Course Handbook Computer Science and Communication Systems Master

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Head of Studies	Prof. Dr. Markus Esch
Deputy Head of Studies	Prof. Dr. Horst Wieker
Chairman of Examination	Prof. Dr. Horst Wieker
Deputy Chairman of Examination	Prof. Dr. Thomas Kretschmer

Computer Science and Communication Systems Master - mandatory courses (overview)

Module name (EN)	**Code**	**Semester**	**Hours per semester week / Teaching method**	**ECTS**	**Module coordinator**
Business Cases in the Telecommunications Sector	KI845	2	2V	2	Prof. Dr. Horst Wieker
Distributed Application Architectures	KI705	1	3V+1P	5	Prof. Dr. Markus Esch
Formal Methods in Telecommunications	KI715	1	2V+2U	5	Prof. Dr. Reinhard Brocks
Higher Mathematics 1	KI735	1	2V	3	Prof. Dr. Barbara Grabowski
Higher Mathematics 2	KI835	2	2V	3	Prof. Dr. Barbara Grabowski

Human Resource and Corporate Management	KI825	2	2V	2	Prof. Dr.-Ing. André Miede
IT, Telecommunications and the Law	KI830	2	2V	2	RA Cordula Hildebrandt
Master Thesis	KI1000	4	- international course	27	Prof. Dr. Damian Weber
Network Architectures	KI810	2	4V	5	Prof. Dr. Horst Wieker
Project Management	KI840	2	2V	2	Dipl.-Ing. Michael Sauer
Protocols in Public and Private Networks	KI720	1	4V	5	Prof. Dr. Horst Wieker
Security and Cryptography	KI725	1	3V+1U	5	Prof. Dr. Damian Weber
Software Development for Communication Networks	KI820	2	4P	6	Prof. Dr. Reinhard Brocks
Study Project or Industrial Placement	KI900	3	- international course	20	Prof. Dr. Damian Weber
Theoretical Informatics	KI710	1	4V	5	Prof. Dr. Thomas Kretschmer

(15 modules)

Computer Science and Communication Systems Master - optional courses (overview)

Module name (EN)	Code	Semester	Hours per semester week / Teaching method	ECTS	Module coordinator
Advanced Presentation and Writing Skills for ICT Studies	KI837	1	2V	3	Prof. Dr. Christine Sick
Algorithms and Complexity	KI745	1	4V	5	Prof. Dave Swayne
Astronomy Seminar	KI752	1	1V+1PA international course	2	Prof. Dr. Martin Löffler-Mang
Automotive Engineering	KI851	2	2V+2P	5	Prof. Dr. Horst Wieker
Automotive Technology and Vehicle Telematics Systems	KI738	1	4V	5	Prof. Dr. Horst Wieker
Bioinformatics	KI850	2	4V	5	Prof. Dr. Barbara Grabowski
Building Systems Technology	KI741	1	4V	6	Prof. Dr. Michael Igel
Business Computing	KI856	2	2V+2U	6	Prof. Dr.-Ing. André Miede
Content Management Systems	KI743	1	2V+2PA	5	Dipl.-Inform. Roman Jansen-Winkeln

Cryptography Project	KI750	1	4PA	6	Prof. Dr. Damian Weber
Discrete Mathematics	KI873	2	3V+1U	6	Prof. Dr. Peter Birkner
Distribution Logistics	KI847	2	2V	3	Prof. Dr. Klaus-Jürgen Schmidt
Embedded Systems	KI880	1	2V+2P	5	Prof. Dr. Martina Lehser
Environmental Decision Support Systems	KI869	2	4V	5	Prof. Dr. Ralf Denzer
Future Internet: Experimental Networks and Software Defined Networking	KI759	1	4V	5	Prof. Dr. Damian Weber
GPU Computing	KI784	1	2V+2P	5	Prof. Dr. Jörg Keller
Hardware Implementation of Digital Algorithms	KI780	1	4V	4	Prof. Dr. Martin Buchholz
Human Factors	KI857	2	4V international course	5	Prof. Steven Frysinger
Intelligent Networks	KI875	1	2V international course	3	Prof. Dr. Horst Wieker
Introduction to Robotics	KI842	2	2V+2P	5	Prof. Dr. Martina Lehser
Knowledge Based Systems	KI877	4	-	5	Prof. Dr. Ralf Denzer

Medical Informatics	KI781	1	2V	3	Dr. Helmut Jäger
Next-Generation Networks	KI865	3	4V	5	Prof. Dr. Horst Wieker
Planning and Running IT Workshops	KI762	1	1V+1P	3	Prof. Dr.-Ing. André Miede
Planning and Running RoboNight Workshops	KI863	2	1PA+1S international course	3	Prof. Dr. Martina Lehser
Planning and Running Technical Workshops	KI836	2	1V+1P	3	Prof. Dr.-Ing. André Miede
Presenting Information	KI846	2	2V+2U	5	Prof. Dr. Thomas Kretschmer
Quality of Service	KI742	1	4V	5	Prof. Joberto Martins
Research and Innovation Management	KI832	2	4SU	5	Prof. Dr. Günter Schultes
Semantic Interoperability	KI854	2	3V+1U	6	Prof. Dr. Reiner Güttler
Service Management with ITIL	KI874	2	2V	3	Prof. Dr.-Ing. André Miede
Shape Analysis	KI844	2	2V+2P	5	Dr.-Ing. Jörg Herter
Simulation and Hardware Implementation of Digital Algorithms and Systems	KI843	1	2V+2P	5	Prof. Dr. Martin Buchholz

Sino-German Smart Sensor Project	KI785	1	4PA	6	Prof. Dr. Martina Lehser
Software Architecture	KI747	1	2V+2PA	5	Prof. Dr. Markus Esch
Software Development Processes	KI841	2	3V+1P	5	Prof. Dr. Helmut Folz
Software Quality Engineering	KI786	1	2V+2PA	6	Prof. Dr. Helmut Folz
Software Quality Management	KI890	2	2V	3	Prof. Dr. Helmut Folz
Telecommunications Management Network (TMN) Systems	KI860	2	1V+1P	3	Prof. Dr. Horst Wieker
Theoretical Informatics Seminar	KI848	2	4V	6	Prof. Dr. Thomas Kretschmer
Traffic Control and Traffic Management	KI833	2	4V	5	Prof. Dr. Horst Wieker
Virtual Machines and Program Analysis	KI744	1	2V+4P	8	Dr.-Ing. Jörg Herter
Web Applications	KI834	2	2V+2U	5	Prof. Dr. Thomas Kretschmer
Web Services	KI775	2	2V+2P	5	Prof. Dr. Martina Lehser

(44 modules)

Computer Science and Communication Systems Master - mandatory courses

Business Cases in the Telecommunications Sector

Module name (EN): Business Cases in the Telecommunications Sector
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI845
Hours per semester week / Teaching method: 2V (2 hours per week)
ECTS credits: 2
Semester: 2
Mandatory course: yes
Language of instruction: German
Assessment: 180-minute written exam, term paper
Curricular relevance: KI845 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, mandatory course KIM-BCTK Computer Science and Communication Systems, Master, ASPO 01.10.2017, semester 2, optional course, telecommunications-specific
Workload: 30 class hours (= 22.5 clock hours) over a 15-week period. The total student study time is 60 hours (equivalent to 2 ECTS credits). There are therefore 37.5 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.

Recommended as prerequisite for:
KI900 Study Project or Industrial Placement
[*updated 01.04.2003*]

Module coordinator:
Prof. Dr. Horst Wieker

Lecturer:
Prof. Dr. Horst Wieker
Joachim Adt
[*updated 01.04.2003*]

Learning outcomes:
The lectures are designed to teach students about the legal, technical and economic conditions and constraints in the liberalized telecommunications market. The content of the course has been tailored to meet the needs of future telecommunications engineers. Students will be required to create a complete business model for the foundation of a telecommunications company.
[*updated 29.06.2007*]

Module content:
1. Fundamental aspects of the liberalization of the telecommunications market
2. Core competencies of telecommunications companies
3. Telecom production platforms
4. Value chains in the telecommunications business
5. Billing procedures
6. Quality management
7. Term paper: Business model with business case
[*updated 29.06.2007*]

Recommended or required reading:
None
[*updated 29.06.2007*]

Module offered in:
SS 2018, SS 2017, SS 2016, SS 2015, SS 2014, ...

Distributed Application Architectures

Module name (EN): Distributed Application Architectures
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI705
Hours per semester week / Teaching method: 3V+1P (4 hours per week)
ECTS credits: 5
Semester: 1
Mandatory course: yes
Language of instruction: German
Assessment: Oral examination: 50 %; case study/student assignment: 50 %
Curricular relevance: KI705 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 1, mandatory course PIM-AVA Applied Informatics, Master, ASPO 01.10.2011, semester 3, mandatory course
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Markus Esch

Lecturer:
Prof. Dr. Markus Esch
Moritz Fey, M.Sc.
[*updated 25.09.2017*]

Lab:
Technical Systems Lab (8207)

Learning outcomes:
Students will be taught the important techniques deployed in the development of complex, distributed systems. The course covers in detail some of the advanced concepts used in developing distributed systems such as ODP and OMA. Students will also be taught the underlying theoretical framework required to develop complex, distributed applications. Areas addressed include the transaction concept, distributed mutual exclusion, distributed termination, clock synchronization and replication mechanisms.
[*updated 08.05.2008*]

Module content:
1. Examples of large software systems
2. Middleware
3. Open Distributed Processing (ODP)
4. Object Management Architecture (OMA)
5. Software development model for designing distributed systems
6. Formal specifications of distributed systems
7. Case studies

[*updated 08.05.2008*]

Recommended or required reading:
POPIEN, Claudia: Verteilte Verarbeitung offener Systeme, Aachener Beiträge zur Informatik, 1996
SPANIOL, Otto; Linnhoff-Popein, Claudia; Meyer, Bernd: Trends in Distributed Systems: CORBA and Beyond 96, Aachen, Germany, October 12, 1996, Proceedings
COLOURIS, George; DOLLIMORE, Jean; KINDBERG, Tim: Distributed Systems Concepts , Addison Wesley. 4th Edition 2005
COLOURIS George; DOLLIMORE Jean; KINDBERG Tim: Verteilte Systeme - Konzepte, Addison Wesley 2002.
[*updated 08.05.2008*]

Module offered in:
WS 2017/18, WS 2016/17, WS 2015/16, WS 2014/15, WS 2013/14, ...

Formal Methods in Telecommunications

Module name (EN): Formal Methods in Telecommunications
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI715
Hours per semester week / Teaching method: 2V+2U (4 hours per week)
ECTS credits: 5
Semester: 1
Mandatory course: yes
Language of instruction: German
Assessment: Written examination
Curricular relevance: E1983 Electrical Engineering and Information Technology, Master, ASPO 01.04.2019, optional course, technical, course inactive since 08.10.2019 E1983 Electrical Engineering, Master, ASPO 01.10.2013, optional course, technical KI715 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 1, mandatory course PIM-WN15 Applied Informatics, Master, ASPO 01.10.2011, semester 1, optional course, not informatics specific
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.

Recommended as prerequisite for:
KI820 Software Development for Communication Networks
[*updated 01.04.2003*]

Module coordinator:
Prof. Dr. Reinhard Brocks

Lecturer:
Prof. Dr. Reinhard Brocks
[*updated 01.04.2003*]

Learning outcomes:
Students will acquire an understanding of how communication protocols function. They will be able to specify services and protocols using formal descriptive languages and will be able to deploy protocol development tools.
[*updated 08.05.2008*]

Module content:
The principles of communication protocols, communication instances and how they function
Message Sequence Charts (MSCs):

- Basic language constructs (Frame, Instance, Message, Condition, Action, Timer, Create)
- Structural language constructs (Coregion, Decomposition, References, Inline expressions, High-level MSC)

Specification and Description Language (SDL):

- Agents
- Process specification
- Transmitting and receiving signals
- Timers
- Procedures

Abstract Syntax Notation One (ASN.1):

- Abstract, concrete and transfer syntax
- Presentation context
- Object identifiers
- Module structure
- Simple and compound types
- Tagging
- BER encoding rules

Testing and Test Control Notation (TTCN-3):

- Protocol development
- Protocol testing

[*updated 08.05.2008*]

Recommended or required reading:
Textbooks
- König, Hartmut: Protocol Engineering, Teubner 2003, ISBN 3-519-00454-2

Specialist literature
- Dubuisson, Olivier: ASN.1, Communication between heterogeneous systems, Morgan Kaufmann, 2001, ISBN 0-12-633361-0, http://asn1.elibel.tm.fr/en/book/
- Ellsberger, Hogrefe, Sarmen: SDL: Formal Object-Oriented Language for Communicating Systems, 1997
- Mitschele-Thiel: Systems Engineering with SDL, John Wiley & Sons, 2001

Specifications
- ITU-T Recommendation Z.120 : Message Sequence Charts (MSC), 2004
- ITU-T Recommendation Z.100: Specification and Description Language SDL, 2002
- ITU-T Recommendation Z.140: Testing and test control notation version 3 (TTCN-3): Core language, 2003

Lecture notes
- Brocks, R.: Lecture notes

Websites
- http://www.itu.int : International Telecommunication Union
- http://asn1.elibel.tm.fr/ : ASN.1 Information Site
- http://www.sdl-forum.org/ : SDL-Forum Society
- http://www.iec.org/ : International Engineering Consortium
- http://www.oss.com/ : OSS Nokalva

[*updated 08.05.2008*]

Module offered in:
WS 2016/17, WS 2015/16, WS 2014/15, WS 2013/14, WS 2012/13, ...

Higher Mathematics 1

Module name (EN): Higher Mathematics 1
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI735
Hours per semester week / Teaching method: 2V (2 hours per week)
ECTS credits: 3
Semester: 1
Mandatory course: yes
Language of instruction: German
Assessment: Written exam
Curricular relevance: KI735 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 1, mandatory course
Workload: 30 class hours (= 22.5 clock hours) over a 15-week period. The total student study time is 90 hours (equivalent to 3 ECTS credits). There are therefore 67.5 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for: KI835 Higher Mathematics 2 KI861 KI867 [*updated 03.02.2011*]

Module coordinator:
Prof. Dr. Barbara Grabowski

Lecturer:
Prof. Dr. Barbara Grabowski
[*updated 01.04.2003*]

Lab:
Applied Mathematics, Statistics, and eLearning (5306)

Learning outcomes:
Students will become acquainted with the fundamental terminology of graph theory and probability calculus and with the significance of these disciplines to information and communication technology.

After completing this course students will be able to independently solve simple problems concerning network optimization, coding and simulation.

[*updated 29.06.2007*]

Module content:
1. Introduction to graph theory
1.1. Graphs
1.2. Eulerian and Hamiltonian circuits
1.3. Minimum spanning trees

2. Fundamentals of probability theory
2.1. Fundamentals
2.2. Random variables and their distributions
2.3. Special probability distributions
2.4. Limiting value theorems
2.5. Multidimensional stochastic variables
2.6. Stochastic processes

3. Mathematical methods used in simulating discrete information systems
3.1. Frequency and probability
3.2. Statistical methods
[*updated 29.06.2007*]

Recommended or required reading:
GRABOWSKI B., Stochastik für Kommunikationsinformatiker, e-learning book in the ActiveMath series.
BRANDSTÄDT A., Graphen und Algorithmen, B.G.Teubner Stuttgart, 1994
[*updated 29.06.2007*]

Module offered in:
WS 2016/17, WS 2015/16, WS 2014/15, WS 2013/14, WS 2012/13, ...

Higher Mathematics 2

Module name (EN): Higher Mathematics 2
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI835
Hours per semester week / Teaching method: 2V (2 hours per week)
ECTS credits: 3
Semester: 2
Mandatory course: yes
Language of instruction: German
Assessment: Written exam
Curricular relevance: KI835 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, mandatory course
Workload: 30 class hours (= 22.5 clock hours) over a 15-week period. The total student study time is 90 hours (equivalent to 3 ECTS credits). There are therefore 67.5 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): KI735 Higher Mathematics 1 [*updated 01.04.2003*]
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Barbara Grabowski

Lecturer:
Prof. Dr. Barbara Grabowski
[*updated 01.04.2003*]

Lab:
Applied Mathematics, Statistics, and eLearning (5306)

Learning outcomes:
Students will be taught the stochastic methods frequently applied in technical implementations of communications systems. They will be able to apply these methods to signal transmission (optimum coding problems) and to the optimization of communications systems (performance analysis, system stability).
[*updated 29.06.2007*]

Module content:
1. Mathematical methods in traffic theory
1.1. Introduction to the basic principles
1.2. Markov chains
1.3. Birth and death processes
1.4. Queues
1.5. Applications in traffic measurement

2. Mathematical methods in information and coding theory
2.1. Entropy
2.2. Information sources, optimal source coding
2.3. Channels and optimized channel coding
2.4. Mathematical methods in pattern recognition
[*updated 29.06.2007*]

Recommended or required reading:
GRABOWSKI B., Stochastik für Kommunikationsinformatiker, e-learning book in the ActiveMath series
KLIMANT, Piotraschke,Schönfeld: Infomations- und Kodierungstheorie, B.G.Teubner, Leipzig, 1996
WAHRMUTH E., Mathematische Modelle in der Simulation diskreter Systeme, ZFH Koblenz, 2002
[*updated 29.06.2007*]

Module offered in:
SS 2017, SS 2016, SS 2015, SS 2014, SS 2013, ...

