Universität Bamberg

Undergraduate and Graduate Studies in Information Systems and Applied Computer Science

Module Handbook and Student Guide
Academic Year 2012-2013



WIAI

www.uni-bamberg.de/wiai

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1 Introduction and General Information

This document lists all modules offered in the Faculty of Information Systems and Applied Computer Sciences during the academic year 2012-2013.

To prevent problems arising from late changes on these offerings, you are advised to confirm module specifications and schedules through the research groups' web pages or directly with the responsible teaching staff. There may also be new courses becoming available on short notice. Please see the faculty's web pages for relevant announcements. The German module handbook can be found at

http://www.uni-bamberg.de/wiai/leistungen/studium/modulhandbuch/

1.1 Fees and Registration

All modules are currently open free of charge to foreign guest students who will study at Bamberg University within the frame of a partnership exchange programme, such as ERASMUS/LLP. There are no tuition or bench fees. Enrolment with the University may incur a nominal registration fee covering administration charges, student union membership (*Studentenwerk*) and the City of Bamberg travel ticket.

Information on the registration and enrolment process may be obtained from the Academic Exchange Office (*Akademisches Auslandsamt*, see address below) who will also be able to advise you on any exchange scheme that may exist between Bamberg University and your home institution.

Once admitted to and enrolled with Bamberg University you do not need to register for attending a teaching module. Feel free to sit in and participate in any course offering that fits your educational needs and time table. Be aware, though, that some courses may have entry requirements.

1.2 Teaching Times

The academic year 2012-2013 consists of two teaching periods:

Winter Semester: 15th October 2012 – 09th February 2013,
Summer Semester: 15th April 2013 – 20st July 2013.

1.3 Assessment

The course assessment is done mostly by written exams and optionally also by way of homework assignments or lab practicals. In some cases the final exam is oral.
Final written exams are usually held immediately after the end of the semester, i.e. February/March for the Winter Semester and end of July/August for the Summer Semester. Be aware that there are firm deadlines for exam registration some time during the second half of the semester. If you miss the online registration deadline set by our FlexNow! system make sure to register with the course lecturer directly. Also, if for some reason you cannot attend the regular exam, say because you are returning home early, talk to the course lecturer. They may be able to arrange an oral exam for you at an earlier date instead. In this case guest students must **not** register with the FlexNow! system.

The official exam language is German, but many courses may offer written or oral exams in English if required. Some modules are taught in English, at the discretion of the lecturer. If you need to be set an English exam for a module delivered in German you should contact the module lecturer early to find out if this is possible. The description of each lecture indicates which part of the module may be offered in English.

1.4 Workload

The module descriptions below specify the total module workload in terms of ECTS (European Credit Transfer System) credit points according to the following approximate accounting scheme:

- 1 ECTS = 25-30 hrs total student workload (all inclusive)
- 30 ECTS = total module load per semester
- 6 ECTS = single standard course module of 4 hrs/week combining lectures+tutorials

Course Levels and Teaching Format

In line with our traditional Diploma degree programmes, modules are taught at 2 major levels:

- Basic Studies

These are foundational and introductory courses in the general disciplines of Information Systems and Applied Computer Sciences corresponding to the 1st and 2nd year of the undergraduate BSc programme.

- Advanced Studies

These are introductory courses to specialised fields within Information Systems and Applied Computer Sciences corresponding to the 3rd and 4th year of the BSc degree and advanced modules in particular research areas which correspond to the 1st and 2nd year of the graduate MSc programme.

Most modules are based on combined lectures and tutorials. Some courses may also involve lab classes, excursions, blended learning and other teaching arrangements. Research groups regularly offer advanced level seminars on varying research topics. These may have special entry prerequisites.

1.5 Other Information

The Academic Exchange Office provides information on accommodation, living expenses, language courses and many other aspects of student life at Bamberg. You are welcome to contact the International Liaison Officer of the WIAI Faculty.

Academic Exchange Office (*Akademisches Auslandsamt*)

Mrs. Stefanie Hofmann

Secretary - Foreign Student Affairs

Akademisches Auslandsamt

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2 Module Descriptions

2.1 Summary

The following table summarises all modules scheduled to run during 2012-2013. It is expected that most of these courses, which are fixed elements of our BSc and MSc programmes, will continue to be offered in 2013-2014 as well.

Abbreviations:

WS = Winter Semester, SS = Summer Semester

Parts of course delivered in English (on demand): M = Module, E = Exam

Basic Studies	Programme	ECTS credits	offering	English	Page ref
Introduction to Media Informatics	B.Sc.	6	WS	ME	11
Software Engineering	B.Sc.	6	WS	ME	20
Software Engineering Lab	B.Sc.	6	SS	ME	20
Imperative Programming Using C	B.Sc.	3	SS	ME	20
Trends in Software Engineering	B.Sc.	3	WS	ME	21

Trends in Programming Laguages		B.Sc.	3	SS	ME	22
Discrete Foundations		B.Sc.	6	WS	ME	23
Machines and Languages		B.Sc.	6	SS	ME	24
Introduction to Computing and Programming for Students from the Humanities		B.Sc.	9	WS		28
Foundations of Business Information Systems		B.Sc.	6	WS		34
Data Management Systems		B.Sc.	6	SS		34
E-Finance		B.Sc.	6	SS	E	37
International Outsourcing Management		B.Sc.	6	SS	ME	38
IT-Controlling		B.Sc.	6	WS	E	38
Introduction to Computer Science		B.Sc.	9	WS/SS		43
consisting of	Algorithms, Programming and Software Technology	B.Sc.		WS	E	43
	Computer Architecture and Operating Systems	B.Sc.		WS	E	44
Introduction to Distributed Systems			6	SS	ME	45
Interactive Systems		B.Sc.	6	WS	ME	51
Project Human Computer Interaction		B.Sc.	6	WS	ME	52
Project Usability in Practice		B.Sc.	6	WS/SS	ME	55
Ubiquitous Systems		B.Sc.	6	WS	ME	52
Cooperative Systems		B.Sc.	6	SS	ME	54
Bachelor Seminar Human-Computer Interaction		B.Sc.	3	SS	ME	54

Advanced Studies	Programme	ECTS credits	Offering	English	Page ref
Information Retrieval 1	M.Sc.	6	WS	ME	12
Information Retrieval 2	M.Sc.	6	SS	ME	12
Web Technologies	B.Sc.	6	SS	ME	13
Computer Graphics and Animation	M.Sc.	6	WS	ME	13
Seminar Media Informatics	B.Sc.	3	SS	ME	14
Research Projects in Media Informatics	M.Sc.			ME	14
Data Communication	B.Sc.	6	WS	ME	15
Multimedia-communication in high-speed networks	M.Sc.	6	SS	ME	15
Mobile communication networks and mobile computing	M.Sc.	6	WS	ME	16
Modelling and analysis of communication networks and distributed systems	M.Sc.	6	WS/SS	ME	17
Fundamentals of Internet Communication	M.Sc.	6	WS/SS	ME	17
Project in Computer Networking		6	WS/SS	ME	18
Seminar Next Generation Networking	M.Sc.	3	WS/SS	ME	19
Principles of Compiler Construction	M.Sc.	6	WS	ME	21
Compiler Construction Project	M.Sc.	6	WS	ME	21
Selected Readings in Parallel Programming	M.Sc.	6	SS	ME	21
Trends in Software Engineering	M.Sc.	3	WS	ME	22
Trends in Programming Laguages	M.Sc.	3	SS	ME	22
Nonprocedural Programming	B.Sc.	6	WS	ME	24

Specification and Verification	B.Sc.	6	SS	ME	25
Communication and Concurrency	M.Sc.	6	SS	ME	25
Information Security	M.Sc.	6	WS	ME	26
Theory Seminar	M. Sc.	3	WS/SS	ME	27
Research Projects in Foundations of Computer Science				ME	27
Semantic Information Processing	M.Sc.	6	WS	ME	29
Geographic Information Systems	B.Sc.	6	SS		29
Mobile Assistance Systems	M.Sc.	6	SS	ME	30
Intelligent Agents	B.Sc.	6	SS	ME	31
Machine Learning	M.Sc.	6	WS	ME	32
Lab Project Cognitive Systems	B.Sc./M.Sc.	6	WS/SS	ME	32
Seminar in Cognitive Systems	B.Sc./M.Sc.	3	WS/SS	ME	32
Modelling of Business Information Systems	B.Sc.	6	WS		35
Systems Engineering	M.Sc.	6	SS		35
Architectures of database management systems and database application systems	M.Sc.	6	SS		35
Advanced application systems for Data, Information, and Knowledge Processing	M.Sc.	6	SS		36
Information Systems and Services I – Standards and Networks	M.Sc.	6	WS	E	39
Information Systems and Services II – Optimization of IT-Reliant Processes	M.Sc.	8	WS	ME	39
Information Systems and Services III – IT Business Value	M.Sc.	8	SS	ME	40
Seminar in Information Systems and Services		3	WS		40

SOA Governance and Evaluation		3	WS	ME	41
Management of external IT Service Providers	B.Sc.	3	SS	ME	41
Service-Oriented Architecture and Web Services	M.Sc.	6	SS	ME	47
Distributed Systems Architecture and Middleware	M.Sc.	6	WS	ME	48
Selected Readings in Distributed Systems	M.Sc.	3	WS/SS	ME	49
Distributed and Mobile Software Project	M.Sc.	9	Aug-Oct	ME	49
Project Usability in Practice		6	WS/SS	ME	55
Ubiquitous Systems		6	WS	ME	52
Master-Seminar Human-Computer Interaction	M.Sc.	3	WS	ME	56
Human-Computer Interaction	M.Sc.	6	SS	ME	57
Master-Seminar Human-Centred Computing	M.Sc.	3	SS	ME	57
Project Human-Computer Interaction	M.Sc.	6	SS	ME	58
Information and Knowledge Management	B.Sc.	6	SS	E	54
Social Network Analysis	B.Sc.	6	WS	E	59
Theories of Social Networks	B.Sc.	6	SS	E	60
SNA Seminar	B.Sc.	3	WS/SS	E	60

2.2 Media Informatics

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Chair of Media Informatics

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General Information:

All exams (basic and advanced) may be taken in English. Lectures and tutorials are offered in German.

Basic Studies (1st – 3rd year)

Introduction to Media Informatics (MI-EMI-B)

Einführung in die Medieninformatik

This course deals with media and media formats. Among that are XML for structured text, SVG and VRML for 2D- and 3D-graphics and animation, JPEG, GIF and PNG for images, PCM, MP3 for audio, as well as MPEG for video. Besides the formats the corresponding fundamentals are examined, like color- and perception-models and engineering-like development of (multi-)media systems. The intention is to teach practical skills with the mentioned formats and with the development of concepts for coding- and compression-techniques. For this, the course, which generally wants to give a broad overview of the domain, looks at selected topics in more detail. Examples for this are JPEG and MP3.

