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## Advanced Computer Graphics

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|---|---|
| Curriculum assignment | MCS, 1. Semester, Spezialisierung Medieninformatik (SPEZ-MI) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 1, practical: 1 |
| Professor(s) in charge | Prof. Dr. rer. nat. Andre Hinkenjann, Dipl. Inform. |
| Language | German or English |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | Basic Knowledge from the course "Computer Graphics"<br>Programming skills from the course "Introduction to Programming" (EidP)<br>"Basics of Mathematics and Physics (MP)" |
| Learning targets | Knowledge and understanding of advanced topics of computer graphics, especially the realistic picture synthesis. In this context the basic terms and vocabulary needed are acquired. The ability to implement the presented topics. Getting to know the theoretical foundations of the global illumination calculation. Solving of complex problems of realistic picture synthesis, like the selection of appropriate procedures and cost estimates (duration,..). Safe handling of various algorithms for imaging with a view to a career in the areas of application of Multimedia-/Computergraphics specialists (e.g. advertising, special effects, product design etc.).<br>Strengthening of the problem-solving skills by getting to know and own implementation of the advanced topics of image synthesis. |
| Content | Advanced topics of realistic picture synthesis<br>Acceleration of the Ray Tracing procedure (algorithms and data structures, e.g. adaptive samling, kd-trees, bounding-volume hierarchies etc.)<br><br>Render Cache procedure<br>Radiometry (terms and procedure for the calculation of Radiosity)<br>The "rendering equation" (picture synthesis equation) of Kajia<br>Approaches to the rendering equation<br>Monte-Carlo Integration<br>Computergraphics-Hardware and -Programming |
| Course work | Prüfung |
| Description of Course work | Oral or written exam |
| Media | Slides/LCD Projector |

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| | Videos<br>Demonstrations<br>Website with slides in pdf -format, further instructions, references to internet sources and the solutions of the assignments/practical lab exercises |
| Literature | Philip Dutré, Philippe Bekaert, Kavita Bala, *Advanced Global Illumination*, AK Peters Ltd., 2006<br>Peter Shirley, Keith Morley, *Realistic Ray Tracing*, AK Peters Ltd., 2008 |

## Advanced concepts of medical imaging

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|---|---|
| Curriculum assignment | MCS, 2. Semester, Spezialisierung Bio-Medizinische Informatik (SPEZ-BMEDI) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 1, practical: 1 |
| Professor(s) in charge | Prof. Dr.-Ing. Rainer Herpers, Dipl.-Inform. |
| Language | German or English |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | Basics of medical or general imaging |
| Learning targets | Ability to analyze, structure and solve complex multi-dimensional image processing problems in the bio-medical field using scientific methods.<br>Practical skills in the processing and analysis of multi-dimensional medical image data on a scientifically sound level.<br>Students will be able, after a successful participation of this module, to relate to other complex bio-medical problems and to find solutions for them. |
| Content | Methods and algorithms for the computer-based processing and analysis of medical pictures:<br>Segmentation of 3D and 4D image sequences<br>Multi-dimensional image registration 2D and 3D<br>Texture based image analysis<br>Image reconstruction techniques and methods for the disposal of artefacts<br><br>Real-time image analysis for functional imaging techniques as fMRI, or real-time angiography.<br>These concepts should be applied to the solution of concrete exemplary problems |
| Course work | Prüfung |
| Description of Course work | The theoretical knowledge of the students will be graded in the context of a written or oral exam.<br>The active participation in the courses, the processing of the assignments with a documentation on a scientific level are expected. The successful solution of the assignments and their practical realization, documentation and presentation in front of the other participants of the course are taken into account for the grade (ca. 33%). This encourages a continuously active participation. |

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| Media | Slides, PC-Demonstrations, Black Board, educational and specialist literature |
| Literature | Handels, H. (2000). Medizinische Bildverarbeitung. Stuttgart: Teubner.<br>Lehmann, Th., Oberschelp, W., Pelikan, E., Repges, R. (1997). Bildverarbeitung für die Medizin: Grundlagen, Modelle, Methoden,Anwendungen, Berlin: Springer.<br>I.N. Bankmann, Handbook of Medical Imaging, Academic Press, 2000. |

## Advanced Mechatronics

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|---|---|
| Curriculum assignment | MCS, 1. Semester, Spezialisierung Eingebettete Systeme (SPEZ-ES) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 1, practical: 1 |
| Professor(s) in charge | Prof. Dr.-Ing. Thomas Breuer<br>Prof. Dr.-Ing. Norbert Jung |
| Language | German (English specialist literature) |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | Participation and good exam results in the specialization "Embedded Systems" of the Bachelor of CS programme<br>Good basic mathematical, technical, physical/natural sciences knowledge<br><br>Interest in technical applications of embedded systems (e.g. consumer electronics, automotive applications, medical technology, telecommunications terminal equipment,..) |
| Learning targets | Advanced understanding of further aspects of the mechatronics of embedded systems from the perspective of computer science<br>Advanced understanding of aspects of mechanical and electrical engineering that are important with respect to the application-specific HW / SW development, and particularly with regard to the issues of reliability and safety.<br>The course is interdisciplinary due to the interlocking of Mechanics, Electronics and Computer Science. |
| Content | Deepening of knowledge on mechanics, electrical engineering and electronics<br>Measurement of physical variables with sensors<br>Influencing physical quantities with actuators<br>Accuracy and error considerations<br>Modeling and simulation of dynamic systems |
| Course work | Prüfung |
| Description of Course work | Assignments and successful completion of the practical lab experiments<br>oral or written examination |
| Media | Lecture with visual support, blackboard, an interactive learning platform, teaching letters |
| Literature | Tietze, U.; Schenk, C.: Halbleiter-Schaltungstechnik, 2002, ISBN: 3-540-428-496 |

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| | Mayr M: Technische Mechanik, 2002, ISBN 3-446-21858-0<br>Heinrich B, Döring P, Klüber L, Nolte S, Simon R: Mechatronik, 2004, ISBN 3-528-03957-4<br>Hering E, Steinhart H: Taschenbuch der Mechatronik, 2005, ISBN 3-446-22881-0<br>Isermann R: Mechatronische Systeme, 1999, ISBN 3-540-64725-2 |

## Advanced Methods in Health Telematics

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|---|---|
| Curriculum assignment | MCS, 3. Semester, Spezialisierung Bio-Medizinische Informatik (SPEZ-BMEDI) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 2 |
| Professor(s) in charge | Prof. Dr. rer. nat. Wolfgang Heiden, Dipl. Biol.<br>Prof. Dr.-Ing. Rainer Herpers, Dipl.-Inform.<br>Prof. Dr.-Ing. Marlis von der Hude<br>Prof. Dr. Ralf Thiele |
| Language | German |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | Basic knowledge of Medical Computer Science and Medicine, Natural Sciences and the national health care system (e.g. relevant Bachelor courses)<br>Specialization Courses in the first and second semester of the Computer Science Master Programme |
| Learning targets | Ability to analyze and structure complex advanced Health Telematics applications, in order to be able to realize solutions and applications on a scientific level.<br>At the same time profound knowledge in various areas of applications of Health Telematics with the multiple aspects of an IT-based communication within Health Care (e.g. standardization, encryption, authentification). |
| Content | Advanced topics in Health Telematics such as: Mobile Health Telematics, health in telemonitoring, disaster medicine, SAR, to provide medical services off shore and on travels in aircrafts, trains, road traffic, on boats and ships and on expeditions in remote regions as well as on travels in general. |
| Course work | Prüfung |
| Description of Course work | White Paper, proposal, written report, scientific talk<br>oral or written exam |
| Media | Slides, Computer demonstrations, black board, educational books and specialist literature |
| Literature | up-to-date specialist literature on HT and:<br>Frank Warda - Guido Noelle, Telemedizin und eHealth in Deutschland: Materialien und Empfehlungen für eine nationale Telematikplattform, Köln 2002 (ISBN 3-89906-701-0); |

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| | Maheu Marlene, Whitten Pamela, Allen Ace, E-Health, Telehealth, and Telemedicine: A Guide to Startup and Success, 2001, Jossey Bass, ISBN-10: 0-7879-4420-3, ISBN-13: 9780787944209, English<br>Current Principles and Practices of Telemedicine and e-Health, Volume 131 Studies in Health Technology and Informatics, R. Latifi, 2008, ISBN: 978-1-58603-806-9, English<br>Haas Peter, Gesundheitstelematik. Springer-Lehrbuch, Grundlagen, Anwendungen, Potenziale , 2006, Springer, ISBN-10: 3-540-20740-6, ISBN-13: 9783540207405, Deutsch<br>Karl Jähn, Nagel Eckhard, E-Health -Telemedizin, Health Cards, Teleconsulting, Telemonitoring, e-Patientenakte, Gesundheitsinformation, Disease Management, Public e-Health, Informationsrecherche, e-Government, e-Pharmacy, 2004, Springer, ISBN-10: 3-540-43937-4,ISBN-13: 9783540439370, Deutsch<br>Telemedizinführer, Jahresbände |

## Advanced Topics in Embedded Systems

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|---|---|
| Curriculum assignment | MCS, 3. Semester, Spezialisierung Eingebettete Systeme (SPEZ-ES) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 1, practical: 1 |
| Professor(s) in charge | Prof. Dr.-Ing. Wolfgang Borutzky<br>Prof. Dr.-Ing. Thomas Breuer<br>Prof. Dr.-Ing. Norbert Jung<br>Prof. Dr.-Ing. Gerhard Kraetzschmar<br>Prof. Dr.-Ing. Kerstin Lemke-Rust<br>Prof. Dr. rer. nat. Paul Gerhard Plöger<br>Prof. Dr. Erwin Prassler |
| Language | German (with English specialist literature) or English |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | This Master programme course builds on an undergraduate course titled "Control of Mechatronic Systems".<br>Students should have an interest in the overlap of multidisciplinary engineering projects with computer science. They should have an understanding of physics and should have some knowledge of mathematical subjects such as linear algebra, differential equations and probability calculus. |
| Learning targets | Deepened theoretical and practical knowledge in a major technical application of embedded systems. |
| Content | The topics of this course and its focus may be subject to changes from term to term. The aim is to make computer science students familiar with some advanced control concepts before they start to develop software for embedded systems in various kinds of mechatronic systems, e.g., robotic or automotive systems. As is true for control theory in general, the theoretical and methodological topics addressed in this course are of fundamental importance in various application areas.<br>It will give an introduction into some advanced control concepts such as<br>Multiple Input, Multiple Output systems (MIMO systems)<br>Stability analysis of MIMO systems<br>Observability & controllability<br>State space control<br>Observers, adaptive control<br>Kalman Filter<br>Uncertain system<br>Robust control |
| Course work | Prüfung |

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| Description of Course work | The course will finish with an oral examination. The result of the oral examination as well as the student's contribution during the term will constitute the grade. |
| Media | Lectures will make use of an LCD projector, a whiteboard; research articles and miscellaneous material will be made available on the intranet. At the beginning, some references for further reading will be given along with some comments. |
| Literature | English and German scientific literature, depending on the chosen topic and application area. |

## Algorithms and Data Analization in Life Science

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| Curriculum assignment | MCS, 2. Semester, Spezialisierung Bio-Medizinische Informatik (SPEZ-BMEDI) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 1, practical: 1 |
| Professor(s) in charge | Prof. Dr.-Ing. Marlis von der Hude<br>Prof. Dr. Ralf Thiele |
| Language | German (English possible) |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | Specialization Biomedical Informatics of the Bachelor Programme Computer Science<br>Programming skills (e.g. Java, Perl etc.) |
| Learning targets | The emphasis is on the development of algorithmic concepts according to current Biomedical Informatics research for solutions to reality based problems in industry and the public sector. The course will consider concepts for the automization of analytical methods and for visualization as to their helpfulness in appraisal and presentation.<br>This course ist the second of two lectures on Biomedical Informatics within the Master Programme. It can be attended before the first one that is offered in every winter semester. The subject matter of these two lectures can be studied more in depth in a seminar in one of the following semesters and possibly by writing a master thesis (preferably in an external project).<br>At the end of the lecture students will know the systematic approach in solving applicational problems in the fields of natural sciences and technics. They will be able to answer the following questions: How can I apply IT methods in order to solve problems of a natural scientific or medical nature?<br>This serves as a preparation for a potential master thesis within the specialization of Biomedical Informatics and later on the start of a professional career.<br>The following skills should be developed:<br>Discussion and an active participation in lecture and lab class<br>group work for solving the assignments |
| Content | Expression measurement in tissues<br>rtPCR and their evaluation, results<br>differential gene expression<br>Arraytechnologies: cDNA versus Oligonucleotid<br>Normalisation & Filtering of the raw data |

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| | Multiple Testing<br>Clustering<br>Classification<br>differential gene expression / Diagnosis / Interpretation<br>Text Mining and preparation of list results |
| Course work | Prüfung |
| Description<br>of Course work | Oral or written exam |
| Media | Powerpoint, black board, Moodle |
| Literature | up-to-date literature in scientific periodicals and journals |