Human Resource and Corporate Management

Module name (EN): Human Resource and Corporate Management
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI825
Hours per semester week / Teaching method: 2V (2 hours per week)
ECTS credits: 2
Semester: 2
Mandatory course: yes
Language of instruction: German
Assessment: 180-minute written exam
Curricular relevance: KI825 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, mandatory course
Workload: 30 class hours (= 22.5 clock hours) over a 15-week period. The total student study time is 60 hours (equivalent to 2 ECTS credits). There are therefore 37.5 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for: KI900 Study Project or Industrial Placement [*updated 01.04.2003*]
Module coordinator: Prof. Dr.-Ing. André Miede

Lecturer:
Prof. Dr.-Ing. André Miede
[*updated 09.05.2014*]

Learning outcomes:
After completing this course students will appreciate the importance of modern corporate and personnel management to business success. Students will be taught the methods and concepts of modern corporate and HR management theory and will analyse cases of practical relevance. The methods taught will enable students to systematically optimize the operational performance of a company business by intelligently deploying the available human resources. By encouraging independence, creativity and communication skills, students will develop the social aptitude and soft skills that they will need in order to meet the complex demands of human resource and corporate management.
[*updated 29.06.2007*]

Module content:
1. Perspectives in business management
2. Terminology and functions in business management
3. Management and decision-making
4. Levels of corporate management
5. Planning and control (planning systems)
6. Company organization (forms and methods)
7. Human resource management tools
8. Employee interviews
9. Performance targets
10. Personnel development (analysis of potential, needs analysis)
11. Employee motivation
12. Management styles and techniques
13. Human resource management
14. Change management
15. Corporate business culture
[*updated 29.06.2007*]

Recommended or required reading:
RAHN H.-J., Unternehmensführung. Ludwigshafen 2002
PORTER M. E., Wettbewerbsstrategie. Frankfurt, 1999
PORTER M. E., Wettbewerbsvorteile. Frankfurt, 1999
GROS E., Anwendungsbezogene Arbeits-, Betriebs- und Organisationspsychologie. Göttingen, 1994
DOPPLER K., LAUTERBURG Chr., Change Management. Frankfurt, 1999
[*updated 29.06.2007*]

Module offered in:
SS 2020, SS 2019, SS 2018, SS 2017, SS 2016, ...

IT, Telecommunications and the Law

Module name (EN): IT, Telecommunications and the Law
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI830
Hours per semester week / Teaching method: 2V (2 hours per week)
ECTS credits: 2
Semester: 2
Mandatory course: yes
Language of instruction: German
Assessment: 120-minute written exam
Curricular relevance: KI830 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, mandatory course MAM.2.2.21 Engineering and Management, Master, ASPO 01.10.2013, semester 8, mandatory course PIM-WN40 Applied Informatics, Master, ASPO 01.10.2011, semester 2, optional course, not informatics specific
Workload: 30 class hours (= 22.5 clock hours) over a 15-week period. The total student study time is 60 hours (equivalent to 2 ECTS credits). There are therefore 37.5 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:

Module coordinator:
RA Cordula Hildebrandt

Lecturer:
RA Cordula Hildebrandt
[*updated 01.04.2003*]

Learning outcomes:
After completing this module students will be able to apply the fundamental legal terminology and legal standards in an everyday IT and telecommunications environment. In addition to general areas such as copyright and patent law, contract law, data protection and customer privacy regulations, students will also be introduced to telecommunications law, software law and internet law that are more specific to the IT and telecommunications fields. Students will be able to analyse the relationships between and the applicability of the different regulations and laws in the field of information technology and by studying relevant examples will learn how to apply them to typical situations.
[*updated 08.05.2008*]

Module content:
1. Internet law
1.1 Websites
1.2 Internet domains
1.3 Formal requirements
1.4 Website content: legal considerations
1.5 Example: Online shops
1.6 Copyright laws
1.7 Competition law: Marketing
1.8 Entering into a contract: offer / acceptance
1.9 Links
1.10 Data protection and privacy
1.11 Security: Watermarks, electronic signatures

2. Telecommunications law
2.1 The Telecommunications Act
2.2 Blanket coverage
2.3 Encouraging competition through regulation
2.4 Frequency regulation
2.5 Licence and frequency allocation
[*updated 08.05.2008*]

Recommended or required reading:
http://bundesrecht.juris.de/aktuell.html (legal texts, BGB)
http://www.jurawelt.de/ go to: "Studentenwelt" (lecture notes, civil law)
http://www.uni-muenster.de/Jura.itm/hoeren/ click on: Lehre, Materialien, Skriptum Internet-Recht
[*updated 08.05.2008*]

Module offered in:
SS 2019, SS 2018, SS 2017, SS 2016, SS 2015, ...

Master Thesis

Module name (EN): Master Thesis
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI1000
Hours per semester week / Teaching method: -
ECTS credits: 27
Semester: 4
Mandatory course: yes
Language of instruction: German
Assessment: Seminars, discussion classes, lectures
Curricular relevance: KI1000 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 4, mandatory course Suitable for exchange students (learning agreement)
Workload: The total student study time for this course is 810 hours.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Damian Weber

Lecturer:
Professoren des Studiengangs
[*updated 09.05.2014*]

Learning outcomes:
The final-year thesis written by students for their Masters degree forms an integral part of a students scientific training and contributes towards the students final examination mark.
[*updated 29.06.2007*]

Module content:
The student will work on a problem of practical relevance in the field of information and communication technology either with a collaborative partner (company, institution, etc.) or as part of a research project. The thesis should apply the knowledge the student has acquired during the Masters degree programme to solving a specific problem. The Masters thesis is to be completed within six months.
[*updated 29.06.2007*]

Recommended or required reading:
To be provided by the project supervisor.
[*updated 29.06.2007*]

Network Architectures

Module name (EN): Network Architectures
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI810
Hours per semester week / Teaching method: 4V (4 hours per week)
ECTS credits: 5
Semester: 2
Mandatory course: yes
Language of instruction: German
Assessment: 180-minute written exam
Curricular relevance: KI810 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, mandatory course PIM-WN14 Applied Informatics, Master, ASPO 01.10.2011, semester 2, optional course, not informatics specific
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Horst Wieker

Lecturer:
Prof. Dr. Horst Wieker
Jonas Vogt, M.Sc.
[*updated 17.02.2016*]

Learning outcomes:
After completing this course, students will be acquainted with the three most important networks (fixed networks, mobile radio networks, private networks) and will be able to analyse network architectures and interfaces in order to plan network convergence.
[*updated 29.06.2007*]

Module content:
1. Fixed networks: Access Network, narrowband switch, Uo-IF, V5.1/2-IF, SS7-IF
2. Mobile networks: Public Land Mobile Network, MSC, GMSC, RNC, SGSN, GGSN
Iu-IF(CS), Iu-IF(PS), Iub-IF, ...
3. Private networks: Ethernet, FDDI, LAN, WAN, WLAN, Bluetooth, HUB, Router, Gateway
4. ATM
[*updated 29.06.2007*]

Recommended or required reading:
HALSALL F., Data Communications, Computernetworks and Open Systems
SIGMUND G., Technik der Netze
BENKENER, STEPPING, UMTS
PITTS J.N., SCHORMANS J.A., UMTS Basics, T.O.P. Businessinteractive
Introduction to ATM
[*updated 29.06.2007*]

Module offered in:
SS 2017, SS 2016, SS 2015, SS 2014, SS 2013, ...

Project Management

Module name (EN): Project Management
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI840
Hours per semester week / Teaching method: 2V (2 hours per week)
ECTS credits: 2
Semester: 2
Mandatory course: yes
Language of instruction: German
Assessment: Project work with student presentations
Curricular relevance: KI840 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, mandatory course PIM-WN12 Applied Informatics, Master, ASPO 01.10.2011, semester 3, optional course, not informatics specific
Workload: 30 class hours (= 22.5 clock hours) over a 15-week period. The total student study time is 60 hours (equivalent to 2 ECTS credits). There are therefore 37.5 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for: KI900 Study Project or Industrial Placement [*updated 01.04.2003*]

Module coordinator:
Dipl.-Ing. Michael Sauer

Lecturer:
Dipl.-Ing. Michael Sauer
[*updated 09.05.2014*]

Learning outcomes:
This module aims to teach students the particular challenges associated with the planning, management and financial control of projects. A key focus of the course is on explaining and applying established project management methods. Students should acquire the skills to be able to actively participate in a project team.
[*updated 29.06.2007*]

Module content:
The importance of projects in industry and commerce
Definition of project and project management
Methods of project management
Special features of software projects

Joint project work with the modules Software Development for Communication Networks and Business English.
[*updated 29.06.2007*]

Recommended or required reading:
BURGHARDT M., Projektmanagement, Publics MCD Verlag, 2000
WESTERMANN R.: Projektmanagement mit System. Gabler Verlag 2001
HIRZEL M., Multiprojektmanagement. FAZ-Verlag 2002
[*updated 29.06.2007*]

Module offered in:
SS 2017, SS 2016, SS 2015, SS 2014, SS 2013, ...

Protocols in Public and Private Networks

Module name (EN): Protocols in Public and Private Networks
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI720
Hours per semester week / Teaching method: 4V (4 hours per week)
ECTS credits: 5
Semester: 1
Mandatory course: yes
Language of instruction: German
Assessment: 180-minute written exam
Curricular relevance: KI720 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 1, mandatory course PIM-WN25 Applied Informatics, Master, ASPO 01.10.2011, semester 1, optional course, not informatics specific
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for: KI833 Traffic Control and Traffic Management KI851 Automotive Engineering [*updated 29.07.2015*]

Module coordinator:
Prof. Dr. Horst Wieker

Lecturer:
Prof. Dr. Horst Wieker
[*updated 01.04.2003*]

Learning outcomes:
Students will learn how the most important protocols in public networks function and how they are used. Based on the knowledge acquired, students will be able to analyse and develop relationships and interactions between individual network protocols.
[*updated 08.05.2008*]

Module content:
Protocols traditionally play a key role in communications technology. They are regarded as central components of the software used in communications devices. Protocols are standardized procedures and rules for exchanging data between communications systems. They include descriptions of the interfaces, data formats, timing and error-correction procedures.

The following protocol standards will be dealt with in detail:
1. Routing protocols
2. SNMP
3. SIP
4. RADIUS
5. H.323
6. SS7
7. SCCP, ISUP, TCAP, INAP
8. SS7 in mobile networks

[*updated 08.05.2008*]

Recommended or required reading:
SUGMUND G., Technik der der Netze
HALSALL F, DataCommunications, Computer Networks and Open Systems
EBERSPÄCHER J., et al, GSM, Global System for Mobile Communication
WALKE B, Mobilfunknetze und ihre Protokolle Band 1 + 2
[*updated 08.05.2008*]

Module offered in:
WS 2016/17, WS 2015/16, WS 2014/15, WS 2013/14, WS 2012/13, ...

Security and Cryptography

Module name (EN): Security and Cryptography
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI725
Hours per semester week / Teaching method: 3V+1U (4 hours per week)
ECTS credits: 5
Semester: 1
Mandatory course: yes
Language of instruction: German
Assessment: Written examination
Curricular relevance: KI725 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 1, mandatory course PIM-SK Applied Informatics, Master, ASPO 01.10.2011, semester 3, mandatory course
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Damian Weber

Lecturer:
Prof. Dr. Damian Weber
[*updated 29.12.2015*]

Learning outcomes:
After completing this course, students will be able to analyse cryptographically relevant processes, identify and exploit errors, and develop cryptographically secure systems based on standard procedures.
[*updated 08.05.2008*]

Module content:
1. Basics, terminology, definitions
2. Algebraic structures
3. RSA
4. The Diffie-Hellman key exchange system
5. The ElGamal cryptosystem
6. Secure hash functions
7. Digital signatures
8. Cryptosystems with elliptic curves

[*updated 08.05.2008*]

Recommended or required reading:
SCHNEIER, Bruce; FERGUSON, Niels: Practical Cryptography, Wiley 2003
KOBLITZ, N.: Algebraic Aspects of Cryptography, Springer, 2. Auflage 2004
[*updated 08.05.2008*]

Module offered in:
WS 2016/17, WS 2015/16, WS 2014/15, WS 2013/14, WS 2012/13, ...

Software Development for Communication Networks

Module name (EN): Software Development for Communication Networks
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI820
Hours per semester week / Teaching method: 4P (4 hours per week)
ECTS credits: 6
Semester: 2
Mandatory course: yes
Language of instruction: German
Assessment: Project work, oral examination
Curricular relevance: KI820 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, mandatory course PIM-WI64 Applied Informatics, Master, ASPO 01.10.2011, semester 2, optional course, informatics specific
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 180 hours (equivalent to 6 ECTS credits). There are therefore 135 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): KI715 Formal Methods in Telecommunications [*updated 01.04.2003*]
Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Reinhard Brocks

Lecturer:
Prof. Dr. Reinhard Brocks
[*updated 01.04.2003*]

Learning outcomes:
After completing this module students will be acquainted with the technical aspects of employing communication protocols and will be in a position to use development tools for protocol implementation. During this module students will acquire new knowledge and be able to apply what they have learnt in real practical contexts. They will also be able to present and discuss specialist knowledge and ideas. They will be in a position to take on a responsible role within a team, to share knowledge and ideas and to coordinate work with others.

[*updated 29.06.2007*]

Module content:
Students will carry out a software project in the field of communication networks. A typical project might involve implementing a protocol service or a specific protocol function. The project will be split up into modules. These modular tasks are tackled by students working individually or in small groups. Their end results are combined and tested. During this work students may be expected to work with previously unknown software libraries and tools. In the course of the project, students will also be expected to give presentations on their work and to document their progress. The project will conclude with a final presentation session.

Technical aspects covered: implementation of protocol layers and state automata; API design; plug-ins and add-ons; interprocess communication; threads; timers; synchronous and asynchronous interfaces; coding and decoding modules; tracing and logging; scheduling; fault-tolerance; active/standby; high-availability; test environments

CASE tools: IDEs; UML tool; SDL tool; ASN.1 compiler; C/C++/Java compiler; version management; BUILD utility; packet manager
[*updated 29.06.2007*]

Recommended or required reading:
Students will generally work with the protocol specifications and product descriptions for special tools or interfaces. Books on programming, software development, system-level programming and software design will also be used. The actual reading list will depend on the details of the project being carried out.
[*updated 29.06.2007*]

Module offered in:
SS 2019, SS 2018, SS 2017, SS 2016, SS 2015, ...

Study Project or Industrial Placement

Module name (EN): Study Project or Industrial Placement
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI900
Hours per semester week / Teaching method: -
ECTS credits: 20
Semester: 3
Mandatory course: yes
Language of instruction: German
Assessment: Seminars, discussion classes, lectures
Curricular relevance: KI900 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 3, mandatory course Suitable for exchange students (learning agreement)
Workload: The total student study time for this course is 600 hours.
Recommended prerequisites (modules): KI825 Human Resource and Corporate Management KI840 Project Management KI845 Business Cases in the Telecommunications Sector [*updated 01.04.2003*]
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Damian Weber

Lecturer:
Prof. Dr. Damian Weber
[*updated 01.04.2003*]

Learning outcomes:
The study project serves to prepare students for their later final-year thesis work. In addition to providing instruction in the methods and techniques of scientific investigation, the course also aims to teach soft skills, team work and project coordination.
[*updated 29.06.2007*]

Module content:
The study project will be assessed by evaluating student contributions to seminars as well as homework assignments and extended essays that go beyond a simple summary of the existing literature. Students will also work together in a team on projects that are academically demanding but that also have a strong practical relevance. The work may involve a challenging project carried out at the university or in cooperation with an industrial partner.
[*updated 29.06.2007*]

Recommended or required reading:
Depends on the specific subjects being addressed in the projects.
[*updated 29.06.2007*]

Module offered in:
WS 2006/07

Theoretical Informatics

Module name (EN): Theoretical Informatics
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI710
Hours per semester week / Teaching method: 4V (4 hours per week)
ECTS credits: 5
Semester: 1
Mandatory course: yes
Language of instruction: German
Assessment: 180-minute written exam
Curricular relevance: KI710 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 1, mandatory course PIM-TI Applied Informatics, Master, ASPO 01.10.2011, semester 1, mandatory course, course inactive since 14.01.2012
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Thomas Kretschmer

Lecturer:
Prof. Dr. Thomas Kretschmer
[*updated 01.04.2003*]

Learning outcomes:
Students will learn the traditional areas of theoretical informatics: automata and languages, computability and complexity theory. Students will acquire an understanding of the fundamental mathematical properties of hardware and software systems. After completing this course, students will understand and be able to apply the theoretical concepts that are used to solve problems of practical relevance. This will allow them to generate theoretically well-grounded and properly conceived solutions. Students will also appreciate the fundamental limitations that apply to certain types of problems. They will also know how to classify problems into complexity classes with respect to runtime and memory requirements.
[*updated 08.05.2008*]

Module content:
1. Automata and languages
- Regular languages
- Context-free languages

2. Computability theory
- The Church-Turing thesis
- Decidability
- Reducibility
- Defining information

3. Complexity theory
- Time complexity with NP-completeness
- Spatial complexity
[*updated 08.05.2008*]

Recommended or required reading:
HOPCROFT John E.; ULLMANN Jeffrey D.; MOTWANI Rajeev: Einführung in die Automatentheorie - Formale Sprachen und Komplexitätstheorie, Pearson Studium, München, 2. Auflage 2002
SIPSER Michael: Introduction to the theory of computation, Course Technology, Boston 1997
[*updated 08.05.2008*]

Module offered in:
WS 2016/17, WS 2010/11, WS 2009/10, WS 2008/09, WS 2007/08, ...