Hours per Week / Semester: 4 / winter		**Teaching Method:** Lectures and Tutorials
Credits: 6		**Examination:** 90 minute written examination
English language on demand:		
Lecture ☒	**Tutorial** ☒	**Written Exam** ☒, **Oral Exam** ☐

Advanced Studies (3rd – 5th year)

Information Retrieval 1 – Fundamentals, Models and Applications (MI-IR1-M)

Information Retrieval 1 – Grundlagen, Modelle und Anwendungen

Information Retrieval (IR) addresses the search for documents. Traditionally these are textual documents. Today the search for multimedia documents, e.g. images, audio, video as well as hypertext documents is getting more and more important. Furthermore with the proliferation of the World Wide Web Information Retrieval gains even more prominence and actuality. Within this course we cover essential information retrieval models and algorithms as well as the evaluation of information retrieval systems and their application for web search:

- Search Engines and Information Retrieval
- Architecture of a Search Engine
- Crawls and Feeds
- Processing Text
- Ranking with Indexes
- Queries and Interfaces
- Retrieval Models
- Evaluating Search Engines
- Classification and Clustering
- Beyond Bag of Words (Multimedia Information Retrieval)

The course is based on the book *Search Engines: Information Retrieval in Practice* by W. Bruce Croft, Donald Metzler, Trevor Strohman; Pearson Education, 2009.

Prerequisites:

Programming skills (in particular, object-oriented)

Hours per Week / Semester: 4 / winter		**Teaching Method:** Lectures and Tutorials
Credits: 6		**Examination:** 90 minute written examination
English language on demand:		
Lecture ☒	**Tutorial** ☒	**Written Exam** ☒, **Oral Exam** ☐

Information Retrieval 2 – Selected Advanced Topics(MI-IR2-M)

Information Retrieval 2 – ausgewählte weiterführende Themen

Within this course we build upon the fundamentals addressed within Information Retrieval 1. We consider advanced information retrieval models as well as advanced algorithms and data structures used for searching images and structured documents. To this end, recent research papers are discussed and small corresponding practical projects are conducted.

The concrete topics are chosen according to current research trends in information retrieval.

Prerequisites:

Introduction to Media Informatics, Information Retrieval 1, programming skills (in particular, object-oriented)

Hours per Week / Semester: 4 / summer		**Teaching Method:** Lectures and Tutorials
Credits: 6		**Examination:** 30 minute oral examination
English language on demand:		
Lecture ☒	**Tutorial** ☒	**Written Exam** ☐, **Oral Exam** ☒

Web Technologies (MI-WebT-B)

Web Technologien

Web applications are of great importance today. The module provides methodological, conceptual and practical skills for the development of web applications. Particular emphasis is placed on Web 2.0 technologies. The module enables students to develop such applications with major frameworks and techniques.
The module addresses various techniques relevant for Web Engineering and has a strong focus on the development of web applications. Particular topics are:

- The Web: Introduction, Architecture, History ...
- Basic Languages to Develop: HTML & CSS
- Client-side Scripting: The Basics & AJAX
- Server-Side Scripting: CGI & PHP
- Frameworks: CakePHP, RubyOnRails
- Security of Web Applications
- CMS, LMS, SEO & Co.

Prerequisites:

Introduction to Media Informatics, programming skills (in particular, object-oriented)

Hours per Week / Semester: 4 / summer		**Teaching Method:** Lectures and Tutorials
Credits: 6		**Examination:** 90 minute written examination
English language on demand:		
Lecture ☒	**Tutorial** ☒	**Written Exam** ☒, **Oral Exam** ☐

Computer Graphics and Animation (MI-CGuA-M)

Computergrafik und Animation

This course deals with all important aspects of three-dimensional computer graphics and covers the basic mathematic principles as well as the implementation in tools for animation development. That provides a basis for a specific use of these tools for creating animations and virtual worlds. The topics of this course are similar to the standard work from Watt: basic mathematic principles of computer graphic, description and modelling of three-dimensional objects, display and rendering, the graphics-pipeline, reflection

models, illumination, the radiosity method, ray tracing techniques, volume rendering, colours in computer graphics, image-based rendering and photo-modelling, computer animation.

Prerequisites:

Multimedia Technology, programming skills (in particular, object-oriented)

Hours per Week / Semester: 4 / winter		**Teaching Method:** Lectures and Tutorials
Credits: 6		**Examination:** 90 minute written examination
English language on demand:		
Lecture ☒	**Tutorial** ☒	**Written Exam** ☒, **Oral Exam** ☐

Seminar Media Informatics (MI-Sem-B)

Bachelor-Seminar zur Medieninformatik

Seminars are offered irregularly on varying topics in Media Informatics, both in the winter and/or summer semesters. The seminars are usually advertised at the beginning of each semester.

Hours per Week / Semester: 2 / winter, summer	**Teaching Method:** Seminar
Credits: 3	**Examination:** Essay, presentation, continuous assessment
English language on demand ☒	

Research Projects in Media Informatics (MI-Prakt-M)

Praktikum zur Medieninformatik

Advanced students interested in pursuing a research project leading to a thesis at undergraduate (bachelor) or graduate (masters, doctoral) level are invited to contact the Media Informatics Group for proposals. Possible topics would typically fall within the fields of information retrieval or visualization. Some selected proposals can be found on the group's web pages. Depending on the candidate's preferences and background the project might focus more on theory or implementation.

2.3 Communication Systems and Computer Networks

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Head of Computer Networks Group

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Advanced Studies (3rd - 5th year)

Data Communication (KTR-Datkomm-B)

Datenkommunikation

Topics:
Introduction to communication networks, layered architectures, OSI protocol reference model, ISDN, TCP/IP suite, fundamentals of digital transmission, peer-to-peer protocols, data link layer and medium access control protocols, local area networks.

Language: German

Prerequisites:
Discrete foundations, programming course, algorithms and data structures

Basic References:
- Kurose, J., Ross, K.W.: Computer Networking, Pearson, Boston, 6th ed., 2013 .
- Tanenbaum, A. S.: Computer Networks, Prentice Hall, 4th ed., 2003.
- Douglas E. Comer: Computer Networks and Internets, 5th ed., Pearson, 2009.

Hours per Week / Semester: 4 / winter	**Teaching Method:** Lectures, Tutorials and Laboratories	
Credits: 6	**Examination**: 90 minutes written examination	
English language on demand:		
Lecture ☒	**Tutorial** ☒	**Written Exam** ☒, **Oral Exam** ☐

Multimedia Communication in High-Speed Networks (KTR-MMK-M)

Multimedia-Kommunikation in Hochgeschwindigkeitsnetzen

Topics:
Fundamentals of data networking, circuit- and packet-switched networking, architecture of high-speed networks (ATM, SDH, WDM), TCP/IP architecture, traffic management,

2nd generation IP networks with QoS mechanisms (Diffserv, Intserv, MPLS/GMPLS), security in IP networks, evolution of communication services, multimedia communication and services (HTTP, Video-Streaming, H.323, SIP, VoIP, IPTV), P2P and CDN networks, future generation Internet and virtualization concepts.

Language: German (or English - depending on the audience)

Prerequisites: Data communication

Recommendation: suitable course for Erasmus and foreign exchange students

Basic References:
- Kurose, J., Ross, K.W.: Computer Networking, Pearson, Boston, 6th ed., 2013.
- Tanenbaum, A. S.: Computer Networks, Prentice Hall, 4. ed., 2003.
- Leon-Garcia, A., Widjaja, I.: Communication Networks, McGraw-Hill, Boston, 2nd ed. 2004.
- Moreno, V, Reddy K.: Network Virtualization, Cisco Systems, 2006.
- Perea, R.M.: Internet Multimedia Communications Using SIP, Morgan Kaufman 2008.

Hours per Week / Semester: 4 / summer (cf. Web)		**Teaching Method:** Lectures, Tutorials and Laboratories
Credits: 6		**Examination:** 30 minutes oral examination
English language on demand:		
Lecture ☒	**Tutorial** ☒	**Written Exam** ☐, **Oral Exam** ☒

Mobile Communication Networks (KTR-Mobi-M)

Mobilkommunikation

Topics:
Development of mobile networks and services, fundamentals of wireless transmission, medium access control protocols, data link layer protocols, network layer protocols and mobility management, mobile IP, TCP in wireless environments, wireless local area networks (IEEE.802.11/16, WiFi, WiMAX), wide area mobile networks (GSM, GPRS, UMTS, LTE), DVB-technology.

Language: English (or German - depending on the audience)

Recommendation: suitable course for Erasmus or foreign exchange students

Prerequisites: Data communication

Basic References:
- Schiller, J.: *Mobile Communications*. Pearson-Education/ Addison-Wesley, München, 2003.
- Walke, B.: *Mobile Radio Networks*, Wiley 2. ed., 2002.
- Pahlavan, K., Krishnamurthy, P.: *Principles of Wireless Networks,* A Unified Approach. Prentice Hall, 2002.
- Pahlavan, K., and Krishnamurthy, P.: *Networking Fundamentals - Personal, Local and Wide Area Communications*, John Wiley and Sons, 2008.

Hours per Week / Semester: 4 / winter (cf. Web)		Teaching Method: Lectures, Tutorials and Laboratories
Credits: 6		Examination: 30 minutes oral examination
English language on demand:		
Lecture ☒	Tutorial ☒	Written Exam ☐, Oral Exam ☒

Modelling and Analysis of Communication Networks and Distributed Systems (KTR-MAKV-M)

Modellierung und Analyse von Kommunikationsnetzen und Verteilten Systemen

Topics:
Modeling of distributed systems, probability theory and statistics, elementary stochastic processes, Poisson and renewal processes, Markov chains, numerical solution methods for Markov chains, theory of complex networks, link analysis of the Web, elementary Markovian queueuíng models, loss networks, elementary queueing networks.

Language: German (or English - depending on the audience)

Recommendation: suitable course for Erasmus or foreign exchange students

Prerequisites: Discrete foundations, programming course

Basic References:
- G. Bolch, S. Greiner, H. de Meer, K. S. Trivedi: Queueing Networks and Markov Chains. Wiley, 2nd edition, 2006.
- R. Nelson: Probability, Stochastic Processes, and Queueing Theory. Springer, 1995.
- Menascé, D.A. et al: Capacity Planning for Web Services, Prentice Hall, 2002.
- Baldi, P. et al.: Modeling the Internet and the Web, Wiley, 2003.

Hours per Week / Semester: 4 / winter or summer (cf. Web)		Teaching Method: Lectures, Tutorials and Laboratories
Credits: 6		Examination: 30 minutes oral examination
English language on demand:		
Lecture ☒	Tutorial ☒	Written Exam ☐, Oral Exam ☒

Fundamentals of Internet Communiation (KTR-GIK-M)

Grundbausteine der Internet-Kommunikation

Topics:
Advanced laboratories are regularly offered on varying topics of computer networking and network programming. They comprise a combination of lectures, assignments, project tasks, presentations, and discussion. The upcoming topics of the laboratory are announced at the beginning of the semester.

Language: English (or German - depending on the audience)

Recommendation: suitable course for Erasmus or foreign exchange students

Prerequisites: Data communication

Basic References:
- J. Liebeherr, M. Elzarki: Mastering Networks, An Internet Lab Manual, Pearson Education, Boston, 2004.
- Kurose, J., Ross, K.W.: Computer Networking, Pearson, Boston, 6th ed., 2013 .
- Stevens, W.R.: TCP/IP Illustrated, Vol. 1, Addison-Wesley, 1994.
- Perea, R.M.: Internet Multimedia Communications Using SIP, Morgan Kaufman 2008.

