Module Handbook

Master-Program
Information and Media Technologies

January 2010

Table of Contents

Subject Module I: Software Systems

Elective Modules

Module: Verified Software Systems

Course Units:

Title	*Type*	*Duration*
Verified Software Systems	Lecture	2
Exercise: Verified Software Systems	Exercise	2

Module Responsible:

Prof. Schupp

Prerequisites:

None

Recommended Previous Knowledge:

Discrete mathematics

Learning Outcomes:

Knowledge: Foundational theories, methods, and techniques for verifying software systems
Skills: Practical experience with relevant tools
Competencies: Assessing and applying different logics, methods, and tools

ECTS Credit Points:

5

Mode of Examination:

Integral Examination

Performance Record:

Written exam

Workload in hours:

Contact Time: 56, Self-study: 64

Course Unit: Verified Software Systems

Lecturer:

Prof. Schupp

Language:

English

Period:

Winter Semester

Contents:

Propositional logic, predicate logic, model checking, modal logic, program verification
Algorithms, modelling languages, tools

Reading Resources:

M. Huth, M. Ryan, Logic in Computer Science, Modeling and Reasoningabout Systems, Cambridge University Press, 2008

Module: Software for Embedded Systems

Course Units:

Title	*Type*	*Duration*
Software for Embedded Systems	Lecture	2
Exercise: Software for Embedded Systems	Exercise	2

Module Responsible:

Prof. Turau

Prerequisites:

None

Recommended Previous Knowledge:

- Bachelor in Computer Science or electrical engineering
- programming language C
- Generally Comprehension of Microprocessors Learning

Learning Outcomes:

Knowledge: Basic Principles and Procedures for the Design of Software for Embedded Systems
Expertise: Analysis of Complex Activities with Temporal Constraints
Competencies: Modularization of Complex Systems

ECTS Credit Points:

5

Mode of Examination:

Integral Examination

Performance Record:

Written Examination

Workload in hours:

Contact Time: 45, Self-study: 105

Course Unit: Software for Emdedded Systems

Lecturer:

Prof. Turau

Language:

English

Period:

Summer Semester

Contents:

- Introduction to Embedded Systems
- Software Development for Embedded Systems
- Concurrent systems
- Realt Time
- Programming Embedded Systems
- Operating for Embedded Systems Reading

Reading Resources:

Peter Marwedel, Eingebettete Systeme, Springer Verlag, 2007
Peter Scholz, Softwareentwicklung eingebetteter Systeme, Springer Verlag, 2005
Peter Liggesmeyer, Dieter Rombach (Hrsg.): Software Engineering eingebetteter Systeme. Grundlagen - Methodik - Anwendungen. Spektrum Akademischer Verlag, 2005

Module: Software Analysis

Course Units:

Title	*Type*	*Duration*
Software Analysis	Lecture	2
Exercise: Software Analysis	Exercise	1

Module Responsible:

Prof. Schupp

Prerequisites:

None

Recommended Previous Knowledge:

Imperative and object-oriented programming; standard data structures in computer science; discrete mathematics.

Learning Outcomes:

*Knowledge:*Standard approaches, methods, and algorithms for automated program analysis
Skills: Practical experience with applications and tools
Competencies: Evaluation and assessment of different approaches and techniques

ECTS Credit Points:

4

Mode of Examination:

Integral Examination

Performance Record:

Written Examination

Workload in hours:

Contact Time: 42, Self-study: 48

Course Unit: Software Analysis

Lecturer:

Prof. Schupp

Language:

English

Period:

Summer Semester

Contents:

- Intermediate representations and models;
- Intraprocedural data flow analysis;
- Interprocedural analysis;
- Source-code analysis;
- Testing;
- Applications in program understanding

Reading Resources:

M. Pezze, M. Young, Software Testing and Analysis, Wiley 2008.
U. Khedker, A.Sanyal, B. Karkare, Data Flow Analysis. Theory and Practice. CRC Press 2009.

Module: Software Security

Course Units:

Title	*Type*	*Duration*
Software Security	Lecture	2
Exercise: Foundations of Machine Learning and Data Mining	Exercise	1

Module Responsible:

Prof. Gollmann

Prerequisites:

None

Recommended Previous Knowledge:

Familiarity with C or C++; object-oriented progra

Learning Outcomes:

- Knowledge: Major causes for software vulnerabilities; current practices for identifying and avoiding software vulnerabilities; fundamentals of code-based access control.
- Competencies: Vulnerability analysis of code and software systems; secure programming.