Computer Science and Communication Systems Master - optional courses

Advanced Presentation and Writing Skills for ICT Studies

Module name (EN): Advanced Presentation and Writing Skills for ICT Studies
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI837
Hours per semester week / Teaching method: 2V (2 hours per week)
ECTS credits: 3
Semester: 1
Mandatory course: no
Language of instruction: English/German
Assessment: 50% oral presentation with grade (10 minutes), 50% written composition with grade
Curricular relevance: KI837 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 1, optional course, general subject KIM-APWS Computer Science and Communication Systems, Master, ASPO 01.10.2017, semester 1, optional course, general subject PIM-WN42 Applied Informatics, Master, ASPO 01.10.2011, semester 1, optional course, not informatics specific PIM-APWS Applied Informatics, Master, ASPO 01.10.2017, semester 1, optional course, general subject
Workload: 30 class hours (= 22.5 clock hours) over a 15-week period. The total student study time is 90 hours (equivalent to 3 ECTS credits). There are therefore 67.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Christine Sick

Lecturer:
Dipl.-Übers. Betina Lang
[*updated 08.07.2013*]

Learning outcomes:
On the basis of the knowledge acquired in the mandatory Bachelor modules, this module focuses on the written and oral presentation of scientific ideas in team meetings and at conferences such as the IEEE Students´ Conferences.
To this end, students will first acquire the linguistic skills and knowledge necessary for writing scientific papers. Based on their papers, they will learn to develop strategies for the conception of lectures and posters, as well as the linguistic means for their design and presentation.
A communicative-pragmatic approach will be taken here. Students will also deepen their previously acquired knowledge about appropriate intercultural communication in English-speaking countries and English as a bridge language. All of the four basic skills (reception, production, interaction and mediation) will be trained in an integrated manner. Content development is supported by the repetition of the relevant linguistic structures and special features. Whenever possible, content from the English-language electives in the Master program will be used.
[*updated 24.02.2018*]

Module content:
- Academic writing: Types of text, form, structure, language requirements
- The description of graphics and tables
- Strategies for team writing and peer review
- Discussion techniques (useful phrases and intercultural skills)
- Presentation (structure and useful phrases)
- Presentation slides, posters
- Grammar as required

[*updated 24.02.2018*]

Teaching methods/Media:
Teaching and learning materials for specific target groups (print, audio, video), multimedia teaching and learning software
[*updated 24.02.2018*]

Recommended or required reading:
Students will receive a list of recommended teaching and learning materials.
[*updated 24.02.2018*]

Module offered in:
WS 2018/19, WS 2017/18, WS 2016/17, WS 2015/16, SS 2015, ...

Algorithms and Complexity

Module name (EN): Algorithms and Complexity
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI745
Hours per semester week / Teaching method: 4V (4 hours per week)
ECTS credits: 5
Semester: 1
Mandatory course: no
Language of instruction: English
Assessment: Written examination
Curricular relevance: KI745 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 1, optional course PIM-WI10 Applied Informatics, Master, ASPO 01.10.2011, semester 1, optional course, course inactive since 29.07.2015
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dave Swayne

Lecturer:
Prof. Dave Swayne
[*updated 10.07.2007*]

Learning outcomes:
The students are capable of classifying algorithmic problems with respect to time and space complexity. The algorithmic tools of this course enable the student to find effective approaches to many problems. Consequently, they are able to propose efficient solutions these may be approximate if the problem is NP-hard.
[*updated 08.05.2008*]

Module content:
. Mathematical tools
- order calculus
- difference equations
- logarithms

2. Brute force

3. Divide and conquer
- large integers and the Strassen algorithm
- fundamental theorem of divide and conquer
- convex hull and closest pair case studies

4. Decrease and conquer, transform and conquer

5. Auxiliary techniques
- Precomputation
- Time and space tradeoffs
- String processing algorithms

6. Hierarchies of computational complexity
7. Approximation algorithms

8. Case studies in approximation algorithms
- branch and bound
- routing
- pipe flow and its applications

[*updated 08.05.2008*]

Recommended or required reading:
To be announced
[*updated 08.05.2008*]

Module offered in:
WS 2007/08

Astronomy Seminar

Module name (EN): Astronomy Seminar

Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016

Module code: KI752

Hours per semester week / Teaching method: 1V+1PA (2 hours per week)

ECTS credits: 2

Semester: 1

Mandatory course: no

Language of instruction:
German

Assessment:
Presentation, composition

Curricular relevance:
KI752 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 1, optional course, general subject
KIM-ASTR Computer Science and Communication Systems, Master, ASPO 01.10.2017, semester 1, optional course, general subject
MAM.2.1.1.1 Engineering and Management, Master, ASPO 01.10.2013, semester 9, optional course
MST.AST Mechatronics and Sensor Technology, Master, ASPO 01.04.2016, optional course, course inactive since 27.10.2015
PIM-WN22 Applied Informatics, Master, ASPO 01.10.2011, semester 1, optional course, not informatics specific
PIM-ASTR Applied Informatics, Master, ASPO 01.10.2017, semester 1, optional course, not informatics specific
MST.AST Mechatronics and Sensor Technology, Master, ASPO 01.10.2011, semester 9, optional course
Suitable for exchange students (learning agreement)

Workload:
30 class hours (= 22.5 clock hours) over a 15-week period.
The total student study time is 60 hours (equivalent to 2 ECTS credits).
There are therefore 37.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Martin Löffler-Mang

Lecturer: Prof. Dr. Martin Löffler-Mang
[*updated 02.03.2010*]

Learning outcomes:
After successfully completing this module, students will be able to read and understand complex articles from specialist journals (e. g."Sterne und Weltraum" or "Spektrum der Wissenschaften"). Based on what they have read, students will give a talk of approx. 60 minutes on a self-chosen astronomical topic and defend it in a discussion group. In addition, they will also actively participate in the discussion and ask questions on their classmates´ topics.
[*updated 24.02.2018*]

Module content:
Current topics from the field of astronomy, such as for example:

+ In the depths of space and time
+ Where did Saturn get its rings from?
+ Omega Centauri - a superlative globular cluster
+ Gravitational waves
+ How galaxies form
+ Neutron stars and black holes
+ Last year´s comets
+ The current state of large telescopes
+ Radio astronomy: LOFAR results from meteorology to cosmology
+ The formation of periodic meteor showers

[*updated 24.02.2018*]

Teaching methods/Media:
Literature research, lecture and independent observation
[*updated 20.12.2017*]

Recommended or required reading:
Kosmos-Himmelsjahr (almanac)
Sterne und Weltraum (monthly journal)
Spektrum der Wissenschaften (professional journal)
[*updated 24.02.2018*]

Module offered in:
WS 2018/19, WS 2017/18, WS 2016/17, WS 2015/16, WS 2014/15, ...

Automotive Engineering

Module name (EN): Automotive Engineering

Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016

Module code: KI851

Hours per semester week / Teaching method: 2V+2P (4 hours per week)

ECTS credits: 5

Semester: 2

Mandatory course: no

Language of instruction:
German

Assessment:
Composition and written exam

Curricular relevance:
E1984 Electrical Engineering, Master, ASPO 01.10.2013, optional course, technical
KI851 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, optional course, telecommunications-specific
KIM-ATEC Computer Science and Communication Systems, Master, ASPO 01.10.2017, semester 1, optional course, telecommunications-specific
PIM-WI74 Applied Informatics, Master, ASPO 01.10.2011, semester 2, optional course, not informatics specific
PIM-ATEC Applied Informatics, Master, ASPO 01.10.2017, semester 1, optional course, not informatics specific

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
KI720 Protocols in Public and Private Networks
[*updated 29.07.2015*]

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Horst Wieker

Lecturer:
Prof. Dr. Horst Wieker
Manuel Fünfrocken, M.Sc.
Sebastian Weber, M.Sc. (practical training)
[*updated 29.07.2015*]

Learning outcomes:
Students will be able to name the advantages and disadvantages of the most common bus systems, as well as their various fields of application. They will be able to encode/decode simple sensor and actuator information on the CAN bus and understand and adapt predefined addressing schemes. When problems occur, students will be able to systematically search for errors. In addition, students will be able to list the data typically generated in modern vehicles and the connections between this data and assistance systems.

They will be capable of demonstrating the basic motivation behind Cooperative Intelligent Transports Systems (car-2-car). Students will be able to reconstruct basic standard use cases and, based on given scenarios, independently determine how messages must to be composed in order to implement the applications. Students will be capable of solving routing problems by calculating the best propagation path.
[*updated 26.02.2018*]

Module content:
* Car-2-Car and GeoNetworking (theory)

* CAN Bus in detail (theory)

* CAN Bus in detail (practice)

* FlexRay Bus in detail (practice)

* Car-2-Car and GeoNetworking (practice)
  - Wrong-way driver warning
  - Traffic light assistant
  - Intersection assistant
  - Emergency vehicle warning system

* Communication-based assistance systems

[*updated 26.02.2018*]

Recommended or required reading:
[*still undocumented*]

Module offered in:
WS 2018/19, WS 2017/18, WS 2016/17, WS 2015/16, SS 2009

Automotive Technology and Vehicle Telematics Systems

Module name (EN): Automotive Technology and Vehicle Telematics Systems
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI738
Hours per semester week / Teaching method: 4V (4 hours per week)
ECTS credits: 5
Semester: 1
Mandatory course: no
Language of instruction: German
Assessment: Written examination
Curricular relevance: E918 Electrical Engineering, Master, ASPO 01.10.2005, semester 9, mandatory course KI738 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 1, optional course, telecommunications-specific
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Horst Wieker

Lecturer: Prof. Dr. Horst Wieker
[*updated 09.01.2010*]

Learning outcomes:
This lecture course covers more than just data acquisition and processing in automotive systems and goes beyond functions such as ESP and blind spot monitoring. Current research work will be examined to show how cars can exchange data and how so-called data fusion can provide new interpretations of vehicle data, such as hazard detection. One of the areas is linking sensor data to generate information about the state of the road surface or visibility conditions.
Students will learn about the currently established information transfer channels (C2C: car-to-car; C2I: car-to-infrastructure). After completing this course of lectures, students will be able to view an automobile as an application and to develop new car-centred services for the automotive sector.
[*updated 12.03.2010*]

Module content:
1.Sensors in vehicle systems
2.Advanced vehicle dynamics
3.Control processes in ABS and ESP systems and their extensions
4.Data generation and distribution models (C2C, C2I)
5.Relevance checking of information
6.Data transmission systems and their effects on message distribution
ad-hoc networks, wireless LAN 802.11x, 802.16, 802.20, GPRS, UMTS, DRSC
[*updated 12.03.2010*]

Teaching methods/Media:
Video projector, blackboard, lecture notes
[*updated 12.03.2010*]

Recommended or required reading:
Accompanying lecture notes
[*updated 12.03.2010*]

Module offered in:
SS 2016, WS 2014/15, WS 2013/14

Bioinformatics

Module name (EN): Bioinformatics
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI850
Hours per semester week / Teaching method: 4V (4 hours per week)
ECTS credits: 5
Semester: 2
Mandatory course: no
Language of instruction: German
Assessment: Project and presentation
Curricular relevance: KI850 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, optional course, informatics specific KIM-BIOI Computer Science and Communication Systems, Master, ASPO 01.10.2017, semester 2, optional course, informatics specific PIM-WI57 Applied Informatics, Master, ASPO 01.10.2011, semester 2, optional course, informatics specific PIM-BIOI Applied Informatics, Master, ASPO 01.10.2017, semester 2, optional course, informatics specific
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Barbara Grabowski

Lecturer:
Melanie Kaspar, M.Sc.
Prof. Dr. Barbara Grabowski
[*updated 08.02.2011*]

Lab:
Applied Mathematics, Statistics, and eLearning (5306)

Learning outcomes:
Students will be familiarized with several application areas of bioinformatics and will be able to efficiently solve typical problems such as the sequencing of genomes or the structure of proteins using algorithms.
[*updated 20.12.2017*]

Module content:
Computer-aided research in the natural sciences (biology, pharmacy, biotechnology,...) generates large amounts of data that must be archived and analyzed. This requires efficient algorithms.

First, the algorithms used in the sequencing of the human genome will be introduced in the lecture. Then, methods for the identification of genes (gene prediction) will be described. Hidden Markov models are an important part of this process. The methods discussed make it possible to predict the 3-D structure and function of proteins.

In conclusion, we will discuss the algorithms and procedures used by pharmaceutical companies in the computer-aided search for new active ingredients (computer-aided drug design).

1. Basics
2. Genome sequencing algorithms
3. Hidden Markov models
4. The application of hidden Markov models for the identification of genes
5. Protein structure predictions and databases
6. Computer-aided drug design

[*updated 24.02.2018*]

Teaching methods/Media:
50% of the lecture will take place in the PC lab AMSEL "Angewandte Mathematik, Statistik und eLearning". Computer-supported practical case studies will be worked through using the algorithms taught in this module.
In addition, the e-learning system ActiveMath: Statistics will be used to learn about topics from the field of stochastics, especially the Markov models.

[*updated 24.02.2018*]

Recommended or required reading:
BALDI, BRUNAK: Bioinformatics, The Machine Learning Approach
[*updated 20.12.2017*]

Module offered in:
SS 2020 (probably), SS 2019, SS 2018, SS 2017, SS 2016, ...

Building Systems Technology

Module name (EN): Building Systems Technology
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI741
Hours per semester week / Teaching method: 4V (4 hours per week)
ECTS credits: 6
Semester: 1
Mandatory course: no
Language of instruction: German
Assessment: Written exam, composition
Curricular relevance: KI741 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 1, optional course, telecommunications-specific KIM-GSYS Computer Science and Communication Systems, Master, ASPO 01.10.2017, semester 1, optional course, telecommunications-specific PIM-WI79 Applied Informatics, Master, ASPO 01.10.2011, semester 1, optional course, informatics specific PIM-GSYS Applied Informatics, Master, ASPO 01.10.2017, semester 1, optional course, informatics specific
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 180 hours (equivalent to 6 ECTS credits). There are therefore 135 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Michael Igel

Lecturer:
Prof. Dr. Michael Igel
[*updated 01.04.2003*]

Learning outcomes:
After successfully completing the course, students will have acquired basic theoretical knowledge of communication technology in residential and functional buildings,
as well as building systems technology. In addition, students will be able to apply the knowledge they have acquired to carry out practical planning projects and to develop and document technical solutions for a given task in the field of building systems technology.

Conceptional application of concepts from building systems technology

The automation of processes in functional and residential buildings using EIB

Planning and implementation of network topologies based on the EIB

Analysis of protocols and EIB telegrams

Process-related selection and project planning of EIB actuators and sensors

[*updated 26.02.2018*]

Module content:
1 Basics of communication technology
1.1 Serial data transmission
1.2 Asynchronous and synchronous communication protocols
1.3 Data flow control
1.4 Data backup (Hamming distance)
1.5 OSI model and EIB system
2 Modern building installation technology
2.1 Requirements on modern building installations
2.2 Limits of the conventional installation, advantages of the EIB system
2.3 Conventional installation <> EIB installation
3 EIB technology
3.1 Structure of an EIB system
3.2 Basic components
3.3 Bus couplers
3.4 Sensors and actuators
4 Topology of an EIB system
4.1 Hierarchical structure of an installation network
4.2 Physical and logical addressing
4.3 Transmission procedures
4.4 Communication objects
5 EIB bus communication
5.1 Signal generation
5.2 Data transmission timing
5.3 Bus access methods
5.4 Data telegrams and protocol structure
6 EIB bus components
6.1 Design, coupling to the EIB bus
6.2 System devices
6.3. Actuators and sensors
6.4 Symbols in EIB technology
7 Project from the field of building systems technology

[*updated 26.02.2018*]

Recommended or required reading:
EIB für die Gebäudesystemtechnik, Michael Rose, Hüthig
Installationsbus EIB/KNX Twisted Pair, Robert Beiter, Hüthig & Pflaum
Elektro-Installation in Gebäuden, Dieter Vogt, VDE Verlag
Training materials from different manufacturers
[*updated 26.02.2018*]

Module offered in:
WS 2018/19, WS 2017/18, SS 2017, WS 2016/17, WS 2015/16, ...