Hours per Week / Semester: 4 / winter or summer (cf. Web)	**Teaching Method:** Lectures and Laboratories	
Credits: 6	**Examination:** Deliverables, presentations, continuous assessment, 20 minutes final oral examination	
English language on demand:		
Lecture ☒	**Tutorial** ☒	**Written Exam** ☐, **Oral Exam** ☒

Project in Computer Networking (KTR-Proj)

Projekt Kommunikationsnetze und -dienste

Topics:
Considering actual research topics in computer networking and the design of next generation service architectures, development projects are offered. Topics may include, for instance, P2P networking as well as the implementation and performance analysis of virtualization and high availability concepts. The course comprises the solution of several development tasks that have to be performed by appropriate team work.
The concept of the course will follow the organization of a development project in industry. It will qualify the partcipants for sophisticated development tasks and project management related to the design of future services and next generation Internetworking. These capabilities are demanded by industry and successful international consulting companies in the field.
Furthermore, a collaboration with the latter partners on such topics are possible during a subsequent thesis project and will be strongly supported by the Professur für Informatik.

Language: English (or German - depending on the audience)

Recommendation: suitable course for Erasmus or foreign exchange students

Prerequisites: Data communication, JAVA or C++ network programming and additional knowledge about IP networking according to the actual announcement

Hours per Week / Semester: 4 / summer or winter (cf. Web)	**Teaching Method:** Tutorials and Laboratory	
Credits: 6	**Examination:** Deliverables, presentations, continuous assessment, 30 minutes final oral examination	
English language on demand:		
Lecture ☒	**Tutorial** ☒	**Written Exam** ☐, **Oral Exam** ☒

Seminar Next Generation Networking (KTR-Sem-M)

Hauptseminar (KTR-Master)

Topics:
Seminars are regularly offered on varying topics of next generation networking. They comprise a combination of homework, presentation, and discussion. The upcoming topics of the seminars are announced at the beginning of the semester.

Language: English (or German - depending on the audience)

Recommendation: suitable course for Erasmus or foreign exchange students

Prerequisites: Data communication

Hours per Week / Semester: 2 / winter or summer (cf. Web)	**Teaching Method:** Seminar
Credits: 3	**Examination:** Essay, 30 minutes final presentation, continuous assessment
English language on demand ☒	

2.4 Software Technologies and Programming Languages

Prof. Dr. Gerald Lüttgen

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Bachelor Studies

Software Engineering (SWT-SWE-B)

Hours per Week / Semester: 4 / winter		**Teaching Method:** Lecture and Practical
Credits: 6		**Examination:** 90 min. written examination
English language on demand:		
Lecture ☒	**Tutorial** ☒	**Written Exam** ☒, **Oral Exam** ☐

Software Engineering Lab (SWT-SWL-B)

Hours per Week / Semester: 4 / summer	**Teaching Method:** Practical (group project)
Credits: 6	**Examination:** Colloquium in group (report and 45 min. oral examination)
English language on demand ☒	

Imperative Programming Using C (SWT-IPC-B)

Hours per Week / Semester: 2 / summer	**Teaching Method:** Practical
Credits: 3	**Examination:** Colloquium (assignment and 20 min. oral examination)
English language ☒	

Trends in Software Engineering (SWT-TSE-B)

Hours per Week / Semester: 2 / winter	**Teaching Method:** Seminar
Credits: 3	**Examination:** 30 min. presentation and essay
English language on demand ☒	

Trends in Programming Languages (SWT-TPL-B)

Hours per Week / Semester: 2 / summer	**Teaching Method:** Seminar
Credits: 3	**Examination:** 30 min. presentation and essay
English language on demand ☒	

Master Studies

Principles of Compiler Construction (SWT-PCC-M)

Hours per Week / Semester: 4 / winter		**Teaching Method:** Lecture and Practical
Credits: 6		**Examination:** Colloquium (assignment and 20 min. oral examination)
English language		
Lecture ☒	**Tutorial** ☒	**Written Exam** ☐, **Oral Exam** ☒

Compiler Construction Project (SWT-CCP-M)

Hours per Week / Semester: 4 / winter	**Teaching Method:** Practical
Credits: 6	**Examination:** Colloquium (report and 20 min. oral examination)
English language ☒	

Selected Readings in Parallel Programming (SWT-RPP-M)

Hours per Week / Semester: 4 / summer		**Teaching Method:** Lecture and Practical
Credits: 6		**Examination:** Colloquium (assignment, active participation, and 20 min. oral examination)
English language		
Lecture ☒	**Tutorial** ☒	**Written Exam** ☐, **Oral Exam** ☒

Trends in Software Engineering (SWT-TSE-M)

Hours per Week / Semester: 2 / winter	**Teaching Method:** Seminar
Credits: 3	**Examination:** 30 min. presentation and essay
English language on demand ☒	

Trends in Programming Languages (SWT-TPL-M)

Hours per Week / Semester: 2 / summer	**Teaching Method:** Seminar
Credits: 3	**Examination:** 30 min. presentation and essay
English language on demand ☒	

2.5 Foundations of Computer Science

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Informatics Theory Group

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General Information:

- **Course Contents:** The content of the courses may be adjusted in line with research interests, new requirements of the curriculum or background of students, possible even on short notice. Although we try to keep the course descriptions up to date, the material presented in the classes in a particular semester may differ slightly from what is given below.
- **Exams:** All courses, except seminars and research projects, unless otherwise specified, are assessed by written question papers presented during the examination period at the end of each semester. Guest students who are staying at Bamberg for just one examination period (i.e., one semester) may contact the course lecturer for special arrangements on alternative oral and resit exams.
- **Course Language:** All exams (basic and advanced) are presented in English. Most tutorials are delivered in English. Advanced level lectures may be offered in English, too, if required. Please contact the course lecturer.

Basic Studies (1st- 3rd year)

Discrete Foundations (GdI-Mfl-B)

Mathematik für Informatiker 1

This module covers key elements in discrete mathematics (set theory, logic and algebra) relevant to Computer Science and Business Informatics. At the end of this course students should be able to perform elementary calculations in algebraic structures such as Boolean, functional and relational algebras; be familiar with basic combinatorial and logical principles (such as Russell's Paradox, diagonalisation and the existence of uncountable sets, Pigeon-Hole Principle, counting, fixed-point theorems, recursion and induction); know basic techniques such as formal power series for solving recurrence equations; be familiar with the concept of a formal system and formal calculus and have understood the fundamental difference between syntax and semantics, soundness and completeness; be able to formalize real-world concepts in propositional and predicate logic and have developed skills in reasoning using formal calculi for these logics; be able to apply elementary proof principles (proof by contraposition, proof by cases, natural and structural induction).

Hours per Week / Semester: 4 / winter		**Teaching Method:** Lectures, Tutorials, Practice Labs
Credits: 6		**Examination:** 90 minute written paper (English)
English language on demand:		
Lecture ☒	**Tutorial** ☒	**Written Exam** ☒**, Oral Exam** ☒

Machines and Languages (GdI-GTI-B)

Grundlagen der Theoretischen Informatik

This course addresses the questions "what is a computation?" and "what is an algorithm?" and explores the capabilities and limitations of computers and programming languages as well as the implication of these for a practical computer scientist. It introduces the basic concepts and methods that underlie the mathematical study of computing machines and formal languages. At the end of this course the students should be able to distinguish finite automata, pushdown automata, Turing machines, and know the difference between the deterministic and non-deterministic versions in each case; be able to distinguish regular, context-free, context-sensitive and general phrase structure grammars in the Chomsky Hierarchy; understand the relations between language classes and machine classes; have developed elementary automata and Turing machine programming skills; know the basic concepts of algorithmic complexity theory such as the big-O notation, complexity classes N and NP.

Hours per Week / Semester: 4 / summer		**Teaching Method:** Lectures and Tutorials
Credits: 6		**Examination:** 90 minute written paper (English)
English language on demand:		
Lecture ☒	**Tutorial** ☒	**Written Exam** ☒**, Oral Exam** ☒

Advanced Studies (3rd – 5th year)

Nonprocedural Programming (GdI-NPP-B)

Nichtprozedurale Programmierung

The aim of this module is to provide a deeper understanding of programming languages, their semantics and applications. This course focuses on the operational semantics of functional and logical programming, and stresses the importance of the concept of types and type checking. At the end of this course students should be familiar with the computational principles behind functional and logical programming, as well as their relationship; be familiar with important language constructs and their semantics (e.g., expressions, local declarations, function and relational abstraction, recursion, lazy and eager evaluation, unification, backchaining); have an appreciation of the major techniques and underlying principles of the formal specification of semantics (axiomatic, denotational, operational) and extended skills in using structural operational rules; have understood the concept of inductive rule systems and their relevance to the specification of complex systems; have an appreciation of the close relationship between programming language types and specification, and the role of type checking as a formal verification method; be familiar with polymorphic Hindley-Milner style type systems.

Hours per Week / Semester: 4 / winter		Teaching Method: Lectures, Tutorials, Practice Labs
Credits: 6		Examination: 90 minute written paper (English)
English language on demand:		
Lecture ☒	Tutorial ☒	Written Exam ☒, Oral Exam ☒

Specification and Verification (GdI-SaV-B)

Modallogik

This advanced module aims to give a thorough introduction to a selection of modal logics with strong applications in Computer Science. Basic knowledge of classical propositional logic and predicate logic and associated calculi is assumed as a prerequisite. Among the logics covered are modal and temporal logics for the analysis of distributed systems or semantic information processing. Depending on the time available, the module also covers belief logics and other specialised logics for security protocols and distributed algorithms. The course addresses theoretical foundations (models and proof systems) but also discusses applications and offers practical experience through hands-on experimentation with automatic and interactive verification tools.

Hours per Week / Semester: 4 / summer		Teaching Method: Lectures and Tutorials
Credits: 6		Examination: 90 minute written paper (English)
English language on demand:		
Lecture ☒	Tutorial ☒	Written Exam ☒, Oral Exam ☒

Communication and Concurrency (GdI-CaC-M)

Theorie Verteilter Systeme

This advanced course gives an introduction to the algorithmic and semantic foundations in the programming of distributed systems and discusses state-of-the-art techniques in the formal modelling and validation of distributed systems. At the end of this course the students should be familiar with elementary algorithms, specifically for resource synchronization, mutual exclusion, leader election, Byzantine agreement, global time-keeping; be able to reason about and argue for the correctness of these algorithms; understand the elementary trade-offs governing the algorithms' time and communication complexities; have a clear appreciation of the intricacies arising from the task of solving global synchronisation problems by local (asynchronous) means of communication; know some of the central impossibility results; be familiar with different behavioural models for distributed systems of varying expressiveness, such as Petri Nets, Kripke structures, labelled transition systems, hybrid automata; understand the operational principles of modern (visual) programming languages for globally-synchronous and locally-asynchronous systems such as Statecharts or Esterel.