## Business Intelligence

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| Curriculum assignment | MCS, 2. Semester, Spezialisierung Wirtschaftsinformatik (SPEZ-WI)<br>MCS, 1. Semester, Spezialisierung Wirtschaftsinformatik (SPEZ-WI) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 2 |
| Professor(s) in charge | Prof. Dr. Rüdiger Buck-Emden |
| Language | German |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | Database systems<br>Interest in enterprise-wide information systems and business application systems (e.g. ERP, CRM)<br>Interest in controlling tasks |
| Learning targets | Expert skills:<br>Development and application of integrated BI systems<br>Working with BI tools<br>Dealing with data quality and the explanatory power of key performance indicators<br>Knowing the relationship between business decisions and data quality<br>Methods competency:<br>Implementing data warehouses<br>Modeling multi-dimensional data spaces<br>Statistical data analysis<br>Implementing balanced scorecards (BSC)<br>Individual skills:<br>Dealing with complex systems and abstraction |
| Content | BI: definition and differentiation<br>Deriving key performance indicators (KPIs) and KPI systems from business goals and strategies<br>Data collection from business application systems<br>Data warehouse systems: meaning, design, architecture<br>Meta data and data quality<br>Extraction, transformation and loading of data (ETL)<br>Data marts and data warehouses with ODS<br>Index structures, query languages and query optimization<br>Data mining and OLAP (relational, multidimensional, hybrid)<br>Working with popular BI tools |

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| Course work | Prüfung |
| Description of Course work | Written or oral exam |
| Media | Lectures supported by LCD projector and discussions<br>Individual tasks and team work<br>Student presentations |
| Literature | Bange, Carsten: *OLAP & Business Intelligence - Softwarewerkzeuge im direkten Vergleich*, Oxygon, 2005, ISBN 3-937818-05-7.<br>Bensberg, Frank: *BI-Portfolioplanung - Handlungsfelder und methodische Aspekte*, Tagungsbeitrag zur Multikonferenz Wirtschaftsinformatik 2008.<br><br>Bauer, Andreas / Günzel, Holger (Hrsg.): *Data-Warehouse-Systeme: Architektur, Entwicklung, Anwendung*, 3. überarb. u. aktual. Auflage, Dpunkt Verlag 2009, ISBN 3-89864-540-1.<br>Devlin, Berry: *Data Warehouse*, Addison-Wesley Professional (November 1996).<br>Grothe, M. / Gentsch, P.: *Business Intelligence - Aus Informationen Wettbewerbsvorteile gewinnen*, München, Addison-Wesley, 2000<br>Hildebrand, K. (Hrsg.): *Business Intelligence*, HMD 222, dpunkt.verlag, Heidelberg 2001, ISBN 3-89864-128-7.<br>Inmon, William: *Building the Data Warehouse*, 4. Auflage, Wiley & Sons, 2005, ISBN 0-76459-944-5.<br>Kemper, H.-G. / Mehanna, W. / Unger, C.: *Business Intelligence - Grundlagen und praktische Anwendungen: eine Einführung in die IT-basierte Managementunterstützung*, Wiesbaden 2004, ISBN 3-528-05802-1.<br>Kemper, Hans-Georg / Mehanna, Walid / Unger, Carsten: *Business Intelligence - Grundlagen und praktische Anwendungen: Eine Einführung in die IT-basierte Managementunterstützung*, 2. erg. Aufl., Vieweg + Teubner 2006, ISBN 3-83480-275-1.<br>Kimball, Ralph / Ross, Margy: *The Data Warehouse Toolkit*, 2. Auflage, John Wiley & Sons 2002, ISBN 0-47120-024-7 .<br>Mertens, P.: *Business Intelligence - Ein Überblick*, in: Information Management & Consulting 17 (2002) Sonderausgabe |

## Business Process Modelling and Organization

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|---|---|
| Curriculum assignment | MCS, 3. Semester, Spezialisierung Wirtschaftsinformatik (SPEZ-WI) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 2 |
| Professor(s) in charge | Prof. Dr.-Ing. Alexandra Kees |
| Language | German |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | Basic knowledge in IT-Projectmanagement and Modelling |
| Learning targets | **Core Competences:**<br>Mapping of complex business issues in models<br>Consolidation and deepening of knowledge on business organization<br>Self-employed application of modelling tools<br>**Methodological Competences:**<br>Consolidation and deepening of different modelling notations and their suitability for different problems<br>Techniques for complexity management in creating, analysing, optimizing and implementing complex enterprise models<br>Application of methods for enterprise reorganization<br>**Individual Competences:**<br>Critical reflection of different aspects of business organization<br>Complexity-management-techniques |
| Content | Application of existing modelling tools to map complex models<br>Methods to create and maintain complex models (e.g. modelling views)<br>Analysis and optimization of complex models (incl. quality of models, e.g. Guidelines of Modelling)<br>Identification of weaknesses in enterprises and derivation of measures for improvement<br>Reorganization methods (e.g. Kaizen, Continuous Improvement, Reengineering, Business Transformation)<br>Implementing improvements in enterprises (Reorganization projects) |
| Course work | Prüfung |
| Description of Course work | Oral or written exam |
| Media | LCD Projector presentations |

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| | Individual and group work<br>Presentations of students |
| Literature | Gadatsch, A.: "Grundkurs IT-Projektcontrolling. Grundlagen, Methoden und Werkzeuge für Studierende und Praktiker." Vieweg + Teubner Wiesbaden 2008. ISBN978-3-8348-0469-3.<br>Gadatsch, A.; Tiemeyer, E. (Hrsg.): „Betriebswirtschaft für Informatiker und IT-Experten". Elsevier Spektrum Akademischer Verlag, München 2007. ISBN 3-82741757-0.<br>Hammer, M; Champy, J: "Reengineering the Corporation. A Manifesto fpr Business Revolution." New York 1993.<br>Rosemann, M: "Komplexitätsmanagement in Prozessmodellen. Methodenspezifische Gestaltungsempfehlungen für die Informationsmodellierung." Gabler Verlag Wiesbaden 1996. ISBN 3-409-12172-2.<br>Schmelzer, H.; Sesselmann, W.: "Geschäftsprozessmanagement in der Praxis. Kunden zufrieden stellen, Produktivität steigern, Wert erhöhen." 5. vollst. überarb. Aufl., Carl Hanser Verlag München Wien 2006. ISBN 978-3-446-40589-9. |

## Color Image Processing and Colorimetry

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| Curriculum assignment | MCS, 2. Semester, Spezialisierung Medieninformatik (SPEZ-MI) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 1, practical: 1 |
| Professor(s) in charge | Prof. Dr.-Ing. Norbert Jung |
| Language | German (English specialist literature) |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | Multimedia basics, basics of signal processing, applied Mathematics (coordinate transformations, vector calculation, Infinitesimal calculus), physics (optics, radiation physics), basic technical computer science, basic concepts of physiology |
| Learning targets | Teaching the scientific methods and theoretical foundations for the visualization according to perception and the creation of data sets taking into account the targeted computer science-profession. Overview of specific applications in the field of multimedia. One of the major learning objectives is the ability to independently design and implement strictly color-correct visualizations in the context of current multimedia applications, as well as the selection and evaluation of appropriate hardware and software. |
| Content | Deepening of knowledge of the structure and functioning of the human eye<br>Relationships between the physical radiation spectra, the color stimulus and the physiological perception of color<br>color stimulus metrics, color measurement systems and conversions<br>fundamentals and applications of technical color analysis and color synthesis<br>technical systems for image capture and reproduction<br>color space representations, distinction of color space - color gamut<br>perception according color measurement systems and visibility limits<br>color management systems, color calibration, Gamut mapping |
| Course work | Prüfung |
| Description of Course work | Oral or written exam, and solutions to the assignments. Successful completion of the lab tests |
| Media | Lecture with visual support, Blackboard, interactive learning platform, educational articles, practical experiments |

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| Literature | Manfred Richter, ”Einführung in die Farbmetrik”, Verlag de Gruyter, Berlin, 2. Auflage 1981<br>Klaus Richter, ”Computergrafik und Farbmetrik”, VDE Verlag, Berlin, 1996<br>Anni Berger-Schunn, ”Praktische Farbmessung”, Verlag Muster-Schmidt, Göttingen, 2. Auflage 1994<br>Heinwig Lang, ”Farbwiedergabe in den Medien (Fernsehen, Film, Druck)“, Muster-Schmidt-Verlag, 1995; 3-7881-4052-6<br>R.W.G. Hunt, ”The reproduction of colour”, 2004, ISBN: 0-470-02425-9<br>R.W.G. Hunt, ”Measuring Color”, Ellis Horwood Ltd Publishers, 2nd Edition 1991, 0-13-567686-X<br>Henry R. Kang, „Color Technology for Electronic Imaging Devices“, SPIE, 1997,ISBN 0-8194-2108-1<br>Günther Wyszecki, W.S. Stilles, „Color Science“, Wiley Publishers, 2000, ISBN 0-471-02106-7<br>Daniel Malacara, „Color Vision and Colorimetry“, SPIE, 2002, ISBN 0-8194-4228-3 |

## Computability and Complexity I

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|---|---|
| Curriculum assignment | MCS, 1. Semester, Pflichtveranstaltungen (PFL) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 2 |
| Professor(s) in charge | Prof. Dr. Kurt-Ulrich Witt |
| Language | German (English specialist literature) |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | Bachelor Course on Theoretical Computer Science |
| Learning targets | Knowledge and understanding of formal accountability models, standard numbering, utm and smn-theorem, complexity terms and relevant complexity classes, decidable and semi-decidable quantities, reducibility, undecidable quantities, the P = NP problem, NP-complete problems<br>Independent scientific work<br>Solving problems in groups, presentation of solutions |
| Content | Chomsky hierarchy of formal languages, decidability of the word problem<br><br>Turing automata, variants of Turing automata and their equivalence, equivalence of Turing automata and type 0 grammars, equivalence of linear bounded automata and context sensitive grammars<br>Computability (Turing-, While-, Goto-progams, primitve and -recursion, Loop-programs, equivalence of Turing-, While-, m -recursion, Church Thesis, Ackermann function, Goto-computability and universal Turing-machines; enumeration of partial recursive functions, utm- and smn-Theorem<br>Decidable and semi decidable sets, recursively enumerable sets, reducability, non recursive and non recursivly enumerable sets, Rice' Theorem<br><br>Complexity, O-notation, complexity classes (time and space), the P=NP-Problem, NP complete sets, Cook's Theorem, reduction, Savitch' Theorem, co-classes |
| Course work | Prüfung |
| Description of Course work | The exercises consist of proofs to theorems from the lecture and solving problems in the context of theorems and algorithms that have been presented in the lecture, sometimes in small groups, presentation of results. |

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| | oral exam |
| Media | Blackboard, electronic presentations, lecture notes |
| Literature | T, H. Cormen, C. E. Leiserson, R. L. Rivest: Introduction to Algorithms; The MIT Press, Cambridge, MA, 1990<br>R. Floyd, R. Beigel: Die Sprache der Maschinen; International Thomson Publishing Company, Bonn, 1996<br>D. Harel: computers Ltd. What they really can't do; Oxford University Press, Oxford, 2000<br>Hopcroft, J. E., R. Motwani, J. D. Ullman: Introduction to Automata Theory, Languages, and Computation, Second Edition; Addison-Wesley, Reading, MA, 2001<br>J. Hromkovivic: Theoretische Informatik - Berechenbarkeit, komplexitätstheorie, Algorithmik, Kryptographie. Eine Einführung - 2. Auflage; Teubner, Stuttgart,2004<br>D. C. Kozen: Automata and Computability; Springer, New York, 1997<br>H. R. Lewis, C. H. Papadimitriou: Elements of the Theory of Computation, 2nd Edition; Prentice Hall, Upper Saddle River, NJ, 1998<br>B. M. Moret: The Theory of Computation; Addison-Wesley, Reading, MA, 1998<br>C. H. Papadimitriou: Computational Complexity; Addison-Wesley, Reading, MA, 1995<br>M. Sipser: Introduction to the Theory of Computation; PWS Publishing Company, Boston, MA, 1997<br>T. A. Sudkamp: Languages and Machines - An Introduction to the Theory of Computer Science; Addison-Wesley, Reading, MA, 1997<br>G. Vossen, K.-U. Witt: Grundkurs Theoretische Infomratik - 4. Auflage; Vieweg, Wiesbaden, 2006<br>I. Wegener: Complexity Theory; Springer, Berlin 2004 |

## Computability and Complexity II

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|---|---|
| Curriculum assignment | MCS, 2. Semester, Pflichtveranstaltungen (PFL) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 2 |
| Professor(s) in charge | Prof. Dr. Kurt-Ulrich Witt |
| Language | German (English specialist literature) |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | Computability and Complexity I |
| Learning targets | Knowledge of the standard complexity classes and their relations; knowledge of probabilistic algorithms and complexity classes, and their relations to each other as well as to standard complexity classes; heuristics and approximated algorithms<br>Knowledge of theoretical and practical applications: e.g. fingerprint, prime number test, graph problems (coloring, Traveling Salesman)<br>Independent scientific work<br>Solving problems in groups, presentation of solutions |
| Content | Las Vegas- and Monte Carlo-Algorithms, probabilistic complexity classes, RP, coRP, ZPP, BPP, their relations and relation to standard complexity classes<br>Applications, primality test<br>Approximation of optimization problems<br>Interactive Proof Systems, IP = PSPACE (Shamir's Theorem)<br>Zero knowledge proofs;<br>Applications (authentification: three color problem, Fiat-Shamir-Protokoll) |
| Course work | Prüfung |
| Description of Course work | The exercises consist of proofs to theorems from the lecture and solving problems in the context of theorems and algorithms that have been presented in the lecture, sometimes in small groups, presentation of results.<br><br>oral exam |
| Media | Blackboard, electronic presentations, lecture notes |
| Literature | Literature from BuK I and further specialist literature on probabilistic and approximative algorithms |