Business Computing

Module name (EN): Business Computing
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI856
Hours per semester week / Teaching method: 2V+2U (4 hours per week)
ECTS credits: 6
Semester: 2
Mandatory course: no
Language of instruction: German
Assessment: Written examination: 40 %; lab course: 40 %; assessed exercises: 20 %
Curricular relevance: KI856 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, optional course, informatics specific PIM-BC Applied Informatics, Master, ASPO 01.10.2011, semester 2, mandatory course
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 180 hours (equivalent to 6 ECTS credits). There are therefore 135 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr.-Ing. André Miede

Lecturer: Prof. Dr.-Ing. André Miede
[*updated 10.02.2009*]

Learning outcomes:
After completing this course, students will be in a position to model and code programming concepts for selected modules in standard enterprise resource planning (ERP) systems, and to modify and extend existing modules. They will understand the architecture of these business applications and can assess and adapt the so-called outcome logic models for business processes in companies. They will also have experience of incorporating and discussing their own ideas in advanced colloquia dealing with the design, implementation and application of enterprise-wide ERP and SCM systems.
[*updated 08.05.2008*]

Module content:
1. Fundamentals of modelling ERP systems
2. Dialogue programming in standard ERP systems
3. Implementing business model applications
a. in procurement and logistics systems
b. in enterprise-wide SCM processes
4. Modelling and development tools
5. Software implementation using the development interface of common ERP systems
[*updated 08.05.2008*]

Recommended or required reading:
KELLER, Horst: ABAP-Referenz, Heidelberg 2004
KELLER, Horst; Krüger, Sascha: ABAP-Objects Einführung in die SAP-Programmierung, Heidelberg 2001
[*updated 08.05.2008*]

Module offered in:
SS 2018, SS 2017, SS 2016, SS 2015, SS 2014, ...

Content Management Systems

Module name (EN): Content Management Systems
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI743
Hours per semester week / Teaching method: 2V+2PA (4 hours per week)
ECTS credits: 5
Semester: 1
Mandatory course: no
Language of instruction: German
Assessment: Project work
Curricular relevance: KI743 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 1, optional course, informatics specific KIM-CMS Computer Science and Communication Systems, Master, ASPO 01.10.2017, semester 1, optional course, informatics specific PIM-WI15 Applied Informatics, Master, ASPO 01.10.2011, semester 1, optional course, informatics specific PIM-CMS Applied Informatics, Master, ASPO 01.10.2017, semester 1, optional course, informatics specific
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:

Module coordinator:
Dipl.-Inform. Roman Jansen-Winkeln

Lecturer:
Dipl.-Inform. Roman Jansen-Winkeln
Dipl.-Wirt.-Inform. Nils Weinzierl
[*updated 20.06.2007*]

Learning outcomes:
After successfully completing this module, students will have an overview of the existing CMS systems and be able to use them competently. They will be able to work with a CMS, i. e. collect content, customize its appearance and add and develop modules. Students will learn about template languages, skins and scripts and be able to use them. Depending on the application, students will be able to select and set up the appropriate infrastructure, e. g. with proxies, caches or as a server farm. With the topics of search engine optimization, enterprise CMS, _Social Software_ and Web 2.0 they will acquire additional knowledge that they can use appropriately depending on the situation.

The goal of this module is to teach students to evaluate, adapt and use content management systems. In addition, they should also be able to introduce these systems and advise others on their use. Exercises, regular short presentations and project work in teams will help solidify the students´ knowledge and skills.

[*updated 26.02.2018*]

Module content:
1. Foundation

Plone/Zope/Python
Communication via the web
Representation in the computer

2. Using and adapting a CMS

Hello World: initial content
Template languages, sever-based scripting
Skins
Custom content types

3. CMS infrastructures

CMS operation
Search engines and search engine optimization
User management
Fat clients, single page applications

4. Using CMS

Classic applications
Enterprise CMS
Web 2.0 applications
Financing CMS platforms
Legal framework
[*updated 26.02.2018*]

Recommended or required reading:
Aspeli, Martin: Professional Plone Development, Packt Publishing Ltd., 2007
ASPELI, Martin: Professional Plone 4 Development, Packt Publishing Ltd., 2011
CLARK, Alex / DE STEFANO, John (u. a.): Practical Plone 3, Packt Publishing Ltd., 2009
[*updated 26.02.2018*]

Module offered in:
WS 2017/18, WS 2016/17, WS 2015/16, WS 2014/15, WS 2013/14, ...

Cryptography Project

Module name (EN): Cryptography Project
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI750
Hours per semester week / Teaching method: 4PA (4 hours per week)
ECTS credits: 6
Semester: 1
Mandatory course: no
Language of instruction: German
Assessment: Project, documentation and presentation
Curricular relevance: KI750 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 1, optional course, informatics specific KIM-PKRY Computer Science and Communication Systems, Master, ASPO 01.10.2017, semester 1, optional course, informatics specific PIM-WI61 Applied Informatics, Master, ASPO 01.10.2011, semester 1, optional course, informatics specific PIM-PKRY Applied Informatics, Master, ASPO 01.10.2017, semester 1, optional course, informatics specific
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 180 hours (equivalent to 6 ECTS credits). There are therefore 135 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Damian Weber

Lecturer:
Prof. Dr. Damian Weber
[*updated 26.07.2009*]

Learning outcomes:
After successfully completing this module, students will be able to analyze and evaluate cryptographic procedures and correct their weak points.

In order to understand the properties of a cryptographic algorithm, we will first demonstrate them based on the implementation of a theoretical specification. Students will be able to break down procedures into their logical components and illustrate their application problems by comparing them with known procedures. They will be capable of deriving attack techniques from theoretical results or generating new ones. Lastly, they will be able to assess the security of a procedure or a modification thereof.

[*updated 26.02.2018*]

Module content:
Implementing and attacking cryptographic methods, that
* are currently being researched or
* currently have security vulnerabilities or
* are currently being used or
* are historically relevant or
* are part of the "Cryptography Engineering" module

[*updated 26.02.2018*]

Recommended or required reading:
Project-related literature will be announced at a later time.
[*updated 26.02.2018*]

Module offered in:
SS 2020 (probably), SS 2019, SS 2018, WS 2017/18, SS 2016, ...

Discrete Mathematics

Module name (EN): Discrete Mathematics
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI873
Hours per semester week / Teaching method: 3V+1U (4 hours per week)
ECTS credits: 6
Semester: 2
Mandatory course: no
Language of instruction: German
Assessment: Written exam
Curricular relevance: KI873 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, optional course, informatics specific KIM-DM Computer Science and Communication Systems, Master, ASPO 01.10.2017, semester 1, mandatory course PIM-DM Applied Informatics, Master, ASPO 01.10.2011, semester 2, mandatory course PIM-DM Applied Informatics, Master, ASPO 01.10.2017, semester 1, mandatory course
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 180 hours (equivalent to 6 ECTS credits). There are therefore 135 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Peter Birkner

Lecturer: Prof. Dr. Peter Birkner
[*updated 31.03.2012*]

Learning outcomes:
After successfully completing this module, students will be able to solve counting problems that have been formulated informally. In doing so, they can either establish a direct link to the principles discussed, or they can use the basic principles
to divide the solution of the counting problem into smaller sub-problems, on which other principles are then used. It is important that the students recognize that simple variations in the formulation of a problem sometimes lead to very complex solution strategies.

For recursive sequences, students will be able to derive a closed representation using generating functions, the validity of which they can prove by means of mathematical induction.

In the field of graph theory, students will learn the concepts of graph theory based on practical exercises. They will be able to identify practical problems with the corresponding mathematical terms. In order to solve these problems, students will learn select graph theory algorithms and will be able to apply them.
[*updated 26.02.2018*]

Module content:
1. Basics
1.1. Sets and set operations
1.2. Mathematical induction

2. Counting
2.1. Basic principles
2.2. Subsets
2.3. Partitions
2.4. Catalan numbers
2.5. Polynomials
2.6. Generating functions
2.7. Asymptotic counting

3. Graph theory
3.1. Introduction
3.2. Discrete optimization
3.2.1. Shortest paths
3.2.2. Minimum spanning tree
3.3. Eulerian path
3.4. Hamiltonian cycle
3.5. The Traveling Salesman Problem
[*updated 26.02.2018*]

Recommended or required reading:
Anusch Taraz: Diskrete Mathematik, Birkhäuser, 2012

M.Aigner: Diskrete Mathematik, Verlag Vieweg + Teubner, 6. Auflage 2006

G.Bamberg und A.G.Coenenberg: Betriebswirtschaftliche Entscheidungslehre. Verlag Vahlen, WiSo Kurzlehrbücher, 10. Aufl. 2008

T.Ihringer: Diskrete Mathematik: iene Einführung in Theorie und Anwendungen, Heldermann Verlag 2002

E.Lawler: Combinatorial Optimization: Networks and Matroids, Oxford University Press 1995

C.H.Papadimitriou und K.Steiglitz: Combinatorial Optimization: Algorithms and Complexity, Springer-Verlag, Berlin 2008
[*updated 26.02.2018*]

Module offered in:
WS 2018/19, WS 2017/18, SS 2017, SS 2016, SS 2015, ...

Distribution Logistics

Module name (EN): Distribution Logistics
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI847
Hours per semester week / Teaching method: 2V (2 hours per week)
ECTS credits: 3
Semester: 2
Mandatory course: no
Language of instruction: German
Assessment: Written examination: (50 %) + problem-solving exercises: (50 %)
Curricular relevance: KI847 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, optional course, informatics specific MST.DLO Mechatronics and Sensor Technology, Master, ASPO 01.04.2016, optional course, non-technical, course inactive since 13.10.2015 PIM-WN50 Applied Informatics, Master, ASPO 01.10.2011, semester 2, optional course, not informatics specific MST.DLO Mechatronics and Sensor Technology, Master, ASPO 01.10.2011, optional course, non-technical, course inactive since 13.10.2015
Workload: 30 class hours (= 22.5 clock hours) over a 15-week period. The total student study time is 90 hours (equivalent to 3 ECTS credits). There are therefore 67.5 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Klaus-Jürgen Schmidt

Lecturer: Prof. Dr. Klaus-Jürgen Schmidt
[*updated 19.07.2007*]

Learning outcomes:
After completing this module students will understand the objectives, tasks and methods of logistics systems and their use in the distribution of end products and spare parts. They will be able to systematically assess the structure and economic feasibility of current logistics systems and will be in a position to develop new concepts and solutions for industrial and commercial applications.

During this module students will work in small teams to develop concepts for solving typical small self-contained logistics problems and will then present their results to decision makers.
[*updated 08.05.2008*]

Module content:
1 Distribution logistics and full-service logistics
1.1 Company logistics
1.2 Objectives and tasks of distribution logistics
1.3 Practical goal and task systems in logistics for the automotive industry

2 Core processes and distribution logistics
2.1 Planning and control processes
2.2 Inbound processes and structures
2.3 Warehouse processes and structures
2.4 Outbound processes and structures
2.5 Projects to design core processes

3 Distribution logistics systems
3.1 System design concepts
3.2 Practical IT systems
3.3 Projects to design IT processes

4 Designing distribution infrastructures
4.1 Example projects from industry
4.2 Student projects
[*updated 08.05.2008*]

Recommended or required reading:
HOPPE, Niklas; CONZEN, Friedrich: Europäische Distributionsnetzwerke, Wiesbaden 2002
SCHMIDT, K.-J.: Logistik, Wiesbaden 1996
ZEILINGER, Peter: Distributionslogistik, in: Logistik, hrsg. Von K.-J. Schmidt, Wiesbaden 1996
[*updated 08.05.2008*]

Module offered in:
WS 2016/17, SS 2016, WS 2015/16, SS 2015, SS 2014, ...

Embedded Systems

Module name (EN): Embedded Systems
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI880
Hours per semester week / Teaching method: 2V+2P (4 hours per week)
ECTS credits: 5
Semester: 1
Mandatory course: no
Language of instruction: German
Assessment: Project and presentation, written exam
Curricular relevance: KI880 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 1, optional course, informatics specific KIM-EMBS Computer Science and Communication Systems, Master, ASPO 01.10.2017, semester 1, optional course, informatics specific PIM-WI25 Applied Informatics, Master, ASPO 01.10.2011, semester 1, optional course, informatics specific PIM-EMBS Applied Informatics, Master, ASPO 01.10.2017, semester 1, optional course, informatics specific
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Martina Lehser

Lecturer:
Prof. Dr. Martina Lehser
Dr.-Ing. Jörg Herter
[*updated 13.01.2014*]

Learning outcomes:
After successfully completing this module, the students will be able to assess the special challenges involved in designing embedded systems with regard to hard and software and take them into consideration during implementation. They will be able to make necessary design decisions based on their background knowledge and develop properties with regard to real-time behavior.
[*updated 24.02.2018*]

Module content:
1. The structure of embedded systems
2. Special security requirements
3. Time behavior requirements, determinism
4. Reliability and error tolerance
5. Embedded system design
6. Real-time operating systems and job scheduling methods
7. Embedded systems project
[*updated 24.02.2018*]

Teaching methods/Media:
Lecture on the theoretical content and supervised practical course, largely independent group work within the framework of the project.
[*updated 24.02.2018*]

Recommended or required reading:
P. Marwedel: Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems, and the Internet of Things, Springer 2017
G. Buttazzo: Hard Real-Time Computing Systems, Springer 2004
P. Pop et al.: Analysis and Synthesis of Distributed Real-Time Embedded Systems, Springer 2004
F. Vahid, T.Givargis: Embedded System Design, John Wiley 2003
[*updated 24.02.2018*]

Module offered in:
SS 2019, SS 2018, SS 2017, SS 2016, SS 2015, ...

Environmental Decision Support Systems

Module name (EN): Environmental Decision Support Systems

Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016

Module code: KI869

Hours per semester week / Teaching method: 4V (4 hours per week)

ECTS credits: 5

Semester: 2

Mandatory course: no

Language of instruction:
English

Assessment:
Group project: requirements specification for an EDSS

Curricular relevance:
KI869 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, optional course, informatics specific
KIM-EDSS Computer Science and Communication Systems, Master, ASPO 01.10.2017, semester 2, optional course, informatics specific
MAM.2.1.2.22 Engineering and Management, Master, ASPO 01.10.2013, semester 8, optional course, informatics specific
PIM-WI65 Applied Informatics, Master, ASPO 01.10.2011, semester 2, optional course, informatics specific
PIM-EDSS Applied Informatics, Master, ASPO 01.10.2017, semester 2, optional course, informatics specific

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Ralf Denzer

Lecturer:
Prof. Steven Frysinger
Prof. Dr. Ralf Denzer
[*updated 25.03.2015*]

Learning outcomes:
After successfully completing this module, students will be able to:
- Explain the natural and social science foundations of environmental decisions;
- Discuss the role of information systems in decision support in general, and environmental decision making in particular;
- Describe the difference between Environmental Management Information Systems and Environmental Decision Support Systems (EDSS);
- Explain the value of integrating such technologies as geographic information systems, mathematical process modeling, Monte Carlo simulation, linear programming, and expert systems into an EDSS;
- Describe the theoretical foundations of geographical information systems;
- Compare and contrast vector vs. raster encoding of spatial data layers;
- Develop a user-centered design of an EDSS for a specific decision and decision maker.
[*updated 26.02.2018*]

Module content:
Environmental Decision Support Systems are computer systems that help humans make environmental management decisions.

They facilitate "Natural Intelligence" by making information available to the human in a form that maximizes the effectiveness of their cognitive decision processes, and they can take a number of forms. EDSSs are focused on specific problems and decision-makers.

This sharp contrast with the general-purpose character of such software systems as Geographic Information Systems (GIS) is essential in order to put and keep EDSSs in the hands of real decision-makers who have neither the time nor inclination to master the operational complexities of general-purpose systems.

This course will combine seminars on various topics essential to EDSS design with a practical project in which students will specify the fundamental interaction design and software architecture of a system supporting an environmental decision problem of their choice.
[*updated 26.02.2018*]

Recommended or required reading:
[*still undocumented*]

Module offered in:
SS 2020 (probably), SS 2019, SS 2018, SS 2017, SS 2016, ...