Hours per Week / Semester: 4 / summer		Teaching Method: Lectures and Tutorials
Credits: 6		Examination: 30 minutes oral examination (English)
English language on demand:		
Lecture ☒	Tutorial ☒	Written Exam ☒, Oral Exam ☒

Information and Security (GdI-IaS-M)

Informationssicherheit

Commercial as well as private and public businesses increasingly exploit the world wide web as an efficient and innovative communication platform. Since the web is openly accessible, widely distributed and largely uncontrolled ("best-effort" principle) the dangers of information security violation are real and bound to cause considerable headaches in the future. This course gives an introduction to the problem and surveys state-of-the-art cryptographic methods and standardised security mechanisms based on them that are designed to counter the risks and to establish secure communication through unsafe channels. It will be discussed how properties such as confidentiality, authentication, data integrity, anonymity, commitment can be achieved systematically through security protocols. At the end of this course students should be familiar with most important modern techniques for encryption and decryption; know some of the prominent historic ciphers; have acquired the necessary elementary background in number and coding theory; understand the difference between symmetric and asymmetric encryption; have understood the RSA cryptographic system and possible attacks on it; be familiar with mathematical technology such as one-way functions and hard-core predicates to amplify secrecy and to turn a cryptographic system such as RSA into practical use; be able to appreciate the difference between perfect information-theoretic secrecy and computational secrecy; be able to compute the information-theoretic secrecy of simple encryption systems; be familiar with BAN logic and able to perform logical analyses of elementary security protocols using BAN or one of its successors.

Hours per Week / Semester: 4 / winter		Teaching Method: Lectures and Tutorials
Credits: 6		Examination: 30 minutes oral examination (English)
English language on demand:		
Lecture ☒	Tutorial ☒	Written Exam ☒, Oral Exam ☒

Theory Seminar

Seminars are offered irregularly on varying topics in the Foundations of Computer Science, Advanced Programming and Formal Methods, both in the winter and/or summer semesters. The seminars are usually advertised at the beginning of each semester. Seminars will be held in English if needed.

Hours per Week / Semester: 2 / winter, summer	**Teaching Method:** Seminar
Credits: 3	**Examination:** Essay, presentation, continuous assessment
English language on demand ☒	

Research Projects in Foundations of Computer Science

Advanced students interested in pursuing a research project leading to a thesis at undergraduate (bachelor) or graduate (masters, doctoral) level are invited to contact the Theory Group for proposals. Possible topics would typically fall within the theory and application of logics, type theory, process algebra and the semantics of visual programming languages. Some selected proposals can be found on the group's web pages. Depending on the candidate's preferences and background the project might focus on theory or implementation.

2.6 Computing in the Cultural Sciences

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Basic Studies (1st – 3rd year)

Introduction to Computing and Programming for Students from the Humanities (Modul KInf-IPKult-E)

Informatik und Programmierung für die Kulturwissenschaften

First course in Computing Science not requiring previous experience with computers. Introduction into basic concepts: information, data, knowledge; architecture of computer systems; principles of programming: control and data structures, software engineering process; computer applications: geographic information systems and digital libraries; theory of computing: fundamental limitations and how to cope with them in practice; future trends of computing: semantic information processing. Exercises include text problems and programming tasks.

Prerequisites: none

Hours per Week / Semester: 6 / winter	**Teaching Method:** Lecture, exercise and tutorial lessons	
Credits: 9	**Examination:** Written final exam, assignments	
English language on demand:		
Lecture ☐	**Tutorial** ☐	**Written Exam** ☐, **Oral Exam** ☐

You may take this course also as module(s) with different level of granularity

- Lecture and exercise: 6 credits, written final exam *(KInf-InfKult-E, Informatik für die Kulturwissenschaften)*
- Programming course: 3 credits, tutorial lessons, assignments *(KInf-ProgKult-E, Programmierkurs für die Kulturwissenschaften)*

Advanced Studies (3rd – 5th year)

Semantic Information Processing (KInf-SemInf-M)

Semantische Informationsverarbeitung

Computational methods and tools for semantic information processing with special focus on knowledge-based approaches. Topics covered include: problem solving by heuristic search, constraint solving, representation and reasoning with domain-specific knowledge, formal ontologies, machine learning and knowledge discovery, neural networks.

The design of intelligent agents and agent systems is adopted as unifying perspective for presenting the material. Examples from GIS applications or digital libraries illustrate how the methods from semantic information processing blend with more traditional approaches to software design. Programming exercises in Java complement the lecture.

Prerequisites: Algorithms and data structures, Machines and Languages

Hours per Week / Semester: 4 / winter		**Teaching Method:** Lecture and exercise lessons
Credits: 6		**Examination:** Written final exam
English language on demand:		
Lecture ☒	**Tutorial** ☒	**Written Exam** ☒, **Oral Exam** ☐

Geographic Information Systems (KInf-GeoInf-B)

Geoinformationssysteme

This lecture introduces into fundamental concepts of geographic information processing. Topics covered include: representation of spatial objects, digital maps, acquisition of geographic data, visualization and analysis of spatial data, spatial indexing (e.g. R-trees), spatial query processing and spatial SQL.
Connections to semantic information processing, especially those arising from interoperability issues, are established. Possible fields of application for GIS are illustrated with special emphasis on current trends in mobile computing.

Prerequisites: Discrete foundations, Algorithms and data structures

Hours per Week / Semester: 4 / summer		**Teaching Method:** Lecture and exercise lessons
Credits: 6		**Examination:** Written final exam
English language on demand:		
Lecture ☐	**Tutorial** ☐	**Written Exam** ☐, **Oral Exam** ☐

Mobile Assistance Systems (KInf-MobAss-M)

Mobile Assistenzsysteme

A digital travel guide running on a smart phone and a CAD-based system for the documentation of built heritage with a TabletPC are two examples of software solutions designed to assist mobile users, that is, examples of mobile assistance systems. The objective of the course is to introduce students to the research literature on mobile assistance systems and to enable them to put the acquired concepts and methods into practice. Half of the material is covered in reading sessions and half in lab sessions. The course is taught in English.

Prerequisites: Algorithms and data structures

Hours per Week / Semester: 4/summer	**Teaching Method:** Reading sessions and lab sessions
Credits: 6	**Examination:** Written final exam, assignments, colloquium
English language on demand ☒	**Written Exam** ☒**, Oral Exam** ☐

2.7 Cognitive Systems

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General Information:

All exams may be taken in English. Lecture slides are in English. Lectures and tutorials may be offered in English, too, if required.

Advanced Studies (3rd – 5th year)

Intelligent Agents (KogSys-IA-B)

Intelligente Agenten

In this course basic concepts and methods of cognitive oriented artificial intelligence are introduced in the context of problem solving and action planning. Core topics are: Strips planning, logic and deductive planning, heuristic search and heuristic planning, planning graph techniques, SAT-planning, and multi-agent planning. Throughout the course, relations to human problem solving and planning are discussed. In the practice part methods and techniques are applied and partially implemented in Prolog. The course language is German, slides and reading materials are in English.

Prerequisites: Basic programming knowledge (for solving the practicals), basic knowledge in algorithms (search algorithms) and logic.

Hours per Week / Semester: 4/summer	**Teaching Method:** Lectures and tutorials, assignments
Credits: 6	**Examination:** 90 minutes written examination
English language on demand:	

Lecture ☒	**Tutorial** ☒	**Written Exam** ☒, **Oral Exam** ☒

Machine Learning (KogSys-ML-M)

Lernende Systeme

In this master-level course well-known symbolical, statistical, and neuronal approaches to machine learning are introduced and relations to human learning are discussed. Core topics are: decision tree algorithms, multi-layer perceptrons, instance-based learning, genetic algorithms, inductive logic programming, Bayesian learning, computational learning theory, inductive program synthesis, and reinforcement learning. In the practice part, some methods and techniques are applied and implemented in Java and Prolog. The course language is German, slides and reading materials are in English.

Prerequisites: Basic programming knowledge (for solving the practicals), basic knowledge in algorithms (search algorithms) and logic.

Hours per Week / Semester: 4/winter	**Teaching Method:** Lectures and tutorials, assignments
Credits: 6	**Examination:** 90 minutes written examination
English language on demand:	
Lecture ☒	**Tutorial** ☒	**Written Exam** ☒, **Oral Exam** ☒

Lab Project Cognitive Systems (KogSys-Proj-B, KogSys-Prak-M)

Projekt Kognitive Systeme

In this course, offered on bachelor and master level, design and analysis of cognitive systems are practiced in small teams. The topics are derived from current research work in the cognitive system group. A practice course is essential as preparation for thesis work. Participation involves: Acquainting oneself with a topic by searching and evaluating the relevant research papers, discuss the planned project work in context with the state of the art in the field and give an oral presentation; structure the work in form of a requirement specification; fulfilling the specified requirements by designing and/or implementing algorithms, performing theoretical analyses and/or an empirical evaluation of algorithms together with a written report (in form of a scientific paper) and an oral presentation of the results.

Hours per Week / Semester: 4/winter, summer	**Teaching Method:** Seminar, programming lab
Credits: 6	**Examination:** written report and oral presentation
English language on demand ☒	

Seminar in Cognitive Systems (KogSys-Sem-B, KogSys-Sem-M1, KogSys-Sem-M2)

Seminar Kognitive Systeme

Seminars are offered bachelor (winter term) and master level (summer term) on varying topics in Cognitive Systems. The seminars are usually advertised at the beginning of each semester.

Hours per Week / Semester: 2 / winter, summer	**Teaching Method:** Seminar
Credits: 3	**Examination:** Essay, presentation, continuous assessment
English language on demand ☒	

2.8 Systems Engineering

Prof. Dr. Elmar J. Sinz

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Basic Studies (1st – 3rd year)

Foundations of Business Information Systems (SEDA-GbIS-B)

Grundlagen betrieblicher Informationssysteme

Comprehensive introduction to concepts, models, and techniques for the analysis and the design of business information systems. Subjects are systems theory, models of business systems, business functions, and modeling of business information systems.

Hours per Week / Semester: 4 / winter	**Teaching Method:** Lecture and Tutorial	
Credits: 6	**Examination**: 90 minute written examination	
English language on demand:		
Lecture ☐	**Tutorial** ☐	**Written Exam** ☐, **Oral Exam** ☐

Data Management Systems (SEDA-DMS-B)

Datenmanagementsysteme

Comprehensive introduction to data management and data management systems. Relational database model, SQL, architecture of data management systems, design of database schemas, case study (development of a data management system), transactions and transaction management, operating of data management systems.

Hours per Week / Semester: 4 / summer	**Teaching Method:** Lecture and Tutorial	
Credits: 6	**Examination**: 90 minute written examination	
English language on demand:		
Lecture ☐	**Tutorial** ☐	**Written Exam** ☐, **Oral Exam** ☐

Advanced Studies (3rd – 5th year)

Modelling of Business Information Systems (SEDA-MobIS-B)

Modellierung betrieblicher Informationssysteme

Introduction to methodological concepts of business information systems modelling; investigation of classical and advanced approaches to information systems modelling (data modelling, business process modelling, object-oriented modelling).

