SCHMALKALDEN UNIVERSITY OF APPLIED SCIENCES

Module manual for the course of studies

Applied Computer Science (M.Sc.)

Faculty of Computer Science

version 08/2020

Content

SCHMALKALDEN UNIVERSITY OF APPLIED SCIENCES

Obligatory

Module Name	**Agile Software Development**
Module Responsibility	*Prof. Dr. Englmeier*
Qualification Targets	***Knowing/Perceiving:*** *Students learn basic concepts and methods of agile software development. Based on their knowledge acquired in the Bachelor course project management they better understand how to adopt the concept of Agility in Project Management. The course addresses in particular the SCRUM methodology.* ***Applying****: The students also learn tools supporting agile project management.* ***Analyzing/Evaluating:*** *The course applies and reflects traditional project management tools in the light of agility. This contrasts the two approaches and highlights the differences and the applicability of agility to different project settings.* ***Synthesizing:*** *The course trains also the use of Agile Project Management tools. The students set up a project in teams and manage their fictive work. They are encouraged to link their project management with a project they complete in a different course during the same semester.*

Content	Know	Understand	Apply	Analyze	Assess	Synthesize
Basics in Project Management	x	x	x	x		
Agile Principles	x	x	x	x		
SCRUM	x	x	x	x	x	x
Agile Lifecycle	x	x	x	x	x	x
Measuring performance	x	x	x	x	x	x

Module Contents	*1. Understanding Agile* • *Values and Principles* • *Agile Methodologies and Frameworks* • *Agile Project Management Model* *2. Adopting the Agile Approach* • *Initiating an Agile Project* • *Creating Vision and Charting a Project* • *Agile Contracts* • *Agile Documentation* *3. SCRUM* • *Fundamental Concepts (User Stories, Iteration, Sprints, Backlogs, …)* • *Roles and team development* • *Communication* *4. Agile Lifecycle* • *Phase models* • *Release planning* *5. Performance measurement*
Teaching Methods	*Lectures (2 hours/week), Exercise (2 hours/week)*
Requirements for Participation	*Programming skills*
Literature / Multimedia-based Teaching Material	*Highsmith, J.: "Agile Project Management: Creating Innovative Products", 2nd Edition, Pearson Education/Addison Wesley Professional.* *Stenbeck, J.: PMI-ACP® and Certified Scrum Professional Exam Prep and Desk Reference.* *Cohn, M.: "User Stories Applied", Addison-Wesley, 2004.* *Online Courses of ACM addressing User Stories und User-Centred Design*
Applicability	*Master Applied Computer Science*
Effort/ Total Workload	*Total 150 hours. Attendance: 60 hours; Self-study: 20 hours; Practical work: 70 hours*
ECTS/ Emphasis of the Grade for the final Grade	*5 CP (Emphasis of the Grade for the final Grade 5/120)*
Performance Record	*Project work*
Semester	*2nd semester*
Frequency of the course	*Once during the academic year (summer semester)*
Duration	*One semester*
Type of Course	*Obligatory course from the area software engineering*

Module Name	**Computer Graphics 1 (Computergraphik 1)**
Module Responsibility	*Prof. Hartmut Seichter, PhD*
Qualification Targets	*Students are able to understand the connection between visual computing techniques and the underlying mathematical concepts and the physiognomy of human beings, especially the visual system. Students further can distinguish the differences between image synthesis methods and related techniques. Students will learn basic techniques of real-time 3D visualization and apply them in exercises.*

Topics	**Know**	**Understand**	**Apply**	**Analyze**	**Assess**	**Synthesize**
Digital Images	X	X	X			
Display Systems	X	X	X	X	x	
3D Model Representations	X	X	X	X	X	
Image Synthesis Methods	X	X	X	X	X	
Texturing	X	X	X	X	X	
Lighting Models	X	X	X			
Shading Models	X	X	X			
Applications	X	X				

Module Contents	*Computer graphics is a melting pot of computer science technologies to present digital content efficiently to users. Topics in this course:* • *Basic knowledge of the human visual system and perceptual psychological concept.* • *Image generation and storage* • *CG in professional application and entertainment* • *Display technologies* • *3D model representations* • *Transformationpipeline: homogenous coordinates and transformations* • *Scenegraphs and realtime rendering APIs* • *Image syntesis methods: Rasterization, Raytracing and beyond.* • *Geometry and Images: samplingmethods and anti-aliasing strategies* • *Texturing, Surfaces and Materials* • *Rendering-Equation and Shadingmodels* • *Lighting models* • *Introduction to scientific and information visualization* • *Graphical User Interfaces*
Teaching Methods	*Lecture (2 SWS), Exercises (2 SWS)*
Requirements for Participation	• *Programming with OOP* • *Basic knowledge of linear algebra*
Literature / Multimedia-based Teaching Material	• *Foley, James D, Andries Van Dam, Steven K Feiner, John F Hughes, and Richard L Phillips. Introduction to Computer Graphics. Vol. 55. Addison-Wesley Reading, 1994.* • *Folien*
Applicability	*Master Applied Computer Science, Master Angewandte Medieninformatik*
Effort / Total Workload	*Total 150 hours. Attendance: 60 hours, Self-Study: 45 hours, Exam Preparation: 45 hours*
ECTS / Emphasis of the Grade for the final Grade	*5 CP (Emphasis of the Grade for the final Grade 5/120)*
Performance Record	*Oral Exam*

Semester	*1st Semester*
Frequency of Occurrence	*Once during the academic year (winter semester)*
Duration	*One Semester*
Type of Course	*Obligatory course from the area of software engineering*

Module Name	**Computational Intelligence**
Module Responsibility	*Prof. Dr. Martin Golz*
Qualification Targets	*The students will get the opportunity to* - *Analyse typical problems of sub-symbolic data and knowledge processing,* - *Conceive the process chain of adaptive data analytics,* - *Comprehend and apply methods of the process chain,* - *Comprehend and apply methods of validation,* - *Know basic assumptions and models of empirical inference,* - *Know some of the mathematical background issues.*