Future Internet: Experimental Networks and Software Defined Networking

Module name (EN): Future Internet: Experimental Networks and Software Defined Networking
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI759
Hours per semester week / Teaching method: 4V (4 hours per week)
ECTS credits: 5
Semester: 1
Mandatory course: no
Language of instruction: English
Assessment: Written exam/paper
Curricular relevance: E2933 Electrical Engineering and Information Technology, Master, ASPO 01.04.2019, optional course, technical KI759 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 1, optional course, informatics specific KIM-FSDN Computer Science and Communication Systems, Master, ASPO 01.10.2017, semester 1, optional course, informatics specific PIM-WI68 Applied Informatics, Master, ASPO 01.10.2011, semester 1, optional course, informatics specific PIM-FSDN Applied Informatics, Master, ASPO 01.10.2017, semester 1, optional course, informatics specific
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Damian Weber

Lecturer:
Prof. Joberto Martins
[*updated 04.09.2012*]

Lab:
Communication Systems Lab (5204)

Learning outcomes:
After successfully completing this course, students will be able to classify all of the consequences of adopting Software Defined Networking (SDN) to the applications development process. Students will be able to assess the impact of SDN for the TCP/IP architecture. They will also be capable of explaining and implementing openflow-based applications. In addition, students will be capable of designing control and monitoring frameworks and writing a concept for a deploying mechanism of such tools using advanced concepts such as federation.
[*updated 26.02.2018*]

Module content:
1. Networking Architectural Approaches and Issues:
- Actual IP architecture scenario and new requirements
- Software Defined Networking (SDN)
- Architectural issues: naming, addressing, mobility, scalability, autonomy and virtualization

2. OpenFlow Protocol:
- OpenFlow (OF) architecture
- OF protocol
- OF and virtualization
- OF use cases: virtual router, level 2 virtualization, other
- OF experimentation with MiniNet (hands-on exercises)

3. Experimental Networks (EN):
- Experimental Networks principles - user-defined, large and innovative experiments, users, reproducibility, scaling and monitoring:
  . Experiment (project) requirements
  . Experiment (project) planning
  . Experiment (project) execution
  . Experiment (project) monitoring
- CMF _ Control and Monitoring Framework _ model and components
- Experimental network OFELIA (OpenFlow in Europe: Linking Infrastructure and Applications) _ Architecture:
components, tools, experimentation facilities, monitoring
- Experimental Network OMF (Orbit Management Framework) _ Architecture:
components, tools, experimentation facilities, monitoring
- Experimental Network FIBRE EU-BR (Future Internet Testbed Experimentation between Brazil and Europe) _ Architecture:
components, tools, experimentation facilities, monitoring
- Experimental networks monitoring:
- Architecture, components and issues on monitoring an experiment using an "Experimental Network" (EN)

- Study case: FIBRE EU-BR I&M Architecture
- Experimental Networks Federation:
  . Federation principles
  . SFA (Slice-based Federation Architecture) approach
- Experimental Networks "hands-on" exercise:
  Exercise: create a project/experiment on one of the above experimental networks (OFELIA, OMF or FIBRE)

4. Future Internet - Trends and Scenarios:
- QoS (Quality of Service) and QoE (Quality of Experience) in FI
- FI use cases
- FI research

[*updated 26.02.2018*]

Recommended or required reading:
[*still undocumented*]

Module offered in:
WS 2018/19, WS 2017/18, WS 2016/17, WS 2015/16, WS 2014/15, ...

GPU Computing

Module name (EN): GPU Computing
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI784
Hours per semester week / Teaching method: 2V+2P (4 hours per week)
ECTS credits: 5
Semester: 1
Mandatory course: no
Language of instruction: German
Assessment: Written exam/Project
Curricular relevance: KI784 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 1, optional course, informatics specific KIM-GPU Computer Science and Communication Systems, Master, ASPO 01.10.2017, semester 1, optional course, informatics specific PIM-WI72 Applied Informatics, Master, ASPO 01.10.2011, semester 1, optional course, informatics specific PIM-GPU Applied Informatics, Master, ASPO 01.10.2017, semester 1, optional course, informatics specific
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Jörg Keller

Lecturer: Prof. Dr. Jörg Keller
[*updated 13.07.2016*]

Lab:
IT-security lab (5103/2)

Learning outcomes:
After successfully completing this module, students will be able to understand the operation of modern CPU/GPU structures and
to compare their essential characteristics. With the help of GPU programming paradigms, they will be able to plan massively parallel approaches to solutions,
assess their resource consumption and demonstrate their practicability on the basis of concrete implementations.

Furthermore, students will be able to adapt learned techniques to new problems and assess the quality of the corresponding solutions.
[*updated 24.02.2018*]

Module content:
The lecture will start with a short overview of the architecture and
basics of parallel programming for multi-core CPUs and GPUs.
In doing so, we will concentrate on the similarities and differences,
in order to simplify the programming of GPUs by transferring parallel programs
for multi-cores. In addition to techniques such as the regularization
of control flow and memory accesses, algorithmic
techniques will also be taught using several application domains
ranging from classical numerics to cryptography.

- The architecture of modern CPU cores
  (super scalability, hyperthreading, etc.)
- The architecture of modern multi-core processors
  (multiple cores, shared caches, memory access)
- The programming of modern multi-core processors
  (basics of POSIX threads and OpenMP)
- Advanced programming of modern multi-core processors
  (examples of coordination by critical sections, barriers, etc)

- The architecture of modern GPU architectures
  (several multiprocessors, multiprocessors as SIMD architectures)
- Differences between GPUs and CPUs
  (SIMD vs MIMD, data transport, CPU/GPU collaboration)
- Advantages of GPUs over CPUs
  (processing power, explicit use of local memory, massive parallelism)
- Basics of GPU programming with CUDA
  (example programs, time measurement, relation calculation transport)
- Differences between CUDA and OpenCL
  (OpenCL more general, but more complex, code usually less efficient)

- Performance dependency between indexing and memory usage
  (differences depending on dimensional number and size, placement of variables)
- Regularization of code for performance enhancement
  (transfer of multi-core code to GPU, SIM, etc.)

- Numeric applications
  (parallel numerical solution of simple differential equations)
- Combinatorial applications
  (problems in graphs, focus on regularization)
- Cryptographic applications
  (focus on regularity, as well as bit-serial implementation)
- Hard problems
  (NP-hard problems, approximations, parallelization for GPU)

[*updated 06.09.2018*]

Teaching methods/Media:
Cuda systems with NVidia Tesla and Kepler GPU architecture
[*updated 20.12.2017*]

Recommended or required reading:
[*still undocumented*]

Module offered in:
WS 2018/19, WS 2017/18, WS 2016/17

Hardware Implementation of Digital Algorithms

Module name (EN): Hardware Implementation of Digital Algorithms
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI780
Hours per semester week / Teaching method: 4V (4 hours per week)
ECTS credits: 4
Semester: 1
Mandatory course: no
Language of instruction: German
Assessment: Written exam
Curricular relevance: KI780 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 1, optional course
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 120 hours (equivalent to 4 ECTS credits). There are therefore 75 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Martin Buchholz

Lecturer:
Prof. Dr. Martin Buchholz
[*updated 01.04.2003*]

Learning outcomes:
This course of lectures introduces students to the fundamentals of digital signal processing. Digital systems in the time and frequency domains will be discussed. The z and df transforms provide the basis for understanding and implementing signal processing algorithms.
[*updated 02.07.2007*]

Module content:
1. CTI systems in the time domain
2. Describing LTI signals and systems in the frequency domain
3. The z-transform
4. Digital filters
5. The discrete Fourier transform (DFT)
6. Signal processing algorithms
[*updated 02.07.2007*]

Recommended or required reading:
LECHNER W., LOHL N., Analyse digitaler Signale, Vieweg
JOHNSON J.R., Digitale Signalverarbeitung, Hanser
ZANDER H., Datenwandler, Vogel, 1990
BRIGHAM E.O., FastFourierTransformation (FFT), Oldenburg, 1992
[*updated 02.07.2007*]

Module offered in:
WS 2004/05

Human Factors

Module name (EN): Human Factors

Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016

Module code: KI857

Hours per semester week / Teaching method: 4V (4 hours per week)

ECTS credits: 5

Semester: 2

Mandatory course: no

Language of instruction:
English

Assessment:
Project

Curricular relevance:
KI857 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, optional course, general subject
KIM-HUMF Computer Science and Communication Systems, Master, ASPO 01.10.2017, semester 2, optional course, general subject
MAM.2.2.6 Engineering and Management, Master, ASPO 01.10.2013, semester 8, optional course, not informatics specific
PIM-WN16 Applied Informatics, Master, ASPO 01.10.2011, semester 2, optional course, not informatics specific
PIM-HUMF Applied Informatics, Master, ASPO 01.10.2017, semester 2, optional course, not informatics specific
Suitable for exchange students (learning agreement)

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Steven Frysinger

Lecturer:
Prof. Steven Frysinger
[*updated 11.02.2009*]

Learning outcomes:
After successfully completing this module, students will be able to:
- Describe the anthropometric, ergonomic, and cognitive abilities and limitations of humans in the context of their use of such systems as automobiles, tools, workstations, and computing systems;
- Conduct critical analyses of systems with respect to the degree and effectiveness of integration with users_ characteristics;
- Identify and characterize the users of a particular product or process to be designed;
- Gather and analyze needs assessment data from representative users of a product or process;
- Develop a hierarchical task analysis of the users;
- Develop both a conceptual design and a physical design of a product or process;
- Write a user requirements specification for the system;
- Develop a test plan by which their system design could be submitted to summative evaluation upon implementation.
[*updated 26.02.2018*]

Module content:
The course content will include some (but not necessarily all) of the following topics, adjusted in part based upon the backgrounds and interests of the students:

1. Introduction to Human Factors
2. Research Methods
3. Design and Evaluation Methods
4. Visual Sensory System
5. Auditory, Tactile, and Vestibular System
6. Cognition
7. Decision Making
8. Displays
9. Controls
10. Engineering Anthropometry and Workspace Design
11. Biomechanics at Work
12. Work Physiology
13. Stress and Workload
14. Safety, Accidents, and Human Error
15. Human-Computer Interaction
16. Automation
17. Transportation Human Factors
18. Selection and Training
19. Social Factors

[*updated 26.02.2018*]

Recommended or required reading:
An Introduction to Human Factors Engineering by Christopher D. Wickens, John Lee, Yili Liu & Sallie E. Gordon-Becker (2nd edition) 2003
[*updated 26.02.2018*]

Module offered in:
SS 2020 (probably), SS 2019, SS 2018, SS 2017, SS 2016, ...

Intelligent Networks

Module name (EN): Intelligent Networks
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI875
Hours per semester week / Teaching method: 2V (2 hours per week)
ECTS credits: 3
Semester: 1
Mandatory course: no
Language of instruction: German
Assessment: 180-minute written exam
Curricular relevance: KI875 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 1, optional course PIM-WN20 Applied Informatics, Master, ASPO 01.10.2011, semester 2, optional course Suitable for exchange students (learning agreement)
Workload: 30 class hours (= 22.5 clock hours) over a 15-week period. The total student study time is 90 hours (equivalent to 3 ECTS credits). There are therefore 67.5 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Horst Wieker

Lecturer:
Prof. Dr. Horst Wieker
Dipl.-Ing. Jens Constroffer
[*updated 01.04.2003*]

Learning outcomes:
Modern telecommunications has become a strategic factor for modern companies and is one of the fastest growing markets today. Modern call-centre applications exploit the full range of options offered by telecom networks. The telecommunications applications are supported by so-called intelligent networks (INs). IN platforms are used to incorporate new complex services into the telecom network. IN platforms are now being used not only in mobile and fixed network applications, but also in the internet. IN applications are network-independent. A major benefit of intelligent networks is that they have been completely specified by the ITU. Students will be taught about the architecture and operation of intelligent networks. This will involve redefining the term service and learning how to describe service implementation in terms of processes.
[*updated 08.05.2008*]

Module content:
1. What is an intelligent network?
2. The IN concept
3. User interfaces
4. Architecture model
5. Signalling protocols in INs
6. Platforms and tools
7. SSP, SCP, SMP, SRP, Service Node
8. IN services
9. Number translation, routing, VPN, mass calling, calling card

[*updated 08.05.2008*]

Recommended or required reading:
SIGMUND G., Intelligente Netze
[*updated 02.07.2007*]

Module offered in:
WS 2006/07, WS 2005/06, WS 2004/05

Introduction to Robotics

Module name (EN): Introduction to Robotics

Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016

Module code: KI842

Hours per semester week / Teaching method: 2V+2P (4 hours per week)

ECTS credits: 5

Semester: 2

Mandatory course: no

Language of instruction:
German

Assessment:
Project work

Curricular relevance:
KI842 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, optional course, informatics specific
MTM.ERO Mechatronics, Master, ASPO 01.04.2020, optional course, informatics specific
MST.ERO Mechatronics and Sensor Technology, Master, ASPO 01.04.2016, optional course, informatics specific
PIM-WI20 Applied Informatics, Master, ASPO 01.10.2011, semester 1, optional course, informatics specific
MST.ERO Mechatronics and Sensor Technology, Master, ASPO 01.10.2011, optional course, informatics specific

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Martina Lehser

Lecturer:
Dipl.-Ing. Dirk Ammon
[*updated 11.05.2007*]

Learning outcomes:
The theoretical part of this course aims to acquaint students with the basic tasks and problems in the field of mobile robotics (self-localization, navigation, map building and route planning) and to provide them with the skills necessary to develop appropriate solutions. This knowledge is then applied to a project carried out in the practical part of the module. The focus of the practical task is less on the pure construction of a robot and more on the programming requirements. Students will learn to interpret sensor data intelligently and to make efficient use of these data by integrating them into multiple processes.
[*updated 08.05.2008*]

Module content:
I. Theoretical part: Lecture course
1. Introduction
   History and development of robotics
   Fundamentals and definitions
   Control paradigms
2. Hardware
   Sensors used in robotics
   Actuators used in robotics
   Mechanics and robot kinematics
3. Navigation
   Mathematical basics
   Coupled navigation
   Navigation using landmarks
   Examples from biology
4. Map building and route planning

II. Practical part: Project
Creation of a mobile robot (students work in groups of two)
- Group-specific definition of task and project discussions
- Development, realization and testing
- Documentation
- Formal presentation of results

[*updated 08.05.2008*]

Recommended or required reading:
NEHMZOW, Ulrich: Mobile Robotik: Eine praktische Einführung, Springer Verlag Berlin-Heidelberg 2002
GOCKEL, DILLMANN: Embedded Robotics: Das Praxisbuch, Elektor-Verlag, Aachen 2005
[*updated 08.05.2008*]

Module offered in:
SS 2013, SS 2012, SS 2011, SS 2010, SS 2009, ...

Knowledge Based Systems

Module name (EN): Knowledge Based Systems
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI877
Hours per semester week / Teaching method: -
ECTS credits: 5
Semester: 4
Mandatory course: no
Language of instruction: German
Assessment:
Curricular relevance: KI877 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 4, optional course, informatics specific
Workload: The total student study time for this course is 150 hours.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Ralf Denzer
Lecturer: Prof. Dr. Ralf Denzer [*updated 01.02.2013*]

Learning outcomes: [*still undocumented*]
Module content: [*still undocumented*]
Recommended or required reading: [*still undocumented*]

Medical Informatics

Module name (EN): Medical Informatics
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI781
Hours per semester week / Teaching method: 2V (2 hours per week)
ECTS credits: 3
Semester: 1
Mandatory course: no
Language of instruction: German
Assessment:
Curricular relevance: KI781 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 1, optional course, informatics specific PIM-WI40 Applied Informatics, Master, ASPO 01.10.2011, semester 1, optional course, informatics specific
Workload: 30 class hours (= 22.5 clock hours) over a 15-week period. The total student study time is 90 hours (equivalent to 3 ECTS credits). There are therefore 67.5 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Dr. Helmut Jäger

Lecturer:
Dr. Helmut Jäger
[*updated 01.10.2006*]

Learning outcomes:
This course is designed to show students the power and potential of medical informatics and establishes the necessary foundation for design-related decisions and for system development in medically relevant areas.
[*updated 08.05.2008*]

Module content:
1) Basic medical terminology:
This section introduces students to the basics of anatomy and physiology. It provides an overview of the structure and function of an individual cell through to the complex organ systems found in the human body. The areas covered have been selected to be of relevance to medical informatics.

2) Basic terminology in the field of informatics:
A number of the basic terms and concepts needed to understand the field of medical informatics will be reviewed. Examples include data structure (lists, graphs, trees, hash tables, etc.), algorithms (sorting, greedy algorithms, dynamic programming) and database models.

3) Medical informatics:
Fundamentals of medical informatics: medical classification systems, IT systems in medical practices, hospital information systems, electronic medical records, medical image processing, lab systems, invoicing modules, etc. As personal data will be processed, data protection and privacy requirements must be met.
[*updated 08.05.2008*]

Recommended or required reading:
To be announced during the course.
[*updated 02.07.2007*]

Module offered in:
WS 2014/15, WS 2013/14, WS 2012/13, WS 2011/12, WS 2010/11, ...

Next-Generation Networks

Module name (EN): Next-Generation Networks
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI865
Hours per semester week / Teaching method: 4V (4 hours per week)
ECTS credits: 5
Semester: 3
Mandatory course: no
Language of instruction: English
Assessment: 180-minute written exam
Curricular relevance: KI865 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 3, optional course, telecommunications-specific
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Horst Wieker

Lecturer:
Prof. Dr. Horst Wieker
Dipl.-Ing. Harald Krauss
[*updated 01.04.2003*]

Learning outcomes:
The aim of this module is to show students the potential behind network convergence (voice, data, etc.) and to illustrate how and with what interfaces and protocols network convergence can be realized.
[*updated 02.07.2007*]

Module content:
1. Introduction: network evolution
1.1.....Conventional network concepts
1.2.....Telephony networks
1.3.....Mobile networks
1.4.....Internet
2. Quality of Service
2.1.....ITU specifications
2.2.....Architecture and protocols
3. The IETF architecture and its protocols
3.1.....Examples of convergence
3.2.....Soft switching
3.3.....Private networks
4. Services
4.1.....Intelligent networks and the internet
4.2.....Authentication, authorization and accounting
4.3.....RADIUS, DIAMETER and COPS
[*updated 02.07.2007*]

Recommended or required reading:
SIGMUND G., Next Generation Networks
FORD M., LEW K., et al, Handbuch Netzwerk-Technologien. Komplettes Grundwissen für Internetworking und Networking. Markt&Technik, 1998
[*updated 02.07.2007*]

Module offered in:
SS 2008, SS 2007, SS 2006, SS 2005

Planning and Running IT Workshops

Module name (EN): Planning and Running IT Workshops
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI762
Hours per semester week / Teaching method: 1V+1P (2 hours per week)
ECTS credits: 3
Semester: 1
Mandatory course: no
Language of instruction: German
Assessment: Project work
Curricular relevance: KI762 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 1, optional course, informatics specific KIM-PDIW Computer Science and Communication Systems, Master, ASPO 01.10.2017, semester 1, optional course, informatics specific PIM-WI48 Applied Informatics, Master, ASPO 01.10.2011, semester 1, optional course, informatics specific PIM-PDIW Applied Informatics, Master, ASPO 01.10.2017, semester 1, optional course, informatics specific
Workload: 30 class hours (= 22.5 clock hours) over a 15-week period. The total student study time is 90 hours (equivalent to 3 ECTS credits). There are therefore 67.5 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:

Module coordinator:
Prof. Dr.-Ing. André Miede

Lecturer: Prof. Dr.-Ing. André Miede
[*updated 14.07.2014*]

Learning outcomes:
After successfully completing this course, students will be able to describe, explain and compare the special challenges involved in planning, organizing and carrying out technical workshops. They will be able to use what they have learned to develop and carry out courses themselves, e. g. for the development of computer games or for the construction and programming of robots.
[*updated 26.02.2018*]

Module content:
* Create a concept for a course
* Develop and create course materials in German
* Plan, organize and conduct a course for a selected target group
* Review and document the experiences made

In addition to the topics mentioned above, this course will also focus on specialized and technical questions pertaining to workshops.