Hours per Week / Semester: 4 / winter		**Teaching Method:** Lecture and Tutorial
Credits: 6		**Examination**: 90 minute written examination
English language on demand:		
Lecture ☐	**Tutorial** ☐	**Written Exam** ☐, **Oral Exam** ☐

Systems Engineering (SEDA-EbIS-2-M)

Systementwicklung

Systems engineering; software engineering of business application systems; generic architectural framework; domain-specific layer; software layer; layer of programming platforms; control of large systems engineering projects by means of process models; different kinds of process models and their applicability.

Hours per Week / Semester: 4 / summer		**Teaching Method:** Lecture and Tutorial
Credits: 6		**Examination:** 90 minute written examination
English language on demand:		
Lecture ☐	**Tutorial** ☐	**Written Exam** ☐, **Oral Exam** ☐

Architectures of database management systems and database application systems (SEDA-EbIS-3-M)

Architekturen von Datenbanksystemen und von datenbankbasierten Anwendungssystemen

Database models; architecture of relational and object-oriented database management systems; transaction models and transaction processing in distributed systems; architectural concepts for improving the data independence of application systems.

Hours per Week / Semester: 4 / summer		**Teaching Method:** Lecture and Tutorial
Credits: 6		**Examination:** 90 minute written examination
English language on demand:		
Lecture ☐	**Tutorial** ☐	**Written Exam** ☐, **Oral Exam** ☐

Advanced application systems for Data, Information, and Knowledge Processing (SEDA-EbIS-1-M)

Fortgeschrittene Anwendungssysteme zur Daten-, Informations- und Wissensverbreitung

Data, information, and knowledge; data warehousing; multi-dimensional data model; architecture of data warehouse systems; data mining; knowledge-based application systems; knowledge representation, programming in prolog.

Hours per Week / Semester: 4 / summer		**Teaching Method:** Lecture and Tutorial
Credits: 6		**Examination:** 90 minute written examination
English language on demand:		
Lecture ☐	**Tutorial** ☐	**Written Exam** ☐, **Oral Exam** ☐

2.9 Information Systems in the Service Industry

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Basic Studies (1st – 3rd year)

E-Finance (ISDL-eFin-B) (Dr. Daniel Beimborn)

E-Finance

E-Finance is the electronic support of financial processes and transactions within and between organizations. This covers (1) all major business processes of the financial industry such as credit processing, payment transactions, and securities trading, (2) secondary financial processes of non-financial firms, such as cash management and financial chain management, and (3) B2B financial transactions, which are usually fulfilled by products and services of financial service providers via their networks.
Information technology is – besides human resources – the critical production factor in all of these processes. The focus of this module is to learn methods that help to shape efficient and effective IT usage within these processes. Main areas will be: types of information systems in financial processes and in the financial industry (such as transaction systems, production systems, CRM, expert systems (e.g. for risk analysis), trading platforms), outsourcing of financial business functions, operational risk management, inter-organizational IT infrastructures for payments and securities transactions, IT compliance in financial services, automation and integration of banking processes, algorithmic trading, and financial chain management in non-financial firms.

Hours per Week / Semester: 4 / summer		**Teaching Method:** Lecture and Tutorial
Credits: 6		**Examination:** 90 minute written examination
English language on demand:		
Lecture ☐	**Tutorial** ☐	**Written Exam** ☒, **Oral Exam** ☒

International Outsourcing Management (ISDL-IOM-B) (Dr. Daniel Beimborn)

International Outsourcing Management

IT outsourcing has become a very common practice in most industries. The whole IT function or parts of it are transferred to an external provider firm which subsequently delivers the IT function as service to the client firm. In this course, students learn the basic concepts of outsourcing and its different forms. As learning outcome, they will be able to evaluate benefits and risks of different IT outsourcing strategies, to plan outsourcing projects (outsourcing strategy, business case, operating models), and to conduct (contract management, outsourcing governance in terms of control, relationship management, and knowledge transfer). Particular emphasis will be put on international cross-border outsourcing such as transferring IT activities to Eastern European or Asian countries (nearshore and offshore outsourcing).

Hours per Week / Semester: 4 / summer		**Teaching Method:** Lecture and Tutorial
Credits: 6		**Examination:** 90 minute written examination
English language on demand:		
Lecture ☒	**Tutorial** ☒	**Written Exam** ☒, **Oral Exam** ☒

IT-Controlling (ISDL-ITCon-B)

IT-Controlling

"IT-Controlling" is the controlling of a firm's information technology (IT) and related resources in order to ensure their effective and efficient usage in terms of time, costs, and quality. IT-Controlling represents a comprehensive coordination function (planning, monitoring, control) for the value-oriented management of IT, including information and information systems (IS). The lecture will cover topics like IT/IS portfolio controlling, IT/IS project controlling, IT/IS product and service controlling, and IT infrastructure controlling. Besides a basic theoretical view on these topics relevant methods and tools that are used by firms to control their IT will be discussed and practiced (e.g., SWOT analysis, IT balanced scorecard, IT portfolio management, benefit and risk analysis, profitability analysis, business case calculation, IT activity-based costing, IT cost allocation).

Hours per Week / Semester: 4 / winter		**Teaching Method:** Lecture and Tutorial
6		**Examination:** 90 minute written examination
English language on demand:		
Lecture ☐	**Tutorial** ☐	**Written Exam** ☒, **Oral Exam** ☒

Advanced Studies (4th – 5th year)

Information Systems and Services I – Standards and Networks (ISDL-ISS-1-M)

Informationssysteme in Dienstleistungsbereichen I – Standards und Netzwerke

This module focuses on models and methods covering intra- and inter-organizational networks and on the necessity of standardization of information systems. Technical aspects of internal and external system integration as well as the economic impact of standards for information production and services lead to standardization problems which are one of the basic topics in the Information Systems discipline. The lecture will focus on the question of how standards can support the automation and inter-organizational integration of processes (i.e. technical aspects of integration; main application domain will be XML and electronic data interchange (EDI)). Furthermore, economic aspects of standardization are discussed like questions regarding the strategic problems of standardization and how economic and game-theoretical models can be used to solve standardization problems.

Hours per Week / Semester: 4 / winter	**Teaching Method:** Lecture and Tutorial
Credits: 6	**Examination:** 90 minute written examination
English language on demand:	

Lecture ☐	**Tutorial** ☐	**Written Exam** ☒, **Oral Exam** ☒

Information Systems and Services II – Optimization of IT-Reliant Processes (ISDL-ISS-2-M)

Informationssysteme in Dienstleistungsbereichen II – Optimierung IT-lastiger Geschäftsprozesse

This module focuses on approaches to optimizing business processes through efficient IT support. Typical primary and secondary processes of service delivery are examined, objectives and methods for optimization are introduced, and procedure models for optimal process design are discussed.

Main focus is on **Business Process Management (BPM)**. Design of business processes is one of the core competencies of IS professionals. Therefore, this lecture focuses on theories, models, tools, and methods of BPM, change management and business process standardization. These BPM concepts will be examined in more detail within the E-Finance, E-HR and Outsourcing sections. The objective is that students are able to design, standardize, manage and change business processes effectively and efficiently.

E-Finance: Financial processes can be generally considered as completely digitalizable and appear both as primary processes in the financial services industry and as secondary processes in all other firms. The lecture discusses how optimal IT usage can be attained in the financial service industry, which optimization potentials can be uncovered in the financial chain management of non-banks, and which re-structuring alternatives for the value chain by a "value chain crossing" are practical.

E-HR: The IT support of HR management processes is surprisingly low. Therefore, the status quo and additional possibilities for this typical secondary process will be

introduced. Particularly, a (partial) automation of the personnel selection process can be realized by employing recommender systems. The lecture will discuss enablers and inhibitors of IT usage in general and in HR in particular.

Sourcing: The questions of which services to be delivered, to where, and by whom, are strategic questions in a BPM context. Advantages and disadvantages, like economies of skill, scale, and scope, will be discussed and decision support models as well as "good practices" of business process outsourcing (BPO), along with problems and cultural barriers, will be examined.

Hours per Week / Semester: 4 / winter		**Teaching Method:** Lecture and Tutorial
Credits: 8		**Examination:** 90 minute written examination
English language on demand:		
Lecture ☒	**Tutorial** ☒	**Written Exam** ☒, **Oral Exam** ☒

Information Systems and Services III – IT Business Value (ISDL-ISS-3-M)

Informationssysteme in Dienstleistungsbereichen III – IT-Wertschöpfung

This module covers approaches for utilizing the human and technological IT resources in order to create business value and generate a competitive advantage. Basic IT issues like the IT paradox, IT strategy, IT governance, IT architecture, and IT assets and capabilities in general will be discussed. Using these concepts, practical guidelines for IT management will be illustrated with the help of several real world cases. Particularly in the services industry, IT represents a key production resource, and therefore, the main focus of this lecture will be on how to determine and how to influence the business value contribution of IT.
A main aspect for high effectiveness of IT is the alignment of business and IT both at strategic (goals, plans, ...) and at operational level (processes, services, ...). How can the interplay between business and IT units be put into effect? It will be shown that an effective application of IT is not primarily a technical problem (choosing the right technology and implementing the right systems) rather than the consideration of an IT/IS portfolio which ensures effective usage and high productivity in the context of particular supported business processes. Based upon this, key techniques for IT management and the valuation of information systems will be introduced.

Hours per Week / Semester: 4 / summer		**Teaching Method:** Lecture and Tutorial
Credits: 8		**Examination:** 90 minutes written examination
English language on demand:		
Lecture ☒	**Tutorial** ☒	**Written Exam** ☒, **Oral Exam** ☒

Seminar

The seminar in Information Systems and Services incorporates three kinds of academic work: seminar thesis, presentation, and discussion. In each semester, the seminar is focused on a topical issue within the research field of Information Systems such as Role of the CIO, Change Management, Outsourcing, Service-oriented Architectures, or

Knowledge and Information Management. The specific seminar topic is published at the beginning of each semester.

Hours per Week / Semester: 2 / winter	**Teaching Method:** Seminar
Credits: 3	**Examination:** Essay (12 pages), presentation, continuous assessment
English language on demand ☐	

SOA Governance and Evaluation (ISDL-SOA) (Dr. Jochen Malinowski)

SOA-Governance and Evaluation

This module deals with the design, implementation, and testing of service-oriented architectures (SOA), as well as with how to set up an effective SOA governance. The lecture combines theoretical information, real life examples from practice and several exercises to enhance the learning experience and leave the participants with an understanding what SOA and SOA governance means when put in practice.
Service-oriented architectures are seen by many people as the gateway to achieve improvements in IT solution development. However, SOA is more than just a new approach to how IT systems are linked together. It calls for a radically different approach to IT governance.
Research shows that while many companies' IT organizations are well on the way to adopting SOA capabilities, many find their progress slowed by big questions about who now owns the business services – and who controls them. IT leaders are learning that if they are to achieve high performance with an SOA strategy and implementation, they must update and extend their IT governance structures so they provide guidance for the development and maintenance needs unique to SOA. SOA governance supports more efficient management of the overall SOA journey. Just as important, such governance supports better ways of funding, managing and operating the IT organization in support of SOA implementation.