## Computer Vision

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| Curriculum assignment | MCS, 2. Semester, Spezialisierung Medieninformatik (SPEZ-MI) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 1, practical: 1 |
| Professor(s) in charge | Prof. Dr.-Ing. Rainer Herpers, Dipl.-Inform. |
| Language | English |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | Basic knowledge in Signal and Image Processing and Numerical Computations (e.g. from BSc courses on Mathematics, Multimedia Systems and Image Processing)<br>Programming experience, C, C++ |
| Learning targets | Computer vision is a very challenging computer science problem with wide application fields in the development of autonomous systems. One objective of the course is to introduce advanced concepts of computer and active vision. An efficient analysis of vision data is only possible, if model knowledge is integrated at the early stages of processing. Advanced computer vision methods acquire and derive model knowledge dynamically from other input sources, which includes also information from other sensors. Therefore, the integration of multisensor information into the vision process as well the acquisition and representation of model knowledge will be a major part of this course. For the visual control of autonomous robots or agents the sensory data provided by vision sensors has to be analyzed very fast. Therefore, a special emphasis will be put on the efficient design and implementation of computer vision algorithms. Furthermore, the control of complex dynamic systems based on purely or based in part on vision data results in a control loop which might influence all participating processes. The course will therefore focus on the complexity of the Perception-Action-Cycle.<br>Ability to apply Computer Vision approaches on a scientific level. |
| Content | After a short review of basic image processing techniques advanced concepts of camera calibration, object detection and tracking, motion and colour analysis are introduced. The course might also cover topics of 3D parameter estimation and modelling, as well as model knowledge representation and advanced matching techniques. Course content:<br>• Introduction to Computer Vision (week 1)<br>• Human Eye, Light and Colour (week 2)<br>• Cameras and Sensors (week 3) |

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| | • Calibration, Presentation of the proposals (week 4)<br>• Filtering, Linear and non linear Morphological operators (week 5)<br>• Edge detection (week 6)<br>• Corner detection (week 7)<br>• Segmentation I (week 8)<br>• Segmentation II (week 9)<br>• Digital watermarking (week 10)<br>• Opt. steerable Filtering (week 11)<br>• Presentation of the projects (week 12) |
| Course work | Prüfung |
| Description of Course work | Active participation in lectures and practical lab work, solution of exercises/assignments, presentation thereof, written examination Evaluation system (grading): All deliverables are marked:<br>• White paper 2%<br>• Proposal 8%<br>• Final report and project 35%<br>• Project presentation 10%<br>• Final exam 45% |
| Media | slides, multimedia material, practical demonstrations |
| Literature | Text book:<br>D.A. Forsyth and J. Ponce, Computer Vision A Modern Approach, Pearson<br>Additional Literature:<br>Dana H. Ballard, Christopher M. Braun, Computer Vision, Prentice Hall;<br><br>B. Jähne, H. Haußecker, Computer Vision and Applications, Academic Press;<br>R. Klette et al., Computer Vision, Vieweg;<br>A. Blake, A Yuielle, Active Vision, MIT Press |

## Human-Computer-Interaction

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| Curriculum assignment | MCS, 3. Semester, Spezialisierung Komplexe Softwaresysteme (SPEZ-KS) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, practical: 2 |
| Professor(s) in charge | Prof. Dr. Simone Bürsner |
| Language | German |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | Profound knowledge in Software Engineering<br>Interest in User-Centered Development of software systems |
| Learning targets | This course aims at sensitizing the participants for the importance of the design of Human-Computer-Interaction in the development of successful interactive systems and websites.<br>The participants know the connection to the topics of Requirements Engineering and Software Architecture. They are proficient in methods and procedures in a User-Centered Design Process. |
| Content | The content of this course is based on currently available literature in the area of User-Centered Design.<br>(1) Introduction to Human-Computer-Interaction and its goals:<br>User – User Task – Software:<br>Interaction Design in accordance with the interaction skills of humans<br>Task-orientation<br>Participation of users in the development process<br>The historical development of software ergonomics<br>Relevant international and national standards<br>(2) Methods for User-Centered Design of interactive systems:<br>Design of human work areas and user tasks<br>Elicitation of user goals and construction of Personas<br>Interaction Design starting with (Scenario-based) Conceptual Design and finally up to Physical Design<br>Interaction Styles and Interaction Design Patterns<br>The effect of a given technological context or platform on the design of interactive systems (platform specific Interface Design Guidelines)<br>(3) The process of User-Centered Design of interactive systems:<br>Methods and techniques of human-centricity |

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| | Elicitation, Analysis, Design and Evaluation of user context and user requirements<br>Conceptual Specification and Prototyping<br>Usability Evaluation |
| Course work | Prüfung |
| Description of Course work | Active collaboration in lectures and in practical courses is demanded. The tasks assigned in practical courses have to be solved and the solutions have to be presented. In order to stimulate personal communication and to enhance the ability to work in a team the tasks are worked on in small teams.<br>Oral or written examination at the end of the semester. |
| Media | A mixture of classical lectures and active collaboration in practical courses is applied. In order to consolidate contents, positive and negative examples from available software systems are investigated. In the practical courses the participants are working on the design and evaluation of an interactive system in a case study for a few weeks. |
| Literature | Dahm M (2006): Grundlagen der Mensch-Computer-Interaktion, Pearson Studium.<br>Heinecke A M (2004): Mensch-Computer-Interaktion, Hanser-Verlag, München.<br>Herczeg M (2005): Software-Ergonomie, Oldenbourg-Verlag, München.<br>Lauesen S (2005): User Interface Design – A Software Engineering Perspective, Pearson Education Limited.<br>Further literature is announced during the semester. |

## Interdisciplinary applications of Visual Computing

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| Curriculum assignment | MCS, 3. Semester, Spezialisierung Medieninformatik (SPEZ-MI) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, practical: 2 |
| Professor(s) in charge | Prof. Dr. rer. nat. Wolfgang Heiden, Dipl. Biol.<br>Prof. Dr.-Ing. Rainer Herpers, Dipl.-Inform.<br>Prof. Dr. rer. nat. Andre Hinkenjann, Dipl. Inform.<br>Prof. Dr. Karl Jonas<br>Prof. Dr.-Ing. Norbert Jung |
| Language | German or English |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Learning targets | Combination and application of knowledge learned in each module of the specialization Visual Computing to new, interdisciplinary issues.<br>Deepening of the cognitive and practical skills acquired within the individual modules.<br>Largely independent development of solutions to new, overall issues.<br>Ability to realize goal oriented solutions in the area of Visual Computing on a scientific level. |
| Content | The course treats interdisciplinary topics of Visual Computing with an application-oriented approach, like e.g. the tracking of interactive devices and users. Hereby Computer Vision is tied to the interactive environments.<br>Topics:<br>Trackingsystems (interactive devices, user)<br>Interaction (innovative concepts, Hardware, Software)<br>Augmentation procedure<br>Parallel, softwarebased rendering in interactive environments<br>collaborative work in interactive environments |
| Course work | Prüfung |
| Description of Course work | oral or written exam |
| Media | Power-Point slides with LCD Projector<br>Videos<br>Demonstrations<br>Website with slides in pdf format, further information, references to internet sources and the solutions to the assignments/lab classes |

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| Literature | Möller, Haines, *Real-Time Rendering*, A.K. Peters Ltd., 2008<br>Foley, van Dam, Feiner, Hughes, *Computer Graphics – Principles and Practice*, Addison Wesley, 1995<br>Alan Watt, *3D Computer Graphics*, Addison Wesley, 1999<br>Doug A. Bowman, Ernst Kruijff, Joseph J. Laviola, *3d User Interfaces: Theory And Practice*, Addison Wesley, 2004<br>A. Blake, A Yuielle, Active Vision, MIT Press<br>Shneiderman, B.: Designing the User Interface. Addison Wesley Longman, 1998<br>current literature from relevant journals, conference proceedings and proceedings |

## IT-Controlling

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| Curriculum assignment | MCS, 2. Semester, Spezialisierung Wirtschaftsinformatik (SPEZ-WI)<br>MCS, 1. Semester, Spezialisierung Wirtschaftsinformatik (SPEZ-WI) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 2 |
| Professor(s) in charge | Prof. Dr. rer. pol. Kai Wiltinger |
| Language | German/English |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | Basic knowledge in financial and management accounting. |
| Learning targets | • Knowing and understanding the relevant theories for assessing the profitability of the use of IT-Systems like CAPM – capital asset pricing model – or the agency theory.<br>• Ability to solve given realistic problems and case studies by using or adapting these theories<br>• The strategic perspective of IT-Controlling will be focused |
| Content | 1. Introduction<br>2. Accounting theory<br>3. Main concepts of profitability<br>4. IT controlling (short term, mid term and strategic perspective)<br>5. Case study |
| Course work | Prüfung |
| Description of Course work | Written exam |
| Media | The course will take the form of seminars:<br>praxis oriented exercises<br>case studies<br>homework<br>student presentations<br>study of literature |
| Literature | Gadatsch, A./Mayer, E.: Masterkurs IT-Controlling, 3. Auflage, Vieweg.<br><br>Krcmar H. (2004): Informationsmanagement, 4. Auflage, Springer. |

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| | Kargl, H./ Kütz, M.: IV-Controlling, 5. Auflage, Oldenbourg.<br>Selected technical articles |

## IT-Management

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| Curriculum assignment | MCS, 2. Semester, Spezialisierung Wirtschaftsinformatik (SPEZ-WI)<br>MCS, 1. Semester, Spezialisierung Wirtschaftsinformatik (SPEZ-WI) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 2 |
| Professor(s) in charge | Prof. Dr. Andreas Hense |
| Language | German |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | Basic knowledge of IT-Servicemanagement<br>Advanced knowledge of Software-Engineering |
| Learning targets | Students get to know the processes of IT-Servicemanagements and how to integrate these into an organisation. They will reach a profound understanding of the workings of management and the organization of IT-branches.<br>At the end of the course students will be capable arguing the use of formally defined processes in this context. They can analyze possible problems of implementation.<br>Students can apply methods and tools for decision making. |
| Content | The IT-Infrastructure Library is the framework for this course. Starting point are the processes of Service-Operation. Afterwards the designing of a new IT-Service is illustrated, including the adjustments according to the client's wishes. After developing the IT-Service, it has to be implemented and established in the respective company.<br>Second part of the course is dedicated to a closer look at the topic of IT-Strategy. This contains processes of Financial Management and Demand Management as well as questions of IT-Organization, including Sourcing. |
| Course work | Prüfung |
| Description of Course work | oral exam |
| Media | Lecture with discussion an integrated exercises, case studies, system demonstrations, group work, self-study<br>Board, flipchart, Metaplan (pinboards), Computer/LCD Projector |
| Literature | [1] J. Bahrs and S. Schmid, Anwendungen und Systeme für das Wissensmanagement - Ein aktueller Überblick, Gito, 2005. |

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| | [2] M.G. Bernhard, R. Blomer, and J. Bonn, Strategisches IT-Management 1. Mit CD-ROM: Organisation - Prozesse - Referenzmodelle, Symposion Publishing, 2003.<br>[3] S. Lacy, and I. Macfarlane, Service transition, The Stationery Office,2007.<br>[4] V. Lloyd, C. Rudd, and S. Taylor, Service design, The StationeryOffice, 2007.<br>[5] M. Iqbal, and M. Nieves, Service strategy, The Stationery Office, 2007.<br><br>[6] D. Cannon, S. Taylor, and D. Wheeldon, Service operation, The Stationery Office, 2007.<br>[7] A. Gadatsch and E. Mayer, Masterkurs IT-Controlling: Grundlagenund Praxis - IT-Kosten und Leistungsrechnung - Deckungsbeitragsund Prozesskostenrechnung - Target Costing, Vieweg+Teubner, 2006.<br>[8] R.D. Galliers and D.E. Leidner, Strategic Information Management.Challenges and Strategies in Managing Information Systems (Butterworth Heinemann): Challenges and Strategies in Managing InformationSystems, Butterworth Heinemann, 2002.<br>Further literature will be announced during the course. |

## IT-Risik-Management

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| Curriculum assignment | MCS, 2. Semester, Spezialisierung Wirtschaftsinformatik (SPEZ-WI)<br>MCS, 1. Semester, Spezialisierung Wirtschaftsinformatik (SPEZ-WI) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 2 |
| Professor(s) in charge | Prof. Dr. Karl W. Neunast |
| Language | German |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | Interest in the questions of risk-management, in particular the IT Risk Management and its technical and economic aspects. |
| Learning targets | Knowledge and understanding of the importance of the systematic risk-management (according to the recommendations of the Basle Committe on banking supervision, Die Neue Baseler Eigenkapitalvereinbarung Basel II)<br>Knowledge and understanding of the importance of IT-systems within the busines processes of modern enterprises as well as the business continuity planning and the IT-emergency planning.<br>Knowledge and understanding of the importance of economic indicators for managment decisions in the field of IT-risk management. |
| Content | In today's economy, no company is able to act without information technology any more. But how great is the dependence within each company? How dependent are the individual business processes on the availability of information technology and what would be the economic consequences of a limited availability?<br>At the beginning of the course is a short recap of the basics of IT risk management: protection targets, threats, protective measures and stages of the systematic IT risk management. Based on this, a risk analysis is run for a sample company. Selected identification and evaluation methods are applied and assessed in their suitability for the sample companies. Based on the resulting risk-catalogue the measures for risk management and control will be selected together and justified technically and economically. This requires calculations of probabilities for losses and the expected magnitude of damage. For the exemplary company a business continuity plan and the necessary IT contingency planning will be created. Here, the required components of this plan will be treated fundamentally and implemented by way of example. To consolidate the acquired knowledge, facts and methods will be prepared by the students in the form of small |