Contents	***Know & Comprehend***	***Apply***	***Analyse & Evaluate***	***Synthesise***
Basics of statistical inference	X			
Process chain of adaptive data analytics	X	X	X	
Statistical learning theory	X			
Multivariate regression analysis	X	X	X	
Linear discriminant analysis	X	X	X	
Kernel function discriminant analysis	X	X	X	
Linear and non-linear adaptive filtering	X	X	X	
Deep learning	X	X	X	

Module Contents

1. Introduction
- *1.1. Five types of statistical inference*
- *1.2. Typical applications*
- *1.3. Process chain*

2. Statistical learning theory
- *2.1. Empirical risk minimisation*
- *2.2. PAC learning*
- *2.3. General learning model*
- *2.4. Learning with uniform convergence*
- *2.5. Bias complexity trade-off*
- *2.6. Vapnik Chervonenkis dimension*

3. Multivariate, linear regression analysis
- *3.1. Introduction*
- *3.2. Model*
- *3.3. Principle of maximal a-posteriori probability*

4. Linear discriminant analysis (LDA)
- *4.1. Introduction*
- *4.2. Multi-class LDA*
- *4.3. Least squares LDA*
- *4.4. Fisher LDA*

5. Kernel function discriminant analysis
- *5.1. Introduction*
- *5.2. Theorem of Cover*
- *5.3. Dual representation*
- *5.4. Generation of kernel functions*
- *5.5. Radial basis function networks*
- *5.6. Recursive least squares minimisation*
- *5.7. Gaussian processes*

	5.8. Applications *6. Adaptive Filter* *6.1. Linear adaptive filtering* *6.1.1. Least squares algorithm (LS)* *6.1.2. Recursive LS algorithm (RLS)* *6.1.3. Extended RLS algorithm (Ex-RLS)* *6.2. Non-linear adaptive filtering* *6.2.1. Reproducing kernel Hilbert space (RKHS)* *6.2.2. Kernel function LS filtering* *6.3. Applications* *7. Deep learning* *7.1. Characterisation* *7.2. Representation learning* *7.3. Deep auto-encoder* *7.4. Restricted Boltzmann machines* *7.5. Applications*

Teaching methods	- *Frontal lectures with*
	  ○ *Digital presentation slides,*
	  ○ *Demonstration programs*
	- *Exercises held in the computer pool*
	  ○ *Programming with MATLAB*
	  ○ *Clarification of open issues*

Requirements for Participation	*No formal suppositions* *Basic knowledge in linear algebra, analysis, statistics*
Literature	*The following books are recommended:* - *Nielsen (2015) Neural networks and deep learning. Determination press* - *Mohri, Rostamizadeh (2012) Foundations of machine learning. MIT press* - *Bishop (2006) Pattern recognition & machine learning. Springer* - *Duda, Hart, Stork (2001) Pattern classification. Wiley*
Applicability	*This module is an obligatory subject.* *An appropriation to similar majors is possible under stipulation of their examination regulations.*
Effort / Total Workload	*180 hours, including 60 hours in presence and 120 hours self-instruction*
ECTS / Emphasis of the Grade for the final Grade	*5 CP (Emphasis of the Grade for the final Grade 5/120)*
Performance Record	*Oral examination (30 minutes)*
Semester	*2nd Semester*
Frequency of Occurrence	*Once a year*
Duration	*One semester*
Type of Course	*Obligatory subject*

Module Name	**Distributed Systems (Verteilte Systeme)**
Module Responsibility	*Prof. Dr. Erwin Neuhardt*
Qualification Targets	*Students learn about important architectures which are relied on in the development of distributed systems. They know about the properties of different architectures. They learn about the different technologies for communication and cooperation in distributed systems and are able to apply these technologies in real world projects.*

Contents	**Know**	**Understand**	**Apply**	**Analyse**	**Assess**	**Synthesize**
Architecture	x	x	x			
Sockets	x	x	x	x	x	
RPC / RMI	x	x	x	x	x	
JEE	x	x	x	x	x	
JMS	x	x	x	x	x	
Threads	x	x	x	x	x	

Module Contents	*Concepts and technologies for the development of distributed Systems:* - *architectures and properties of distributed systems: client server-architectures, transparency* - *Programming concepts for the communication in distributed systems: sockets, remote procedure call, remote method invocation, component based distributed systems, message based distributed systems* - *Concurrent programming: java thread, synchronization and coordination, concurrent data structures, java executor framework*
Teaching Methods	*Lecture (2 hours/week), tutorial (2 hours/week)*
Requirements for Participation	*Skills and knowledge in Java programming and software engineering (at least 10 ECTS)*
Literature / Multimedia-based Teaching Material	*Andrew S. Tanenbaum, Maarten van Steen, Distributed Systems, Published by Maarten* von Steen, 2017 *Jendrock, E. et al.: The Java EE Tutorial, Enterprise Java Beans, online on docs.oracle.com* *w/o author: Sockets, Java Remote Method Invocation, Concurrency, online on docs.oracle.com* *Brian Goetz, Joshua Bloch, Joseph Bowbeer, Doug Lea, David Holmes, Tim Peierls, Java Concurrency in Practice, Addison-Wesley, 2006* *David A. Chappell, Richard Monson-Haefel, Java Message Service, O'Reilly 2009*
Applicability	*Master of Applied Computer Science, Master Angewandte Medieninformatik*
Effort / Total Workload	*Total 150 hours. Attendance: 60 hours, Self-Study: 60 hours, Exam Preparation 30 hours*
ECTS / Emphasis of the Grade for the final Grade	*5 ECTS (Emphasis of the Grade for the final Grade 5/120)*
Performance Record	*Written examination on PC*
Semester	*1st semester*
Frequency of Occurrence	*Once during the academic year*
Duration	*One semester*

