Scarpino et.al., "SWT/JFace in Action", Manning Publications Co., 2005 - J. McAffer, J. M. Lemieux, "Eclipse Rich Client Platform", Addison-Wesley Longman (Pearson Education), 2010 - G. Wütherich, N. Hartmann, B. Kolb, M. Lübken, "Die OSGi Service Platform", dpunkt-Verlag, 2008 - http://www.ralfebert.de/rcpbuch/ - http://www.eclipse.org/swt/ - http://www.eclipse.org/articles/Article-UI-Guidelines/Index.html - http://www.eclipse.org/swt/snippets/ - http://wiki.eclipse.org/index.php/JFaceSnippets - http://www.java2s.com/
Exams	Written Exam 90 Min. (graded)
Comments	Lecture preparation, exam preparation, implementing the bonus exercise, 30% of the lecture is held as a computer exercise

Lecture Softwareengineering Special Chapters	
Internal number	I W342
Lecturers	Prof. Dr. Thomas Fuchß M.Sc. Alexander Hasel
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 course focuses on fundamental object-oriented design methods with an emphasis on design patterns and model driven concepts. The students learn to recognize, to know when to use, and to apply design patterns in varying situations in the context of an evolutionary development process. Furthermore the ability of an axiomatic rule base application of patterns, within a model driven approach, are discussed.
Recommended reading	Slides, textbooks, and other literature: Folien-Skript, Lehrbücher: - Gamma, Erich et. al. Entwurfsmuster: Elemente wiederverwendbarer objektorientierter Software - München : Addison-Wesley, 2001. - Buschmann, Frank. A system of patterns (Pattern-Oriented Software Architecture Volume 1) - John Wiley & Sons. 1996. - Schmidt, Douglas C. Patterns for concurrent and networked objects (Pattern-Oriented Software Architecture Volume 2) - John Wiley & Sons. 2000. - Michael Kircher, Prashant Jain. Patterns for Resource Management (Pattern-Oriented Software Architecture Volume 3) - John Wiley & Sons. 2004. - Frank Buschmann, Kevlin Henney, Douglas C. Schmidt. A Pattern Language for Distributed Computing (Pattern-Oriented Software Architecture Volume 4) - John Wiley & Sons. 2007. - Frank Buschmann, Kevlin Henney, Douglas C. Schmidt. On Patterns and Pattern Languages (Pattern-Oriented Software Architecture Volume 5) - John Wiley & Sons. 2007. - Fowler, Martin. Analysemuster: wiederverwendbare Objektmodelle: Ein Pattern-Katalog für Business-Anwendungen - Addison-Wesley-Longman. 1999. - OMG Object Management Group. Meta Object Facility (MOF) Specification - Version 2.4.1: OMG, 2011.
Exams	Verbal Exam/Concept 20 Min. (graded)
Comments	The lecture will take the form of seminars with exercises.

Lecture IT-Security Management	
Internal number	I W394
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	
Recommended reading	
Exams	Written Exam 90 Min. (graded)
Comments	

Lecture IT Consulting

Internal number	I W433
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	First, students are given an overview of the international consulting market and learn the methodological principles of this industry as well as the main areas of work of IT consulting. Various approaches to strategy consulting, process consulting and IT system consulting are discussed, along with the respective consulting tools and methods.
Recommended reading	Lecture material completely as pdf documents, blackboard notes for interactive development of central problem positions, instructions for interactive role play and case study material
Exams	Written Exam 90 Min. (graded)
Comments	Participation lecture, development of an interactive role play in the group, individual execution of a short case study.