Hours per Week / Semester: 2 / winter		**Teaching Method:** Lecture and Tutorial
Credits: 3		**Examination:** 90 minute written examination
English language on demand:		
Lecture ☒	**Tutorial** ☒	**Written Exam** ☒, **Oral Exam** ☒

Management of external IT Service Providers (ISDL-MED-B) (Dr. Wolfgang Bremer)

Management of external IT Service Providers

This module imparts basic knowledge and conditions for outsourcing intentions in enterprises. Attendees is given an overview on elementary aspects of outsourcing decisions and their practical relevance for cooperating with IT service providers. The module is strongly practically oriented and demands an active participation of the students.

Outsourcing IT tasks is common practice in many companies. Thereby, the outsourcer resp. the client company is motivated by both cost reasons and a focus on core competencies. Until a few years ago, the outsourcing market was mainly characterized by large scale enterprises on the provider as well as on the client side. Today, however, highly diverse delivery models can be observed. Labeled, for instance, “Cloud”, “Software-as-a-Service” or “On-Demand”, outsourcing becomes more and more important for small and medium-sized enterprises (SME) as well. This module addresses the wide range of IT outsourcing possibilities in a structured way and reveals courses of action and control mechanisms for client companies. A core section is about the IT supplier lifecycle: From the initiation of a new IT supplier relationship to its ongoing management and monitoring/controlling to its possible termination and the subsequent shift to another IT service provider, a wide range of feasible instruments, documents, and decision-making procedures are discussed. At that, the legal form of the outsourcing contracts, from which rights and obligations of the client and the IT service provider follow, plays a special role. Moreover, with regard to IS nearshoring and offshoring, cultural aspects and specificities concerning the geographic distance of IT outsourcing relationships will be revealed. The module concludes with the benchmarking of outsourcing performance, i.e., the regular assessment of the provider’s market-conform service provision.

<table>
<tr><td>Hours per Week / Semester:
2 / summer</td><td colspan="2">Teaching Method:
Lecture and Tutorial</td></tr>
<tr><td>3</td><td colspan="2">Examination:
90 minute written examination</td></tr>
<tr><td colspan="3">English language on demand:</td></tr>
<tr><td>Lecture ☒</td><td>Tutorial ☒</td><td>Written Exam ☒, Oral Exam ☒</td></tr>
</table>

2.10 Practical Computer Science (Distributed Systems)

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Basic Studies (Bachelor level, 1st – 3rd year)

Introduction to Computer Science (DSG-EiAPS-B/DSG-EiRBS-B)

Introduction to Computer Science is a combined module organized as a 2 semester course which introduces CS from the perspective of algorithms and programming (DSG-EiAPS-B) as well as from a systems perspective (DSG-EiRBS-B). As a basic course there are no prerequisites. Students may start with either course depending of their start in winter term where DSG-EiAPS-B is offered regularly or in summer term where DSG-EiRBS-B is offered regularly. The examination covers both courses and is offered after each semester (for details of the courses see below.)

Hours per Week / Semester: 3 /winter + 3/summer	**Teaching Method:** Lectures (2) and tutorials (1) for each of the two semesters
Credits: 9	**Examination:** 120 Minutes written examination about topics from both courses
English language on demand:	
Lecture ☐	**Tutorial** ☐	**Written Exam** ☐, **Oral Exam** ☒

Introduction to Computer Science (DSG-EiAPS-B)

Einführung in Algorithmen, Programmierung und Softwaretechnik
Introduction to Algorithms, Programming and Software Technology

Prerequisites: - none - This course requires no basic a priori knowledge in programming languages or computer systems and may be chosen as a first course in computer science.

Objective: To provide students with a basic understanding of and an overview about the principles of computer science with an emphasis on algorithms, programming and

software development in an imperative and object-oriented paradigm. Students should be able to apply basic abstraction and representation techniques and should know about the concepts of specification, implementation and correctness as well as syntax and semantics in the context of programming languages. Students gain practical experience with these concepts and techniques by programming in Java. Students should be able to develop small programs for simple problems on their own using the correct choice of data and control structures as provided by the Java programming language. Moreover, students should be familiar with the different steps involved in developing programs and should be able to use common tools (editor, compiler, documentation, libraries) needed when programming.

Contents: The course offers a first introduction in computer science from the programming perspective. The topics discussed include the correspondences between information representation, interpretation and manipulation, syntax and semantics, problem classes and instances, design of algorithms and their implementation via programs, declarative specification vs. algorithmic implementation, data abstraction and functional abstraction as well as the basics of object-orientation. Most of these topics are discussed in the context of the Java programming language. Students are required to use the concepts discussed in designing and implementing small programs in Java. Hence, the course also discusses the main concepts of Java as an enabling technology for object-oriented Programming in the Small and introduces to the abstraction and structuring techniques offered by Java like, e.g. interfaces, abstract classes, inheritance and implementation relations, polymorphic typing, packages and visibility rules..

Literature:

1. Barbara Liskov with John Guttag: Program Development in Java. Addison-Wesley, 2001
2. Bert Bates, Kathy Sierra: Head First Java. O'Reilly, 2005 (2nd)
3. Timothy Budd: An Introduction to Object-Oriented Programming, Pearson/Addison Wesley, 2002 (3rd)
4. John Lewis, Joseph Chase: Java Software Structures. Pearson/Addison-Wesley, 2010 (3rd)

Organization: The course is organized in lectures discussing the main concepts and labs offering practical programming experience for the different aspects of the course. Participants are assumed to work on assignments (specification and programming) throughout the term.

Hours per Week / Semester: 3 / winter		**Teaching Method:** Lectures (2) and tutorials (1)
Credits: See module description		**Examination:** See module description
English language on demand:		
Lecture ☐	**Tutorial** ☐	**Written Exam** ☐, **Oral Exam** ☒

Introduction to Computer Science (DSG-EiRBS-B)

Einführung in Rechner- und Betriebssysteme
Introduction to Computer Architecture and Operating Systems

Prerequisites: - none -

This course requires no basic a priori knowledge in programming languages or computer systems and may be chosen as a first course in computer science.

Objective: To provide students with a basic understanding of systems, esp. computer-based systems, in general. Students should be able to apply basic abstraction and modelling techniques to simple systems and understand the interdependencies between system structure and system behaviour. Students know about the basic mechanisms working in computer systems in general and understand the principles underlying modern hardware architectures and operating systems. Students should be aware of the interdependencies between hardware and operating systems issues.

Contents: The course discusses simple notions of system structure and behaviour. These are made more concrete by discussing hardware architectures and operating systems. The stepwise development of hardware from basics like Boolean algebra to the implementation of circuits and registers provides the basis for understanding the von-Neumann architecture and more advanced modern RISC and CISC computers using parallelism and pipelining. Additionally, the basic principles of system software (synchronisation and scheduling of processes and resources, virtual memory techniques, file systems etc.) as used in modern operating systems like Windows and Unix-Derivates are discussed. The course puts its emphasis on aspects required to understand and evaluate modern hardware/software systems and discusses the relationship between hardware and system software issues.

Literature:

1. Andrew S. Tanenbaum: *Structured Computer Organization*. Prentice Hall, 2006 (5th)
2. Douglas E. Comer: *Essentials of Computer Architecture*. Pearson/Prentice Hall, 2005(1st)
3. Silberschatz, A./Gagne, G./Galvin, P. B.: Operating Systems Concepts Essentials. John Wiley and Sons, 2010 (8th)
4. Andrew S. Tanenbaum: *Modern Operating Systems*. Prentice-Hall 2007 (3rd)
5. Murdocca, M./Heuring, V.P.: Computer Architecture and Organization. Prentice Hall 2007 (1st)

Organization: The course is organized in lectures discussing the main concepts and labs offering practical experience through exercises for the different aspects of the course.

Hours per Week / Semester: 3 / winter		**Teaching Method:** Lectures (2) and tutorials (1)
Credits: See module description		**Examination:** See module description
English language on demand:		
Lecture ☐	**Tutorial** ☐	**Written Exam** ☐, **Oral Exam** ☒

Introduction to Distributed Systems (DSG-EiDistrSys)

Einführung in Verteilte Systeme

Prerequisites: A basic understanding of computer systems and operating systems at least as it is offered by the module *Introduction to Computer Science (DSG-EiAPS-B/ DSG-EiRBS-B)* is required as well as additional experience in Java programming and basic skills in software engineering.

Objective: To expose students to the problems involved in designing and programming parallel and distributed applications. Students should gain an in-depth understanding of the most important system structures and programming paradigms used in the context of distributed and mobile systems.

Contents: The course gives an introduction into the characteristics and most important applications of distributed systems, discusses the technical basics as well as typical distributed algorithms and provides a first overview over state-of-the-art middleware systems:
(1) Introduction: characteristics, pros/cons, typical applications;
(2) Basics and Technological Background: states, events, processes, non-determinism, concurrency, dependencies, cooperation vs. competition, deadlocks, fairness, starvation; classification of computer architectures, static and dynamic computer networks, operating system issues, tasks and threads
(3) Interaction Paradigms: Heterogeneous systems and protocols, shared vs. distributed memory, message passing: ports, channels, mailboxes, synchronous vs. asynchronous; Client/Server: RPC, naming, binding, protocols, parameter handling, error handling semantics, call backs; Group communication: broadcast and multicast, group management, semantics issues; LINDA coordination. Throughout this chapter, practical issues using Java are handled in assignments: Threads, synchronization, socket communication (stream and datagram), Java RMI, transaction processing;
(4) Basic Distributed Algorithms: real and logical time in distributed systems, message ordering, distributed mutual exclusion, termination and deadlock detection, consistent global snapshots, agreement protocols;
(5) Distributed Middleware: (sketch): single-system image, failure tolerant systems, replication of active and passive components, consistency issues, short overview of state-of-the-art middleware systems

Literature

1. Andrew S. Tanenbaum, Marten van Steen: *Distributed Systems*, Prentice Hall 2006 (2^{nd})
2. George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair: Distributed Systems. Pearson Education UK 2011 (5^{th})

Organization: The course is offered each summer term, consists of 2 hours lecture and 2 hours tutorial/lab each week. Participants are assumed to work on 2-3 programming assignments throughout the term.

Note: This course is available for bachelor as well as master students.

Hours per Week / Semester: 4/summer		**Teaching Method:** Lectures (2) and tutorials (2)
Credits: 6		**Examination:** Graded assignments and oral examination (20 minutes)
English language on demand:		
Lecture ☒	**Tutorial** ☒	**Written Exam** ☐, **Oral Exam** ☒

Advanced Studies (Master level, 3rd – 5th year)

Service-Oriented Architecture and Web Services (DSG-SOA-M)

Prerequisites: A basic understanding of distributed systems as it is offered, e.g., by the course *Introduction to Distributed Systems (DSG-EiDistrSys)* (basic studies), as well as additional experience in Java programming and basic skills in software engineering.