In addition to this course, we recommend students take part in the elective "Planung und Durchführung technischer Workshops" ("Planning and Running Technical Workshops"). It focuses in the didactic aspects in the planning, implementation and evaluation of workshops. The order in which the two courses are taken is arbitrary (the courses have different thematic focuses, but they both accompany a complete workshop life cycle).
[*updated 26.02.2018*]

Recommended or required reading:
Literature and external support will be provided for the implementation and moderation of workshops.
[*updated 26.02.2018*]

Module offered in:
WS 2018/19, WS 2017/18, WS 2016/17, WS 2015/16, WS 2014/15

Planning and Running RoboNight Workshops

Module name (EN): Planning and Running RoboNight Workshops
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI863
Hours per semester week / Teaching method: 1PA+1S (2 hours per week)
ECTS credits: 3
Semester: 2
Mandatory course: no
Language of instruction: German
Assessment: Participation in 5 classes, 3 workshops, the competition + a written composition
Curricular relevance: KI863 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, optional course, general subject KIM-PDRW Computer Science and Communication Systems, Master, ASPO 01.10.2017, semester 2, optional course, general subject MTM.PRN Mechatronics, Master, ASPO 01.04.2020, optional course, not informatics specific MAM.2.1.1.10 Engineering and Management, Master, ASPO 01.10.2013, semester 8, optional course, not informatics specific MST.PRN Mechatronics and Sensor Technology, Master, ASPO 01.04.2016, optional course, not informatics specific PIM-WN21 Applied Informatics, Master, ASPO 01.10.2011, semester 2, optional course, not informatics specific PIM-PDRW Applied Informatics, Master, ASPO 01.10.2017, semester 2, optional course, not informatics specific MST.PRN Mechatronics and Sensor Technology, Master, ASPO 01.10.2011, optional course, not informatics specific Suitable for exchange students (learning agreement)

Workload:
30 class hours (= 22.5 clock hours) over a 15-week period.
The total student study time is 90 hours (equivalent to 3 ECTS credits).
There are therefore 67.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Martina Lehser

Lecturer: Prof. Dr. Martina Lehser
[*updated 18.02.2010*]

Learning outcomes:
After successfully completing this module, the students will be able to assess the special challenges involved in conducting technical
workshops and take them into regard during the preparatory phase of the workshop. They will be able to adapt the contents of the training courses to the participants´ previous knowledge and provide appropriate support in dealing with technical questions. Students will also be able to collect and prepare the knowledge necessary for the course and impart it to the workshop participants in such a manner as to fit their age groups.

In addition, they will be able to put together tasks that are specifically adapted to their target groups and will help build and consolidate their workshop participants´ knowledge in the programming and construction of robots. They will know the technical possibilities and limitations of the systems used and will be able to estimate the logistical work involved in preparing the workshop.
[*updated 24.02.2018*]

Module content:
- Conceive and formulate tasks (for workshops and competition)
- Design and implement possible solutions
- Create training materials and video tutorials
- Conduct intensive courses for small groups
- Organize and conduct 3 workshops
- Organize and supervise the competition
- Conduct follow-up work and document the experiences made
[*updated 24.02.2018*]

Teaching methods/Media:
Introductory workshop for robot programming with Mindstorm robots on computers and tablets, supervised practical course, largely independent development of the contents in groups, project discussions and workshop coaching.
[*updated 24.02.2018*]

Recommended or required reading:
- EV3-Programmierung Kurse, htw saar, EmRoLab 2017
- Programming LEGO NXT Robots using NXC, Daniele Benedettelli
- Workbook Bluetooth, HTWdS, EmRoLab 2011
- NXT-Programmierung I und II: Einführung und Fortgeschrittene, HTWdS, EmRoLab 2011
[*updated 24.02.2018*]

Module offered in:
SS 2020 (probably), SS 2019, SS 2018, SS 2017, SS 2016, ...

Planning and Running Technical Workshops

Module name (EN): Planning and Running Technical Workshops
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI836
Hours per semester week / Teaching method: 1V+1P (2 hours per week)
ECTS credits: 3
Semester: 2
Mandatory course: no
Language of instruction: German
Assessment: Workshop, written composition and presentation
Curricular relevance: KI836 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, optional course, general subject KIM-PDTW Computer Science and Communication Systems, Master, ASPO 01.10.2017, semester 2, optional course, general subject PIM-WN13 Applied Informatics, Master, ASPO 01.10.2011, semester 2, optional course, not informatics specific PIM-PDTW Applied Informatics, Master, ASPO 01.10.2017, semester 2, optional course, not informatics specific
Workload: 30 class hours (= 22.5 clock hours) over a 15-week period. The total student study time is 90 hours (equivalent to 3 ECTS credits). There are therefore 67.5 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:

Module coordinator:
Prof. Dr.-Ing. André Miede

Lecturer: Prof. Dr.-Ing. André Miede
[*updated 13.01.2014*]

Learning outcomes:
After successfully completing this course, students will be able to describe, explain and compare the special challenges involved in planning, organizing and carrying out technical workshops. They will be able to use what they have learned to develop and carry out courses themselves, e. g. for the development of computer games or for the construction and programming of robots.
[*updated 26.02.2018*]

Module content:
* Create a concept for a course
* Develop and create course materials in German
* Plan, organize and conduct a course for a selected target group
* Review and document the experiences made

In addition to the topics mentioned above, this course will also focus on specialized and technical questions pertaining to workshops.

In addition to this course, we recommend students take part in the elective "Planung und Durchführung von IT-Workshops" ("Planning and Running IT Workshops"). It focuses on the specialized, technical aspects of workshops. The order in which the two courses are taken is arbitrary (the courses have different thematic focuses, but they both accompany a complete workshop life cycle).
[*updated 26.02.2018*]

Recommended or required reading:
* Werner Hartmann, Michael Näf, Raimond Reichert: Informatikunterricht planen und durchführen. Springer. http://link.springer.com/book/10.1007/978-3-540-34485-8

* Peter Hubwieser: Didaktik der Informatik -- Grundlagen, Konzepte, Beispiele. Springer. http://link.springer.com/book/10.1007/978-3-540-72478-0

[*updated 26.02.2018*]

Module offered in:
SS 2018, SS 2017, SS 2016, SS 2015, SS 2014

Presenting Information

Module name (EN): Presenting Information
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI846
Hours per semester week / Teaching method: 2V+2U (4 hours per week)
ECTS credits: 5
Semester: 2
Mandatory course: no
Language of instruction: German
Assessment: Project work
Curricular relevance: KI846 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, optional course, informatics specific PIM-WI35 Applied Informatics, Master, ASPO 01.10.2011, semester 2, optional course, informatics specific
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Thomas Kretschmer

Lecturer: Prof. Dr. Thomas Kretschmer
[*updated 19.07.2007*]

Learning outcomes:
After completing this module students will
- understand and be able to use platform-independent document formats
- be able to design multimedia content based on open standards
- understand and be able to take into account different target groups and target media.

[*updated 08.05.2008*]

Module content:
- Basics (psychology of perception, accessibility (input and representational aids), internationalization)
- Target-oriented design of user interfaces, device- and platform-independent representation
- Structure and display of complex multimedia documents
- Automated document generation

[*updated 08.05.2008*]

Recommended or required reading:
http://www.w3.org
COOPER, Alan; REIMANN, Robert: About Face 2.0: The Essentials of Interaction Design, Wiley 2003
BULTERMAN, Dick; RUTLEDGE, Lloyd: SMIL 2.0 : Interactive Multimedia for Web and Mobile Devices, Springer 2004
MEYER, Eric: Cascading Style Sheets: The Definitive Guide, 2nd Edition, OReilly 2004
[*updated 08.05.2008*]

Module offered in:
SS 2013, SS 2012, SS 2011, SS 2010, SS 2009, ...

Quality of Service

Module name (EN): Quality of Service
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI742
Hours per semester week / Teaching method: 4V (4 hours per week)
ECTS credits: 5
Semester: 1
Mandatory course: no
Language of instruction: English
Assessment: Written exam
Curricular relevance: KI742 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 1, optional course, informatics specific
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Joberto Martins

Lecturer:
Prof. Joberto Martins
[*updated 01.04.2003*]

Learning outcomes:
The student will acquire an overview of QoS technical alternatives, their applicability and project issues, and will gain a deeper insight into MPLS technology and its main applications. The student is able to assess the benefits of optical networking in the context of quality of service.
[*updated 02.07.2007*]

Module content:
1. Quality of Service Principles and target applications: IP application scenario
Requirements definition: SLA (Service Level Agreement), SLS (Service Level Specification)

2. Router QoS: basic review:
Queue scheduling, congestion control and token bucket
Classification, policing and shaping

3. QoS with differentiated services architecture Principles and applicability:
DiffServ services: expedited forwarding and assured forwarding
End-to-end quality of service
Implementation analysis

4. MPLS (MultiProtocol Label Switching):
MPLS Principles and applications
LDP Label Distribution Protocol
Constraint-based routing, CR-LDP and RSVP-TE

5. MPLS application Traffic engineering:
Traffic engineering principles
Technical aspects and MPLS-based implementation

6. MPLS application VPN (Virtual Private Networks):
VPN principles
Technical aspects and MPLS-based implementation

7. GMPLS Generalized MPLS:
MPLS and optical switching
Protocol architectures, signalling and frameworks
Technical aspects: resilience, traffic engineering, others

8. Management frameworks:
QoS management: overview and issues
QoS and MPLS solutions: COPS, mobile agents, others
[*updated 02.07.2007*]

Recommended or required reading:
Aidarous, S., Plevyack, T., Martins, J. S. B., et al.; Managing IP Networks Challenges and Opportunities, IEEE Press, John Wiley, 2003.
Martins, J.S.B., Quality of Service and MPLS Technologies and Applications Course Notes, 2004.
[*updated 02.07.2007*]

Module offered in:
WS 2011/12, WS 2010/11, WS 2009/10, SS 2009, WS 2007/08, ...

Research and Innovation Management

Module name (EN): Research and Innovation Management

Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016

Module code: KI832

Hours per semester week / Teaching method: 4SU (4 hours per week)

ECTS credits: 5

Semester: 2

Mandatory course: no

Language of instruction:
German

Assessment:
Project, talk

Curricular relevance:
E1845 Electrical Engineering, Master, ASPO 01.10.2013, optional course, non-technical
KI832 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, optional course, non-technical
KIM-FUIM Computer Science and Communication Systems, Master, ASPO 01.10.2017, semester 2, optional course, non-technical
MAM.2.2.19 Engineering and Management, Master, ASPO 01.10.2013, semester 2, optional course, non-technical
PIM-WN43 Applied Informatics, Master, ASPO 01.10.2011, semester 2, optional course, not informatics specific
PIM-FUIM Applied Informatics, Master, ASPO 01.10.2017, semester 2, optional course, not informatics specific
MST.FIM Mechatronics and Sensor Technology, Master, ASPO 01.10.2011, optional course, non-technical

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Günter Schultes

Lecturer:
Gastdozenten aus Unternehmen
Dr. Olivia Freitag-Weber
[*updated 30.03.2015*]

Learning outcomes:
After successfully completing this module, students will be able to
develop innovative ideas in a team using creative methods and to define a new product, quantify its degree of innovation and differentiate it from the current state of the art or direct competitors,
select a product-specific development and production environment,
divide the work required to turn the idea into a marketable product into work packages, estimate the time and cost involved and identify financing options and
present their idea, its feasibility and the market opportunities in a joint presentation in a well-founded and convincing manner.

[*updated 24.02.2018*]

Module content:
_ Definition and concept of the term innovation and the innovation process
_ Methods for finding new ideas
_ From the project idea to project management
_ Marketing I: developing strategic options
_ Marketing II: advertising, price, product features
_ Introduction to knowledge management
_ Intellectual capital as a management tool
_ State of the art, including property and patent rights
_ "Open innovation" strategic approach
_ Becoming an innovative company through organizational development
[*updated 24.02.2018*]

Teaching methods/Media:
_ Workshops
_ Group work
[*updated 20.12.2017*]

Recommended or required reading:
_ Walter Jakoby: _Projektmanagement für Ingenieure_, Springer Vieweg (2012)
_ Lothar Haberstock: _Kostenrechnung I_, Erich Schmidt Verlag
[*updated 24.02.2018*]

Module offered in:
WS 2018/19, WS 2017/18, WS 2016/17, WS 2015/16, SS 2015

Semantic Interoperability

Module name (EN): Semantic Interoperability
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI854
Hours per semester week / Teaching method: 3V+1U (4 hours per week)
ECTS credits: 6
Semester: 2
Mandatory course: no
Language of instruction: German
Assessment: Written exam: 60 %; presentation: 40 %
Curricular relevance: KI854 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, optional course, informatics specific PIM-SIVS Applied Informatics, Master, ASPO 01.10.2011, semester 2, mandatory course
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 180 hours (equivalent to 6 ECTS credits). There are therefore 135 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Reiner Güttler

Lecturer: Prof. Dr. Reiner Güttler
[*updated 10.02.2009*]

Learning outcomes:
Students will learn the significance of semantic integration as an important and frequently underestimated component of software architectures. Why do we need semantic interoperability? Why is it so difficult to implement? After being introduced to the fundamental definitions and terminology of semantics, students will learn to recognize that semantic conflicts are unavoidable and therefore have to be treated appropriately.

Students will become acquainted with the ideas and approaches used in solving semantic interoperability problems, and with their use in typical applications such as a e-business and Enterprise Application Integration (EAI).
[*updated 08.05.2008*]

Module content:
1. The meaning of semantic interoperability
2. Fundamentals of semantics
3. Semantic conflicts and solution patterns
4. Metadata and ontology design patterns
5. Interoperability architectures
6. Semantic Web
7. Infrastructure
8. Case studies

[*updated 08.05.2008*]

Recommended or required reading:
POLLOCK, Jeffrey, T.; HODGSON, Ralph: Adaptive Information, Wiley 2004
Proceedings of Semantic Web Conferences, e.g. ISWC 2004
Websites of relevant stakeholders and special-interest groups: e.g. http://www.wsmo.org/
[*updated 08.05.2008*]

Module offered in:
SS 2016, SS 2015, SS 2014, SS 2013, SS 2012, ...

Service Management with ITIL

Module name (EN): Service Management with ITIL

Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016

Module code: KI874

Hours per semester week / Teaching method: 2V (2 hours per week)

ECTS credits: 3

Semester: 2

Mandatory course: no

Language of instruction:
German

Assessment:
Written or oral exam

Curricular relevance:
KI874 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, optional course, general subject
KIM-ITIL Computer Science and Communication Systems, Master, ASPO 01.10.2017, semester 2, optional course, general subject
MAM.2.2.17 Engineering and Management, Master, ASPO 01.10.2013, semester 8, optional course, general subject
MST.SMI Mechatronics and Sensor Technology, Master, ASPO 01.04.2016, optional course, general subject, course inactive since 27.10.2015
PIM-WN31 Applied Informatics, Master, ASPO 01.10.2011, semester 2, optional course, not informatics specific
PIM-ITIL Applied Informatics, Master, ASPO 01.10.2017, semester 2, optional course, not informatics specific
MST.SMI Mechatronics and Sensor Technology, Master, ASPO 01.10.2011, optional course, general subject

Workload:
30 class hours (= 22.5 clock hours) over a 15-week period.
The total student study time is 90 hours (equivalent to 3 ECTS credits).
There are therefore 67.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr.-Ing. André Miede

Lecturer:
Dipl.-Ing. Markus Collet
Dipl.-Ing. Edgar Scholz
[*updated 16.01.2013*]

Learning outcomes:
Students will know and be able to explain the practice-proven procedures for the successful provision of IT services, including the necessary definitions of terms according to the international framework ITIL. They can differentiate between processes, their goals, roles and functions in the Service Life Cycle.
[*updated 20.12.2017*]

Module content:
The course will take place as a block lecture on several Saturdays. There will be a kick-off event at the beginning of the semester. For more information, please see further bulletins.