Lecture Projective geometry

Internal number	I W501
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	
Recommended reading	
Exams	Written/verbal Exam 90/20 Min. (graded)
Comments	

Lecture Philosophy and theory of computer science

Internal number	I W502
Lecturer	Prof. Dr. Thomas Morgenstern
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	Presentation 20 Min. (graded)
Comments	
Lecture Mathematics for Machine Learning	
Internal number	I W610
Lecturers	Prof. Dr.-Ing. Astrid Laubenheimer M.Sc. Ahmad Assani
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 90/20 Min. (graded)
Comments	
Lecture Game Programming	
Internal number	I W620
Lecturer	Prof. Dr. Peter Henning
Scope	2.0 ECTS points, 2.0 Contact hours 60 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	English
Content	
Recommended reading	
Exams	Written Exam 90 Min. (graded)
Comments	
Lecture Computer Vision	
Internal number	I W772
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	Written Exam 60 Min. (graded)
Comments	

Lecture Computer Vision Laboratory	
Internal number	I W773
Lecturer	Prof. Dr.-Ing. Astrid Laubenheimer
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	Laboratory Work 1 Semester (graded)
Comments	
Lecture Enterprise software from the cloud	
Internal number	I W779
Lecturer	Prof. Dr. Zoltán Nochta
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 Python frameworks	
Internal number	I W800
Lecturer	Prof. Dr. Jürgen Zimmermann
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 Exam 90 Min. (graded)
Comments	
Lecture Sound design	
Internal number	I W801
Lecturer	Prof. Thomas Hinz
Scope	2.0 ECTS points, 2.0 Contact hours 60 Stunden gesamt, davon 30 Stunden Kontaktstudium.

Type/mode	Thesis
Language of instruction	German
Content	
Recommended reading	
Exams	Written Exam 60 Min. (graded)
Comments	

Lecture Business Process Management

Internal number	I W854
Lecturer	Prof. Dr. Uwe Haneke
Scope	2.0 ECTS points, 2.0 Contact hours 60 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German
Content	Starting with clarifying the terminology of business process management, the lecture gives an introduction and analysis of various concepts for business process documentation and modeling. This includes a discussion of support through appropriate methodologies and software tools. Modern concepts such as process mining are also covered. Using different tools, business processes are documented and subsequently simulated as part of a case study. Finally, aspects of process quality assurance, performance evaluation, and process cost accounting are addressed. Students are enabled to independently handle processes in a business environment, including documentation, modeling, and analysis. Overview: - The concept of processes and types of processes - Methodologies in process management - Process analysis (documenting processes) - Process modeling (modifying processes) - Tools for process modeling - Process simulation - Process mining - Key performance indicators for evaluating business processes
Recommended reading	
Exams	Written Exam 90 Min. (graded)
Comments	

Lecture Databases Special Chapters

Internal number	I W907
Lecturer	M.Sc. Tobias Wink
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 90/20 Min. (graded)
Comments	

Lecture SAP Certification

Internal number	I W908
Lecturers	M.Sc. Matthias Mruzek-Vering 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	TERP10: SAP ERP - Integration of Business Processes is a 10-day training course held at the universities participating in the pilot project. The students learn how the fundamental integrative business processes in procurement, production, planning, project management, sales, customer service, asset management, financial accounting, human resources, and analytics interact within the SAP ERP application. The course provides students with a broad basic knowledge of the core business processes, business interrelations, and integration of business processes in SAP ERP. At the end of the course, students take a certification examination. If they pass the examination, they receive an SAP certificate, which is a fully recognized qualification in the industry.
Recommended reading	cource book
Exams	Written Exam 90 Min. (graded)
Comments	10-day training: in the moring: theory in the evening: laboratory last day: SAP certification 3 hours multiple chioce and multiple responce questions

Lecture Serious Games

Internal number	I W910
Lecturer	Prof. Daniel Schwarz
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 Exam 90 Min. (graded)
Comments	
Lecture Model-based Software Development	
Internal number	I W911
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	This course covers principles and tools for the compilation and analysis of programs. Selection of topics covered: - Syntax analysis (Parser Tools/Generators) - Semantics of programs Typesystems Operational semantics Interpreters/Virtual machines - Program analysis
Recommended reading	- Lecture notes - Lab and written exercies - Online references
Exams	Written Exam 90 Min. (graded)
Comments	Prerequisistes - Some programming experiences - Logic (propositional logic) Mix of lecture and exercis. In case of an oral examination, group work will be permitted.
Lecture App Programming	
Internal number	I W912
Lecturer	M.Sc. Adrian Wörle
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 teaches the construction of mobile media applications. The main concepts are discussed using the Android platform. In a first partt, the basic technologies and limitations of mobile devices are shown. The second part examins different development strategies like native applications, device independend abstractions and web applications. A main part of the lecture is the integration of different media types into mobile applications and the constraints the developer has to keep in mind.
Recommended reading	will be announced
Exams	Written Exam 90 Min. (graded)
Comments	Leacture with exercise