ECTS Credit Points:

4

Mode of Examination:

Integral Examination

Performance Record:

Written Examination

Workload in hours:

Contact Time: 42, Self-study: 78

Course Unit: Software Security

Lecturer:

Prof. Gollmann

Language:

English

Period:

Winter Semester

Contents:

- Reliability & software security
- Unicode attacks
- Integer overflows
- Buffer overflows
- Race conditions
- Security testing

- Type-safe languages
- SQL attacks
- Scripting languages
- Identity-based access control
- Code-based access control
- Java security model
- .NET CLR security model
- Stack walks and history-based access control

Reading Resources:

Viega & McGraw: Building Secure Software, Addison Wesley (2001)
Howard & LeBlanc: Writing Secure Code, 2nd Edition, Microsoft Press (2002)
LaMacchia, Lange, Lyons, Martin, Price: .NET Framework Security, Addison-Wesley Professional (2002)
Li Gong: Inside Java 2 Platform Security, Addison-Wesley (1999)

Subject Module II: Media Technologies

Elective Modules

Module: Digital Video Signal Coding

Course Units:

Title	*Type*	*Duration*
Digital Video Signal Goding	Lecture	2

Module Responsible:

Prof. Grigat

Prerequisites:

None

Recommended Previous Knowledge:

Linear algebra, basic stochastics, binary arithmetics

Learning Outcomes:

- Knowledge: Broad theoretical and methodological foundations of data compression, advanced training on the example of MPEG-4 AVC
- Competece of Systems and Problem Solving: Understanding of problems, creative usage of scientific problem analysis and mathematical formalization (comparison of lossy and lossless coding schemes based on source models)

ECTS Credit Points:

3

Mode of Examination:

Integral Examination

Performance Record:

Written Examination

Workload in hours:

Contact Time: 28, Self-study: 62

Course Unit: Digital Video Signal Coding

Lecturer:

Prof. Grigat

Language:

English

Period:

Winter Semester

Contents:

- Information and entropy
- entropy coding (Huffman, arithmetic)
- lossless coding (DPCM, RLC, Ziv-Lempel, CALIC, JPEG-LS)
- quantisation (scalar, vector quantisation)
- transform coding (DCT, hybrid DCT)
- motion estimation
- subband coding

Reading Resources:

Salomon, Data Compression, the Complete Reference, Springer, 2000
Solari, Digital video and audio compression, McGraw-Hill, 1997
Tekalp, Digital Video Processing, Prentice Hall, 1995

Module: Man-Machine-Interfaces

Course Units:

Title	*Type*	*Duration*
Man-Machine-Interfaces	Lecture	2
Exercise: Man-Machine-Interfaces	Exercise	1

Module Responsible:
Dr. Kreft

Prerequisites:

None

Recommended Previous Knowledge:

Programing of graphical interfaces, Visual Basic for Applications

Learning Outcomes:

After successful completion of this course students should be able to

- to understand the man-machine-communication and the design process
- to develop the process starting with the task analysis, followed by the analysis of the user behaviour, expectation and expectation under consideration of the design rules
- to implement the design process systematically and finally to evaluate and refine the result by usability engineering
- to work efficiently in a team

ECTS Credit Points:

4

Mode of Examination:

Integral Examination

Performance Record:

Oral Examination

Workload in hours:

Contact Time: 42, Self-study: 78

Course Unit: Man-Machine-Interfaces

Lecturer:

Dr. Kreft

Language:

English

Period:

Winter Semester

Contents:

- human factors
- theories, principles, guidelines
- interaction devices
- interaction styles
  error handling
- usability engineering
- virtual reality
- manuals, help, tutorials

Reading Resources:

Ben Shneiderman & Catherine Plaisant, Designing the User Interface,
Pearson International Edition, 2005
Georg Geiser, Mensch-Maschine-Kommunikation, E. Oldenbourg, 1990
Gunnar Johannsen, Mensch-Maschine-Systeme, Springer Verlag, 1993

Module: Computer Graphics and Animation

Course Units:

Title	*Type*	*Duration*
Computer Graphics and Animation	Lecture	2
Exercise: Computer Graphics and Animation	Exercise	2

Module Responsible:

Prof. Weberpals

Prerequisites:

None

Recommended Previous Knowledge:

Students are expected to have a solid knowledge of object-oriented programming as well as of linear algebra and geometry.

Learning Outcomes:

Knowledge: Foundational theories, methods, and techniques for computer animation and computer graphicd
Skills in modelling and shading and in computer animation techniques a thorough command of Maya, a first-class animation system.
Competencies: Students are able to direct a computer animation project: subdividing the project, devising the appropriate modelling and animation techniques on a theoretical basis, setting up illumination, shading, and rendering.