In addition to the written exam, students will have the chance to become certified by an external examiner (ITIL Foundation). More information will be available in the lecture.

1. IT Service Management according to ITIL
ITIL provides a systematic introduction into the quality of IT services. It is used worldwide (T-Systems, IBM, Microsoft....) as a standard framework.
2. Service Strategy
The service life cycle starts with a strategy. It provides instructions on how to design and implement service management. The goal is to achieve and maintain an advantage.

3. Service Design
The design and development of services, incl. their respective processes (for example: Service Level Management) will be discussed.

4. Service Transition
The development, testing and transfer of services to an operative business mode. Important processes here are change and release management.

5. Service Operation
Responsible for operating the technology required for service provision.

6. Continual Service Improvement
Today, IT departments must continuously improve their services (measure and analyze), in order to remain attractive for business.
[*updated 24.02.2018*]

Teaching methods/Media:
Case studies, practice test, coaching
[*updated 20.12.2017*]

Recommended or required reading:
ITIL Foundation Handbook (updated to the 2011 syllabus, English), ISBN 9780113313495
ITIL Foundation Handbuch (Aktualisiert gemäß Syllabus 2011), ISBN 9780113314690
ITIL Das Taschenbuch 2011 edition (German), ISBN 9789087537050
Die 5 Core Bücher: http://www.itil-officialsite.com/Publications/Core.aspx
[*updated 24.02.2018*]

Module offered in:
WS 2018/19, WS 2017/18, WS 2016/17, WS 2015/16, WS 2014/15, ...

Shape Analysis

Module name (EN): Shape Analysis
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI844
Hours per semester week / Teaching method: 2V+2P (4 hours per week)
ECTS credits: 5
Semester: 2
Mandatory course: no
Language of instruction: German
Assessment: Project (presentation and documentation)
Curricular relevance: KI844 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, optional course, informatics specific KIM-SHAN Computer Science and Communication Systems, Master, ASPO 01.10.2017, semester 2, optional course, informatics specific PIM-WI52 Applied Informatics, Master, ASPO 01.10.2011, semester 2, optional course, informatics specific PIM-SHAN Applied Informatics, Master, ASPO 01.10.2017, semester 2, optional course, informatics specific
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): KI744 Virtual Machines and Program Analysis [*updated 17.01.2008*]

Recommended as prerequisite for:

Module coordinator:
Dr.-Ing. Jörg Herter

Lecturer:
Dr.-Ing. Jörg Herter
[*updated 17.01.2008*]

Learning outcomes:
After successfully completing this course, students will have intensified their theoretical and practical knowledge about
static program analysis techniques.
They will have an overview of different shape analysis approaches,
can differentiate between the different approaches and can
describe the analysis by means of 3-valued logic.
Students will be able to independently understand sample analyses from scientific publications, reproduce their results
and adapt solutions from these analyses for their own
analyses.
Students will be able to plan and carry out analyses independently within a group
by means of 3-valued logic and to document the resulting results.

[*updated 26.02.2018*]

Module content:
Shape analyses are highly comprehensive program analyses that attempt to calculate all possible (heap) memory states (which objects are created, how these objects are connected to each other [field pointers] and how they are used), which a program can achieve using the program code. An attempt is then made to derive what the program does, whether it might contain errors, and so on from this set of program states.
Unlike typical program analyses that compilers perform to detect optimization possibilities, shape analyses can for example, be used to automatically check whether a program is working correctly.

Course content:
1. Introduction/Motivation
2. Kleene´s 3-valued logic
3. Shape analysis with 3-valued logic
4. Introduction into TVLA (Three Valued Logical Analyzer)
5. Case studies and example analyses with TVLA
[*updated 26.02.2018*]

Recommended or required reading:
Mooly Sagiv, Thomas Reps und Reinhard Wilhelm:
Parametric Shape Analysis via 3-Valued Logic
ACM Transactions on Programming Languages and Systems, 2002.

Jan Reineke:
Shape Analysis of Sets.
Masterarbeit an der Universität des Saarlandes, 2005.

Tal Lev-Ami, Thomas W. Reps, Mooly Sagiv und Reinhard Wilhelm:
Putting static analysis to work for verification: A case study.
ISSTA 2000: 26-38.

Tal Lev-Ami und Mooly Sagiv:
TVLA: A System for Implementing Static Analyses.
SAS 2000: 280-301.

Tal Lev-Ami:
TVLA: A framework for Kleene based static analysis.
Masterarbeit an der Universität Tel-Aviv, Israel, 2000.
[*updated 26.02.2018*]

Module offered in:
SS 2020 (probably), SS 2019, SS 2018, SS 2017, SS 2016, ...

Simulation and Hardware Implementation of Digital Algorithms and Systems

Module name (EN): Simulation and Hardware Implementation of Digital Algorithms and Systems

Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016

Module code: KI843

Hours per semester week / Teaching method: 2V+2P (4 hours per week)

ECTS credits: 5

Semester: 1

Mandatory course: no

Language of instruction:
German

Assessment:
Project, oral examination

Curricular relevance:
KI843 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 1, optional course, telecommunications-specific
KIM-DALG Computer Science and Communication Systems, Master, ASPO 01.10.2017, semester 1, optional course, telecommunications-specific
PIM-WI76 Applied Informatics, Master, ASPO 01.10.2011, semester 1, optional course, informatics specific
PIM-DALG Applied Informatics, Master, ASPO 01.10.2017, semester 1, optional course, informatics specific

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Martin Buchholz

Lecturer:
Prof. Dr. Martin Buchholz
Prof. Dr. Albrecht Kunz
Dipl.-Ing. Hans Rieder
[*updated 09.05.2007*]

Learning outcomes:
After successful completion of this module, students will understand the complex algorithms of telecommunications engineering. They will be capable of optimizing a digital system, because they know the limiting conditions of optimal software/hardware partitioning. Students will be able to estimate the effort required to implement this system and select the suitable technology (digital signal processors, microcontrollers or a hardware-based solution).

Students can use the process flow to implement these systems in DSP and FPGA and are familiar with the most common EDA tools.

Students can verify the successful implementation of the algorithms in metrological terms and record and evaluate them quantitatively.
[*updated 20.12.2017*]

Module content:
1.Complex digital algorithms in telecommunications engineering
Digital modulators und demodulators
Source and channel coding and decoding
Digital audio and video signal processing
Error protection methods
Synchronization methods
2.Software Defined Radio architectures
3.Hardware-Software partioning
4.Simulation with EDA tools such as Simulink, SPW (Signal Processor Workstation) and ML Designer, Co-simulation
5.Fundamentals of Digital Signal Processors (DSP)
6.Introduction to programmable hardware (FPGA)
7.Computer-aided, real-time implementation in digital signal processors (DSP) and programmable hardware (FPGA)
8.Synthesis, place and route, back annotation and debugging
9.Digitale measurement technology
[*updated 24.02.2018*]

Teaching methods/Media:
Lecture notes, projector, EDA simulation tools, lab work
[*updated 20.12.2017*]

Recommended or required reading:
Oppenheim, A. V.; Schafer, R. W.: Zeitdiskrete Signalverarbeitung, Oldenbourg Verlag, 1999
Proakis, J.G.: Digital Communications, Mc Graw Hill, 2000
Stearns, S.D.; Hush D.R.: Digitale Vararbeitung analoger Signale, Oldenbourg, 1999
Von Grünigen, D. Ch.: Digitale Signalverarbeitung, Carl-Hanser Verlag, 2004
Kammeyer, K.-D. / Kroschel K.: Digitale Signalverarbeitung - Filterung und Spektralanalyse, Teubner
Haykin, S.: Digital Communication Systems, John Wiley and Sons, 200
Abut, H. ; Hansen, J. ; Takeda, K.: DSP for IN-Vehicle and Mobile Systems, Springer, 2005
Bateman, A.; Paterson-Stephens, I.: The DSP Handbook, Algorithms, Applications and Design Techniques, Prentice Hall, 2002
Wolf, W.: FPGA Based System Design, Prentice Hall, 2004
[*updated 24.02.2018*]

Module offered in:
WS 2018/19, WS 2017/18, WS 2016/17, WS 2015/16, WS 2014/15, ...

Sino-German Smart Sensor Project

Module name (EN): Sino-German Smart Sensor Project
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI785
Hours per semester week / Teaching method: 4PA (4 hours per week)
ECTS credits: 6
Semester: 1
Mandatory course: no
Language of instruction: German
Assessment: Project
Curricular relevance: KI785 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 1, optional course, informatics specific KIM-SGSP Computer Science and Communication Systems, Master, ASPO 01.10.2017, semester 1, optional course, informatics specific PIM-WI73 Applied Informatics, Master, ASPO 01.10.2011, semester 1, optional course, informatics specific PIM-SGSP Applied Informatics, Master, ASPO 01.10.2017, semester 1, optional course, informatics specific
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 180 hours (equivalent to 6 ECTS credits). There are therefore 135 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Martina Lehser

Lecturer: Prof. Dr. Martina Lehser
[*updated 26.06.2017*]

Lab:
Embedded Robotics Lab (5307)

Learning outcomes:
After successfully completing this module, students will be able to design and develop Smart Services based on Industry 4.0 or the Internet of Things in an international and globally distributed project team.

In addition to acquiring professional qualifications in a project team with different linguistic, social and geographical environments, students will:
- learn to assume professional and organizational responsibility
- receive insights into intercultural competence with a focus on China
- be capable of communicating in and with the foreign language environment
- be able to arrange work with team members from different learning backgrounds and nations
- establish contacts with foreign partners promoting internationalization
- analyze and where necessary, adapt to other work methods

All of the above will enable students to quickly enter international project management after starting their career.
[*updated 24.02.2018*]

Module content:
Students from various fields and levels of study and with different degrees from the htw saar and CDHAW (Tongji Univ., Shanghai) will form a globally distributed team. The team will consist of 5 to 15 students. Over the period of a full semester, the team will work on a specific task within the project.
At the team´s locations, different aspects will be dealt with. At the htw saar the topic will be software development and at the CDHAW the topics will be hardware and production.

The project results will be presented to the lecturers in the form of a presentation and a final report.

Project management:
- Specifications
- Project planning
- Version management
Software development:
- Embedded devices
- Data logging
- Machine-to-machine communication
- Protocols (MQTT, OPC UA, AMQP)
Interfaces:
- Generic interfaces as Smart Services
- Integration of Smart Services
- Communication between Smart Services
- Gradual aggregation of Smart Services
Intercultural competence:
- Focus: China
- Patterns of communication
- Work methods
- The concept of time
[*updated 24.02.2018*]

Teaching methods/Media:
Lecture, workshop, training
Online/offline meetings
[*updated 20.12.2017*]

Recommended or required reading:
- China-Strategie des BMBF 2015_2020: Strategischer Rahmen für die Zusammenarbeit mit China in Forschung, Wissenschaft und Bildung
- Umsetzungsempfehlungen für das Zukunftsprojekt Industrie 4.0: Abschlussbericht des Arbeitskreises Industrie 4.0
- Konflikte und Synergien in multikulturellen Teams, Petra Köppel
- Management von IT-Projekten, Dr. Hans W. Wieczorrek, Dipl.-Math. Peter Mertens
- Führung im Projekt, Dr. Thomas Bohinc
- Embedded Technologies, Joachim Wietzke
- Embedded Linux, Joachim Schröder · Tilo Gockel · Rüdiger Dillmann
[*updated 20.12.2017*]

Software Architecture

Module name (EN): Software Architecture
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI747
Hours per semester week / Teaching method: 2V+2PA (4 hours per week)
ECTS credits: 5
Semester: 1
Mandatory course: no
Language of instruction: German
Assessment: Project
Curricular relevance: KI747 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 1, optional course, informatics specific KIM-SAR Computer Science and Communication Systems, Master, ASPO 01.10.2017, semester 1, optional course PIM-SAR Applied Informatics, Master, ASPO 01.10.2011, semester 1, mandatory course PIM-SAR Applied Informatics, Master, ASPO 01.10.2017, semester 1, mandatory course
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Markus Esch

Lecturer: Prof. Dr. Markus Esch
[*updated 08.07.2007*]

Learning outcomes:
After successfully completing this module, students will be capable of naming the basic concepts and methods of software architecture. They will be able to describe the tasks and role of a software architect in a project team and understand the importance of software architecture in large software projects.

They will be capable of deriving properties of a software architecture from user requirements and of developing and documenting a design using modern architectural approaches. In addition, they will also be able to analyze the advantages and disadvantages of an architecture and derive potential for improvement.

In the case studies accompanying the lectures, students will learn to work independently in small groups. They will be able to present their results and to document them in the form of a scientific publication.
[*updated 24.02.2018*]

Module content:
- Requirements for a software architecture
- The role and tasks of a software architect
- Process models
- Architectural views
- Architecture styles and patterns
- The documentation of a software architecture

[*updated 20.12.2017*]

Teaching methods/Media:
Lecture slides, annotated lecture slides as a script
[*updated 20.12.2017*]

Recommended or required reading:
Len BASS, Rick KAZMAN, Paul CLEMENTS: Software Architecture in Practice, Addison Wesley, 3rd Edition 2012

Gernot STARKE: Effektive Softwarearchitekturen: Ein praktischer Leitfaden, Hanser Verlag, 7. Auflage, 2015

Stefan ZÖRNER: Softwarearchitekturen dokumentieren und kommunizieren: Entwürfe, Entscheidungen und Lösungen nachvollziehbar und wirkungsvoll festhalten, Hanser Verlag, 2. Auflage, 2015

Rick KAZMAN, Humberto CERVANTES: Designing Software Architectures - A Practical Approach, Addison Wesley, 2016

George FAIRBANKS: Just Enough Software Architecture: A Risk-Driven Approach, Marshall & Brainerd, 2010
[*updated 20.12.2017*]

Module offered in:
WS 2018/19, WS 2017/18, WS 2016/17, WS 2015/16, WS 2014/15, ...

Software Development Processes

Module name (EN): Software Development Processes
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI841
Hours per semester week / Teaching method: 3V+1P (4 hours per week)
ECTS credits: 5
Semester: 2
Mandatory course: no
Language of instruction: German
Assessment: Oral examination 40%, term paper 30%, presentation 30%
Curricular relevance: KI841 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, optional course, informatics specific KIM-SEP Computer Science and Communication Systems, Master, ASPO 01.10.2017, semester 2, optional course PIM-SEP Applied Informatics, Master, ASPO 01.10.2011, semester 2, mandatory course PIM-SEP Applied Informatics, Master, ASPO 01.10.2017, semester 2, mandatory course
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Helmut Folz

Lecturer:
Prof. Dr. Helmut Folz
[*updated 01.04.2003*]

Learning outcomes:
After successfully completing this module, students will:
_ be able to analyze and evaluate the most important process models of software development from a higher perspective and to implement them project-specifically.
_ be able to master essential concepts of software quality management from the project manager´s point of view and will be able to plan their implementation.
_ be capable of assessing, explaining and applying the problems and the most important techniques of requirements engineering.
_ be able to familiarize themselves with new non-trivial problems in a team and to research, prepare and present them.
[*updated 24.02.2018*]

Module content:
Part 1 Process Models
1. Introduction to and overview of classic process models
2. The Rational Unified Process
3. The V-model XT
4. Agile process models
   4.1. Agile software development in general
   4.2. Extreme programming
   4.3. Scrum
   4.4. Other agile process models

Part 2 Software Quality Management
1. Introduction and overview
2. Analytical quality management
3. Constructive quality management
5. Quality models (ISO 15504, CMMI, ...)

Part 3 Requirements Engineering and Management
1. Introduction and overview
2. Requirement assessment
3. Requirement documentation
4. Requirements management

[*updated 24.02.2018*]

Teaching methods/Media:
Transparencies, projector
[*updated 24.02.2018*]

Recommended or required reading:
Rupp, Chris
Requirements-Engineering und -Management
Hanser Verlag

Ludewig, Jochen; Lichter, Horst
Software Engineering. Grundlagen, Menschen, Prozesse, Techniken
dpunkt.verlag

Ian Sommerville
Software Engineering
Pearson; München

Balzert, Helmut
Lehrbuch der Softwaretechnik (Band 2): Software-Management
Spektrum Akademischer Verlag

Ernest Wallmüller
Software Quality Engineering
Carl Hanser Verlag München / Wien

Peter Liggesmeyer
Software-Qualität
Spektrum Akademischer Verlag

Andreas Spillner; Tilo Linz
Basiswissen Softwaretest
dpunkt.verlag
[*updated 24.02.2018*]

Module offered in:
SS 2020 (probably), SS 2019, SS 2018, SS 2017, SS 2016, ...