Lecture Cloud Computing	
Internal number	I W913
Lecturers	Dipl. Inform. (FH) Michael Fischer Dipl. Inform. (FH) Georg Magschok
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 buzzword "Cloud" represents a variety of interesting technologies which gained importance in the life of a computer science professional. Those are being collected, examined, explained and understood during the course. Primary objective is usefulness for the student, regardless of whether he acts as a cloud user, developer, administrator or even entrepreneur. Understand the broad meaning of "Cloud Computing" from a variety of perspectives: Definition, use cases, technology basics, key players, APIs, scaling, redundancy …
Recommended reading	Powerpoint slides
Exams	Written Exam 90 Min. (graded)
Comments	
Lecture Mobile Kommunikation	
Internal number	I W914
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 learn about the basic principles and technologies of mobile communication systems. After completing the course, they will be able to describe problems of mobile networks such as wireless signal transmission, media access and mobility management, identify and apply solution modules to solve these problems and evaluate existing solutions. They will also be able to analyze the characteristics and applications of various wireless systems such as WLAN, Bluetooth, mobile radio technologies (e.g. GSM, UMTS, LTE, 5G) and their underlying protocols and architectures. The lecture covers the following topics: - Basics of mobile communication: wireless signal transmission, multiplexing techniques, band spreading, OFDM, MIMO and multipath propagation. - Media access: methods such as Aloha, Carrier Sense Multiple Access (CSMA) and time-slot-based protocols. - Mobility management: position management, handover and routing in mobile networks. - Technologies and standards: WLAN (IEEE 802.11), Bluetooth, mobile networks (GSM, UMTS, LTE, 5G). The course is held in a flipped classroom format. Students prepare for the live sessions independently using lecture slides and explanatory videos. In the classroom sessions, the content is deepened through case studies and practical exercises. The examination consists of an oral examination or a written exam, depending on the agreement. The total workload is 60 hours, of which 20 hours are spent on asynchronous learning, 20 hours on face-to-face events and 20 hours on exam preparation.
Recommended reading	- Slide collection and explanatory videos in the ILIAS system - Jochen Schiller, Mobile Communication. Pearson Studium, 2003. - 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	Verbal Exam 20 Min. (graded)
Comments	
Lecture Concept, Design und Presentation of interactive Projects	
Internal number	I W915
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	
Recommended reading	
Exams	Homework 1 Semester (graded)
Comments	
Lecture CC Operation	
Internal number	I W917

Lecturer	Dr. Günther Schreiner
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 Exam 90 Min. (graded)
Comments	

Lecture In-memory Databases

Internal number	I W920
Lecturer	Prof. Dr. Zoltán Nochta
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 Exam 90 Min. (graded)
Comments	

Lecture Affective Computing

Internal number	I W924
Lecturers	M.Sc. Bernd Dudzik 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	Emotional expressions are important signals for people to make sense of situations, actions and relationships in their social interactions with each other. Is the empowerment of technological systrms with the capacity to also sense and express emotions able to improve their users' interactions with them? This question is the driving force behind the field of Affective Computing. The students know different theories of emotions, contrast them with each other and debate them. They apply the acquired knowledge by addressing problems from within the primary areas of application for Affective Computing through the development of prototypical interactive systems that are capable of sensing or expressing emotions.
Recommended reading	Lecture notes, case studies.
Exams	Homework 1 Semester (graded)
Comments	