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| | e-learning modules. The conclusion of the course are the presentations of the e-learning modules. |
| Course work | Prüfung |
| Description of Course work | Presentations and documentations<br>written or oral exam |
| Media | Slide presentations with board<br>group work supported by electronic media as moodle and Wiki |
| Literature | The course is mostly based on these books:<br>H.-P. Königs: *IT-Risiko-Management mit System*, 1. Auflage; Vieweg, Wiesbaden, 2005<br>N. Pohlmann, H. Blumberg: *Der IT-Sicherheitsleitfaden*, 1. Auflage; mitp-Verlag, 2004<br>J. Slay, A. Koronios: *Information Technology Security & Risk Management,* 1. Auflage; John Wiley & Sons, Australia, 2006<br>A list of about ten more books will be presented and commented upon. |

## Management Qualifications

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| Curriculum assignment | MCS, 3. Semester, Pflichtveranstaltungen (PFL) |
| Credits | 3 |
| Teaching format (hours/week) | |
| Professor(s) in charge | |
| Language | German |
| Workload (compulsory attendance) | 45 hours |
| Workload (private study) | 45 hours |
| Recommended Prerequisites | Interest in assuming managerial responsibility in projects or organizations in context with software development or IT-departments. |
| Learning targets | Communication, organizing and decision-making are core skills of a project manager - either regarding the own project organization and team or the stakeholders like the projects' customer or software engineers. Both relationships have to be managed by the project manager.<br>The students learn to understand these relationships and learn how to arrange them. |
| Content | The main topics are the special characteristics of software development projects.<br>Differences in roles and responsibilities of the project manager und the customer of the project in different process models like traditional project management, RUP or SCRUM<br>Stakeholder analysis: Identifying the main partner, their intention and expectations<br>Realizing an effective communication structure and culture<br>„Project business is people's business": Developing management principles for software projects following the book of Tom de Marco: Der Termin<br><br>Discussing patterns of behavior in software development teams<br>Conflict management and management of negotiations |
| Course work | Leistungsnachweis |
| Description of Course work | An active participation, solving of exercises, a presentation on one of the discussed topics with a written report are prerequisites for a certificate of performance.<br>In order to further communication and team spirit, the work is being done in groups. |

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| Media | Lecture with presentational material and active participation; self-study and study assignments |
| Literature | DeMarco T (2005): Der Termin - Ein Hörspiel über Projektmanagement,Hanser-Verlag München. Stellvertretend für evtl. weitere ausgewählte Veröffentlichungen von Tom DeMarco.<br>DeMarco T, Hruschka P, Lister T, McMenamin S, Robertson J, RobertsonS (2007): Adrenalin-Junkies und Formular-Zombies - Typisches Verhalten in Projekten, Hanser-Verlag.<br>Hindel B, Hörmann K, Müller M, Schmied J (2009): Basiswissen Software-Projektmanagement: Aus- und Weiterbildung zum Certified Professional for Project Management nach iSQI-Standard, dpunkt-Verlag Heidelberg, 3. überarbeitete u. erweiterte Auflage.<br>Project Management Institute (PMI) (2008): A Guide to the Project Management Body of Knowledge: PMBOK Guide, 4. Auflage.Vigenschow U, Schneider B (2007): Soft Skills für Softwareentwickler. Fragetechniken, Konfliktmanagement, Kommunikationstypen und -modelle, dpunkt-Verlag, Heidelberg.<br>Further literature on the different topics during the course |

## Master-Project

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| Curriculum assignment | MCS, 3. Semester, Projekt (PRO) |
| Credits | 12 |
| Teaching format (hours/week) | project: 2 |
| Professor(s) in charge | |
| Workload (compulsory attendance) | 30 hours |
| Workload (private study) | 330 hours |
| Learning targets | The master project allows students to work on a complex problem within a business enterprise, an external scientific institution or a R&D Project at their own university. They apply scientific concepts, methods and principles of Computer Science, developing them further or conceiving them. Students supply documentation and report on their work. The master project can serve as a preparation for the master thesis. |
| Content | Fachliches Thema nach individueller Vereinbarung, Einsatz von Projektmanagementmethoden<br>Specialist topic that has been agreed upon on an individual basis; application of project management methods |
| Course work | Prüfung |
| Description of Course work | Written project report and Colloquium |
| Media | |
| Literature | Depending on the topic: selected literature<br>Methods:<br>Deininger M., Lichter H., Ludewig J., Schneider K.: Studienarbeiten - ein Leitfaden, Vdf Hochschulverlag, ETH Zürich, 5. überarbeitete Auflage, 2005.<br>H. Balzert, C. Schäfer, M. Schröder, U. Kern, Wissenschaftliches Arbeiten - Wissenschaft, Quellen, Artefakte, Organisation, Präsentation, W3L, 2008. |

## Neural Networks

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| Curriculum assignment | MCS, 2. Semester, Wahlpflichtveranstaltungen (W)<br>MCS, 1. Semester, Wahlpflichtveranstaltungen (W) |
| Credits | 6 |
| Teaching format (hours/week) | |
| Professor(s) in charge | Prof. Dr. rer. nat. Paul Gerhard Plöger |
| Language | Englisch |
| Workload (compulsory attendance) | 90 hours |
| Workload (private study) | 90 hours |
| Recommended Prerequisites | solid foundation in linear algebra (like given in the book of G. Strang: Linear Algebra) and the basics of probability (like in book of Papoulis/Pillai: Probability Random Variables and Stochastic Processes) |
| Learning targets | Put neural network into the general contexts of other machine learning approaches<br>deepen the understanding of neural networks<br>understand the workings of some advanced neural network concepts like ESNs<br>learn to apply NNs to some applied problems of autonomous robots<br>apply standard tools for the solution of practical exercises (e.g. WEKA etc)<br>map problems to appropriate models and identify and apply solution approaches<br>Since more and more CPU power is getting cheaper and more energy efficient more and more complicated e.g. pattern matching problems can get embedded recently. Examples are face recognition in digital cameras or failure detection and classification. |
| Content | In the introductory part we describe largely in qualitative terms what NNa are, how they are composed and how they are related to AI. The we study first simple classes of NNs and then in depth the respective algorithms to train them (perceptron convergence, weighted LMS and back propagation). We finish by studying radial basis function networks, support vector machines and echo state networks. |
| Course work | Prüfung |
| Description of Course work | Students have to attend lectures and exercises. They have to solve 50% of all exercises correctly. |
| Media | slides, blackboard handouts |

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| Literature | The lecture is based on the following book: Neural Networks, Simon Haykin, 2nd ed, 1999, Prentice Hall.<br>Helpful in other parts will be: Pattern Recognition and Machine Learning, Chris M. Bishop, 2006, Springer. |

## New Businesses: Commercialisation of new technologies

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| Curriculum assignment | MCS, 2. Semester, Wahlpflichtveranstaltungen (W)<br>MCS, 1. Semester, Wahlpflichtveranstaltungen (W) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 2 |
| Professor(s) in charge | Prof. Dr. Karl W. Neunast |
| Language | German |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | Interest in business questions, especially product-management and Product innovation |
| Learning targets | To appraise and illustrate the innovation content of new technologies; to deviate potential product families from technology features; to estimate the essential steps for product development and their time and financial expenditure; to analyse market potential and market entry barriers |
| Content | Besides the ability to develop new technologies, it is increasingly important for graduates of academic institutions, to be able to assess and exploit their economic potential. These trans-disciplinary skills are required not only by founders who want to market their inventions themselves, but also all senior employees of an innovative company who want to contribute to the economic success of their employer.<br>The course will commence with a dicussion of the various marketing strategies for new technologies. In order to find partners for the financing, development and marketing of new technological products, it is necessary to be able to appropriately characterize the level of innovation of new technologies for the different target groups. The planning and implementation of innovation- and product management will be introduced and implemented with regard to the example of a selected technology.<br>The successful commercialization of a new technology requires the successful exploration of the target market (market size, potential competitors, market entry barriers, regulatory framework). These methods are discussed and sources of existing market research results evaluated.<br>To deepen the previously learned, the project planning for product development and product marketing will be treated and carried out by way of example, including financial planning and risk management for the project implementation. Finally, the scenario for the market introduction of a new product is developed and presented together with the project plan by the students. |
| Course work | Prüfung |

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| Description of Course work | Academic record in form of presentations and documentations and an oral or written exam |
| Media | Slide presentations and board; group work, supported by electronic media like moodle und Wiki |
| Literature | An extensive literature list of ca. 20 books will be presented and commented. |

## Object-oriented Component-Architectures

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| Curriculum assignment | MCS, 2. Semester, Wahlpflichtveranstaltungen (W)<br>MCS, 1. Semester, Wahlpflichtveranstaltungen (W) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, practical: 2 |
| Professor(s) in charge | Prof. Dr. Manfred Kaul |
| Language | German |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | Good knowledge of Programming languages and -experience in Java and object-oriented development with UML |
| Learning targets | To address systematically the component-based development system<br>To understand and master UML for component systems<br>To know and judge component-architectures<br>To apply and create selected frameworks plugins<br>*With regard to the module:*<br>Abstraction, structure- and module generation in software engineering<br>To acquire a feeling for architecture and large structures<br>*Subject-/Methodological/Learning/Social skills:*<br>Academic research<br>Write your own scientific texts<br>Individual and Team Work<br>Capacity for abstract thinking<br>*Part of the vocational preparation:*<br>To deepen understanding of software engineering<br>To acquire practical core competencies as a software engineer |
| Content | Object-oriented Component-Architectures<br>Framework-Paradigms and Plugins<br>System development with Components<br>UML for Component-Systems |
| Course work | Prüfung |
| Description of Course work | Active participation in the lecture and in the practical sessions, reading of scientific literature, summary, scientific talk (powerpoint slides), demo of a selected system and active participation in the scientific discussion within the course. Independent writing of scientific texts.<br>At least 70% of the possible points have to be reached in the weekly lab classes. This is the prerequisite for the participation at the exam (written |

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| | or oral according to number of participants) at the end of the semester. The mark will be given only according to the examination results. |
| Media | Reading, writing and evaluation of scientific articles (Author-Reviewer-Cycle), Blended Learning, Self-study units, interactive work with according systems, projectwork;<br>Powerpoint slides, board, webpages. |
| Literature | Dirk König: Groovy im Einsatz, Hanser-Verlag.<br>Clemens Szyperski: Component Software, Addison-Wesley, 2002.<br>Krysztof Czarnecki, Ulrich W. Eisenecker: Generative Programming, Addison-Wesley Professional, 2000.<br>Kent Beck, Erich Gamma: Contributing to Eclipse, Addison-Wesley Professional, 2003. |

## Object-oriented Webarchitectures

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| Curriculum assignment | MCS, 2. Semester, Wahlpflichtveranstaltungen (W)<br>MCS, 1. Semester, Wahlpflichtveranstaltungen (W) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, practical: 2 |
| Professor(s) in charge | Prof. Dr. Manfred Kaul |
| Language | German |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | Basic knowledge of HTML, CSS, JavaScript, Servlets, JSP and Database and a script-language like Ruby or Python |
| Learning targets | The students know object-oriented web-architectures, -formats und protocols.<br>The students have an advanced knowledge of the functioning of database-supported, object-oriented web-applications. They are able to independently conceive and develop object-oriented web-applications and to implement them with established object-oriented frameworks and IDEs and to organise them in web-projectsc |
| Content | Object-oriented web-applications<br>Object-oriented web-architectures<br>web-projects<br>persistence-mechanisms<br>application server<br>application management<br>popular web frameworks, e.g. Grails, Ruby on Rails<br>Web 2.0 |
| Course work | Prüfung |
| Description of Course work | Active participation in lectures and lab classes. The scientific literature has to be studied in depth on a by-weekly basis and to be presented in the lecture or lab class.<br>Individual solutions for exercises are to be handed in by all students on a regular basis via intra- or internet and to be presented in the following lab class.<br>70% of all mark-relevant points have to be reached in the by-weekly lab classes as a prerequiste for the participation at the exam (written or oral exam according to number of participants). The assessment load comprises all written or orally presented topics, including the set books. |

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| Media | First of all exercises have to solved individually and small projects are to be implemented.Support is offered in the form of demos, joint interactive development of solutions, joint interactive fault finding, demonstration and practical application of suitable instruments.<br>Reading, writing and evaluation of scientific articles (author-reviewer-cycle), blended learning, self-study units, interactice work with suitable systems, projectwork, powerpoint slides, board, webpages. |
| Literature | Gerti Kappel: Web Engineering, dpunkt-Verlag.<br>Morsy, Otto: Ruby on Rails, Verlag Galileo Computing.<br>Friedman: Praxisbuch Web 2.0, Verlag Galileo Computing.<br>Rocher: The Definitive Guide to Grails, apress. |