Objective: To introduce students to the basic ideas, benefits, technologies and issues related to Service-Oriented Architectures and their implementation inside enterprises (EAI) as well as in the context of Business-to-Business integration (B2Bi) between different enterprises. Students know about the different aspects of service-oriented architectures and their practical use. Students are able to design and implement SOAs from scratch as well as in the context of integrating legacy systems. Students can apply standard web service technology and are familiar with quality of service issues and solutions in this context.

Contents: The course gives an introduction into the characteristics and most important applications of service-oriented systems:

- Basics: It's all about middleware - so, what is middleware ?
- SOA - what's it all about? SOA as an architectural means;
- Webservice Architecture Standards
    - Architectural Model
    - Basic Standards and WebService Stack
        - HTTP, XML and SOAP
        - WebService Description Language (WSDL)
        - Registries, e.g. UDDI and ebXML registry
    - When and how to use WebServices
- Approaches to Coordination and Orchestration
    - From simple services to complex processes
    - Choreography vs. Orchestration: WS-BPEL, WS-CDL, ebXML ebBP (BPSS); Comparison of Approaches
    - Expressiveness of Business process description languages
- Additional WS-* standards state-of-the-art: Reliable Messaging, Security, Coordination, Atomic Transactions, Business activities, Addressing, Negotiation
- Advanced issues: SOA for EAI and B2Bi

Literature: This is a fast emerging field with new insights every year. So, up-to-date literature will be provided at the beginning of each course.

Organization: The course is offered each summer term, consists of2 hours lecture and 2 hour tutorial/lab each week. Participants are assumed to work on 2 programming assignments throughout the term.

Hours per Week / Semester: 4/summer	**Teaching Method:** Lectures (2) and tutorials (2)
Credits: 6	**Examination:** Graded Assignments and oral examination (20 minutes)
English language	
Lecture ☒	**Tutorial** ☒	**Written Exam** ☐, **Oral Exam** ☒

Distributed Systems Architecture and Middleware (DSG-DSAM-M)

Prerequisites: A basic understanding of distributed systems as it is offered, e.g., by the course *Introduction to Distributed Systems (DSG-EiDistrSys)* (basic studies), as well as additional experience in Java programming and basic skills in software engineering.

Objective: To introduce students to the basic ideas, benefits, technologies and issues related to server-centric distributed systems and middleware in general. Students are able to evaluate, plan, design and implement server-centric distributed systems using up-to-date technology. Students are familiar with recent approaches and standards for building and managing such systems, know about the central problems involved as well as ways to overcome these issues. Students have hands-on experience with up-to-date middleware and tools for building server-centric systems.

Contents: The course introduces and discusses in-depth topics concerning distributed middleware and its practical use:
- Middleware: Motivation, Classification, typical usage scenarios
- Comparison of different architectural approaches
- Interoperability: Standards and Challenges
- Components and Component Models, Container architectures
- Server-centered middleware; Enterprise Service Bus Concepts
- Enterprise Application Integration (EAI), Integration Architectures
- Practical Experience: CORBA, EJB, JCA, .NET, ..., SCA, OSGI (selection)

Literature: This is a fast emerging field with new insights every year. So, up-to-date literature will be provided at the beginning of each course.

Organization: The course is offered each winter term, consists of 2 hours lecture and 2 hour tutorial/lab each week. Participants are assumed to work on 2-3 programming assignments throughout the term.

Hours per Week / Semester: 4/winter	**Teaching Method:** Lectures (2) and tutorials (2)
Credits: 6	**Examination:** Graded Assignments and oral examination (20 minutes)
English language	
Lecture ☒	**Tutorial** ☒	**Written Exam** ☐, **Oral Exam** ☒

Selected Readings in Distributed Systems (DSG-SRDS-M)

Prerequisites: A basic understanding of distributed systems as it is offered, e.g., by the course *Introduction to Distributed Systems (DSG-EiDistrSys-B)* (basic studies), as well as a deeper insight in middleware or SOA issues as offered, e.g., by one of the courses DSG-SOA-M/DSG-DSAM-M or comparable knowledge from similar courses or private studies (concrete prerequisite depends on special topic of each selected reading course; if you are in doubt, please contact the lecturer)

Objective: To introduce students to the field of research methods and topics that are state-of-the-art in the area of complex distributed systems. Students will learn how to read and work on recent research papers and how to present their essence as an outline talk to colleguages (students). Students will be able to classify and compare results from papers in the context of a specific research question. Moreover, students will become proficient in the developments of the specialized research area that is the topic of the particular course.

Contents: The course discusses special research topics around SOA and Middleware in-depth.

Literature: Topics change from term to term every year. So, up-to-date literature will be provided at the beginning of each course.

Organization: The course is offered each term, consists of 2 hours class each week. Participants are assumed to read papers, present and discuss research papers in a research lab like setting throughout the term.

Note: As there is almost each term a new special topic, it is possible to enroll in this course more than once; for specific advice please contact the lecturer.

Hours per Week / Semester: 2/winter and summer	**Teaching Method:** Introduction lectures and presentation/discussion meetings
Credits: 3	**Examination:** oral examination (20 minutes)
English language ☒	

Distributed and Mobile Software Project (DSG-Project-M)

Requirements: A basic understanding of distributed systems as it is offered, e.g., by the course *Introduction to Distributed Systems (DSG-EiDistrSys)* (basic studies), as well as a deeper insight in middleware or SOA issues as offered, e.g., by one of the courses DSG-SOA-M/DSG-DSAM-M or comparable knowledge from similar courses or private studies (concrete prerequisite depends on special topic of each selected reading course; if you are in doubt, please contact the lecturer)

Objective: To gain an in-depth understanding of the practical problems related to distributed programming and software projects using multi-vendor middleware platforms. To apply theoretical concepts of distributed and mobile systems when designing, implementing and testing distributed software.

Contents: After a short introduction in (typically) a middleware system like CORBA, Java-related technology, .NET, SOA, SCA, etc., students work in cooperating and/or concurring groups on a mid-size distributed software project continuously over the 7 weeks.

Hours per Week / Semester: 6 (in between terms: Aug..-Oct.)	**Teaching Method:** Guided Project (working in groups)
Credits: 9	**Examination:** Short presentations of technical topics used for the project, presentation of the final results: software architecture, demonstration, handbook, lessons learned; production of a poster summarizing the project and its outcome. *part* of final oral examination (20 minutes)
English language on demand ☒	

2.11 Human-Computer Interaction

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General Information:

All teaching material and background literature of the HCI group is available in English; teaching and presentations in any course as well as Bachelor's and Master's theses are offered in English on demand.

Basic Studies (Bachelor level, 1st – 3rd year)

Interactive Systems (HCI-IS-B)

Interaktive Systeme

The aim of this module is a general introduction to fundamental paradigms, concepts, and principles of user interface design. The primary focus is on the conceptual design, the implementation, and the evaluation of interactive systems.

In the lecture the following topics are covered:
- Introduction to the design of user interfaces
- Human factors
- Technological factors
- Interaction, design, prototyping, and implementation
- Evaluation of interactive systems
- Design process of interactive systems
- Interactive systems in a broader context and related topics

The course is based on a compilation of different sources; as additional sources and as a reference are recommended:
- Preece, J., Rogers, Y. and Sharp, H. Interaction Design: Beyond Human-Computer Interaction. Wiley, New York, NY, 3rd Edition, 2011.
- Dix, A., Finlay, J., Abowd, G.D. and Beale, R. Human-Computer Interaction. Pearson, Englewood Cliffs, NJ, 3rd Edition, 2004.

Prerequisites:

Basic knowledge in computer science to the extent of an introduction to computer science

Hours per Week / Semester: 4 / winter	**Teaching Method:** Lectures and Tutorials
Credits: 6	**Examination:** 90 minutes written examination
English language on demand:	
Lecture ☒	**Tutorial** ☒	**Written Exam** ☒, **Oral Exam** ☐

Project Human-Computer Interaction (HCI-Proj-B)

Projekt Mensch-Computer-Interaktion

Based on the knowledge and skills obtained in the human-computer interaction lectures and tutorials a group of students will develop a small prototype based on current research topics. Central to this project is the development of skills regarding the implementation of systems as well as competencies regarding project management and teamwork.

The project covers diverse topics based on the contents of the courses. The project task is significantly more comprehensive then the normal assignments accompanying the lectures and is therefore solved in a small group. The results of the project will be documented and demonstrated in a final presentation.

Prerequisites:

Algorithms and Data Structures (MI-AuD-B) and Interactive Systems (HCI-IS-B)

Hours per Week / Semester: 4 / winter	**Teaching Method:** Project
Credits: 6	**Examination:** Ca. 30 minutes Colloquium (as well as documentation of the system and development process)
English language on demand ☒	

Project Usability in Practice (HCI-Proj-Usab)

Projekt Usability in der Praxis

In this project the knowledge and skills obtained in the human-computer interaction lectures and assignments are applied in practice. Based on real use cases from industry contexts students will analyse the usability of existing concepts and systems and gather requirements for innovative concepts. Central to this project is the development of skills regarding the practical application of methods as well as competencies regarding project management and teamwork.
The project covers diverse topics form human-computer interaction that are cooperatively solved with companies. The project typically ranges from specifying challenges to selecting and applying methods as well as analysing the captured data to deriving conclusions. The project task is significantly more comprehensive then the normal assignments accompanying the lectures and therefore is solved in a small group. The result of the project will be documented and demonstrated in a final presentation.

Prerequisites:

Interactive Systems (HCI-IS-B)

Hours per Week / Semester: 4 / winter, summer	**Teaching Method:** Project
Credits: 6	**Examination:** Ca. 30 minutes Colloquium (as well as documentation of the development process and project results)
English language on demand ☒	

Ubiquitous Systems (HCI-US)

Ubiquitäre Systeme

The aim of this module is to teach advanced knowledge and skills in the area of ubiquitous systems as well as a broad theoretical and practical methodological expertise concerned with the design, conception and evaluation of ubiquitous systems. Students of this course learn the relevant literature and systems in breadth and depth and should be able to critically review new literature and systems.

The lecture gives an introduction to the subject of Ubiquitous Computing—that is, the paradigm of invisible computing, with computers embedded into everyday objects that act as client and server and communicate with each other—and includes the following conceptual, technical and methodological topics:

- Basic concepts
- Base technology and infrastructures
- Ubiquitous systems and prototypes
- Context awareness
- User interaction
- Ubiquitous systems in a broader context and related topics

The course is based on a compilation of different sources; as additional sources and as a reference are recommended:

- Krumm, J. (Ed.). Ubiquitous Computing Fundamentals. Taylor & Francis Group, Boca Raton, FL, 2010.

Prerequisites:

Algorithms and Data Structures (MI-AuD-B) and Introduction to computer science (DSG-EidI-B)

Hours per Week / Semester: 4 / winter		**Teaching Method:** Lectures and Tutorials
Credits: 6		**Examination:** 90 minutes written examination
English language on demand:		
Lecture ☒	**Tutorial** ☒	**Written Exam** ☒, **Oral Exam** ☐

Cooperative Systems (HCI-KS-B)

Kooperative Systeme

The aim of this module is to teach advanced paradigms and concepts of computer-supported cooperative work (CSCW) and the resulting design principles and prototypes. Hereby a broad perspective on the topic is applied; accordingly, a central concern is the general technological support of social interaction, spanning cooperative work and learning as well as leisure activities.