Lecture Video	
Internal number	I W925
Lecturers	Prof. Thomas Hinz Marc Steinmetz
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	Homework 1 Semester (graded)
Comments	
Lecture Big Data Engineering	
Internal number	I W926
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 Big Data Engineering addresses the systematic construction of data-intensive systems. Generic architectural approaches are introduced in order to design robust, performant and scalable data systems for various applications. For different architectural areas various kinds of data storage and processing models are discussed. Topics include, among others, distributed file systems, serialization, batch and stream processing with MapReduce and other programming models, queuing mechanisms and NoSQL databases. These are both conceptually described as well as implemented by means of exemplary tools and techniques. The focus is on established industry standards such as Apache Thrift, Hadoop, Kafka, Cassandra, Storm. These are illustrated by means of an exemplary Web Analytics application. During the course students acquire, among others, the following abilities: - They evaluate different approaches of data systems for given application problems with specific requirements. - They describe structure and function of specific architectural approaches for Big Data systems. - They categorize tools and techniques for Big Data systems and utilize them professionally. - They design architecture and data models as well as processing logic and queries for given Big Data applications and implement these based on specific open source tools and techniques.

Recommended reading	- Nathan Marz, James Warren, "Big Data: Principles and best practices of scalable realtime data systems", Manning, 2015, ISBN: 1-617290-34-3 - Martin Kleppmann, "Designing Data-Intensive Applications", O'Reilly, 2014 (Early Release), ISBN: 978-1-4493-7332-0 - Tom White, "Hadoop: the definitive guide: storage and analysis at internet scale", 4. ed., O'Reilly, 2015, ISBN: 978-1-491-90163-2 - Michael Frampton, "Big Data Made Easy: A Working Guide to the Complete Hadoop Toolset", Apress, 2015, ISBN: 978-148-420-094-0 - Vivek Mishra, "Beginning Apache Cassandra Development", Apress, 2014, ISBN: 978-148-420-142-8 - Additional literature will be announced during the lecture
Exams	Written Exam 90 Min. (graded)
Comments	Independent work relates to the preparation and followup of lectures, laboratory exercises and exam preparation.
Lecture Planning and optimisation with evolutionary methods	
Internal number	I W927
Lecturer	Dr.-Ing. Wilfried Jakob
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 Exam 90 Min. (graded)
Comments	
Lecture Predictive Modelling and Machine Learning	
Internal number	I W928
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	English
Content	This course introduces the principles, theories and concepts of statistics and data modelling. Students will learn - how to construct and interpret graphical presentations of data, - conduct appropriate statistical tests, use the appropriate techniques in data modelling, - interpret the results generated, - apply these statistics and data modelling techniques in practical projects, and - develop real world analytics solutions using Spark Machine Learning and Scala.

Recommended reading	Lecture notes and online references provided. 1) Statistics for Managers: Using Microsoft Excel (6th ed.), David M. Levine et al. (2011), OT, B. 2) Foundations of Predictive Analytics, James Wu & Stephen Coggeshall (2012), OT, B. 3) Data Mining: Concepts and Techniques, Jiawei Han, Micheline Kamber, and Jian Pei, (2011), OT, B. 4) Programming in Scala, 3rd ed, by Martin Odersky, Lex Spoon and Bill Benners (2016), OT, B 5) Learning Spark: Lightning-Fast Big Data Analysis, by Andy Konwinski, Holden Karau, Matei Zaharia, and Patrick Wendell (2015), OR, B
Exams	Module exam
Comments	Prerequisites: Target audience are 6th and 7th semester students. If in doubt contact lecture in charge. Assessment: - Continuous assessment (individual) - Group project (presentation + term paper) Intensive course, given within the first two weeks of October. Schedule TBA. Teaching staff: Dr. Kenny Lu, Dr. Noi Sian Koh (Nanyang Polytechnic Singapore)

Lecture Digital Transformation & digital Marketing

Internal number	I W929
Lecturers	Marc Steinmetz 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	
Recommended reading	
Exams	Homework 1 Semester (graded)
Comments	