## Optical and wireless transmission networks

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| Curriculum assignment | MCS, 2. Semester, Spezialisierung Telekommunikation (SPEZ-TK) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 2 |
| Professor(s) in charge | Prof. Dr. Kerstin Uhde |
| Language | German |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | Solid knowledge of the fundamental processes and protocols of telekommunication |
| Learning targets | Students<br>master methods and processes of optical and wireless transmission technics<br>and have deepened knowledge within the field of optical and wireless telecommunication and the according transmission networks<br>are able to work indepently and scientifically |
| Content | Within the course the following main topics are treated:<br>• Assembly and structure of modern telecommunications networks<br>• Basics of high frequency technic and the optical communications engineering<br>• Optical transmission system<br>• Components of optical networks<br>• Optical transmission systems<br>• Wave propagation in free space<br>• Components of wireless networks<br>• wireless communications system<br>• current examples for application e.g. 10 Gigabit Ethernet, UMTS etc. |
| Course work | Prüfung |
| Description of Course work | Regular participation at the lecture and the lab classes<br>successful solution of assignments<br>oral or written exam |
| Media | Medianmix: LCD projector presentations with deepening explanations at the board |

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| Literature | Voges, Edgar: Hochfrequenztechnik, Bd. 2, Hüthig, Heidelberg, 1991<br>Voges, Edgar und Petermann, Klaus: Optische Kommunikationstechnik, Springer, Berlin, 2002<br>Schiller, Jochen: Mobilkommunikation, Pearson Studium, München, 2003<br><br>Kauffels, Franz-Joachim: Optische Netze, mitp, Bonn, 2001<br>Wrobel, Christoph: Optische Übertragungstechnik in der Praxis, Hüthig, Heidelberg, 2004<br>Kiefer, Roland u. Winterling, Peter: DWDM, SDH & Co, Hüthig, Heidelberg, 2002<br>Lüders, Christian: Mobilfunksysteme, Vogel, Würzburg, 2001<br>Sauter, Martin: Mobile Kommunikationssysteme, Vieweg, Wiesbaden, 2004<br>Wuschke, Martin: UMTS, Teubner, Wiesbaden, 2003<br>ITU und IEEE Standards |

## Parallel Algorithms

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|---|---|
| Curriculum assignment | MCS, 2. Semester, Spezialisierung Komplexe Softwaresysteme (SPEZ-KS) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 2 |
| Professor(s) in charge | Prof. Dr. Rudolf Berrendorf |
| Language | German/ English |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | Knowledge of algorithm design and complexity.<br>Knowledge of parallel program execution, program optimization and parallel computer architecture.<br>Founded knowledge of the programming languages C and Java |
| Learning targets | Students can design parallel algorithms and pertinent data structure, analyze existing parallel algorithms and apply them within concrete problems with a view to an acceleration of complex calculations. |
| Content | This lecture deals with advanced design concepts for parallel algorithms. Based on a discussion on principle aspects of parallel algorithm design and parallelism, several theoretical machine and programming models are introduced (PRAM, BSP, LogP) that allow complexity allegations. Students learn principle techniques for systematic design of parallel algorithms.<br>Topics of interest are:<br>Introductionto the topic<br>Performance Metrics for Parallel Algorithms<br>Abstract Machine Models<br>Design Patterns for Parallel Algorithms<br>Non-Numerical Algorithms (Searching, Merging, Sorting, Graph Algorithms)<br>Numerical Algorithms |
| Course work | Prüfung |
| Description of Course work | The credits will be granted if at least 70% of the practice problems have been successfully executed and an oral or written examination at the end of the course has been successfully passed. |
| Media | Lecture slides, practise problems, sample programmes |

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| Literature | Ananth Grama et.al.: Introduction to Parallel Computing. Second Edition, Addison-Wesley, 2003<br>R. Miller, L.Boxer: Algorithms Sequential and Parallel - A Unified Approach. Second Edition, Charles River Media Inc., 2005<br>At the beginning of the course further up-to-date literature will be quoted on the various topics. |

## Parallel Systems

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| Curriculum assignment | MCS, 1. Semester, Spezialisierung Komplexe Softwaresysteme (SPEZ-KS) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 2 |
| Professor(s) in charge | Prof. Dr. Rudolf Berrendorf |
| Language | German/ English |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | Knowledge of the:<br>• Programming languages C and Java<br>• Graph theory<br>• Computer architecture |
| Learning targets | Students can develop efficient parallel software systems and analyze and optimize the performance of existing parallel systems. They know specific techniques and methods and are capable of developing them further on their own. |
| Content | This lecture deals with profound aspects of software and system development for parallel systems as well as program optimization. Analysis methods and adequate representations for certain aspects in the area of parallel programs are discussed (data dependencies, task graph, locality metrics, load metrics). A emphasis is placed on load balance methods (loop scheduling, locality based methods, space-filling curves, graph partitioning).<br>Topics of interest are:<br>Introduction and Motivation<br>Parallel System Architecture<br>Performance Analysis<br>Program Parallelization<br>Program Optimization<br>Load Balance Methods<br>Parallel I/O |
| Course work | Prüfung |

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| Description of Course work | The credits will be granted if at least 70% of the practice problems have been successfully executed and an oral or written examination at the end of the course has been successfully passed. |
| Media | Lecture slides, practise problems, sample programmes |
| Literature | Ananth Grama et.al.: Introduction to Parallel Computing. Second Edition, Addison-Wesley, 2003<br>Barry Wilkinson, Michael Allen: Parallel Programming: Techniques and Applications Using Networked Workstations and Parallel Computers. Second Edition, PearsonEducation International, 2005<br>Michael Quinn: Parallel Programming in C with MPI and OpenMP. McGraw-Hill, 2003<br>During the course further up-to-date literature will be quoted on the various topics. |

## Planning, Realisation, Operation and Optimisation of Communication Networks

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| Curriculum assignment | MCS, 3. Semester, Spezialisierung Telekommunikation (SPEZ-TK) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 1, practical: 1 |
| Professor(s) in charge | Prof. Dr. Stefan Böhmer<br>Prof. Dr.-Ing. Norbert Jung<br>Prof. Dr. Martin Leischner<br>Prof. Dr. Kerstin Uhde |
| Language | German |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | A competent knowledge of Telecommunication, especially with regard to currently deployed Communicationprotocols and -systems. |
| Learning targets | A competent knowledge of theoretically founded concepts, techniques, methods and processe of telecommunication as well as the current application areas and their duties and ways of looking at a problem; to further improve the skills of independent scientific work. |
| Content | Die Veranstaltung behandelt, semesterweise wechselnd, Schwerpunktthemen aus den Bereichen Planung, Realisierung, Betrieb und Optimierung von Kommunikationssystemen und -netzen. Die derzeitigen Schwerpunktthemen sind:<br>• Zuverlässigkeit und Verfügbarkeit<br>• Sicherheit<br>• Übertragungssysteme<br>• Quality of Service<br>• Netzplanung und Verkehrsführung<br>• Management und Betrieb<br>Beispielhaft sind nachfolgend die Themen der Veranstaltung **Algorithmen und Technologien der OSI-Sicherungsschicht** aufgeführt: Design von Sicherungsschichtprotokollen<br>• Medienzugriffskontrolle,<br>• Fehlererkennung/- korrektur,<br>• Flusskontrolle,<br>• Verbreitung und Verwaltung von Topologieinformationen (SPT, RSPT),<br>• Algorithmen für Sicherungsschichtprotokolle<br>Multiprotocol Label Switching (MPLS) |

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| | • MPLS Grundlagen, Labels, Tunnels and Hierarchy,<br>• MPLS and Hop by Hop Routed Traffic,<br>• MPLS and Explicitly Routed LSPs,<br>• Label Distribution Procedures,<br>• GMPLS<br><br>Dienstqualität (QOS)<br><br>• Integrated Services und RSVP,<br>• Differentiated Services, Constraint Based Routing,<br>• VLAN und VPN Technologien IEEE 802.1 q,<br>• Virtual Private LAN Service (VPLS),<br>• Virtual Private Wire Service (VPWS),<br>• IP-only VPNs |
| Course work | Prüfung |
| Description of Course work | oral exam (30 min.) or written exam |
| Media | Presentation slides, assignment, Experimentalumgebung |
| Literature | Wird jeweils in den Ankündigungen bekanntgegeben. |

## Predictive methods of Bioinformatics

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| Curriculum assignment | MCS, 1. Semester, Spezialisierung Bio-Medizinische Informatik (SPEZ-BMEDI) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 2 |
| Professor(s) in charge | Prof. Dr. Ralf Thiele |
| Language | German/English |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | Lecture Algorithms and Datastructures<br>Knowledge in Programming (e.g. Java, Perl etc)<br>Lecture Fundamentals of Human- and Bio medicine<br>Lectures on Bio Informatics of the Bachelor Programme |
| Learning targets | The course introduces fundamental principles, definitions and algorithms from the area Bio Informatics. The focal point is on the development of algorithmic concepts for the solution of realistic problems from current bioinformatics research in industry and the public sector.<br>This course is the first of two lectures in the field of Bioinformatics of the Master Programme. It is the foundation for the continuation and a seminar in the summer semester and potential master theses (e.g. in industrial projects).<br>Students learn the systematic approach in solving applicational problems from natural sciences and technic. They can apply IT methods in order to solve problems from the fields of natural sciences and medicine. This serves as preparation for a potential master thesis in this area and as a vocational training.<br>*The following skills will be encouraged:*<br>Discussion and active participation in lecture and lab class<br>Group work solving the assignments |
| Content | The knowledge of biomolecular and medicinal-pharmacological procedures in living organisms has expanded enormously in recent years. Without the application of informatics' methods a processing and interpretation would not be possible in many areas of molecular biology. The course introduces fundamental problems of bioinformatics and explains the used models as well as the algorithmic solutions.<br>Hidden Markov Models<br>Phylogenetical trees & comparison of genomes<br>Structure comparison<br>Secundary structure prediction |

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| | Tertiary structure prediction<br>Homology based structure prediction<br>Threading<br>Ab initio structure modeling |
| Course work | Prüfung |
| Description of Course work | oral (or written (depending on number of participants)) exam on topics of lecture and lab classes |
| Media | Board, Powerpoint slides, Moodle |
| Literature | up to date original literature from magazines and journals |

## Projektmanagement

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| Curriculum assignment | MCS, 3. Semester, Pflichtveranstaltungen (PFL) |
| Credits | 3 |
| Teaching format (hours/week) | |
| Professor(s) in charge | |
| Language | Deutsch |
| Workload (compulsory attendance) | 45 hours |
| Workload (private study) | 45 hours |
| Recommended Prerequisites | Interesse an dem für Softwareprojekte essentiellen Faktor Mensch, denn Menschen bilden den Mittelpunkt erfolgreicher Softwareentwicklung und des IT-Projektmanagements.<br>Grundkenntnisse zur Gestaltung und Durchführung von Softwareprojekten (Prozesse, Aktivitäten, Artefakte und beteiligte Rollen) aus Software Engineering eines vorangegangenen Bachelor-Studiums. |
| Learning targets | Die Studierenden kennen Methoden zur Gestaltung des Managements von Softwareprojekten und verfügen über die fachliche und methodische Kompetenz zur Ausübung der Rolle des Projektleiters. Mit mindestens einem professionellen Projektmanagement-Werkzeug haben die Studierenden praktisch gearbeitet. |
| Content | Die Studierenden kennen in der Regel die Rolle des Software-Entwicklers bislang am besten. Je nach Wahl der Spezialisierung und der Wahlpflichtfächer haben sie auch andere im Softwareentwicklungsprozess relevante Rollen kennen gelernt. In diesem Modul lernen Sie Methoden und Techniken zur Gestaltung der Aktivitäten des Managements von Softwareprojekten. Dazu orientiert sich das Modul inhaltlich an den Wissensgebieten des Projektmanagements wie sie im PMBok Guide (Fourth Edition) vom Project Management Institute (PMI) in der Version von 2008 beschrieben sind.<br>• Grundlagen des Projektmanagements: Definitionen, Aufgaben und Ziele des Projektmanagements sowie Organisationsformen<br>• Vorbereitung und Start eines Softwareprojektes: Ermittlung der Projektziele, Beantragung, Preis- und Vertragsgestaltung, Teamaufbau und -organisation, Rollen und Verantwortlichkeiten im Team, Zusammenhang zwischen Teamstruktur und der Systemzerlegung im Rahmen des Systementwurfs, Umgang mit Zulieferungen |