Module Name	**IT Security**

Module Responsibility	*Prof. Ralf C. Staudemeyer, Ph.D.*
Qualification Targets	*In this course students will learn how to determine the level of security of a computer system or service, specify vulnerabilities, and to estimate the potential damage resulting from a successful attack. It covers the basic principles and key concepts for the operation of secure and (mostly) distributed systems, which includes partial components from operating systems and computer networks. The focus of this course is to deepen the understanding of network attacks and the cryptographic techniques to ensure integrity and confidentiality of information. Topics include various sub-components like cryptographic key management, biometrics, authentication in distributed systems, and basic security protocols and standards.*
Module Contents	*The course starts with a general introduction into IT-Security, Cryptography and Privacy-Enhancing Technologies. The main focus of this course is on cryptographic algorithms and security protocols. Principally this module treats a selection of the following topics:* • *Selected Attacks (attacks analysis, protection mechanisms)* • *Cryptographic Algorithms (AES, RSA, ECC, MACs, signatures)* • *Cryptographic Key Management (Diffie-Hellman key exchange, certificates, public-key infrastructure)* • *Digital Identity (multi-factor authentication, challenge-response protocols, authentication in distributed systems)* • *Mobile Security (mobile networks, Internet-of-Things, SmartCities)* • *Network Security (security protocols, virtual private networks, secure Internet services)* • *User-tools for IT-Security and Privacy in daily practise (email, web, chat, filesystems)* *This module is under constant development to reflect the most recent developments.*
Teaching Methods	*Lecture (2 hours/week), Exercise (2 hours/week)*
Requirements for Participation	*Decent programming skills and basic knowledge in IT-security*
Literature / Multimedia-based Teaching Material	• *Eckert, C. (2018). IT-Sicherheit. Berlin, München, Boston. De Gruyter.* • *Stallings, W. (2016). Cryptography and network security, principles and practices (7th edition). Prentice Hall.* • *Paar, C., & Pelzl, J. (2010). Understanding Cryptography. Berlin, Heidelberg: Springer Berlin Heidelberg.* • *Schneier, B. (1996), Applied Cryptography, John Wiley & Sons.* • *Hoglund, G, & McGraw , G. (2004). Exploiting Software, how to break code, Addison Wesley.* • *Selected sources announced in the lecture.*
Applicability	*Master of Applied Computer Science*
Effort/ Total Workload	*Total 150 hours. Attendance: 60 hours, Self-Study incl. exam preparation: 90h.*
ECTS/ Emphasis of the Grade for the final Grade	*5 CP (Emphasis of the Grade for the final Grade 5/120)*
Performance Record	• *successfully completed exercises* • *oral exam or written exam (>14 participants)*

Semester	*1st semester*
Frequency of Occurrence	*annually (WS)*
Duration	*one semester*
Type of Course	*Obligatory course from the area IT-Security*

Module Name	**Mobile Systems (Mobile Systeme)**
Module Responsibility	*Prof. Dr. Michael Cebulla*
Qualification Targets	*Students learn about substantial concepts and technologies for the development of smart, mobile applications. One focus area consists in the programming with sensor data.*

Content	Know	Understand	Apply	Analyze	Assess	Synthesize
Location-based Services	x	x	x	x	x	x
Communication	x	x	x	x	x	
Sensorics	x	x	x	x	x	
Activity Recognition	x	x	x	x	x	x
Track & Trace	x	x	x	x	x	x

Module Contents	*Concepts and technologies for the development of advanced mobile applications. Special focus lies on the contextual dependencies of system behavior and the communication between different components. The following topics are examined:* - *Location-based Services: application of different localization services with different properties, services for the visualization of geographical data, management of geographical data, geofencing, location-based social networking (lbsn)* - *Communication in mobile applications: bluetooth, NFC, http etc.* - *Acquisition of environmental data using sensoric interfaces* - *Activity Recognition* - *Track & Trace-applications: acquisition of position data and environmental data, collection and management of data, automated situation monitoring and recognition*
Teaching Methods	*Lecture (2 hours/week), excercise (2 hours/week)*
Requirements for Participation	*Skills and Knowledge in Programming with Java and Android*
Literature / Multimediabased Teaching Material	*Bill Philips, Chris Stewart, Brian Hardy, Kristin Marsiciano, Android Programming – The big Nerd Ranch Guide (2nd Edition), Big Nerd Ranch.* *Thomas Künneth, Android 5 - Apps entwickeln mit dem Android SDK, Galileo Press, Bonn 2012* *Greg Milette, Adam Stroud, Professional Android Sensor Programming, John Wiley, Indianapolis 2012*
Applicability	*Master of Applied Computer Science*
Effort/ Total Workload	*150 hours: 60 hours presence, 45 hours self-study, 45 hours preparation of exam*
ECTS / Emphasis of the Grade for the final Grad	*5 CP (Emphasis of the Grade for the final Grade 5/120)*
Performance Record	*Written exam*
Semester	*2nd semester*
Frequency of Occurrence	*Once a year*

Duration	*One semester*
Type of Course	*Obligatory course from the area distributed and mobile systems*