Lecture Modern server applications and web apps with TypeScript

Internal number	I W934
Lecturer	Prof. Dr. Jürgen Zimmermann
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 Exam 90 Min. (graded)
Comments	
Lecture Microtechnology Laboratory	
Internal number	I W935
Lecturer	Prof. Dr. rer. nat. Oliver Schecker
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	Development of applications with a microtechnology focus. Examples include autonomous micro airships, self-monitored first aid kits, energy self-sufficient door signs, components of the "High Speed Karlsruhe" racing car if the student is involved in this project (https://www.highspeed-karlsruhe.de/).
Recommended reading	
Exams	Hands-on Work 1 Semester (not graded)
Comments	

Module Selected Chapters Computer Science 2	
Internal number	INFB710
Coordinator	Prof. Dr.-Ing. Holger Vogelsang
Scope	8.0 ECTS points, 8.0 Contact hours
Placement	7th Semester
Pre-requisites with regard to content	Internship, Internship Preparation and Roundup
Pre-requisites according to the examination regulations	§43 (4)
Competences	- Autonomous Systems Lab - Multimedia Studies (Blended Learning) - Project Management - Quality Assurance - Teamteaching
Exams	Individual exams
Lecture Autonomous Systems Labor	
Internal number	I W276
Lecturers	Dipl. Inf. (FH) Oktavian Gniot Prof. Dr. Norbert Link
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	Project 1: Implementation of an image-processing-based handling system, which performs transport activities on the basis of information extracted from a digital video camera Project 2: Implementation of the core functionality of an aircraft docking guidance system, which directs aircraft to their respective stopping position at the airport gate Project 3: Autonomous navigation, obstacle avoidance and object following with robots
Recommended reading	Lecture notes, task descriptions, project guidelines and FAQs, all accessible via the internet. Handbooks and relevant literature is available on site and for homework in the library.
Exams	Laboratory Work 1 Week (graded)
Comments	Theoretical familiarisation, practical work, reporting, partly as self-responsible work
Lecture Software Quality	
Internal number	I W392
Lecturer	Prof. Dr. Dirk Hoffmann

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 gain practical access to the field of software quality assurance. They work on a specific chapter from the field of software quality assurance and present their results to the other students in a series of short presentations. The participants then discuss the results.
Recommended reading	Hoffmann: "Software-Qualität", Springer-Verlag, 2013
Exams	Presentation 20 Min. (graded)
Comments	Lecture, student presentations

Lecture Search Engines

Internal number	I W393
Lecturer	B.Sc. Michael Siebers
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	Concept 1 Semester (graded)
Comments	

Lecture Project Management

Internal number	I W422
Lecturer	Prof. Dr. Uwe Haneke
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	The lecture focuses mainly on practice oriented project management and new procedure models like Scrum. - Introduction to IT project management - Procedure models in IT project management - Defining a project - The project plan: the heart of the project - Getting started: Initialisation of the project - Project controlling - The final words: how to complete a project
Recommended reading	
Exams	Verbal Exam 20 Min. (graded)
Comments	

Lecture External selected chapter 1	
Internal number	I W600
Lecturer	Prof. Dr.-Ing. Holger Vogelsang
Scope	2.0 ECTS points, 2.0 Contact hours 60 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German
Content	This course is a placeholder for an external, graded course from another faculty or university. You must have the external subject approved before attending it.
Recommended reading	
Exams	Written Exam 90 Min. (graded)
Comments	
Lecture InspirING	
Internal number	I W600.a
Lecturer	Prof. Dr.-Ing. Holger Vogelsang
Scope	2.0 ECTS points, 2.0 Contact hours 60 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Hands-on Experience
Language of instruction	German
Content	
Recommended reading	
Exams	Verbal Exam 20 Min. (graded)
Comments	
Lecture External selected chapter 2	
Internal number	I W700
Lecturer	Prof. Dr.-Ing. Holger Vogelsang
Scope	2.0 ECTS points, 2.0 Contact hours 60 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Lecture
Language of instruction	German
Content	This course is a placeholder for an external, graded course from another faculty or university. You must have the external subject approved before attending it.
Recommended reading	
Exams	Written Exam 90 Min. (not graded)
Comments	
Lecture Softwareengineering Special Chapters	
Internal number	I W701
Lecturer	Prof. Dr. Peter Henning