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| | • Projektplanung: Projektumfang und Meilensteine, Projektstruktur, Größen- und Aufwandsschätzung (versch. Schätzverfahren), Planung von Aktivitäten, Personaleinsatz und Kosten<br>• Einsatz von Software-Werkzeugen zum Erstellen und fortlaufenden Aktualisieren des Projektplanes<br>• Projektkontrolle und -steuerung im Zusammenspiel mit dem Modul Management-Qualifikation<br>• Personal-, Qualitätsmanagement und Risikomanagement im Zusammenspielmit dem Modul Management-Qualifikation<br>• Änderungs- und Konfigurationsmanagement<br>• Projektabnahme und -abschluss<br><br>Ausgewählte weiterführende Themen, wie beispielsweise:<br><br>• Einfluss des gewählten Prozessmodells auf die Gestaltung des Projektmanagements: z.B. Projektmanagement bei Anwendung agiler Verfahren vs. Projektmanagement in einem nach V-Modell-XT organisierten Softwareprojekt.<br>• Innovative Werkzeuge zur stärkeren Verzahnung von Softwareentwicklung und Projektmanagement (z.B. Jazz-Projekt und andere Ansätze)<br>• Reifegradmodelle, wie CMMI und SPICE, und ihr Bezug zum Management von Softwareprojekten |
| Course work | Leistungsnachweis |
| Description of Course work | Die aktive Mitarbeit, die Bearbeitung von Übungsaufgaben sowie die Anfertigung einer schriftlichen Ausarbeitung mit Präsentation zu einem der behandelten Themengebiete sind Voraussetzung für den Erhalt des Leistungsnachweises. Um Kommunikation und Teamfähigkeit zu fördern, wird in Teams gearbeitet. |
| Media | Unter Einbindung praktischer Probleme und Situationen werden die Inhaltein der Präsenzveranstaltung zum einen klassisch im Vortragsstil mit Präsentationsmaterial eingeführt, zum anderen mit aktivierenden Methoden erarbeitet. In der selbstständigen Nachbereitung der Präsenzveranstaltung und in der Bearbeitung von Übungsaufgaben werden die Inhalte vertieft und angewandt. |
| Literature | Hindel B, Hörmann K, Müller M, Schmied J (2009): Basiswissen Software-Projektmanagement: Aus- und Weiterbildung zum Certified Professional for Project Management nach iSQI-Standard, dpunkt-Verlag Heidelberg, 3. überarbeitete u. erweiterte Auflage.<br>Ludewig J & Lichter H (2007): Software Engineering, Grundlagen, Menschen, Prozesse, Techniken, dpunkt-Verlag Heidelberg.<br>Oestereich B, Weiss C (2008): APM – Agiles Projektmanagement, dpunkt-Verlag Heidelberg.<br>Project Management Institute (PMI) (2008): A Guide to the Project Management Body of Knowledge: PMBOK Guide, 4. Auflage.<br>Aktuell jeweils ergänzt um spezielle Literatur zu einzelnen Themen. |

## Quality of Service in Networks - Technics and Management

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| Curriculum assignment | MCS, 2. Semester, Wahlpflichtveranstaltungen (W)<br>MCS, 1. Semester, Wahlpflichtveranstaltungen (W) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 1, practical: 1 |
| Professor(s) in charge | Prof. Dr. Martin Leischner |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | Basic knowledge of telekommunication and Computer networks. |
| Learning targets | **Expertise**: After this course students shall be able to describe and to critically analyze the essential mechanisms, principles, methods and the technical and organisational approaches for the Quality of Service in networked systems.<br>**Methodological Competence**: The students should be able to analyze and to critically evaluate technical and organisational problems within the context of grade of service and to develop suitable solutions. The recognition of certain contexts, the structuring of problems and the abstraction of the essentials are prerequisites for these skills. The problem "Quality of Service" shall be applied methodologically sound to real scenarios in the context of telecommunication and implemented according to practical requirements. The course will deepen the capacity for using and critically questioning original scientific literature<br>**Social skills**: Within the integrated internship students will learn to work on specialist problems within teams, and to solve them in a constructive way. |
| Content | Definition von Dienstgüteparameter in Kommunikationsnetzen<br>Erfassen, messen, auswerten und analysieren von Dienstgüteparametern<br>Mechanisms for safeguarding Quality of Service (QoS): MPLS, IntServ/RSVP, DiffServ, Traffic-Conditioning, Queuing-Methods, Guaranteed-Service and Controlled-Load-Services etc.<br>Communications applications and QoS: e.g. IP-Telefonie, Videostreaming<br><br>Management instruments and -architectures for safeguarding the QoS, rule-based networks.<br>Operational and organisational aspects of the IT-Servicemanagement: Business processes, SLA, ITIL and CMDB |
| Course work | Prüfung |
| Description of Course work | Oral exam |

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| Media | Lecture with Tablet-PC and LCD projector, script (PDF)<br>Demonstration of simulations and animations<br>Presentations/elaborations of students<br>Single- and group work as lab internship with tutor |
| Literature | Szigeti Tim„ Hattingh Christina: End-to-End QoS Network Design: Quality of Service in LANs, WANs, and VPNs (Networking Technology), ciscopress.com, 2004<br>Jan Van Bon (Editor): Foundations of IT Service Management: based on ITIL, Van Haren Puvlishing, 2005<br>The topics will be deepened within the course using special technical and scientific original literature. Students are meant to be able to find, get and use specialist literature on their own regarding a specific problem and understand the relevance for their own topic. |

## Reliability analysis and modeling of residual risks of technology

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| Curriculum assignment | MCS, 2. Semester, Spezialisierung Eingebettete Systeme (SPEZ-ES) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 1, practical: 1 |
| Professor(s) in charge | Prof. Dr.-Ing. Norbert Jung<br>Prof. Dr. Dietmar Reinert |
| Language | German (English specialist literature) |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | Participation and in particular good exam results in the specialization "Embedded Systems" of the BCS<br>Good basic mathematical, technical, physical/natural sciences knowledge<br><br>Interest in technical applications of embedded systems (eg consumer electronics, automotive applications, medical devices, telecommunications devices,..) |
| Learning targets | Students learn and understand methods for the quantitative modeling of reliability and safety of safety-related embedded systems, and how to apply them. |
| Content | Reliability and safety play a key role in modern technology. It was possible to describe the behavior of simple electro-mechanical systems and simple communication systems with deterministic models, whereas nowadays complex semiconductor technology and programmability require the application of probability methods, especially with regard to the reliability and safety of the systems. The course first introduces the reliability theory in order to model the failure probabilities of complex telecommunication systems against this background. The relevant factors influencing the reliability at the system level, and relevant properties of the components are described and the mathematical apparatus for calculating the failure rates is discussed.<br>The modeling of modern technical systems through fault tree analysis, reliability block diagrams and Markov-Models is demonstrated by concrete technical examples. The strengths and limitations of each method are discussed using examples. Especially the strength of the Markov modeling is illustrated in some practical exercises. By means of the modeling the influences of Hardware and Software are considered. |
| Course work | Prüfung |
| Description of Course work | Solutions to the exercises and successful completion of the practical experiments, and an oral or written exam |

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| Media | The lecture is done with visual support, blackboard, an interactive learning platform, teaching letters and practical guides |
| Literature | Reliability, Maintainability and Risk, David J. Smith, ISBN 0 7506 5168 7<br>Electronic Safety Systems, Josef Börcsök, ISBN 3-7785-2944-7<br>Control Systems Safety Evaluation & Reliability, William M. Goble, ISBN 1-55617-636-8<br>Software Reliability Engineering: More Reliable Software Faster and Cheaper, John D. Musa, ISBN 1-41849387-2 |

## Reliability of Communication Networks

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| Curriculum assignment | MCS, 1. Semester, Spezialisierung Telekommunikation (SPEZ-TK) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 1, practical: 1 |
| Professor(s) in charge | Prof. Dr.-Ing. Norbert Jung |
| Language | German (English specialist literature) |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | Participation and in particular good exam results in the specialization "Telecommunications" or "Embedded Systems" of the BCS<br>Good basic mathematical, technical, physical/natural sciences knowledge,<br>Interest in technical applications of embedded Telecommunications in infrastructure and in Telecommunications terminals and application of mathematics |
| Learning targets | Knowledge and understanding of methods for quantitative modeling of reliability and safety of safety-related technical systems, particularly for communication systems. |
| Content | Reliability and safety play a key role in modern technology. It was possible to describe the behavior of simple electro-mechanical systems and simple communication systems with deterministic models, whereas nowadays complex semiconductor technology and programmability require the application of probability methods, especially with regard to the reliability and safety of the systems. The course first introduces the reliability theory in order to model the failure probabilities of complex telecommunication systems against this background. The relevant factors influencing the reliability at the system level, and relevant properties of the components are described and the mathematical apparatus for calculating the failure rates is discussed.<br>The modeling of modern technical systems through fault tree analysis, reliability block diagrams and Markov-Models is demonstrated by concrete technical examples. The strengths and limitations of each method are discussed using examples. Especially the strength of the Markov modeling is illustrated in some practical exercises. By means of the modeling the influences of Hardware and Software are considered. |
| Course work | Prüfung |
| Description of Course work | Solutions to Exercises and successful completion of the Practical experiments, oral or written examination |

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| Media | Lecture with visual support, arithmetics at the blackboard, exercises, interactive learning platform, preparatory papers and hands-on training guides |
| Literature | Reliability, Maintainability and Risk, David J. Smith, ISBN 0 7506 5168 7<br>Control Systems Safety Evaluation & Reliability, William M. Goble, ISBN 1-55617-636-8<br>Software Reliability Engineering: More Reliable Software Faster and Cheaper, John D. Musa, ISBN 1-41849387-2 |

## Requirements Engineering

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| Curriculum assignment | MCS, 2. Semester, Wahlpflichtveranstaltungen (W)<br>MCS, 1. Semester, Wahlpflichtveranstaltungen (W) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, practical: 2 |
| Professor(s) in charge | Prof. Dr. Simone Bürsner |
| Language | German |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | Interest in the importance of communication and cooperation of software developers, clients and potential users of software systems. |
| Learning targets | Students know the methods for arranging a continuous Requirements Engineering within software projects and are able to shape such a process. They have worked with at least one professional RE instrument.<br>Investigation, analysis and management of changing requirements challenge the social skills and the willingness to relate to the client's domain, his way of thinking, tasks, worries, difficulties, etc.). Goal of this course is to strengthen these skills. |
| Content | Introduction and Basics:<br>• Terminology: Requirement and forms of Requirement<br>• Introduction of a framework for the Requirements Engineering that defines the structural components of a Requirements-Engineering-Process (see Pohl 2007).<br>The following topics will be introduced and then deepened using various selected RE-approaches (Volere according to Robertson & Robertson 2006, COSMOD-RE according to Pohl 2007, Task-based approach according to Lauesen 2002, 2005):<br>Analysis of the actual condition and description of the visualized goal system<br>Investigation and Modeling of the System context<br>Focal- and cross-section activities of the RE<br>requirement artefacts and methods for their specification<br>Management of requirements in softwareprojects (e.g. traceability, priorisation and change management for requirements)<br>The practical application of these RE-approaches takes place within the framework of a RE specification. The students work in small teams. Difficulties met will advance their understanding of the methods. Further topics are: |

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| | • Instruments for supporting the RE (e.g. DOORS, RequisitePro)<br>• Differences in the shaping of the RE depending on criteria like Project size, form of contract, process model.<br>• Interaction of the RE with other disciplines of Software Engineering: Projectmanagement, Usability Engineering and Softwarearchitecture. |
| Course work | Prüfung |
| Description of Course work | Active participation in both lecture and lab class. The assisgments have to be solved and the solutions personally presented. In order to boost communication and the capacity for teamwork, the assignments may be solved in small groups. |
| Media | The theoretical principles will be presented lecture style with presentation material, other, activating methods will also be used. Within the practical classes the Requirements-Engineering-Process will be demonstrated with its different stages by work units of several weeks for an example project and in the development in iterations of a requirement- and software specification, using professional instruments. |
| Literature | Primary literature:<br>• Pohl K (2007): Requirements Engineering – Grundlagen, Prinzipien, Techniken, dpunkt-Verlag, Heidelberg.<br>Further literature:<br>• Lauesen S (2002): Software Requirements – Styles and Techniques, Pearson Education Limited.<br>• Robertson S & Robertson J (2006): Mastering the Requirements Process, Second Edition, Addison-Wesley. |

## Routing und Traffic Engineering

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| Curriculum assignment | MCS, 2. Semester, Spezialisierung Telekommunikation (SPEZ-TK) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 1 |
| Professor(s) in charge | Prof. Dr. Stefan Böhmer |
| Language | Deutsch |
| Workload (compulsory attendance) | 45 hours |
| Workload (private study) | 135 hours |
| Recommended Prerequisites | Communication Networks I/II (Bachelor Course) |
| Learning targets | Die Studierenden sind befähigt, die wesentlichen Techniken, Methoden und Verfahren der Verkehrsführung und Verkehrslenkung für konkrete Netzplanungen anzuwenden. Die Studierenden sind in der Lage, mittels mathematischer und simulativer Verfahren eine Netzinfrastruktur für multimediale Dienste zu dimensionieren bzw. zu optimieren. Sie sind insbesondere vertraut mit der Anwendung verkehrstheoretischer Methoden (Warteschlangenmodelle). |
| Content | Verkehrstheorie<br>• Kendall'sche Notation,<br>• Geburts - und Sterbeprozess,<br>• Verlust- und Wartesysteme,<br>• spezielle Verkehrsmodelle: M/M/1, M/G/1, M/ER/1, G/M/m, G/G/1<br>Simulative Leistungsbewertung<br>• Erzeugung gleichverteilter Zufallszahlen,<br>• Erzeugung beliebiger Verteilungen,<br>• Modellbildung,<br>• statistische Auswertung (Erzeugung der Verteilungsfunktion)<br>Verkehrstheorie in IP Netzen<br>• On-Off Modell,<br>• Heavy-Tail Verteilung,<br>• Fraktionale Brownsche Bewegung,<br>• Farima Modelle<br>Routing in IP basierten Netzen |