ECTS Credit Points:

5

Mode of Examination:

Integral Examination

Performance Record:

Oral Examination

Workload in hours:

Contact Time: 56, Self-study: 94

Course Unit: Computer Graphics and Animation

Lecturer:

Prof. Weberpals

Language:

English

Period:

Summer Semester

Contents:

- Object-oriented Computer Graphics
- Projections and Transformations
- Polygonal and Parametric Modelling
- Illuminating, Shading, Rendering
- Computer Animation Techniques
- Kinematics and Dynamics Effects

Reading Resources:

Alan H. Watt: 3D Computer Graphics. Harlow: Pearson (3rd ed., repr., 2005)

Module: Media Design

Course Units:

Title	*Type*	*Duration*
Media Design	Lecture	2
Exercise: Media Design	Exercise	1

Module Responsible:

Prof. Turau

Prerequisites:

None

Recommended Previous Knowledge:

Basic experience in computer and application handling.

Learning Outcomes:

Knowledge: Deepened Knowledge in the design of digital media
Methodical skills: Qualify students to design and implementat digital media, document project development by usage of a storyboard
System skills: Acquaintance of important media applications enable to combine different media types with consideration of usage capabilities particular media
Competence: Creation of digital media solutions

ECTS Credit Points:

4

Mode of Examination:

Integral Examination

Performance Record:

Oral Examination

Workload in hours:

Contact Time: 42, Self-study: 78

Course Unit: Media Design

Lecturer:

Prof. Turau

Language:

English

Period:

Summer Semester

Contents:

- Web Publishing
- - Still Images (Vector Graphics, Bitmapped Images)
- Colour Management
- Animation
- Typography
- Layout and Design
- Media Integration and ergonomics

Reading Resources:

Nigel Chapman, Jenny Chapman: Digital Multimedia, 2nd edition, 2004, TIO-302
Nigel Chapman, Jenny Chapman: Digital Media Tools, 2003, TIO-339

Robert S. Tannenbaum: Theoretical Foundations of Multimedia, 1998, TIO-330
Lynda Weinman: Designing web Graphics, how to prepare images and media for the web, 2003, TIE-132

Module: Multimedia Information Extraction and Retrieval

Course Units:

Title	*Type*	*Duration*
Multimedia Information Extraction and Retriebal	Lecture	2
Exercise: Multimedia Information Extraction and Retriebal	Exercise	1

Module Responsible:

Prof. R. Möller

Prerequisites:

None

Recommended Previous Knowledge:

Basic knowledge of computer science and discrete mathematics

Learning Outcomes:

Knowledge: Detailed knowledge the area of "Information Extraction, Management, and Retrieval"
Skills: Understanding of the interplay of non-machine processable data and metadata, which is directly machine processable
Competence: Acquisition of theory-based capabilities for the design and analysis of multimedia management systems

ECTS Credit Points:

4

Mode of Examination:

Integral Examination

Performance Record:

Written Examination

Workload in hours:

Contact Time: 42, Self-study: 78

Course Unit: Multimedia Information Extraction and Retrieval

Lecturer:

Prof. R. Möller

Language:

English

Period:

Summer Semester

Contents:

- Introduction
- Streaming and Encoding
- Metadata
- Media Analysis
- Content Description Theory 1
- Content Description Theory 2
- Query Answering and Media Retrieval
- Interpretation (high-level)
- Fusion
- Retrieval (querying, pull technology)
- Distribution (knowledge management, push technology)

Reading Resources:

Multimedia Content and the Semantic Web Methods, Standards and Tools, Editors: Giorgos Stamou, Stefanos Kollias, John Wiley & Sons Ltd., 2005.

Module: 3D Computer Vision

Course Units:

Title	*Type*	*Duration*
3D Computer Vision	Lecture	2

Module Responsible:

Prof. Grigat

Prerequisites:

None

Recommended Previous Knowledge:

Linear Algebra, basics of stochastics

Learning Outcomes:

Knowledge: Broad theoretical and methodological foundations of feature selection and classification, advanced training on the example of parameter estimation for camera calibration
Skills: Understanding of problems, creative usage of scientific problem analysis and mathematical formalization (calibration of a real camera, lens errors)
Competence: Theory-driven application of very demanding methods and procedures (Plücker matrices, strong and weak calibration, DLT, EM, trifocal tensor)

ECTS Credit Points:

3

Mode of Examination:

Integral Examination

Performance Record:

Written Examination

Workload in hours:

Contact Time: 28, Self-study: 72

Course Unit: 3D Computer Vision

Lecturer:

Prof. Grigat

Language:

English

Period:

Summer Semester

Contents:

- Projective Geometry and Transformations in 2D und 3D
- Epipolar Geometry and the Fundamental Matrix
- Homographies
- Trifocal Tensor

Reading Resources:

Skriptum Grigat/Wenzel
Hartley, Zisserman: Multiple View Geometry in Computer Vision. Cambridge 2003.