Module Name	**Service-Oriented Networks**
Module Responsibility	*Prof. Dr.-Ing. Heinz-Peter Höller*
Qualification Targets	*Students* - *will get advanced knowledge on the requirements of multimedia streams in networks,* - *should be able to correlate deficiencies in the quality of network services with properties of the network and traffic characteristics,* - *will get advanced knowledge on the approach of quality of service and congestion control,* - *should be able to identify and to analyze quality of service as well as congestion control approaches at all concerned OSI levels and* - *should be able to react on shift and variation of quality of service when programming distributed systems.*
Module Contents	*Modern applications and their requirements for networks* *Congestion control* *Quality of service* • *classes of service* • *signaling* • *traffic management* • *buffer management* *TCP congestion control* *quality of service at OSI level two (ATM, LAN, MPLS)* *Internet quality of service* • *Integrated services* • *Differentiated services* *Advanced transport control protocols*
Teaching Methods	*Seminar-like lecture (3 hours/week)* *Exercises and discussions to deepen the knowing (1 hour/week)*
Requirements for Participation	*There are no formal prerequisites. Good knowledge in communication networks is expected.*
Literature / Multimedial-based Teaching Material	*Badach, A., Voice over IP Die Technik, Hanser, München, 2005.* *Braun, T. & Zitterbart, M.. Hochleistungskommunikation, Band 2: Transportdienste und –protokolle.Oldenbourg Verlag 1996.* *Kurose, J.F. & Ross, K.W. Computernetzwerke. Pearson Studium, München 2008.* *Lu, G., Communication and Computing for Distributed Multimedia Systems.Artech House 1996.* *Schmitz, R., Kiefer, R., Maucher, J., Schulze, J. &Suchy, T. Kompendium Medieninformatik. Mediennetze. Springer 2006.* *Shin, J., Lee, D.C. &Kuo, C.-C.J., Quality of Service for Internet Multimedia,Prentice Hall 2004* *Siegel, E.D., Quality of Service. Solutions for the Enterprise.Wiley 2000* *Stalling, W.. Quality of Service and Quality of Experience. The Internet Protocol Journal (2016, March), 14-40.*
Applicability	*„Service-Oriented Networks“ is compulsory in the master program. Gained expertise is essential where quality of service issues have to be considered.*
Effort / Total Workload	*Total 150 hours. Attendance: 60 hours, Self-Study: 45 hours, Exam Preparation 45 hours*
ECTS / Emphasis of the Grade for the final Grade	*5 CP (Emphasis of the Grade for the final Grade 5/120)*
Performance Record	*Oral examination*
Semester	*2nd semester*
Duration	*One semester*
Type of Course	*Obligatory*

Module Name	**Signals and Systems**
Module Responsibility	*Prof. Dr. Martin Golz*
Qualification Targets	*The students will get the opportunity to* - *Analyse typical problems of signal processing,* - *Comprehend integral transforms of continuous functions,* - *Comprehend the discrete Fourier transforms of sequences,* - *Comprehend and apply the discrete Fourier transform,* - *Comprehend and apply digital filters,* - *Comprehend and apply spectral estimation of stochastic signals,* - *Comprehend and apply time-frequency analysis,* - *Know some of the mathematical background issues.*

Contents	***Know & Comprehend***	***Apply***	***Analyse & Evaluate***	***Synthesise***
Fourier integral	X			
Fourier series	X			
Convolution integral	X	X		
Sampling theorem & aliasing	X	X	X	
Diskrete Fourier transform	X	X	X	
Linear time-invariant systems	X	X	X	
stochastic processes, spectral estimation	X	X	X	
Time-Frequency analysis	X	X	X	

Module Contents	*8. Introduction* *9. Fourier integral* *9.1. Integral transforms, Fourier kernel* *9.2. Dirichlet conditions, properties* *9.3. Elementary signals* *9.4. Signal energy, signal power, decibel, band width* *10. Fourier series* *11. Convolution* *12. Sampling theorem* *13. Discrete Fourier transform* *13.1. Properties* *13.2. Discrete Walsh transform, z-transform* *14. Linear, time-invariant systems* *14.1. Properties* *14.2. Impulse response, transfer function, Bode plot* *14.3. Pole-Zero plot, stability* *14.4. State space description* *15. Stochastic signals* *15.1. Properties* *15.2. Probability density function* *15.3. Wiener-Khinchin theorem, power spectral density* *15.4. Cepstrum* *15.5. Spectral estimation* *15.6. Applications* *16. Time-frequency analysis* *16.1. Short-time Fourier transform*

	16.2. Gabor series *16.3. Wavelet transform* *16.4. Applications*

Teaching methods	- *Frontal lectures with*
	  o *Digital presentation slides,*
	  o *Demonstration programs*
	- *Exercises held in the computer pool*
	  o *Programming with MATLAB and signal processing toolbox*
	  o *Clarification of open issues*

Requirements for Participation	*No formal requirements* *Basic knowledge in linear algebra, analysis, statistics*
Literature	*The following books are recommended:* - *Oppenheim (1997) Signals and systems. Prentice Hall* - *Haykin, van Veen (2003) Signals and systems. Wiley* - *Percival, Walden (2000) Wavelet methods for time series analysis. Cambridge University Press*
Applicability	*This module is an obligatory subject.* *An appropriation to similar majors is possible under stipulation of their examination regulations.*
Effort / Total Workload	*Total 150 hours. Attendance: 60 hours, Self-Study: 45 hours, Exam Preparation 45 hours*
ECTS / Emphasis of the Grade for the final Grade	*5 CP (Emphasis of the Grade for the final Grade 5/120)*
Performance Record	*Oral examination (30 minutes)*
Semester	*1st Semester*
Frequency of Occurrence	*Once during the academic year*
Duration	*One semester*
Type of Course	*Obligatory subject*

Module Name	**Web Applications**
Module Responsibility	*Prof. Dr. Erwin Neuhardt*
Qualification Targets	*The students get to know the structure and the functionality of a web application. They will know two frameworks for building web applications based on the programming language Java. They get to know REST which is a standard for communicating between applications. The students know how to apply a framework for building web applications. They know the advantages and disadvantages of different frameworks.*

Contents	Know	Understand	Apply	Analyse	Assess	Synthesize
HTML, CSS, HTTP	x	x	x			
Model-View-Controller	x	x	x	x	x	
Spring MVC	x	x	x	x	x	
Vaadin	x	x	x	x	x	
REST	x	x	x	x	x	