After an introduction to the subject the following topics are covered in the lecture:
- Basic concepts
- Technological support for mutual awareness, communication, coordination, collaboration, and online communities
- Analysis of cooperative environments
- Design of CSCW and groupware systems
- Implementation of CSCW and groupware systems
- CSCW in a broader context and related topics

The course is based on a compilation of different sources; as additional sources and as a reference are recommended:
- Gross, T. and Koch, M. Computer-Supported Cooperative Work (Computer-Supported Cooperative Work; in German). Oldenbourg, Munich, 2007.
- Borghoff, U.M. and Schlichter, J.H. Computer-Supported Cooperative Work: Introduction to Distributed Applications. Springer-Verlag, Heidelberg, 2000.

Prerequisites:

Basic knowledge in computer science to the extent of an introduction to computer science as well as programming skills in Java.

Hours per Week / Semester: 4 / summer		**Teaching Method:** Lectures and Tutorials
Credits: 6		**Examination:** 90 minutes written examination
English language on demand:		
Lecture ☒	**Tutorial** ☒	**Written Exam** ☒, **Oral Exam** ☐

Bachelor-Seminar Human-Computer Interaction (HCI-Sem-B)

Bachelor-Seminar Mensch-Computer-Interaktion

The aim of this course is the acquisition of abilities to do research and presentation of topics in the filed of human-computer interaction on basis of the existing literature. The focus lies on the development of skills that allow to critically and systematically review literature and to give presentations.

Based on the knowledge and skills obtained in the human-computer interaction lectures and assignments varying, current research topics are discussed in this seminar. Thereby, aspects of several courses are of relevance.

Prerequisites:

Interactive Systems (HCI-IS-B)

Hours per Week / Semester: 2 / summer	**Teaching Method:** Seminar
Credits: 3	**Examination:** Essay, presentation, continuous assessment
English language on demand ☒	

Advanced Studies (Master level, 3rd – 5th year)

Project Usability in Practice (HCI-Proj-Usab)

Projekt Usability in der Praxis

In this project the knowledge and skills obtained in the human-computer interaction lectures and assignments are applied in practice. Based on real use cases from industry contexts students will analyse the usability of existing concepts and systems and gather requirements for innovative concepts. Central to this project is the development of skills regarding the practical application of methods as well as competencies regarding project management and teamwork.

The project covers diverse topics form human-computer interaction that are cooperatively solved with companies. The project typically ranges from specifying challenges to selecting and applying methods as well as analysing the captured data to deriving conclusions. The project task is significantly more comprehensive then the normal assignments accompanying the lectures and therefore is solved in a small group. The result of the project will be documented and demonstrated in a final presentation.

Prerequisites:

Interactive Systems (HCI-IS-B)

Hours per Week / Semester: 4 / winter, summer	**Teaching Method:** Project
Credits: 6	**Examination:** Ca. 30 minutes Colloquium (as well as documentation of the development process and project results)
English language on demand ☒	

Ubiquitous Systems (HCI-US)

Ubiquitäre Systeme

The aim of this module is to teach advanced knowledge and skills in the area of ubiquitous systems as well as a broad theoretical and practical methodological expertise concerned with the design, conception and evaluation of ubiquitous systems. Students of this course learn the relevant literature and systems in breadth and depth and should be able to critically review new literature and systems.

The lecture gives an introduction to the subject of Ubiquitous Computing—that is, the paradigm of invisible computing, with computers embedded into everyday objects that act as client and server and communicate with each other—and includes the following conceptual, technical and methodological topics:

- Basic concepts
- Base technology and infrastructures
- Ubiquitous systems and prototypes
- Context awareness
- User interaction
- Ubiquitous systems in a broader context and related topics

The course is based on a compilation of different sources; as additional sources and as a reference are recommended:

- Krumm, J. (Ed.). Ubiquitous Computing Fundamentals. Taylor & Francis Group, Boca Raton, FL, 2010.

Prerequisites:

Algorithms and Data Structures (MI-AuD-B) and Introduction to computer science (DSG-EidI-B)

Hours per Week / Semester: 4 / winter		**Teaching Method:** Lectures and Tutorials
Credits: 6		**Examination:** 90 minutes written examination
English language on demand:		
Lecture ☒	**Tutorial** ☒	**Written Exam** ☒, **Oral Exam** ☐

Master-Seminar Human-Computer Interaction (HCI-Sem-M)

Master-Seminar Mensch-Computer-Interaktion

The aim of this course is the acquisition of abilities to do independent research as well as the presentation of topics in the filed of human-computer interaction based on existing literature. The focus lies on the development of skills that allow to critically and systematically review literature in order to develop and present of one's own perspective.

The seminar is concerned with topics on current concepts, technologies, and tools of human-computer interaction.

Hours per Week / Semester: 2 / winter	**Teaching Method:** Seminar
Credits: 3	**Examination:** Essay, presentation, continuous assessment
English language on demand ☒	

Human-Computer Interaction (HCI-MCI-M)

Mensch-Computer-Interaktion

The aim of this module is to teach advanced knowledge and skills in the area of human-computer interaction as well as a broad theoretical and practical methodological expertise concerned with the design, conception, and evaluation of ubiquitous systems. Students of this course learn relevant literature and systems in breadth and depth and are later able to critically review new literature and systems.

After an introduction into the subject the following topics are covered in the lecture:
- Mobile human-computer interaction
- Adaptivity and adaptibility
- Information visualisation
- Tangible user interaction
- Usability engineering
- Usability and economics

The course is based on a compilation of different sources; as additional sources and as a reference are recommended:
- Jacko, J.A. and Sears, A., (Eds.). Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies, and Emerging Applications. Lawrence Erlbaum, Hillsdale, NJ, 2002.
- Hammond, J., Gross, T. and Wesson, J., (Eds.). Usability: Gaining a Competitive Edge. Kluwer Academic Publishers, Dordrecht, 2002.

Prerequisites:

Algorithms and Data Structures (MI-AuD-B) and Introduction to computer science (DSG-EidI-B)

Hours per Week / Semester: 4 / summer		**Teaching Method:** Lectures and Tutorials
Credits: 6		**Examination:** 90 minutes written examination
English language on demand:		
Lecture ☒	**Tutorial** ☒	**Written Exam** ☒, **Oral Exam** ☐

Master-Seminar Human-Centred Computing (HCI-Sem-HCC-M)

Master-Seminar Human-Centred Computing

The aim of this course is the acquisition of abilities that allow the independent research and presentation of topics in the filed of human-computer interaction on basis of the existing literature. The focus lies on the development of skills that allow to critically and systematically review literature in order to develop and present of an own perspective.

The seminar is concerned with novel research methods in the fields of human-computer interaction, computer-supported cooperative work, and ubiquitous computing.

Hours per Week / Semester: 2 / summer	**Teaching Method:** Seminar
Credits: 3	**Examination:** Essay, presentation, continuous assessment
English language on demand ☒	

Project Human-Computer Interaction (HCI-Proj-M)

Projektpraktikum Mensch-Computer-Interaktion

Based on the knowledge and skills obtained in the human-computer interaction lectures and assignments, a group of students develops a small prototype based on current research topics. Central to this project is the development of skills regarding the implementation of systems as well as competencies regarding project management and teamwork. Through the complexity of the task and the direct relation to on-going research at the human-computer interaction group this project is significantly different from the projects at Bachelor's level.

The project will cover varying topics based on the contents of the courses. As normally the aspects of several courses are relevant, teams of students that have visited different courses will supplement each other. The project task is significantly more comprehensive then the normal assignments accompanying the lectures and therefore is solved in a small group. The result of the project will be documented and demonstrated in a final presentation.

Prerequisites:

Algorithms and Data Structures (MI-AuD-B)

Hours per Week / Semester: 4 / summer	**Teaching Method:** Project
Credits: 6	**Examination:** Ca. 30 minutes Colloquium (as well as documentation of the system and development process)
English language on demand ☒	

2.12 Social Networks

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Advanced Studies (4th - 5th year)

Information and Knowledge Management (SNA-IWM-B)

Informations- und Wissensmanagement

Business information systems can be interpreted as the nervous system of an enterprise in analogy to the nervous system of an organism. The information management of an enterprise has the function to specify, to build and to operate the business information system according to the business objectives. Knowledge management completes the information management in management of human knowledge and the computer supported representation and processing of knowledge. This module deals with tasks and methods of information management as well as knowledge management and derives necessary characteristics of the appropriate resources from them.

Hours per Week / Semester: 4 / summer	**Teaching Method:** Lecture and Tutorial
Credits: 6	**Examination:** 90 minutes written examination
English language on demand:	
Lecture ☐	**Tutorial** ☐	**Written Exam** ☒, **Oral Exam** ☐

Social Network Analysis (SNA-ASN-B)

Analyse sozialer Netzwerke

Social network analysis focuses on relationships between or among social entities. This course presents an introduction to various concepts, methods, and applications of social network analysis. The primary focus of these methods is the analysis of relational data measured on populations of social actors. Topics include an introduction to graph theory and the use of directed graphs and matrices to study actor interrelations; structural and locational properties of actors, such as centrality, prestige, and prominence; subgroups and cliques; equivalence of actors, including structural equivalence and, blockmodels;

local analyses, including dyadic and triad analysis; and introduction to statistical global analyses, using models such as p* and their relatives. Methods are illustrated on a wide range of social network examples using both standard social network analysis software and special purpose computer programs.

Hours per Week / Semester: 4 / winter	**Teaching Method:** Lecture and Tutorial
Credits: 6	**Examination:** 90 minutes written examination
English language on demand:	
Lecture ☐	**Tutorial** ☐	**Written Exam** ☒, **Oral Exam** ☐

Theories of Social Networks (SNA-NET-B)

Netzwerktheorie

Individuals and technology shape and are shaped by organizations. Individuals and organizations are also affected by sets of interlinked networks linking people, technology, organizations, knowledge and resources. In this world of networks and organizations, how do coordination, communication, power, tasks, goals, and information interact to affect group and organizational behavior and the impact of information technology on this behavior? How do we conceptualize, measure, and evaluate organizations and networks? How do we evaluate the impact of policies and technology on these organizations and networks especially given the fact that organizations and networks are dynamic?
This course provides an overview of the dominant perspectives on organizations and networks from a macro perspective. Topics covered include knowledge management, organizational design, organizational learning, organizational evolution and population ecology, organizational culture, organizations as complex systems, social and organizational networks, and dynamic network analysis.

Hours per Week / Semester: 4 / summer	**Teaching Method:** Lecture and Tutorial
Credits: 6	**Examination:** 90 minutes written examination
English language on demand:	
Lecture ☐	**Tutorial** ☐	**Written Exam** ☒, **Oral Exam** ☐

SNA Seminar

Seminars are offered regularly on varying topics, both in the winter and summer semesters. The seminars are usually advertised at the beginning of each semester. Seminars will be held in English if needed.

Hours per Week / Semester: 2 / winter, summer	**Teaching Method:** Seminar
Credits: 3	**Examination:** Essay, presentation, continuous assessment
English language on demand ☐	