Module: Digital Image Processing

Course Units:

Title	*Type*	*Duration*
Digital Image Processing	Lecture	2
Exercise: Digital Image Processing	Exercise	1

Module Responsible:

Prof. Grigat

Prerequisites:

None

Recommended Previous Knowledge:

LTI system theory of one-dimensional signals (sampling theory, interpolation, Fourier transform, linear time-invariant systems), linear algebra (Eigenvalue decomposition), basic stochastics (expectation values and samples)

Learning Outcomes:

Knowledge: Broad theoretical and methodological foundations of imaging capture and processing algorithms, in depth knowledge of digital filtering of image signals. In-depth knowledge of interdisciplinary relations and embedding the field into the scientific and social environment (system theory, filter, physiology, perception psychology)
Competence of Methods: Theory-driven application of very demanding methods and procedures (multidimensional sampling theory, untary transforms, characterization of sensor and display)
Competence of Problem Solving: Understanding of problems, creative usage of scientific problem analysis and mathematical formalization (applications to mobile phone cameras)
Competence of Systems: Quantitative Comparison of competing methodology in multidimensional decision spaces (spatio-temporal signal processing, image deficiencies as an interrelation of perception and signal theory)

ECTS Credit Points:

4

Mode of Examination:

Integral Examination

Performance Record:

Written examination

Workload in hours:

Contact Time: 42, Self-study: 78

Course Unit: Digital Image Processing

Lecturer:

Prof. Grigat

Language:

English

Period:

Winter Semester

Contents:

- Perception of luminosity and color
- color spaces
- multidimensional sampling in space and time
- decimation, de-interlacing

- large area and edge flicker
- apertures of image sensors and displays in space and time
- image transforms
- image filtering
- edge operators
- histogram equalisation
- morphological operators
- homomorphic filtering
- hough transform
- geometric moments

Reading Resources:

Pratt, Digital Image Processing, Wiley, 2001
Jain, Fundamentals of Digital Image Processing, Prentice Hall, 1989
Jähne, Haußecker, Computer Vision and Applications, Academic Press, 2000

Module: Digital Audio Signal Processing

Course Units:

Title	*Type*	*Duration*
Digital Audio Signal Processing	Lecture	2

Module Responsible:

Prof. Zölzer

Prerequisites:

None

Recommended Previous Knowledge:

Signals and systems, Fourier, Laplace and Z transforms

Learning Outcomes:

Knowledge: Principles of digital audio signal processing with broad theoretical fundamentals.
Competence of Methods: Theory driven applications of methods for advanced signal processing.
Competence of Problem Solving: Identification of problems and creative application of scientific methods and strategies for solving problems.

ECTS Credit Points:

3

Mode of Examination:

Integral Examination

Performance Record:

Written Examination

Workload in hours:

Contact Time: 28, Self-study: 62

Course Unit: Digital Audio Signal Processing

Lecturer:

Prof. Zölzer

Language:

English

Period:

Winter Semester

Contents:

- Introduction (Studio Technology, Digital Transmission Systems, Storage Media, Audio Components at Home)
- Quantization (Signal Quantization, Dither, Noise Shaping, Number Representation)
- AD/DA Conversion (Methods, AD Converters, DA Converters, Audio Processing Systems, Digital Signal Processors, Digital Audio Interfaces, Single-Processor Systems, Multiprocessor Systems)
- Equalizers (Recursive Audio Filters, Nonrecursive Audio Filters, Multi-Complementary Filter Bank)
- Room Simulation (Early Reflections, Subsequent Reverberation, Approximation of Room Impulse Responses)
- Dynamic Range Control (Static Curve, Dynamic Behavior, Implementation, Realization Aspects)
- Sampling Rate Conversion (Synchronous Conversion, Asynchronous Conversion, Interpolation Methods)
- Data Compression (Lossless Data Compression, Lossy Data Compression, Psychoacoustics, ISO-MPEG1 Audio Coding)

Reading Resources:

U. Zölzer, Digitale Audiosignalverarbeitung, 3. Aufl., B.G. Teubner, 2005.
U. Zölzer (Ed), Digital Audio Effects, J. Wiley & Sons, 2002.

Subject Module III: Networking

Elective Modules

Module: Communication Networks I: Principles

Course Units:

Title	*Type*	*Duration*
Communication Networks I	Lecture	2
Exercise: Communication Networks I	Exercise	1

Module Responsible:

Prof. Timm-Giel

Prerequisites:

None

Recommended Previous Knowledge:

Probability theory fundamentals, Poisson process

Learning Outcomes:

- After successful completion of this course students should be able to
- to identify and to explain principles and generic problems of communication networks and protocols
- to explain solution methods of the different problem classes
- to develop solutions for problem statements similar to the generic paradigms
- to participate in English based communication during the lesson

ECTS Credit Points:

4

Mode of Examination:

Integral Examination

Performance Record:

Written Examination

Workload in hours:

Contact Time: 42, Self-study: 78

Course Unit: Communication Networks I

Lecturer:

Prof. Timm-Giel

Language:

English

Period:

Winter Semester

Contents:

- Introduction to Communication Networks
- OSI – Model
- Basic Principles:
    - Error handling (detection, correction, repeat request)
    - Flow control (window technique, channel utilization)
    - Routing (shortest path routing, bifurcated routing, broadcast routing)
    - Multiple access protocols (TDMA, reservation, token, ALOHA, CSMA, CSMA/CD)
- Sample Networks

- TCP/IP and the Internet
- WLAN
- Mobile Communication Networks

Reading Resources:

A.S. Tanenbaum: Computer Networks, 4th ed., Pearson Education International (2003)
A.S. Tanenbaum: Computernetzwerke, 4.Aufl.,Pearson Studium (2003)
J. Schiller, Mobile Communication Networks
M. Bossert, M. Breitbach, Digitale Netze, Teubner Leipzig (1999)
Larry L. Peterson & Bruce S.Davie: Computer Networks, Morgan Kaufmann Publisher (2000)
James F. Kurose & Keith W. Ross: Computer Networking, Pearson/Addison Wesley (2005)

Module: Analysis and Structure of Communication Networks

Course Units:

Title	*Type*	*Duration*
Communication Networks II	Lecture	2
Modern Methods for Modelling of Communicaton Networks	Labor	2
Exercise: Communication Networks II	Exercise	1

Module Responsible:

Prof. Timm-Giel

Prerequisites:

None

Recommended Previous Knowledge:

Understanding of basic principles of communication networks and their protocols as presented in "Communication Networks I"

Learning Outcomes:

- After successful completion of this course students should be able to
- to explain principles of discrete event simulations for communication networks
- to explain principles of network planning
- to evaluate network performance using event discrete simulation and network planning tools
- to evaluate the reliability of the simulation results, e.g. using confidence intervals
- to develop solutions for problem statements similar to the generic paradigms
- to participate in English based communication during the lesson

ECTS Credit Points:

6

Mode of Examination:

Integral Examination

Performance Record:

Written Examination

Workload in hours:

Contact Time: 56, Self-study: 124

Course Unit: Communication Networks II: Topical Networking Technologies

Lecturer:

Prof. Timm-Giel

Language:

Englisch

Period:

Summer Semester

Contents:

Discrete Event Simulations

- Random Number Generators
- Statistical Evaluation
- Simulation Systems

Network Planning

- Principles of Network Planning and Optimization
- Exact Methods, e.g. Simplex algorithm, Branch and Bound

- Heuristics, e.g. genetic algorithms, simulated annealing
- Examples

Reading Resources:

P. Bratley, B.L. Fox, L.E. Schrage: A Guide to Simulation. Springer 1983, 1987
B.P. Zeigler, H. Praehofer, T.G. Kim: Theory of Modeling and Simulation, Academic Press, 2000
R.Y. Rubinstein, B. Melamed: Modern Simulation and Modeling. Wiley Series in Probability and Statistics 1998

Labor Unit: Modern Methods for Modelling of Communication Networks

Lecturer:

Dr. Kreft

Language:

Englisch

Period:

Summer Semester

Contents:

- Learning the capabilities and the programming of an event-driven simulator
- Definition and modeling of specific problems in the area of communication networks
- Solving the problems by using discrete event simulators and MATLAB
- Understanding of network planning as an optimization problem
- Solving of discrete or mixed integer linear optimization problems

Reading Resources:

Linear Programming FAQs http://www-unix.mcs.anl.gov/otc/Guide/faq/linear-programming-faq.html

Module: Network Security

Course Units:

Title	*Type*	*Duration*
Network Security	Lecture	2
Exercise: Network Security	Exercise	1

Module Responsible:

Prof. Gollmann

Prerequisites:

None

Recommended Previous Knowledge:

Discrete mathematics, computer networks (TCP/IP)

Learning Outcomes:

Knowledge: Fundametal methods of modern cryptography; currently deployed standard network security protocols and mechanisms
Competencies: Analysis of network security problems; identification of appropriate security solutions

ECTS Credit Points:

4

Mode of Examination:

Integral Examination

Performance Record:

Written Examination

Workload in hours:

Contact Time: 42, Self-study: 78

Course Unit: Network Security

Lecturer:

Prof. Gollmann

Language:

English

Period:

Summer Semester

Contents:

- Security objectives
- Cryptographic services and mechanisms
- Hash functions
- Digital signatures: RSA and DSA
- Encryption algorithms: DES, AES, block cipher modes, stream ciphers
- Cryptanalysis, differential power analysis
- Diffie-Hellman key exchange, Kerberos
- IPsec protocols, mobile IPv6·
- SSL/TLS
- GSM/UMTS security protocols
- Firewalls and Intrusion Detection Systems
- Testing network security