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| | • Algorithmen und Protokolle,<br>• Adaptive, nicht adaptive und hierarchische Routing Verfahren,<br>• Redundanz, Symmetrie und Lastverteilung,<br>• Design und Optimierung von Netzinfrastrukturen |
| Course work | Prüfung |
| Description of Course work | Müdliche Prüfung |
| Media | Präsentationsfolien, Übungsunterlagen, Experimentalumgebung |
| Literature | ITU und IETF Standards (`www.ietf.org` und `www.itu.org`)<br>Christian Grimm;Georg Schlüchtermann, Verkehrstheorie in IP-Netzen, Hüthig, 2004<br>Leonhard Kleinrock, Queueing Systems, Volume I: Theory und Volume II: Computer Applications, Wiley, Chicester (UK), 1975 |

## Semantic Web

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|---|---|
| Curriculum assignment | MCS, 2. Semester, Wahlpflichtveranstaltungen (W)<br>MCS, 1. Semester, Wahlpflichtveranstaltungen (W) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 2 |
| Professor(s) in charge | Prof. Dr. Peter Becker |
| Language | Deutsch |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Learning targets | Fachkompetenz: Modellierungstechniken für Web-Ressourcen kennen und einsetzen können; Konzepte der Wissensrepräsentation beherrschen, insbesondere Prädikatenlogik, Beschreibungslogiken und Ontologien; Beherrschung einer Abfragesprache für RDF; Inferenzmethoden für das Semantic Web verstehen und zielgerichtet einsetzen können.<br>Methodenkompetenz: Inferenzkonzepte für web-basierte Informationssysteme entwerfen und implementieren können |
| Content | Die Vision des Semantic Web; Einfache Wissensrepräsentation mit RDF und RDF-Schema; RDF-Abfragesprache: SPARQL; Wissensrepräsentation und Inferenz mit Prädikatenlogik; Beschreibungslogik; Web Ontology Language (OWL); Inferenzverfahren für Beschreibungslogik; Anwendungen von Semantic Web Technologie |
| Course work | Prüfung |
| Description of Course work | Mündliche Prüfung |
| Media | Folienbasierte Präsentation, Übungsaufgaben, Einsatz von Softwarewerkzeugen (Protege, KAON2), Homepage zur Veranstaltung und E-Mail-Verteiler als Kommunikationsmedium |
| Literature | G. Antoniou, F. van Harmelen, A Semantic Web Primer, MIT Press, 2004.<br>P. Hitzler, M. Krötzsch, S. Rudolph, Y. Sure, Semantic Web, Springer, 2008.<br>F. Baader, D. Calvanese, D. McGuinness, D. Nardi, P. Patel-Schneider, The Description Logic Handbook, Cambridge, 2003.<br>L. W. Lacy, OWL: Representing Information Using the Web Ontology Language, Trafford, 2005. |

## Seminar

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|---|---|
| Curriculum assignment | MCS, 3. Semester, Pflichtveranstaltungen (PFL) |
| Credits | 6 |
| Teaching format (hours/week) | seminar: 2 |
| Professor(s) in charge | Prof. Dr.-Ing. Alexandra Kees |
| Language | Deutsch |
| Workload (compulsory attendance) | 30 hours |
| Workload (private study) | 150 hours |
| Learning targets | Fachkompetenz:<br>• Selbstständige Vertiefung des Fachwissens in einzelnen Themenfeldern<br>• Beherrschung der Gliederung und Formulierung wissenschaftlicher Sachverhalte<br>Methodenkompetenz:<br>• Selbstständige Auswahl und Anwendung geeigneter Methoden zur Lösung von Problemen aus dem Bereich der Wirtschftsinformatik<br>• Beherrschung von Techniken zum Finden, Auswählen, Lesen und Zitieren von Literatur<br>• Sichere Anwendung von Projektmanagementtechniken bei der Erstellung wissenschaftlicher Arbeiten<br>Individualkompetenz:<br>• Professionelles Dokumentieren und Präsentieren von Arbeitsergebnissen |
| Content | Selbstständige Erstellung und Präsentation einer wissenschaftlichen Arbeit zu Themen aus dem Bereich der Informatik |
| Course work | Prüfung |
| Description of Course work | Seminararbeit, -vortrag und mündliche Prüfung |
| Media | Beamerpräsentationen<br>Einzel- und Gruppenarbeit |
| Literature | Rechenberg, P.: "Technisches Schreiben". München 2006.<br>Burkhardt, M.: "Projektmanagement". Erlangen 2002.<br>Theisen, M. R.: "Wissenschaftliches Arbeiten". München 2000. |

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| | Kees, A.; Pohl, H.: "Regeln für wissenschaftliche Arbeiten". Sankt Augustin 2009.<br>div. Fachliteratur zu den jeweiligen Themen |

## Sicherheit in Netzen

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|---|---|
| Curriculum assignment | MCS, 1. Semester, Spezialisierung Telekommunikation (SPEZ-TK) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 1, practical: 1 |
| Professor(s) in charge | Prof. Dr. Martin Leischner |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | Schwerpunkt Telekommunikation oder Netze in einem vorangegangenen Bachelorstudiengang wünschenswert.<br>Kenntnisse der Grundlagen der Kommunikationsnetze, der Internetkommunikation, der Kryptographie sowie der Informationssicherheit.<br>Die vorhandenen Vorkenntnisse der Teilnehmer werden zu Beginn über einen Fragebogen erfasst. In den ersten beiden Termine der Lehrveranstaltung werden gezielt ausgewählte Grundlage wiederholt. Bei Bedarf erhalten die Studenten zusätzliche individuelle Hinweise. |
| Learning targets | **Fachkompetenz:** Der Student soll nach dem Besuch der Lehrveranstaltung in der Lage sein, wesentliche Modellbildungen, Prinzipien, Methoden und Vorgehensweisen einer sicheren Kommunikation in vernetzten Systemen vergleichend zu beschreiben und kritisch zu erläutern.<br>**Methodenkompetenz:** Der Student soll in der Lage sein, Sicherheitsprotokolle mit formalen Methoden zu analysieren, kritisch zu bewerten und weiterzuentwickeln. Dies setzt das Erkennen von Zusammennhängen, die Strukturierung von Problemen und das Abstrahieren auf das Wesentliche voraus. Ferner soll er Konzepte der sicheren Kommunikation auf reale Szenarien im Telekommunikations-, IT- und Bankenumfeld übertragen und praxisgerecht anwenden können.<br>**Sozialkompetenz:** Im Rahmen des integrierten Praktikums soll der Student lernen, fachliche Probleme und Aufgabenstellungen in Gruppen- und Teamarbeit zu erarbeiten, zu diskutieren und konstruktiv zu lösen. |
| Content | Überblick kryptographische Grundlagen mit Vertiefung elliptische Funktionen<br>Angriffe, Schwachstellen, Schutzziele<br>Design, Analyse und Methoden für sichere Netzprotokolle<br>Protokolle für die Netzsicherheit (IPsec, TLS, secure VoIP)<br>Authentication, Autorization, Access (mit den Beispielen Kerberos, Radius)<br>Firewalls<br>Sicherheit auf Anwendungsebene am Beispiel der iKP-Protokolle |

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| | Automatisierte Validierung von Internet Sicherheitsprotokollen gemäß AVISPA-Methodik(`http://avispa-project.org`) |
| Course work | Prüfung |
| Description of Course work | Mündliche Prüfung |
| Media | Vortrag mit Tablet-PC und Beamer, Skriptum (PDF)<br>Vorführung von Simulationen und Animationen<br>Präsentationen/Ausarbeitungen der Studenten<br>Einzel- und Gruppenarbeit als Laborpraktikum mit Tutor<br>Praktikum im Labor unter Verwendung der AVISPA-Tools |
| Literature | Kaufman C., Perlman R., Speciner M.: Network Security - PRIVATE Communication in a PUBLIC World, Prentice Hall, 2nd ed., 2002.<br>Mitchell John C., Shmatikov Vitaly, Stern Ulrich : Finite state analysis of SSL 3.0, 7th USENIX Security Symposium, pages 201-15, 1998<br>Schäfer Günter: Netzsicherheit - algorithmische Grundlagen und Protokolle, dpunkt.verlag, 2003.<br>Schneier Bruce: Angewandte Kryptographie, Addison-Wesley, 1996.<br>Uyless Black: Internet Security Protocols - Protecting IP Traffic, Prentice Hall Series in Advanced Communications Technologies, 2000.<br>Viganò L.: Automated Security Protocol Analysis with the AVISPA Tool. Proceedings of the XXI Mathematical Foundations of Programming Semantics (MFPS'05), ENTCS 155:61–86, Elsevier, 2006<br>Weaver Randy: Network Defense and Countermeasures. Thomson, second Ed., 2007 |

## Stochastic Processes and Discrete Event Simulation 1

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|---|---|
| Curriculum assignment | MCS, 1. Semester, Wahlpflichtveranstaltungen (W) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 3 |
| Professor(s) in charge | Prof. Dr.-Ing. Wolfgang Borutzky |
| Language | German |
| Workload (compulsory attendance) | 75 hours |
| Workload (private study) | 105 hours |
| Recommended Prerequisites | Students should have got a good ability to abstract and should be used to mathematical formulations. Furthermore, it is advised that they participate constantly and actively in the course. In particular, assigned homework problems are to be solved independently. Students are expected to present their solutions during classes. |
| Learning targets | In this course, the participants will learn how to model and to analyse service systems with limited resources facing demands that are non-deterministic with regard to their arrival, frequency, their service time and their need for resources. Moreover, students will come to know modelling languages and software tools for computer based experiments with discrete event models. It is an aim of the course to enable the participants to apply the considered theoretical and methodological issues in various fields. The course provides fundamentals for modelling and analysis in various fields such as operating systems and computer networks, manufacturing, logistics, transportation systems, or the analysis of traffic. |
| Content | Readings will address the following subjects:<br>Basics of probabilistic calculus that are needed<br>Stochastic processes<br>Marcov chains<br>Queueing systems, especially the M/M/1 system<br>Queueing networks<br>Languages and software tools for discrete event modelling and simulation<br><br>Paper and pencils examples as well as experiments with modelling and simulation software such as MATLAB®, SimEvents® will give participants the opportunity to apply and to train what they have learned in the readings. |
| Course work | Prüfung |

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| Description of Course work | Both parts of the course (winter and summer term ) will finish with an oral examination. The result of the oral examination as well as the student's contribution during the term will constitute the grade for each part. |
| Media | Lectures will make use of an LCD projector, a whiteboard, research articles and miscellaneous material made available on the intranet. At the beginning, some references for further reading will be given along with some comments. |
| Literature | F. Beichelt: Stochastische Prozesse für Ingenieure, Teubner, 1997<br>U. Kiencke: Ereignisdiskrete Systeme: Modellierung und Steuerung verteilter Systeme, Oldenbourg, 1997 |

## Stochastische Prozesse und diskrete Simulation 2

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|---|---|
| Curriculum assignment | MCS, 2. Semester, Wahlpflichtveranstaltungen (W) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 2, seminar: 1 |
| Professor(s) in charge | Prof. Dr.-Ing. Wolfgang Borutzky |
| Language | Deutsch |
| Workload (compulsory attendance) | 75 hours |
| Workload (private study) | 105 hours |
| Recommended Prerequisites | Grundlagen der Stochastik; gute Kenntnisse und Erfahrungen mit den Programmiersprachen C++ und Java |
| Learning targets | Die Teilnehmer kennen und verstehen die Grundlagen der diskreten Simulation.Sie sind in der Lage, selbstständig für Aufgabenstellungen in verschiedenen Bereichen ereignisdiskrete oder prozeßorientierte Modellezu erstellen, in einer Modellierungssprache oder einer Programmiersprache zu formulieren und durch rechnergestützte Experimente am Modell zu lösen. |
| Content | Nachdem im ersten Teil Grundlagen aus der Stochastik und analytische Ansätze behandelt wurden, steht im zweiten Teil die diskrete ereignisorientiere Simulation und die Validierung von Ergebnissen im Vordergrund.<br>Vorlesung:<br>• Grundlagen der diskreten Simulation<br>• Aspekte von geeigneten Modellierungssprachen<br>Praktikum:<br>• Erstellung von Modellen für Aufgaben aus verschiedenen Bereichen, Formulierung in C++ oder Java unter Verwendung von Bibliotheken mit Funktionen für die diskrete Simulation<br>Seminar:<br>Die in der Vorlesung vermittelten Grundlagen der diskreten Simulation werden im Seminar durch Vorträge zu ausgewählten Themen ergänzt. Dazu wählen die Studierenden aus einer vorgegebenen Liste ein Thema, bereiten dieses anhand von Fachliteratur auf und stellen es in einem Kurzvortrag vor. |
| Course work | Prüfung |
| Description of Course work | Regelmäßige aktive Teilnahme an Vorlesung, Übung und Seminar<br>Eigenständige Bearbeitung der Hausaufgaben und vorbereitete Vorstellung von Lösungen in der Übung |

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| | Schriftliche Ausarbeitung eines selbstgewählten Themas aus einer Liste von Themenvorschlägen und Vorstellung in einem Seminarvortrag |
| Media | Folien, Tafel, Programm Simplex3, Bibliotheken mit Funktionen für die diskrete Simulation, im Intranet bereitgestelltes zusätzliches Material. |
| Literature | Th. Müller: Einführung in die ereignisgesteuerte Simulation, Vorlesungsskript WS 2002/2003 |