Scope	2.0 ECTS points, 2.0 Contact hours 60 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Seminar
Language of instruction	German
Content	The course focuses on fundamental object-oriented design methods with an emphasis on design patterns and model driven concepts. The students learn to recognize, to know when to use, and to apply design patterns in varying situations in the context of an evolutionary development process. Furthermore the ability of an axiomatic rule base application of patterns, within a model driven approach, are discussed.
Recommended reading	Slides, textbooks, and other literature: Folien-Skript, Lehrbücher: - Gamma, Erich et. al. Entwurfsmuster: Elemente wiederverwendbarer objektorientierter Software - München : Addison-Wesley, 2001. - Buschmann, Frank. A system of patterns (Pattern-Oriented Software Architecture Volume 1) - John Wiley & Sons. 1996. - Schmidt, Douglas C. Patterns for concurrent and networked objects (Pattern-Oriented Software Architecture Volume 2) - John Wiley & Sons. 2000. - Michael Kircher, Prashant Jain. Patterns for Resource Management (Pattern-Oriented Software Architecture Volume 3) - John Wiley & Sons. 2004. - Frank Buschmann, Kevlin Henney, Douglas C. Schmidt. A Pattern Language for Distributed Computing (Pattern-Oriented Software Architecture Volume 4) - John Wiley & Sons. 2007. - Frank Buschmann, Kevlin Henney, Douglas C. Schmidt. On Patterns and Pattern Languages (Pattern-Oriented Software Architecture Volume 5) - John Wiley & Sons. 2007. - Fowler, Martin. Analysemuster: wiederverwendbare Objektmodelle: Ein Pattern-Katalog für Business-Anwendungen - Addison-Wesley-Longman. 1999. - OMG Object Management Group. Meta Object Facility (MOF) Specification - Version 2.4.1: OMG, 2011.
Exams	Presentation 20 Min. (graded)
Comments	The lecture will take the form of seminars with exercises.

Lecture Teamteaching

Internal number	I W730
Lecturers	Prof. Dr.-Ing. Holger Vogelsang Alle Dozenten
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	Verbal Exam 20 Min. (graded)

Comments	- Preparation of a tutorial, support of student groups - Organisation of events
Lecture Multimedia (Blended Learning)	
Internal number	I W774
Lecturer	Prof. Dr. Peter Henning
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	Book: Henning, Taschenbuch Multimedia.
Exams	Online Test 4 Parts (graded)
Comments	
Lecture Reinforcement Learning	
Internal number	I W775
Lecturer	Prof. Dr. Patrick Baier
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 90/20 Min. (graded)
Comments	
Lecture Social commitment	
Internal number	I W776
Lecturer	Prof. Dr.-Ing. Holger Vogelsang
Scope	2.0 ECTS points, 2.0 Contact hours 60 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Hands-on Experience
Language of instruction	German