Reading Resources:

A. Menezes, P. van Oorschot, S. Vanstone: Handbook of Applied Cryptography, CRC Press (1997)
D. Gollmann: Computer Security (2. Auflage), Wiley (2006)
V. Niemi, K. Nyberg: UMTS Security, Wiley (2003)

Subject Module IV: Applications

Elective Modules

Module: Web Engineering

Course Units:

Title	*Type*	*Duration*
Web Engineering	Lecture	2
Exercise: Web Engineering	Exercise	2

Module Responsible:

Prof. Turau

Prerequisites:

None

Recommended Previous Knowledge:

Bachelor in computer science, good knowledge of the programming language Java and basic knowledge about relational databases (at the level of simple SQL statements). Basic understanding of HTML.

Learning Outcomes:

Knowledge: Deepened knowledge in design and implementation of web-based systems and the specification non-functional requirements of such systems
Skills: Dissection of complex web-based systems in modules and specification of interfaces
Competence: System-oriented thinking, decomposition of complex systems

ECTS Credit Points:

5

Mode of Examination:

Integral Examination

Performance Record:

Written Examination

Workload in hours:

Contact Time: 56, Self-study: 94

Course Unit: Web Engineering

Lecturer:

Prof. Turau

Language:

Englisch

Period:

Winter Semester

Contents:

Web engineering comprises the application of systematic, disciplined and quantifiable approaches to the cost-effective development and evolution of high-quality, large-scale applications in the WorldWideWeb. This course covers the underlying technologies and introduces techniques for the design of these applications from a software engineering perspective. Furthermore, it provides a categorization of web-based applications and introduces tools supporting the complete development and maintenance life cycle. Topics covered:

- Technologies, protocols, and standards
- Categories of applications
- Requirements analysis and systems design

- Web application development processes and design methodologies
- Web application frameworks and component-based Web Engineering
- Integration with legacy systems
- Managing system evolution, deployment, and maintenance
- Testing, verification and validation techniques
- Web metrics, performance specification and evaluation
- Tools supporting design, implementation and monitoring

Reading Resources:

Web-basietre Anwendungen entwickeln mit JSP 2, V. Turau, K. Saleck, C. Lenz, dpunkt, 2004, 3898642356
Web Engineering, G. Kappel, B. Pröll, S. Reich, W. Retschitzegger, dpunkt, 2004, 3898642348
Web Engineering, R. Dumke, M. Lother, C. Wille, F. Zbrog, Pearson Studium, 2003, 827370809
Patterns of Enterprise Application Architecture, Martin Fowler, Addison Wesley Professional, ISBN: 0321127420, 2002

Module: Application Security

Course Units:

Title	*Type*	*Duration*
Application Security	Lecture	2
Exercise: Application Security	Exercise	1

Module Responsible:

Prof. Gollmann

Prerequisites:

None

Recommended Previous Knowledge:

Web services, middleware architectures

Learning Outcomes:

Knowledge: Current approaches to implementing security in distributed applications, in particular in web services
Skills: Understanding of application security problems, creative usage of scientific problem analysis.
Competencies: Security analysis and design of security solutions for distributed applications

ECTS Credit Points:

4

Mode of Examination:

Integral Examination

Performance Record:

Written Examination

Workload in hours:

Contact Time: 42, Self-study: 78

Course Unit: Application Security

Lecturer:

Prof. Gollmann

Language:

Englisch

Period:

Summer Semester

Contents:

- Security principles
- Web services security
- Middleware security (CORBA)
- Access control – trust management – Trusted Computing
- Privacy: OECD principles, data protection legislation
- Security solutions for selected applications

Reading Resources:

Webseiten der OMG, W3C, OASIS, WS-Security, OECD, TCG
Ulrich Lang: CORBA Security, Artech House, 2002
D. Gollmann: Computer Security (2. Auflage), Wiley (2006)

Module: Foundations of Machine Learning and Data Mining

Course Units:

Title	*Type*	*Duration*
Foundations of Machine Learning and Data Mining	Lecture	2
Exercise: Foundations of Machine Learning and Data Mining	Exercise	1

Module Responsible:

Prof. R. Möller

Prerequisites:

None

Recommended Previous Knowledge:

Elementary knowledge in Computer Science and Mathematics as usual for a Master course.