Module Contents	*Elements of a web application: HTML. CSS, HTTP, Model-View-Controller Pattern, creating different parts of a web application with a framework, forms, validation, creating a response page, error handling, layout of web pages, reusable parts of web pages, principles of REST, elements of a REST interface, implementation of a REST interface*
Teaching Methods	*Lecture and tutorial (3+1 hours per week)*
Requirements for Participation	*Skills and knowledge in Java programming and software engineering (at least 10 ECTS)*
Literature / Multimedia-based Teaching Material	*Johnson, Rod et al.: Spring Framework Reference Documentation, online at docs.spring.io* *w/o author: Spring Guides, online at spring.io/guides* *w/o author: Apache FreeMarker, online at freemarker.org* *w/o author: Bootstrap, online at getbootstrap.com* *w/o author: Vaadin Documentation, online at vaadin.com* *Burke, B.: RESTful Java with JAX-RS 2.0, O'Reilly, 2014*
Applicability	*Master of Applied Computer Science, Master Angewandte Medieninformatik*
Effort / Total Workload	*Total 150 hours. Attendance: 60 hours, Self-Study: 60 hours, Exam Preparation 30 hours*
ECTS / Emphasis of the Grade for the final Grade	*5 ECTS (Emphasis of the Grade for the final Grade 5/120)*
Performance Record	*Written examination on PC (120 min)*
Semester	*3 rd semester*
Frequency of Occurrence	*Once during the academic year*
Duration	*One semester*
Type of Course	*Obligatory course*

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Optional section I

Module Name	**IT-Security (adv. chapters)**
Module Responsibility	*Prof. Ralf C. Staudemeyer, Ph.D.*
Qualification Targets	*This course teaches students to improve their ability to understand and master current developments in IT-Security and Privacy-Enhancing Technologies (PET). Students learn research techniques that they will apply on pre-selected research topics. Aside from a comprehensive literature research, students will develop a scientific contribution. Results will be presented in form of a conference contribution. This includes a presentation and an academic publication.*
Module Contents	*This course takes place in form of an academic conference. Students go thought the typical phases of a scientific contribution: extended abstract, review, camera ready version, full paper and 30minutes presentation. All presentations will be in the course of an internal conference-like event open to all university members near the end of the semester. A selection of the written contributions will be published in form of a technical report. Overall, the event comes with few meetings of all participants. Questions that arise during the processing of the individual research topics are clarified within working groups and with the lecturer at regular individual meetings.* *Typical "hot" research topics are, for example, in the areas* • *Security monitoring and visualization* • *Internet-of-Things // Industry4.0* • *Privacy-Enhancing Technologies* • *Machine Learning in IT-Security*
Teaching Methods	*lecture (2 SWS), exercises (2 SWS)* *students per course: restricted; exercises: 10*
Requirements for Participation	*Basic knowledge in IT-security and cryptography*
Literature / Multimedia-based Teaching Material	Selected sources for the preparation of current topics.
Applicability	*Master of Applied Computer Science (MACS)* *Master Angewandte Medieninformatik (MaI)*
Effort/ Total Workload	*Total 150 hours: Attendance: 60 hours, Self-study incl. exam preparation: 90h.*
ECTS/ Emphasis of the Grade for the final Grade	*5 CP (Emphasis of the Grade for the final Grade 5/120)*
Performance Record	• *presentation (30min)* • *academic publication (5pages)*
Semester	*2nd/ 3rd Semester (MACS/MaI)*
Frequency of Occurrence	*every semester*
Duration	*one semester*
Type of Course	*Obligatory course from the area IT-Security*

Module Name	**Distributed Systems Advanced Chapters (Vertiefung Verteilte Systeme)**
Module Responsibility	*Prof. Dr. Michael Cebulla*
Qualification Targets	*Students extend and deepen their knowledge about architectures of distributed systems. They become acquainted with additional architectures and development platforms. They develop their programming skills concerning the development of distributed systems in practical exercises. Generally the focus lies on the concept of intelligent middleware.*

Content	Know	Understand	Apply	Analyze	Assess	Synthesize
Analysis and properties of architectures	x	x	x	x	x	
Service oriented architectures	x	x	x	x	x	
Stream Processing	x	x	x	x	x	
Actors and agents	x	x	x	x	x	

Module Contents	*Advanced Topics in the Development of Distributed Systems:* - *Architectures of Distributed Systems: Structure and Properties* - *Serviceoriented Architectures: Properties, Solutions, Perspectives* - *Data-driven Systems: Stream Processing* - *Actor und Agent Systems* - *Clustering, Container, Cloud Computing*
Teaching Methods	*Lectures (2 hrs/week), Exercise (2 hrs/week)*
Requirements for Participation	*Programming skills in Java*
Literature / Multimedia-based Teaching Material	*Andrew S. Tanenbaum, Maarten van Steen, Distributed Systems: Principles and Paradigms, Pearson Prentice Hall 2007* *George F. Coulouris, Jean Dollimore, Tim Kindberg, Distributed Systems: Concepts and Design, Pearson Prentice Hall, 2003* *Nicolai M. Josuttis, SOA in Practice – The Art of Distributed Systems Design, O'Reilly 2007* *Raymond Roestenburg, Rob Bakker, Rob Williams, Akka in Action, Manning Publication 2016* *Fabio Bellifemine, Giovanni Caire, Dominic Greenwood, Developing Multi-Agent Systems with JADE, John Wiley & Sons, 2004*
Applicability	*Master of Applied Computer Science, Master Angewandte Medieninformatik*
Effort/ Total Workload	*150 hours: Presence 60 hours, 45 hours self-study, 45 hrs exam preparation*
ECTS/ Emphasis of the Grade for the final Grade	*5 CP (Emphasis of the Grade for the final Grade 5/120)*
Performance Record	*Written exam*
Semester	*1st or 3rd semester*
Frequence of Occurrence	*Every second year*
Duration	*One semester*
Type of Course	*Selectable course from the area distributed and mobile systems*

Module Name	**Semantic Technologies in Distributed Systems (Semantische Technologien in verteilten Systemen)**

Module Responsibility	*Prof. Dr. Michael Cebulla*
Qualification Targets	*Students understand concepts and technologies from the area „intellegent middleware“ and are able to apply them. They are able to analyze and assess existing solutions on the basis of these concepts.*

Contents	Know	Understand	Apply	Analyze	Assess	Synthesize
Ontologies	x	x	x	x	x	
SOA-platforms / Enterprise Service Bus	x	x	x	x	x	
Situation monitoring/ Complex Event Processing	x	x	x	x	x	