Content	This course enables students to obtain ECTS credits for social work done at Karlsruhe University of Applied Sciences. The activity must be closely coordinated with a professor of the faculty. This can be, for example, support for the O-Phase or support for visually impaired students. In the case of the O-Phase, you will usually have to work on two semesters in order to achieve the required minimum number of hours. If you are interested, you can also obtain the "Certificate of International and Intercultural Competence (CIIC)". It certifies the intercultural competences and foreign language skills acquired during the degree programme, provides evidence of study-related experiences abroad and lists the framework in which the participants have been involved in intercultural activities. To earn the CIIC, you must cover three of four subject areas. The main component in subject area 1 is the voluntary commitment of at least 50 hours (about 2 hours per week in one semester), which can be completed in institutions or projects with an international and/or intercultural connection. In addition to the commitment, you will attend an introductory event as well as a reflection workshop and prepare an experience report, which is necessary to pass the subject area. If you have any questions about the certificate, please contact the Center of Competence: https://www.h-ka.de/ciic Through the Center of Competence, it is also possible to obtain the "Certificate for Social Engagement (ZGE)". It takes into account an even wider range of opportunities to get involved. Find your suitable area, whether it is community, social, cultural or ecological engagement. Your social engagement should comprise at least 100 time hours and last for at least one year. In addition to your commitment, you will attend various seminars from the Studium Generale (a total of 8 ECTS) to link your practical experience with theoretical knowledge. This certificate cannot be recognised as an elective subject. You can find more information here: https://www.h-ka.de/zge At regular intervals, the Center of Competence offers introductory events and reflection workshops for HKA students who are involved in voluntary work outside of their studies. This gives them the opportunity to exchange their experiences as volunteers with other participants and learn to reflect on and classify the insights they have gained. The next dates can be found on the CIIC website.
Recommended reading	
Exams	Verbal Exam 20 Min. (not graded)
Comments	

Lecture Real-time graphics

Internal number	I W777
Lecturer	B.Sc. Tim Hänlein
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	Hands-on Work 1 Semester (graded)
Comments	
Lecture High Performance Computing	
Internal number	I W909
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 90/20 Min. (graded)
Comments	
Lecture ABAP Programming	
Internal number	I W918
Lecturers	B.Sc. Soeren Schlegel 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	Introduction to the ABAP programming language with practical exercises in SAP NetWeaver Application Server ABAP. Students should familiarise themselves with language elements, workbench, database, selection screens, function modules and ABAP OO and be able to apply them independently to new problems.
Recommended reading	- Lecture material completely in PowerPoint slides - Blackboard notes for interactive development of core problems - Exercise sheets and independent practical exercises on the SAP system
Exams	Written Exam 90 Min. (graded)
Comments	
Lecture Game AI	
Internal number	I W923
Lecturers	Prof. Dr.-Ing. Astrid Laubenheimer Dr. Patrick Glauner
Scope	2.0 ECTS points, 2.0 Contact hours 60 Stunden gesamt, davon 30 Stunden Kontaktstudium.

Type/mode	Lecture
Language of instruction	English
Content	
Recommended reading	
Exams	Written Exam 90 Min. (graded)
Comments	
Lecture High Speed Karlsruhe	
Internal number	I W936
Lecturer	Prof. Dr.-Ing. Holger Vogelsang
Scope	2.0 ECTS points, 2.0 Contact hours 60 Stunden gesamt, davon 30 Stunden Kontaktstudium.
Type/mode	Hands-on Experience
Language of instruction	German
Content	Collaboration on the "High Speed Karlsruhe" project in the MMT faculty. If you are interested, please contact Mr Stumpf: oliver.stumpf@h-ka.de
Recommended reading	http://www.hskampus.de https://www.facebook.com/hskampus https://www.instagram.com/hskampus/
Exams	Hands-on Work 1 Semester (graded)
Comments	

Module Scientific Working	
Internal number	INFB720
Coordinator	Prof. Dr. Heiko Körner
Scope	5.0 ECTS points, 3.0 Contact hours
Placement	7th Semester
Pre-requisites with regard to content	Communication Competence, Internship
Pre-requisites according to the examination regulations	§43 (4)
Competences	This module enables students to apply the basic principles of research in computer science in a method-based manner. They can evaluate scientific literature to use it in their own work. They are then able to write their own scientific papers.
Exams	Individual exams