Learning Outcomes:

- Knowledge foundational techniques, theories and methods of Machine Learning and Data Mining
- Capabilities for applying theory-based learning procedure in the context of industrial problems
- Skills for assessing the pros and cons of specific learning procedures

ECTS Credit Points:

4

Mode of Examination:

Integral Examination

Performance Record:

Written examination

Workload in hours:

Contact Time: 42, Self-study: 78

Course Unit: Foundations of Machine Learning and Data Mining

Lecturer:

Prof. R. Möller

Language:

English

Period:

Summer Semester

Contents:

- Introduction
- Learning from observations
- Inductive learning, introduction to learning decision trees
- Decision tree learning
- Information theory, information gain (ID3), extensions (C4.5), translating decision trees to rules
- Computational learning theory (PAC learning), incremental learning (version spaces)
- Uncertainty
- Bayesian networks
- Learning parameters of Bayesian networks
- BME, MAP, ML, EM algorithm
- Learning structures of Bayesian networks
- kNN-Classifier, neural network classifier, support vector machine (SVM) classifier
- Clustering
- Distance measures, k-means clustering, nearest neighbor clustering

- Knowledge in learning
- Inductive logic programming
- Learning of probabilistic relational models (PRMs)

Reading Resources:

Artificial Intelligence: A Modern Approach (Second Edition), Stuart Russel, Peter Norvig, Prentice Hall, 2003 Chapters 13-14, 18-21.

Introducion to Machine Learning Ethem Alpaydin, MIT Press, 2004

Module: Pattern Recognition

Course Units:

Title	*Type*	*Duration*
Pattern Recognition	Lecture	2
Exercise: Pattern Recognition	Exercise	1

Module Responsible:

Prof. Grigat

Prerequisites:

None

Recommended Previous Knowledge:

linear algebra, basics of stochastics

Learning Outcomes:

Knowledge: Broad theoretical and methodological foundations of feature selection and classification, advanced training on the example of face recognition
Skills: Theory-driven application of very demanding methods and procedures (Bayes estimation, classification methods, support vector machines, algorithm independent learning, boosting), Understanding of problems, creative usage of scientific problem analysis and mathematical formalization (mapping of face analysis to the methods and procedures of pattern recognition)
Competence: Quantitative Comparison of competing methodology in multidimensional decision spaces (trade off between feature selection and classification, optimal dimension of the decision space for face analysis)

ECTS Credit Points:

4

Mode of Examination:

Integral Examination

Performance Record:

Written examination

Workload in hours:

Contact Time: 42, Self-study: 78

Course Unit: Pattern Recognition

Lecturer:

Prof. Grigat

Language:

English

Period:

Summer Semester

Contents:

- Structure of a pattern recognition system
- statistical decision theory
- classification based on statistical models
- polynomial regression
- dimension reduction
- multilayer perceptron regression
- radial basis functions
- support vector machines
- unsupervised learning and clustering

- algorithm-independent machine learning

Reading Resources:

Schürmann: Pattern Classification, Wiley 1996
Duda, Hart, Stork: Pattern Classification, Wiley, 2001
Bishop: Pattern Recognition and Machine Learning, Springer 2006

Module: Intelligent Autonomous Agents

Course Units:

Title	*Type*	*Duration*
Intelligent Autonomous Agents	Lecture	2
Exercise: Intelligent Autonomous Agents	Exercise	1

Module Responsible:

Prof. R. Möller

Prerequisites:

None

Recommended Previous Knowledge:

Knowledge in stochastic processes is helpful but not mandatory

Learning Outcomes:

Knowledge: foundational techniques, theories, and methods of ECommerce with a specialization on "Intelligent Autonomous Agents" and "Mechanism Design"
Skills: Assessment of possibilities and dangers arising with e-commerce systems from a mathematical point of view
Competence: Acquisition of the theory-based design and analysis of e-commerce systems

ECTS Credit Points:

4

Mode of Examination:

Integral Examination

Performance Record:

Written Examination

Workload in hours:

Contact Time: 42, Self-study: 78

Course Unit: Intelligent Autonomous Agents

Lecturer:

Prof. R. Möller

Language:

English

Period:

Winter Semester

Contents:

- Introduction
  Terminology, 4-phase model(s), agents, rational behavior, goals, utilities, PEAS, environment types
- Adversarial Agent Cooperation
  Agents with complete access to the state(s) of the environment, games, Minimax algorithm, alpha-beta pruning, elements of chance
- Uncertainty
  Motivation: agents with no direct access to the state(s) of the environment, probabilities, conditional probabilities, product rule, Bayes rule, full joint probability distribution, marginalization, summing out, answering queries, complexity, independence assumptions, naive Bayes, conditional independence assumptions
- Bayesian networks
  Syntax and semantics of Bayesian networks, answering queries revised (inference by enumeration), typical-case complexity, pragmatics: reasoning from effect (that can be perceived by an agent) to cause (that cannot be directly perceived).