Module Contents	*Concepts and technologies for intelligent middleware:* - *Ontologies: concepts for semantic data management, ETL process, ontology description languages, knowledge bases and inference mechanisms* - *Middleware platforms and architectures: Enterprise service bus, service oriented architectures* - *Process Mining* - *Situation recognition: event-based architectures, event-based programming, complex event processing*
Teaching Methods	*Lecture (2 SWS)*
Requirements for Participation	*Java Programming*
Literature / Multimedia-based Teaching Material	*Franz Baader, Deborah L. McGuinness, Daniele Nardi, Peter F. Patel-Schneider, The Description Logic Handbook (2nd Edition), Cambridge University Press, 2010* *David Chappell, Enterprise Service Bus: Theory in Practice, O'Reilly 2004* *David Luckham, The Power of Events: An Introduction to Complex Event Processing in Distributed Systems, Addison-Wesley 2002* *Wil M. P. van der Aalst, Process Mining – Data Science in Action, Springer 2016*
Applicability	*Master of Applied Computer Science, Master Angewandte Medieninformatik*
Effort/ Total Workload	*120 hrs, presence time 45 hours, self study 40 hrs, exam preparation 35 hrs*
ECTS / Emphasis of the Grade for the final Grade	*4 CP (Emphasis of the grade for the final grade 4/120)*
Performance Record	*Written exam*
Semester	*1st and 3rd Semester*
Frequency of Occurrence	*Every second year*
Duration	*One Semester*
Type of Course	*Selection area*

Module Name	**Software Quality (Softwarequalität)**
Module Responsibility	*Prof. Dr. Erwin Neuhardt*
Qualification Targets	*The students get to know different methods for describing and assuring software quality. They know tools and methods for examining software quality. They can apply these tools and methods to software projects. They can evaluate the efficacy of the methods in different application contexts.*

Contents	Know	Understand	Apply	Analyse	Assess	Synthesize
Definition of software quality	x	x	x			
Test methods	x	x	x	x	x	
Static analysis	x	x	x	x	x	
Software Metrics	x	x	x	x	x	
Theoretical background of static analysis	x	x				

Module Contents	*Definition of software quality, test methods for unit test, integration test, system test, static analysis, software metrics, tools and methods for examining software quality and measuring metrics*
Teaching Methods	*Lecture (1 hour/week), tutorial (1 hour/week)*
Requirements for Participation	*Skills and knowledge in Java programming and software engineering (at least 10 ECTS)*
Literature / Multimedia-based Teaching Material	*Binder, Robert V.: Testing object-oriented systems: models, patterns, and* tools, Addison-Wesley, 2000 *w/o author: SonarCube Documentation, online at docs.sonarqube.org* *Reichenbach, C.: Program Analysis Overview,* https://www.youtube.com/watch?v=ABqLrCf5BsA Reichenbach, C.: Foundations of Dataflow Analysis, https://www.youtube.com/watch?v=fWoc2bZZ59A Reichenbach, C.: Computation, https://www.youtube.com/watch?v=jnbMirDEByY
Applicability	*Master of Applied Computer Science, Master Angewandte Medieninformatik*
Effort / Total Workload	*Total 90 hours. Attendance: 30 hours, Self-Study: 40 hours, Exam Preparation 20 hours*
ECTS / Emphasis of the Grade for the final Grade	*3 ECTS (Emphasis of the Grade for the final Grade 3/120)*
Performance Record	*Written Examination*
Semester	*2nd semester*
Frequency of Occurrence	*Once during the academic year*
Duration	*One semester*
Type of Course	*Compulsory optional course from the area software engineering*

Module Name	**Text Mining and Search**

Module Responsibility	*Prof. Dr. Englmeier*
Qualification Targets	***Knowing/Perceiving:*** *Students learn essentials in content extraction and information retrieval as the basis of content analysis in texts, which, in turn, provide the theoretical basis for the successful design of advanced content analysis.* ***Applying:*** *The students implement the methods they learn while using well-established tools for data analysis (for example, Apache Lucene), which are valuable for the design of search engines.* ***Analyzing/Evaluating:*** *In the teamwork of the project, the students apply their theoretical design knowledge in the development of specialty search engines. They embrace thus the design versatility in the development of features for text analysis and retrieval. In their practical work they can reflect the effectiveness and potentials of their design approaches.* ***Synthesizing:*** *The result of the course is manifested in a course-wide project that involves the development of a search engine with special search features. Application development is thereby broken down into smaller work packages. Each team (two or three students) assumes a work package, organizes its individual tasks, and contributes to the management of the overall project.* *The self-empowered organization of the project work also includes explorative learning. Students are so encouraged to learn new methodologies or tools on their own (with support from the professor), provided their individual part of the project work requires that.*

Content	Knowing	Perceiving	Applying	Analyzing	Evaluating	Synthesizing
Basics	X	X				
User interaction		X	X	X		X
Retrieval models & evaluation	X	X	X	X	X	X
Apache Lucene		X	X	X	X	X
Content extraction	X	X	X	X	X	X
Indexing		X	X	X	X	X
Query matching		X	X	X	X	X

Module Contents	*1. Fundamentals in Information Retrieval (IR)* • *Basic IR concepts* • *Regular Expressions* • *XML* *2. User Interaction* • *User story structure & validation* • *Feature charts* • *User support* *3. Retrieval models & evaluation* *4. Apache Lucene* • *Modules* • *Integration (Java)* *5. Indexing* • *Tokenization* • *Stopwords* • *Stemming* • *Synonyms* *6. Query matching* • *Query vectors* • *Matching models*
Teaching Modalities	*Lectures, workshops, team cooperation*
Requirements for Participation	*Solid practical programming skills*
Literature / Multimedia-based Teaching Material	*Baeza-Yates, R.; Ribeiro-Neto, B.: "Modern Information Retrieval", ACM Press, New York, 1999.* *McCandless, M. et al: "Lucene in Action", Second Edition, Manning, Stamford, 2010* *Application examples from search engines in practice*
Applicability	*Master Applied Computer Science*
Effort/ Total Workload	*Total 90 hours. Attendance: 30 hours, Self-Study: 30 hours, Practical work: 30 hours*
ECTS/ Emphasis of the Grade for the final Grade	*3 CP (Emphasis of the Grade for the final Grade 3/120)*
Performance Record	*Project work*
Semester	*2nd semester*
Frequency of the course	*Once during the academic year (summer semester)*
Duration	*One semester*
Type of Course	*Compulsory elective course*