Lecture Scientific Working	
Internal number	INFB721
Lecturer	Alle Dozenten
Scope	5.0 ECTS points, 3.0 Contact hours 150 Stunden gesamt, davon 45 Stunden Kontaktstudium.
Type/mode	Hands-on Experience
Language of instruction	German
Content	Students work independently on a practical problem using scientific and practical methods. Topics include the independent development of the methodology, the topic and the exact problem as well as the structure of the paper and the creation of a bibliography. The results are discussed and presented with the lecturers. The students thus learn the procedure for writing the final Bachelor's thesis.
Recommended reading	- Documents on the process, the structure of a paper and citation - Peter Rechenberg, Gustav Pomberger: Informatik-Handbuch. Hanser Fachbuch, 2006, ISBN 3446218424 - Jürg Niederhauser: Die schriftliche Arbeit - kurz gefasst. Bibliographisches Institut, Mannheim, 2006, ISBN 3411042346
Exams	Exercise 1 Month (not graded)
Comments	

Module Thesis	
Internal number	INFB730
Coordinator	Prof. Dr. Heiko Körner
Scope	12.0 ECTS points, 0.0 Contact hours
Placement	7th Semester
Pre-requisites with regard to content	Antomation and Declarative Programming, System Software and System Programming, Business Administration, Computer Graphics with Laboratory, Databases and Communication Networks 1, Databases and Communication Networks 2, ERP Systems, Embedded Software, Computer Science 1, Computer Science 2, Communication Competence, Mathematics 1, Mathematics 2, Man-Machine-Communication, Internship, Internship Preparation and Roundup, Student Research Project, Computer architecture and Autonomous Systems, Key Qualification, Software Engineering and Distributed Systems 2, Software Laboratory, Language Competence, Computer Engineering 1, Computer Engineering 2, Theoretical Computer Science 1, Distributed Systems 1 and Theoretical Computer Science 2, Scientific Working
Pre-requisites according to the examination regulations	Modul Internship,<= 4; siehe § 43-I/b (7); Min. 120 CP aus dem Hauptstudium
Competences	After successfully completing this module, students are able to independently solve a practical problem or research task using scientific methods within a specified period of time. They can structure the task, check dependencies, collect the necessary resources and then work on the task using a specially derived schedule. They can present the written results in an appealing form.
Exams	Individual exams

Lecture Thesis	
Internal number	INFB731
Lecturer	Alle Professoren
Scope	12.0 ECTS points, 0.0 Contact hours 360 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	Bachelor Thesis 4 Months (graded)
Comments	

Module Final examination	
Internal number	INFB740
Coordinator	Prof. Dr. Heiko Körner
Scope	3.0 ECTS points, 0.0 Contact hours
Placement	7th Semester
Pre-requisites with regard to content	Thesis, Selected Chapters Computer Science 1, Antomation and Declarative Programming, System Software and System Programming, Business Administration, Computer Graphics with Laboratory, Databases and Communication Networks 1, Databases and Communication Networks 2, ERP Systems, Embedded Software, Computer Science 1, Computer Science 2, Communication Competence, Mathematics 1, Mathematics 2, Man-Machine-Communication, Internship, Internship Preparation and Roundup, Student Research Project, Computer architecture and Autonomous Systems, Key Qualification, Software Engineering and Distributed Systems 2, Software Laboratory, Language Competence, Computer Engineering 1, Computer Engineering 2, Theoretical Computer Science 1, Distributed Systems 1 and Theoretical Computer Science 2
Pre-requisites according to the examination regulations	Modul Internship
Competences	Participation in this module enables students to convincingly present the results achieved within a specialised, application-related thesis to an expert audience. They can analyse the content of such work, select the key aspects and present these in a didactically appropriate short presentation. In a subsequent discussion, they are also able to defend their results.
Exams	Individual exams
Lecture Final examination	
Internal number	INFB741
Lecturer	Alle Professoren
Scope	3.0 ECTS points, 0.0 Contact hours 90 Stunden gesamt, davon 0 Stunden Kontaktstudium.
Type/mode	Colloquium
Language of instruction	German
Content	The final examination covers all topics relevant to computer science in the main study programme. Students demonstrate that they have understood and can apply interdisciplinary contexts. They answer questions from various areas of media informatics that are related to their final thesis. With the final examination, they demonstrate that they have the competence to independently work on novel problems in the field of media informatics.
Recommended reading	
Exams	Verbal Exam 20 Min. (not graded)
Comments	