- Probablistic reasoning over time (1)
  Motivation: environmental state may change even without the agent performing actions, dynamic Bayesian networks, Markov assumption, transition model, sensor model, inference problems: filtering, prediction, smoothing, most-likely explanation
- Probablistic reasoning over time (2)
  Special cases: hidden Markov models, Kalman filters, exact inferences and approximations
- Decision making under uncertainty (1): simple decisions
  Utility theory, multivariate utility functions, dominance, decision networks, value of information
- Decision making under uncertainty (2): complex decisions
  Sequential decision problems, value iteration, policy iteration, MDPs
- Decision making under uncertainty (3): decision-theoretic agents
  POMDPS, reduction to multidimensional continuous MDPs, Dynamic Decision Networks
- Game theory
  Decisions with multiple agents, Nash equilibrium, Bayes-Nash equilibrium
- Social Choice
  Voting protocols, preferences, paradoxes, Arrow's Theorem
- Mechanism Design
  Fundamentals, dominant strategy implementation, Revelation Principle, Gibbard-Satterthwaite Impossibility Theorem, Direct mechanisms, incentive compatibility, strategy-proofness, Vickrey-Groves-Clarke mechanisms, expected externality mechanisms, participation constraints, individual rationality, budget balancedness, bilateral trade, Myerson-Satterthwaite Theorem
- Recommendation Systems
  Content-based recommendation, collaborative filtering, hybrid techniques

Reading Resources:

Stuart Russell, Peter Norvig: Artificial Intelligence: A Modern Approach, (Second Edition), , Prentice Hall, 2003
Maria Fasli: Additionally: Agent Technology For E-Commerce, Wiley, January 2007.

Module: Project Seminar

Course Units:

Title	*Type*	*Duration*
Seminar: Realization of an I&K Application System	Seminar	1
Project: Realization of an I&K Application System	Project	3

Module Responsible:

Prof. Schupp

Prerequisites:

None

Recommended Previous Knowledge:

- Bachelor in computer science
- Basic knowledge of a (preferably object-oriented) programming language
- Familiarity with basic concepts of the Internet

Learning Outcomes:

Knowledge: Concepts, techniques and tools of today's innovative information and communication systems. In addition, deepened knowledge required for conduction the project depending on the topic
Methodical skills: Learning and applying object-oriented analysis, design and implementation
System skills: Practically experiencing the difficulties of developing a non-trivial system

ECTS Credit Points:

6

Mode of Examination:

Integral Examination

Performance Record:

Presentations, oral participation, submitted programs

Workload in hours:

Contact Time: 52, Self-study: 108

Course Unit: Project Seminar

Lecturer:

Prof. Schupp; Prof. Turau

Language:

English

Period:

Winter Semester

Contents:

- Object-oriented analysis, design and implementation
- An object-oriented programming language (typically: Java)
- Communication protocols
- Further software technologies as required for the project
- Conducting software development projects

Reading Resources:

Ian Sommerville: Software-Engineering. Addison-Wesley. (Grundlagen: Analyse, Design, Realisierung)
J. Rumbaugh et al.: Objektorientiertes Modellieren und Entwerfen. Hanser, 1991. (Objektorientiertes OMT-Modell und Entwurfsprozeß)

Martin Fowler: UML Distilled, Applying the Standard Object Modeling Language. Addison Wesley, 1997. (Kompakte Einführung in die UML-Notation)
E. Gamma, R. Helm, R. Johnson, J. Vlissides: Design Patterns, Elements of Reusable Object-Oriented Software. Addison-Wesley, 1995.

Assignment and Thesis

Compulsory Modules

Module: Project Work

Module Responsible:

A professor of the TUHH

Prerequisites:

none

Recommended Previous Knowledge:

All knowledge, skills and competencies that are taught and developed in the first year.

Learning Outcomes:

The students are able to work scientifically correct. They have the ability to complete and document research on a subject matter assignment with scientific methods independently and within a given timeframe. The students are able to develop solutions for technical problems on the basis of pure science with regards to safety, environmental, ethical and economic aspects.

ECTS Credit Points:

15

Mode of Examination:

Integral Examination

Performance Record:

Project work and oral exam

Workload:

Self-study: 450

Module: Master Thesis

Module Responsible:

A professor of the TUHH

Prerequisites:

Achievements of at least 80 ECTS from the the curriculum

Recommended Previous Knowledge:

All knowledge, skills and competencies that are taught and developed in semesters 1-3.

Learning Outcomes:

The graduates have the necessary competencies for correct scientific work and are able to write profound research papers. They have the ability to complete research on a pure science subject matter with sophisticated scientific methods independently and within a given timeframe. The students are able to analyze and evaluate possible solutions for the given problem and can put their work into the context of current research.

ECTS Credit Points:

30

Mode of Examination:

Integral Examination

Performance Record:

Thesis and Presentation

Workload:

Self-study: 900