Optional section II

Module Name	**eBusiness**
Module Responsibility	*Prof. Dr. Thomas Urban*
Qualification Targets	*Expertise is in terms of knowledge and understanding of business models and processes, provides typical eBusiness architectures and social media characteristics and the design of specific marketing requirements. The basic technical standards are considered. Methodological expertise is sought in particular in the process design, the implementation and realization of customer relationship based marketing concepts in eBusiness.*
Module Contents	*Based on the technical and economics requirements regarding the implementation of electronic business processes and the economic characteristics of the Net Economy, different forms of communication and transactions between business partners are discussed. This concerns the design of the procurement (eProcurement), sales (eShop) and mediation processes (eMarketplace) and on the other hand also with Web 2.0 created electronic contact networks (eCommunitys). In addition to discussing the system requirements, process design requirements and management requirements specific design requirements on the marketing and implementation of electronic platforms for business transactions are treated.*
Teaching Methods	*Overhead, Power-Point-slides*
Requirements for Participation	*Basic knowledge of information management and distributed systems ; Basic knowledge in business administration*
Literature / Multimedia-based Teaching Material	*Hass, B./Walsh, G./ Kilian, Th. (Hrsg.) (2008): Web 2.0 – Neue Perspektiven für Marketing und Medien; Springer Verlag Heidelberg* *Kollmann, T. (2013): E-Business, Gabler Verlag Wiesbaden* *Meier, A./Stormer, H. (2008): eBusiness & eCommerce - Management der digitalen Wertschöpfungskette; Springer Verlag Heidelberg, 2. Auflage* *Merz, M. (2002): E-Commerce und E-Business, dpunkt.verlag Heidelberg* *Sigler, C. (2010): Online-Medienmanagement* *Thome, R. et al. (2005): Electronic Commerce und Electronic Business, Verlag Vahlen München* *Weiber, R. (2002): Handbuch Electronic Business, Gabler Verlag Wiesbaden* *Wirtz, B. W. (2013): Electronic Business, Springer Gabler Verlag Wiesbaden*
Applicability	*The module aims to provide a practical orientation by specifying concrete problems of business practices and exemplary propose solutions based on a theoretical framework. Furthermore, realized through the integration of best-practice lectures the close integration of theory and practice.*
Effort/ Total Workload	*Contact time/Presence studies 30 hours; Self-study and 50 hours; Test and exam preparation time: 10 hours*
ECTS/ Emphasis of the Grade for the final Grade	*3*

Performance Record	*written exam*
Semester	*2*
Frequency of Occurrence	*winter semester*
Duration	*1 semester*
Type of Course	*lecture*

Module Name	**Human-Computer Interaction**
Module Responsibility	*Prof. Dr. Englmeier*
Qualification Targets	***Knowing/Perceiving:*** *Students learn essentials in cognitive science as the basis of human-machine communication, which, in turn, provide the theoretical basis for the successful design of user interaction. They deal in particular with the user and task analysis.* ***Applying:*** *The theoretical knowledge guides the students in developing user stories that serve as blueprints for the user interaction. The course emphasizes the implementation of interaction in different environments using, for example, the description language for user interfaces in mobile applications (XAML etc.). It outlines in particular the role of natural language in interaction.* ***Analyzing/Evaluating:*** *Students develop in teams concrete user interfaces for different tasks. According to the task and user analysis they set up objectives, that are validated in the actual implementation.* ***Synthesizing:*** *The result of the course is manifested in a course-wide project that involves the development of an application with a high degree of user interaction. Application development is thereby broken down into smaller work packages. Each team (two or three students) assumes a work package, organizes its individual tasks, and contributes to the management of the overall project.* *The self-empowered organization of the project work also includes explorative learning. Students are so encouraged to learn new methodologies or tools on their own (with support from the professor), provided their individual part of the project work requires that.*

Content	*Knowing*	*Perceiving*	*Applying*	*Analyzing*	*Evaluating*	*Synthesizing*
Basics in cognition	*X*	*X*	*X*	*X*		
User analysis	*X*	*X*	*X*	*X*	*X*	*X*
Design, Impementation	*X*	*X*	*X*	*X*	*X*	*X*
Evaluation			*X*	*X*	*X*	*X*

Module Contents	*1. Basics* • *Essentials in Cognition* • *Basic Information Retrieval (IR) concepts* • *Regular Expressions* • *XML* *2. User Analysis* • *How to Define Users and Tasks* • *Mental Models* • *Development of User Stories* *3. Design, Implementation* • *GUI controls* • *XAML* • *GUI Development in Different Environments* *4. Evaluation* • *Usability Principles* • *Methods*
Teaching Methods	*Lectures supported with multimedia courses offered by ACM. Workshops, team cooperation*
Requirements for Participation	*Solid practical programming skills*
Literature / Multimedia-based Teaching Material	*Carroll, J.M.: "Human-Computer Interaction in the New Millennium", ACM Press, New York, 2001.* *Cohn, M.: "User Stories Applied", Addison-Wesley, 2004.* *Online Courses of ACM addressing User Stories und User-Centred Design*
Applicability	*Master Applied Computer Science*
Effort/ Total Workload	*Total 150 hours. Attendance: 60 hours, Self-Study: 45 hours, Exam Preparation 45 hours*
ECTS/ Emphasis of the Grade for the final Grade	*5 CP (Emphasis of the Grade for the final Grade 5/120)*
Performance Record	*Project work*
Semester	*2nd semester*
Frequency of the course	*Once during the academic year (summer semester)*
Duration	*One semester*
Type of Course	*Elective course*