Software Quality Engineering

Module name (EN): Software Quality Engineering
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI786
Hours per semester week / Teaching method: 2V+2PA (4 hours per week)
ECTS credits: 6
Semester: 1
Mandatory course: no
Language of instruction: German
Assessment: Project with final presentation
Curricular relevance: KI786 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 1, optional course, informatics specific KIM-SQE Computer Science and Communication Systems, Master, ASPO 01.10.2017, semester 1, optional course, informatics specific PIM-WI78 Applied Informatics, Master, ASPO 01.10.2011, semester 1, optional course, informatics specific PIM-SQE Applied Informatics, Master, ASPO 01.10.2017, semester 1, optional course, informatics specific
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 180 hours (equivalent to 6 ECTS credits). There are therefore 135 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Helmut Folz

Lecturer: Prof. Dr. Helmut Folz
[*updated 04.07.2017*]

Learning outcomes:
In times of large IT projects on the one hand and agile software development (with shorter and shorter release cycles) on the other, the importance of software quality assurance increases.
_ After successfully completing this course, students will be able to define the most important terms and concepts in software quality engineering and explain them using examples.
_ They will know and understand the various concepts of static and dynamic test techniques and be able to apply them to actual problems.
_ Students will be able to differentiate between different types of tests and know how they are used in different test stages and how to integrate them into the test process.
_ Students will become familiar with the different requirements for quality assurance in classic and agile development models and how these can be met.
_ Students will understand how to use tools for support in different scenarios and types of tests (test organization, test automation, load and performance tests, etc.)
[*updated 24.02.2018*]

Module content:
1. Basics of software quality assurance and introduction to software testing
2. Basics of agility and agile testing
3. Statistic software quality measures and black box test design techniques
4. White box test design techniques and code-driven metrics
5. Test automation I (general introduction and use in the classic process model)
6. Test automation II (use in the agile process model)
7. Test management, management-driven metrics and test planning and _estimates
8. Tool support and non-functional tests I (usability, security, operational tests)
9. Non-functional tests II (load and performance tests)
10. Final exercise (group work)
[*updated 24.02.2018*]

Teaching methods/Media:
Slides -

The slides can be used as a script and will be made available to students. In addition, selected articles on the topics of the lecture will be recommended.
[*updated 20.12.2017*]

Recommended or required reading:
Andreas Spillner,Tilo Linz:
Basiswissen Softwaretest: Aus- und Weiterbildung zum Certified Tester - Foundation Level nach ISTQB-Standard (ISQL-Reihe), dPunkt Verlag

[*updated 20.12.2017*]

Module offered in:
WS 2018/19, WS 2017/18

Software Quality Management

Module name (EN): Software Quality Management
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI890
Hours per semester week / Teaching method: 2V (2 hours per week)
ECTS credits: 3
Semester: 2
Mandatory course: no
Language of instruction: German
Assessment: Case study and oral examination
Curricular relevance: KI890 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, optional course, informatics specific PIM-WI45 Applied Informatics, Master, ASPO 01.10.2011, semester 2, optional course, informatics specific
Workload: 30 class hours (= 22.5 clock hours) over a 15-week period. The total student study time is 90 hours (equivalent to 3 ECTS credits). There are therefore 67.5 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Helmut Folz

Lecturer:
Prof. Dr. Helmut Folz
[*updated 01.04.2003*]

Learning outcomes:
This course addresses those subjects that in addition to the core activities of analysis, design and programming are of key importance in IT projects.

Particular emphasis will be given to the quality management procedures typically used in industrial software development processes. The course is suitable for students of informatics and engineers interested in working in IT project management and IT management.
[*updated 08.05.2008*]

Module content:
1. Software quality management: An overview
2. IT risk management
3. Constructive quality assurance techniques
4. Analytical quality assurance techniques
5. Planning software tests and test stages
6. Quality performance indices
7. Quality function deployment
8. Quality models (ISO 15504, CMMI, etc.)
9. Achieving quality through organization and communication
10. European Foundation for Quality Management (EFQM)

[*updated 08.05.2008*]

Recommended or required reading:
BALZERT, HELMUT: Lehrbuch der Softwaretechnik, Spektrum Akademischer Verlag, Band 2 Software-Management, 1998
WALLMÜLLER, ERNEST: Softwarequalitätsmanagement in der Praxis, Carl Hansen Verlag, 2. Auflage, München/Wien 2001
[*updated 08.05.2008*]

Module offered in:
SS 2011, SS 2010, SS 2009, SS 2008, SS 2007, ...

Telecommunications Management Network (TMN) Systems

Module name (EN): Telecommunications Management Network (TMN) Systems
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI860
Hours per semester week / Teaching method: 1V+1P (2 hours per week)
ECTS credits: 3
Semester: 2
Mandatory course: no
Language of instruction: German
Assessment: 180-minute written exam
Curricular relevance: KI860 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, optional course
Workload: 30 class hours (= 22.5 clock hours) over a 15-week period. The total student study time is 90 hours (equivalent to 3 ECTS credits). There are therefore 67.5 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Horst Wieker

Lecturer:
Prof. Dr. Horst Wieker
[*updated 01.04.2003*]

Learning outcomes:
The rapid growth and merging of modern communications networks brings with it the need to manage individual network elements as well as the overall network. A system is required that can cover all areas, ranging from customer requirements and technical implementation to network operations at all levels.
Students will become acquainted with the typical problems of managing todays networks. After completing this course they will be able to analyse the architecture of both software-based and hardware-based systems, plan a management system using new, advanced communication interfaces and test its functionality.
[*updated 02.07.2007*]

Module content:
1. Standardization
2. Identifying and defining problems
3. Functional architecture used in TMN
4. The physical architecture of TMN
5. Theoretical considerations of applications in the GSM and fixed networks
6. Development of TMN systems
7. Databases
8. Interfaces and protocols

Practical exercise: Working on a real SDH network
[*updated 02.07.2007*]

Recommended or required reading:
SIEMENS: Systems documentation
MICROSOFT: SQL Database
[*updated 02.07.2007*]

Theoretical Informatics Seminar

Module name (EN): Theoretical Informatics Seminar
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI848
Hours per semester week / Teaching method: 4V (4 hours per week)
ECTS credits: 6
Semester: 2
Mandatory course: no
Language of instruction: German
Assessment: Practice talk, talk
Curricular relevance: KI848 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, optional course, informatics specific KIM-STI Computer Science and Communication Systems, Master, ASPO 01.10.2017, semester 2, optional course, informatics specific PIM-STI Applied Informatics, Master, ASPO 01.10.2011, semester 2, mandatory course PIM-STI Applied Informatics, Master, ASPO 01.10.2017, semester 2, mandatory course
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 180 hours (equivalent to 6 ECTS credits). There are therefore 135 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Thomas Kretschmer

Lecturer: Prof. Dr. Thomas Kretschmer
[*updated 18.02.2008*]

Learning outcomes:
After successfully completing this module, students will be able to independently analyze, prepare and present the content of a challenging scientific topic pertaining to theoretical computer science in an understandable way within a given period of time. In addition, they will be able to participate actively in a technical discussion and concisely summarize the lectures they have heard.
[*updated 24.02.2018*]

Module content:
Advanced topics pertaining to the computability theory, complexity theory and algorithms, e. g. probabilistic algorithms, alternating automata, zero-knowledge proofs, approximation algorithms.
[*updated 24.02.2018*]

Teaching methods/Media:
Practice talk, talk by student, discussion, summary by listeners
[*updated 24.02.2018*]

Recommended or required reading:
Berstel, Boasson, Carton, Fagnot: Minimization of automata, http://arxiv.org/abs/1010.5318
Berstel, Perrin, Reutenauer: Codes and Automata, Cambridge University Press 2010.
Cormen, Leiserson, Rivest: Introduction to Algorithms, The MIT Press 1997.
Hopcroft, Ullman: Ullman: Einführung in die Automatentheorie, Formale Sprachen und Komplexitätstheorie, Addison-Wesley, 1994.
Moore, Christopher; Mertens, Stefan: The Nature of Computation, Oxford University Press 2011.
Motwani, Rajeev; Raghavan, Prabhakar: Randomized Algorithms, Cambridge University Press 2007.
Sipser: Introduction to the Theory of Computation, Second Edition, Thomson 2006.
Vazirani, Vijay: Approximation Algorithms, Springer 2003.
and other articles
[*updated 24.02.2018*]

Module offered in:
SS 2020 (probably), SS 2019, SS 2018, SS 2017, SS 2016, ...

Traffic Control and Traffic Management

Module name (EN): Traffic Control and Traffic Management
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI833
Hours per semester week / Teaching method: 4V (4 hours per week)
ECTS credits: 5
Semester: 2
Mandatory course: no
Language of instruction: German
Assessment: Written exam
Curricular relevance: KI833 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, optional course, telecommunications-specific KIM-VSVM Computer Science and Communication Systems, Master, ASPO 01.10.2017, semester 2, optional course, telecommunications-specific MAM.2.1.4.10 Engineering and Management, Master, ASPO 01.10.2013, semester 2, optional course, technical PIM-WI77 Applied Informatics, Master, ASPO 01.10.2011, semester 2, optional course, informatics specific PIM-VSVM Applied Informatics, Master, ASPO 01.10.2017, semester 2, optional course, informatics specific
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
KI720 Protocols in Public and Private Networks
[*updated 08.05.2014*]

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Horst Wieker

Lecturer:
Dr.-Ing. Frank Offermann
[*updated 08.05.2014*]

Learning outcomes:
After successfully completing this module, students will be able to correctly classify traffic control and traffic management methods and procedures.

They will be able to describe the requirements and challenges of traffic control from an operational point of view.

Students will be able to apply the traffic flow theory to traffic control procedures. In doing so, they will be able to evaluate urban traffic disturbances and highway traffic control correctly in order to be able to make recommendations for control procedures. Students will also be able to take the operational view of traffic into account.

In addition, students will be capable of applying methodological approaches and explaining the data standards used.

Students will be able to describe the technical requirements of cooperative systems (Car2X) on the infrastructure and be able to assign them to vehicle-related applications.

The goal of this module is to enable students to analyze future development trends in traffic management and assess their effects.

[*updated 26.02.2018*]

Module content:
1. Definition of traffic management and traffic control and the differentiation between urban and suburban areas
2. Extra-urban traffic control systems
3. Urban traffic control systems
4. Traffic management
5. Extra-urban data standards
6. Urban data standards
7. Planning process and planning tools
8. Integrated traffic management, strategy management
9. Telematics, vehicle-related applications
10. Infrastructure quality in Germany
11. Infrastructure quality ROW and in particular, USA
12. Car2X and Car2Car, application overview
13. Car2X demands on traffic infrastructure
14. Intermodal traffic management
15. Outlook/Development trends in traffic management and control

[*updated 26.02.2018*]

Recommended or required reading:
[*still undocumented*]

Module offered in:
SS 2020 (probably), SS 2019, SS 2018, WS 2017/18, WS 2016/17, ...

Virtual Machines and Program Analysis

Module name (EN): Virtual Machines and Program Analysis
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI744
Hours per semester week / Teaching method: 2V+4P (6 hours per week)
ECTS credits: 8
Semester: 1
Mandatory course: no
Language of instruction: German
Assessment: Written exam, project
Curricular relevance: KI744 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 1, optional course, informatics specific KIM-VMPA Computer Science and Communication Systems, Master, ASPO 01.10.2017, semester 1, optional course, informatics specific PIM-WI55 Applied Informatics, Master, ASPO 01.10.2011, semester 1, optional course, informatics specific PIM-VMPA Applied Informatics, Master, ASPO 01.10.2017, semester 1, optional course, informatics specific
Workload: 90 class hours (= 67.5 clock hours) over a 15-week period. The total student study time is 240 hours (equivalent to 8 ECTS credits). There are therefore 172.5 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.

Recommended as prerequisite for:
KI844 Shape Analysis
[*updated 17.01.2008*]

Module coordinator:
Dr.-Ing. Jörg Herter

Lecturer:
Dr.-Ing. Jörg Herter
[*updated 21.06.2007*]

Learning outcomes:
Students will become acquainted with the concept of and motivation behind virtual machines using the CMa as an example.
Students will be able to translate C code to CMa code.

Students will be familiar with the most important program analyses (available expressions, interval analysis, constant propagation, dead variables, etc.).
Students will be able to work out the (fixed-point) algorithms used in program analysis: naive fixed-point iteration, round robin, worklist, recursive iteration.
Students will understand the mathematics behind the methods of analysis, in particular the concept of complete lattices.

State-of-the-art analyzers will be used in the project "Statische Analyse von sicherheitskritischem C-Code" to analyze code used in industry. Students will gain insights into which analyses are technically possible and how the development/programming style of safety-critical software (e. g. from the aerospace or automotive industry) differs from the development of "normal software".

[*updated 26.02.2018*]

Module content:
1. Introduction (high-level programming languages, implementation of programming languages)
2. The architecture of CMa
3. Translating simple C language elements
4. Translating structs
5. Translating functions
6. Introduction (program analysis and transformations)
7. Operational semantics/CFGs
8. Not available and available expressions
9. Fixed point iteration: naive, round-robin, worklist and recursive iteration
10. Mathematical background (How can we prove that our analysis provides the best results resp. even terminates?)
11. Live, dead and strongly live variables
12. Equality of variables
13. Constant propagation and interval analysis
[*updated 06.09.2018*]

Recommended or required reading:
R. WILHELM, H. SEIDL: Übersetzerbau. Virtuelle Maschinen
H. SEIDL, R. WILHELM, S. HACK: Übersetzerbau. Analyse und Transformation
F. NIELSON, H. NIELSON, C. HANKIN: Principles of Program Analysis
P. COUSOT, R. COUSOT: Abstract interpretation: a unified lattice model for static analysis of programs by construction or approximation of fixpoints
[*updated 26.02.2018*]

Module offered in:
WS 2018/19, WS 2017/18, WS 2016/17, WS 2015/16, WS 2014/15, ...

Web Applications

Module name (EN): Web Applications

Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016

Module code: KI834

Hours per semester week / Teaching method: 2V+2U (4 hours per week)

ECTS credits: 5

Semester: 2

Mandatory course: no

Language of instruction:
German

Assessment:
Project

Curricular relevance:
KI834 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, optional course, informatics specific
KIM-WEBA Computer Science and Communication Systems, Master, ASPO 01.10.2017, semester 2, optional course, informatics specific
PIM-WI49 Applied Informatics, Master, ASPO 01.10.2011, semester 2, optional course, informatics specific
PIM-WEBA Applied Informatics, Master, ASPO 01.10.2017, semester 2, optional course, informatics specific

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Thomas Kretschmer

Lecturer: Prof. Dr. Thomas Kretschmer
[*updated 03.02.2014*]

Lab:
Technical Systems Lab (8207)

Learning outcomes:
Students will be given an overview of the current status of the most important tools and technologies for developing web applications. They will be able to analyze a given task and decide which technologies are most suitable for solving it. In addition, they will be able to create the respective web application together with their team.
[*updated 24.02.2018*]

Module content:
Basics (HTML5, CSS3, JavaScript)
EcmaScript6
Functional programming with JavaScript
Use of Node.js
GUI frameworks (e.g. Angular, Polymer, React)
Full stack frameworks (e.g. Meteor)

[*updated 24.02.2018*]

Teaching methods/Media:
Presentation with examples
Exercises
Project
[*updated 24.02.2018*]

Recommended or required reading:
Rauschmayer, Axel: Speaking JavaScript, http://speakingjs.com/es5/
Rauschmayer, Axel: Exploring ES6, http://exploringjs.com/
Springer, Sebastian: Node.js: Das umfassende Handbuch. Serverseitige Webapplikationen mit JavaScript entwickeln,Rheinwerk Computing; Auflage: 2 (30. Mai 2016)
W3C: HTML5, http://www.w3.org/TR/html5/
[*updated 24.02.2018*]

Module offered in:
SS 2020 (probably), SS 2019, SS 2018, SS 2017, SS 2016, ...

Web Services

Module name (EN): Web Services
Degree programme: Computer Science and Communication Systems, Master, ASPO 01.04.2016
Module code: KI775
Hours per semester week / Teaching method: 2V+2P (4 hours per week)
ECTS credits: 5
Semester: 2
Mandatory course: no
Language of instruction: German
Assessment: Graded project work and presentation
Curricular relevance: KI775 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, optional course, informatics specific PIM-WI60 Applied Informatics, Master, ASPO 01.10.2011, semester 2, optional course, informatics specific
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Martina Lehser

Lecturer:
Prof. Dr. Martina Lehser
Dipl.-Ing. Michael Sauer
[*updated 01.04.2003*]

Learning outcomes:
Students will acquire a deeper understanding of the concepts, architectures and technologies used in the field of internet-based applications. Conceptual design and realization of internet applications. Review of security concepts and development of a web server (client and server applications using AXIS2).
[*updated 08.05.2008*]

Module content:
1. Basics
2. XML schemas and XML namespace
3. SOAP
4. WSDL
5. UDDI
5. Security
6. Tools (AXIS2, Java Web Services)
[*updated 08.05.2008*]

Recommended or required reading:
T. Frotscher, M. Teufel, D.Wang et al.: Java Web Services mit Apache Axis2, Software & Support Verlag. 2007
A. Eberhart, S. Fischer: Web Services, Hanser 2003
T. Langner: Web Services mit Java, M&T Verlag 2003
D. Chappell, T. Jewell: Java Web Services, O´Reilly 2003
J. Snell et al.: Webservice-Programmierung mit SOAP, O´Reilly 2002
G. Alonso et al.: Web Services, Springer 2004
[*updated 08.05.2008*]

Module offered in:
SS 2010, SS 2009, SS 2008, SS 2007, SS 2006, ...