## Vertiefung Signalverarbeitung - Advanced Signal Processing

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| Curriculum assignment | MCS, 2. Semester, Spezialisierung Eingebettete Systeme (SPEZ-ES) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 1, practical: 1 |
| Professor(s) in charge | Prof. Dr.-Ing. Wolfgang Borutzky<br>Prof. Dr.-Ing. Thomas Breuer<br>Prof. Dr.-Ing. Norbert Jung<br>Prof. Dr. rer. nat. Paul Gerhard Plöger |
| Language | Deutsch (Englisch-sprachige Fachliteratur im Original) |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | Teilnahme und insbesondere gute Prüfungsergebnisse in der Spezialisierung "Eingebettete Systeme" des BCS; fundiertes mathematisches, technisches, physikalisch-naturwissenschaftliches Grundwissen, Interesse an technischen Einsatzgebeiten eingebetteter Systeme (z.B. Unterhaltungselektronik, Automotive-Anwendungen, Medizintechnik, Telekommunikationsendgeräten, ...) und Anwendung der Mathematik |
| Learning targets | Vertiefung der methodischen und theoretischen Grundlagen von Systemen zur Signalverarbeitung unter Berücksichtigung des angestrebten Berufsbildes.<br>Lernziel ist im wesentlichen die Fähigkeit zur eigenständigen Konzeption und Implementation von Signalverarbeitung im Rahmen von eingebetteten Systemen.<br>*im Hinblick auf das Modul:* Die Veranstaltung stellt die Basis für spätere Vertiefungen dar (z.B. Modellierung und Regelungstechnik). |
| Content | Aufarbeitung und Vertiefung zu determinierten und zufälligen Signalen in linearen, zeitinvarianten Systemen;<br>Grundlagen und Anwendungen zu Adaptiven Filtern, adaptiver Prädiktion<br>Behandlung ausgewählter nichtlinearer und mehrdimensionaler Systeme<br><br>Vertiefung Messtechnik in Zeit- und Frequenzbereich |
| Course work | Prüfung |
| Description of Course work | Lösungen zu den Übungsausfaben und erfolgreiches Absolvieren der Praktikumsversuche; mündliche oder schriftliche Prüfung |
| Media | Vorlesung mit visueller Unterstützung, Vorrechnen an der Tafel, Übungsaufgaben, Interaktive Lernplattform, Lehrbriefe, Praktikumsanleitungen |

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| Literature | Smith, S.W.: The Scientist and Engineer's Guide to Digital Signal Processing; ISBN 0-9660176-7-6 hardcover; ISBN 0-9660176-4-1 paperback; ISBN 0-9660176-6-8 electronic ( `http://www.DSPguide.com` );<br>Ohm J., Lüke H.; Signalübertragung-Grundlagen der digitalen und analogen Nachrichtenübertragungssysteme; ISBN 3-540-67768-2, 2002;<br>O. Föllinger, Regelungstechnik, ISBN 3-7785-2336-8, 1994;<br>B.D.O. Anderson, J.B. Moore, Optimal Filtering, Dover Books on Engineering<br>B. Widrow, S. D. Stearns, Adaptive Signal Processing, Pearson Education, ISBN 9788131705322, 2nd printing 2009;<br>B. Farhang-Boroujeny, Adaptive filters, Wiley, ISBN 978-0-471-98337-8, 2006. |

## Vertiefung System Architektur - Advanced Embedded Systems Architecture

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| Curriculum assignment | MCS, 1. Semester, Spezialisierung Eingebettete Systeme (SPEZ-ES) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 1, practical: 1 |
| Professor(s) in charge | Prof. Dr.-Ing. Thomas Breuer<br>Prof. Dr.-Ing. Norbert Jung |
| Language | Deutsch (Englisch-sprachige Fachliteratur im Original) |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | Teilnahme und insbesondere gute Prüfungsergebnisse in der Spezialisierung "Eingebettete Systeme" des BCS; fundiertes technisches und physikalisch-naturwissenschaftliches Grundwissen, Interesse an technischen Einsatzgebeiten eingebetteter Systeme (z.B. Unterhaltungselektronik, Automotive-Anwendungen, Medizintechnik, Telekommunikationsendgeräten, ...) |
| Learning targets | Vertiefung in Eingebetteten Systeme mit weiterführenden Aspekten der Architektur der programmierbaren Komponenten solcher Systeme. Vertiefte Kenntnisse über mechanische und elektrotechnische Zusammenhänge, die für die anwendungsspezifische HW/SM-Entwicklung insbesondere auch im Hinblick auf Zuverlässigkeit und Sicherheit wichtig sind. Durch die Verzahnung von Mechanik, Elektronik und Informatik ist diese Veranstaltung interdisziplinär aufgebaut. Weiterführendes Verständnis der funktionalen und strukturellen Grundlagen von eingebetteten Rechnerplattformen, methodischen Ansätzen zur Erstellung eines Anwendungsprofils und zur Beurteilung von Rechnerplattformen. Vertieftes Grundlagenwissen der digitalen Schaltungstechnik wie Elektro-Magnetische- Verträglichkeit, High-Speed-Design und Low-Power-Systeme. |
| Content | Vertiefung Basiskonzepte für eingebetteter Rechnersysteme<br>Charakteristika von Digitalen Signal Prozessoren, Mikrocontrollern und Spezialprozessoren<br>applikationsspezifische Optimierungen von Steuerwerken und Rechenwerken<br>programierbare Logik<br>Beispiele zu applikationsspezifisch optimierten eingebetteten Rechnersystemen<br>Microcontroller-Familien<br>Digitale Signalprozessoren Speicher und Massenspeichersysteme |

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| | Speichertechnologie (SRAM, DRAM, Festspeicher), Speicherverwaltung, Massenspeichersysteme (Technologien, Arten von Speichergeräten, Zugriffsverfahren, Redundanz)<br>I/O Systeme und Interfaces<br>Prinzipien und Konzepte<br>applikationsspezifische Optimierungen, Performance und Begrenzungen<br>Interfacing von internen Subsystemen und externen Geräten<br>Analog/Digitale-Interfaces<br>Genauigskeits- und Fehlerbetrachtungen |
| Course work | Prüfung |
| Description of Course work | Lösungen zu den Übungsausfaben und erfolgreiches absolvieren der Praktikumsversuche, mündliche oder schriftliche Prüfung |
| Media | Vorlesung mit visueller Unterstützung, Tafel, Interaktive Lernplattform, Lehrbriefe, Praktikumsversuchsanleitungen |
| Literature | Andrew S. Tanenbaum, Structured Computer Organization, 2005, ISBN: 01-314-852-10<br>John L. Hennessy and David A. Patterson, Computer Architecture: A Quantitative Approach, 3rd Edition, 2002, ISBN 1-55860-724-2<br>Dembowski, K.: Computerschnittstellen und Bussysteme; ISBN 3-7785-2526-3<br>Tietze, U.; Schenk, C.: Halbleiter-Schaltungstechnik, 2002, ISBN: 3-540-428-496<br>Webseiten der Prozessorhersteller z.B. Texas Instruments, Infinion, Analog Devices, Freescale, ... |

## Web Engineering

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|---|---|
| Curriculum assignment | MCS, 1. Semester, Spezialisierung Komplexe Softwaresysteme (SPEZ-KS) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, practical: 2 |
| Professor(s) in charge | Prof. Dr. Manfred Kaul |
| Language | German |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | Basic knowledge of Java, HTML, CSS, JavaScript, Servlets, JSP and database |
| Learning targets | The students of this course get to know about web engineering and basic web architectures, web formats and web protocols. They know how web applications supported by data base function and are able to on their own design web-applications with java technology and to implement with the established frameworks and ide. |
| Content | Web-Applications<br>Web-Architectures<br>Web-Project<br>Java Server Faces<br>Java Persistence<br>Java Application Server<br>Java Application Management<br>Web Frameworks<br>Web 2.0 |
| Course work | Prüfung |
| Description of Course work | Active participation in lectures and seminars. The set books are to be studied in depth and to presented within the context of the course (lecture or seminar). All students have to hand in individual problem solutions on a regular basis via Intra- or Internet and to present them in the following seminar session.<br>70% of scores are to be met within the weekly seminars and are prerequisite for the participation at the exam at the end of the semester (written or oral exam according to the number of participants).<br>The assessment load comprises all topics treated within the course, whether written or oral or within the set books. |

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| Media | Problem solutions have to be achieved individually and smaller projects have to be implemented. Demos assist in the joint interactive error search and the design of problem solutions as well as the application of adequate tools.<br>Reading, writing and appraisal of scientific articles (author-reviewer-circle), blended learning, units of self-study, project work, Powerpoint, board, websites. |
| Literature | Gerti Kappel: Web Engineering, dpunkt-Verlag.<br>Eric Jendrock et al: The Java EE 5 Tutorial, Verlag Sun.<br>Volker Turau: Web-basierte Anwendungen entwickeln mit JSP 2, dpunkt-Verlag.<br>Bernd Müller: Java Server Faces, Hanser-Verlag.<br>Friedman: Praxisbuch Web 2.0, Verlag Galileo Computing. |

### Wissensarchitekturen

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|---|---|
| Curriculum assignment | MCS, 2. Semester, Spezialisierung Komplexe Softwaresysteme (SPEZ-KS) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 2 |
| Professor(s) in charge | Prof. Dr. Peter Becker |
| Language | Deutsch |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Learning targets | Fach- und Methodenkompetenz: Methoden des maschinellen Lernens kennen und beherrschen; Erfahrungswissen repräsentieren und nutzen können; Unsicheres Wissen mit Hilfe von quantitativen Methoden behandeln können; Wissensbasierte Techniken in Anwendungssysteme integrieren können |
| Content | Induktives Lernen; Lernen mit Vorwissen; Induktive Logikprogrammierung; Instanzbasiertes Lernen; Support Vector Machines; Reinforcement Learning; Text Mining; Anwendungen und Werkzeuge |
| Course work | Prüfung |
| Description of Course work | mündliche Prüfung |
| Media | Folienbasierte Präsentation, Übungsaufgaben, Einsatz von Softwarewerkzeugen (SWI-Prolog, Jess, Weka, S-Plus, RapidMiner), Homepage zur Veranstaltung und E-Mail-Verteiler als Kommunikationsmedium |
| Literature | S. Russell, P. Norvig, Artificial Intelligence - A Modern Approach, Prentice Hall, 1995.<br>C. Beierle, G. Kern-Isberner, Methoden wissensbasierter Systeme, Vieweg, 2003.<br>T. Mitchell, Machine Learning, McGraw-Hill, 1997.<br>I. H. Witten, F. Eibe, Data Mining, Morgan Kaufmann, 2005. |

## Wissenschaftliche Visualisierung

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| Curriculum assignment | MCS, 1. Semester, Spezialisierung Bio-Medizinische Informatik (SPEZ-BMEDI)<br>MCS, 1. Semester, Spezialisierung Medieninformatik (SPEZ-MI) |
| Credits | 6 |
| Teaching format (hours/week) | lecture: 2, exercise: 2 |
| Professor(s) in charge | Prof. Dr. rer. nat. Wolfgang Heiden, Dipl. Biol. |
| Language | Deutsch/Englisch |
| Workload (compulsory attendance) | 60 hours |
| Workload (private study) | 120 hours |
| Recommended Prerequisites | Grundkenntnisse Computergrafik<br>Grundkenntnisse Programmierung<br>Naturwissenschaftliche Grundkenntnisse hilfreich |
| Learning targets | Grundlegende und fortgeschrittene Prinzipien der Visualisierung kennen und verstehen<br>realistische und abstrakte Visualisierungsmethoden (u.a. mehrdimensionale und Massen-Daten) kennen und zielorientiert anwenden können<br>Anwendungsbeispiele, besonders aus den Naturwissenschaften, bearbeiten können Fach-/Methoden-/Lern-/soziale Kompetenzen:<br>• Fähigkeit, bestehende Visualisierungswerkzeuge im wissenschaftlichen Kontext einzusetzen, diese ggf. anzupassen und eigene Visualisierungswerkzeuge zielorientiert zu entwickeln<br>• wissenschaftliches Arbeiten im Grenzbereich Informatik und Naturwissenschaften<br>• eigenständige Erarbeitung zielorientierter Visualisierungsmethoden |
| Content | Vertiefung allgemeiner Visualisierungkonzepte für konkrete und abstrakte Daten<br>Visualisierung multidimensionaler Massendaten<br>Visualisierung in Physik, Chemie und den Biowissenschaften<br>Volumenvisualisierung und visuelle Quantifizierung in hybriden Abbildungsverfahren<br>interaktive Visualisierungskonzepte und deren Realisierung |
| Course work | Prüfung |
| Description of Course work | Mündliche oder schriftliche Prüfung |
| Media | Powerpoint-Folien |

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| | Multimedia-Material<br>Demonstrationen<br>Webseite mit Folien im PDF-Format, weiteren Hinweisen, Verweisen auf Quellen im Internet und den Lösungen für die Übungen/Praktika |
| Literature | Spence, R.: Information Visualization. Addison-Wesley, 2001<br>Shneiderman, B.: Designing the User Interface. Addison Wesley Longman, 1998<br>Weitere Literatur wird in der Veranstaltung bekannt gegeben. |