Modul Name	**Image Processing 1**
Modul Responsibility	*Prof. Dr. Klaus Chantelau*
Qualification Targets	*Students should be able* *to analyse typical problems of the development of audio-visual digital formats* *to understand the foundations of the compression of audio-visual signals* *to understand the methods and the structure of audio-visual digital standards (G7xx, mp3, GIF/PNG, JPEG, H26x, MPEG1 / 2 / 4)* *to apply the most important mathematical and algorithmical methods for the development of compression software moduls*
Module Contents	*Color Spaces, filtering processes, Fourier, DCT, and wavelet transform, image segmentation, motion estimation and image recognition. A method for data compression (entropy coding, transform coding, predictive coding), quantization, signal processing of the human visual system, motion prediction*
Teaching Methods	*Blackboard lectures, PowerPoint slides, computer exercises.*
Requirements for Participation	*Fundamentals of Linear Algebra and Programming, the scope of the Bachelor Module Multimedia and Communications Systems.*
Literature / Multimedia based Teaching Material	*„Digitale Bildcodierung“ - Jens Rainer Ohm* *Springer 1995, ISBN 3-540-58579-6* *“A Wavelet Tour of Signal Processing” - Stephane Mallat* *Academic Press 1999, ISBN 0-12-466606-X* *„Bildverarbeitung für die Medizin“ - Lehmann et al.* *Springer 1997, ISBN3-540-61458-3* *“Coding and Information Theory” - Steven Roman* *Springer 1992* *„Digitale Fernsehtechnik: Datenkompression und Übertragung für DVB“* *2.Auflage - Ulrich Reimers* *Springer 1997, ISBN 3-540-60945-8*
Applicability	*Master Applied Computer Science, Master Angewandte Medieninformatik*
Effort/ Total Workload	*Total 150 hours. Attendance: 60 hours, Self-Study: 45 hours, Exam Preparation 45 hours*
ECTS / Emphasis of the Grade for the final Grade	*5 CP (Emphasis of the Grade for the final Grade 5/120)*
Performance Record	*Written examination*
Semester	*1st semester*
Frequency of Occurence	*Once during the academic year (winter semester)*
Duration	*One semester*
Type of Course	*Elective course*

Module Name	**Image Processing 2**
Module Responsibility	*Prof. Dr. Klaus Chantelau*
Qualification Targets	*The students should be able to* *analyze typical problems of the processing of digital audio-visual signals* *to understand the most important mathematical and algorithmic methods for feature extraction, classification and 3D analysis of audio-visual signals.* *The student should be able to apply mathematical and algorithmic methods for the development of audio and image analysis software modules.*
Module Contents	*Image acquisition and illumination, image conversion (front-background separation, transformations, ...), image enhancement (filtering, segmentation, labeling, ...), feature extraction, (geometry / contour descriptors, texture descriptors, ...), 3D scene analysis, classification and measurement*
Teaching Methods	*Blackboard lectures, PowerPoint slides, computer exercises.*
Requirements for Participation	*Modul Image Processing 1*
Literature / Multimedia based Teaching Material	*„Handbuch zur Industriellen Bildverarbeitung“, FhG IRB Verlag, 2007* *ISBN 978-3-8167-7386-3* *“Introduction to MPEG 7” - Manjunath, Salembier, Sikora* *Wiley 2003, ISBN 0-471-48678-7* *“Stereoanalyse und Bildsynthese”, O. Schreer, Springer 2005, ISBN 3-540-23439-X*
Applicability	*Master Medieninformatik, Master Applied Computer Science*
Effort/ Total Workload	*Total 90 hours. Attendance: 30 hours, Self-Study: 45 hours, Exam Preparation 15 hours*
ECTS / Emphasis of the Grade for the final Grade	*3 CP*
Performance Record	*Written exam*
Semester	*3rd semester*
Frequency of Occurence	*Once during the academic year (winter semester)*
Duration	*One semester*
Type of Course	*Elective Course*

Modul Name	**Media Production 1**
Modul Responsibility	*Prof. Dr. Klaus Chantelau*
Qualification Targets	*The students should be able to* – *analyze typical problems in the field of video production* – *to understand the technical quality features of videos* – *to use the main software tools for video production.* – *to use the lighting, recording and post-production equipment of a virtual studio for video production .*
Module Contents	*Practically-oriented exercises with animation, audio and video production tools, especially Maxon Cinema 4D, Adobe Master Collection.* *Video camera technology, video lighting equipment.* *Theory and practice of recording technology and the use of green screen technology with real-time systems, video composition with Adobe After Effects and video editing with Adobe Premiere and DaVinci Resolve. Sound creation and composition with Cubase*
Teaching Methods	*Slides, computer exercises (C4D, Adobe Master-Collection), exercises in a green screen studio.*
Requirements for Participation	*The scope of the Bachelor Module Multimedia and Communications Systems.*
Literature / Multimedia based Teaching Material	*„Professionelle Videotechnik“ - U. Schmidt* *Springer 2000, ISBN 3-540-66854-* *“Cinema 4D 12”, Andreas Ansanger, Galileo Design 2011, ISBN 9-783-836-21-7071* *“Adobe After Effects CS 5”, Philippe Fontaine, Gaileo Design 2011, ISBN 978-3-8362-1593-0*
Applicability	*Master Angewandte Medieninformatik, Master Applied Computer Science*
Effort/ Total Workload	*Total 90 hours. Attendance: 30 hours, Self-Study: 30 hours, Exam Preparation 30 hours*
ECTS / Emphasis of the Grade for the final Grade	*3 CP*
Performance Record	*Project and project defense*
Semester	*2nd semester*
Frequency of Occurence	*Once during the academic year (winter semester)*
Duration	*One semester*
Type of Course	*Elective course*