Curriculum für das

Masterstudium Business Informatics

an der Technischen Universität Wien

Gültig ab 1. Oktober 2011

Inhaltsverzeichnis

1 Grundlage und Geltungsbereich 3

2 Qualifikationsprofil 3

3 Dauer und Umfang 5

4 Zulassung zum Masterstudium 5

5 Aufbau des Studiums 6

6 Lehrveranstaltungen 17

7 Prüfungsordnung 17

8 Studierbarkeit und Mobilität 18

9 Diplomarbeit 18

10 Akademischer Grad 19

11 Integriertes Qualitätsmanagement 19

12 Inkrafttreten 20

13 Übergangsbestimmungen 21

A Modulbeschreibungen 21

B Lehrveranstaltungstypen 77

C Semestereinteilung der Lehrveranstaltungen 78

D Semestereinteilung für schiefeinsteigende Studierende 81

E Innovation – Supplementary Curriculum 83

1 Grundlage und Geltungsbereich

Das vorliegende Curriculum definiert und regelt das ingenieurwissenschaftliche Masterstudium *Business Informatics* an der Technischen Universität Wien. Es basiert auf dem Universitätsgesetz 2002 BGBl. I Nr. 120/2002 (UG) und dem Satzungsteil *Studienrechtliche Bestimmungen* der Technischen Universität Wien in der jeweils geltenden Fassung. Die Struktur und Ausgestaltung dieses *englischsprachigen* Studiums orientieren sich am folgenden Qualifikationsprofil.

2 Qualifikationsprofil

Das Masterstudium *Business Informatics* vermittelt eine vertiefte, wissenschaftlich und methodisch hochwertige, auf dauerhaftes Wissen ausgerichtete Bildung, welche die Absolventinnen und Absolventen sowohl für eine Weiterqualifizierung vor allem im Rahmen eines facheinschlägigen Doktoratsstudiums als auch für eine Beschäftigung in beispielsweise folgenden Tätigkeitsbereichen befähigt und international konkurrenzfähig macht.

Three main role models are considered in this master program:

- Employment in an enterprise or a public organization, including managing responsibility or consulting (master practitioner)
- Qualification for a scientific career in the course of a doctorate study or PhD program in technical, social, or economic sciences (scientist)
- Future activity within an area of innovation, either as a free lancer or entrepreneur or a high position of an enterprise's innovation branch (innovator)

The Master of Business Informatics aims at a strong international embedding in research and economics. In order to ensure this, all the lectures of the master program are held in English and the master's thesis is written in English.

The area of Business Informatics covers information and knowledge as well as information-processing processes in organizations and society. It therefore builds the interface between humans, organizations, and information technology. The subjects of the research-driven teaching are thereby information and communication systems in economics and society, especially the analysis, modeling, design, implementation, and evaluation of such systems. Besides the primarily computer science-oriented approach, the success of such systems requires the consideration of technical, economic, and social aspects. Thereby, computer science and economics are combined.

Graduates are among others qualified for the following fields of activity:

- Analysis and optimization as well as development of business processes and according information processes
- Strategic and executive planning, realization, and steering of information systems
- Advanced and application-oriented system design and development

- IT-supported enterprise management (corporate governance) based on a holistic view of the enterprise and its environment as information system, by considering strategic and IT-related factors
- Management as CIO (chief information officer) or CTO (chief technology officer) as well as mediator between IT, economics, and society
- Management or IT consultant as well as business analyst
- Research and development

Due to the occupational requirements, qualifications regarding the following categories are included in the Master of Business Informatics:

Fachliche und methodische Kenntnisse The master program offers highly specialized knowledge as well as a critical understanding of the theories and principles of areas of computer science and economics, which are relevant for business informatics.

The main focus lies in the teaching of deepening knowledge in selected areas of expertise as well as the interdisciplinary extension of the knowledge, which was acquired in the bachelor program:

- Advanced formal and scientific methods
- Constructional and analytic methods of business informatics
- Innovation concepts in business informatics
- Special concepts and methods of computer science
- Advanced methods of business informatics

Kognitive und praktische Fertigkeiten The emphasis lies on the development of cognitive and practical abilities that are essential for problem solving. By using appropriate exercises supported by current technologies, the following methods and toolsets are taught:

- Modeling and abstraction
- Integrative use of formal, technological, and socioeconomic knowledge for the design and critical evaluation of systems
- Interdisciplinary, system-oriented thinking
- Scientifically profound approach to problem-solving
- Documentation of solutions, critical reflection on findings, as well as their convincing presentation
- Ability for theoretical system analysis
- Ability to select and apply the scientific method best suited to the current problem

Soziale Kompetenzen, Innovationskompetenz und Kreativität The focus lies on promoting key abilities necessary to develop creativity and innovation:

- Self organization, personal responsibility
- Highly competitive skill sets in international business and scientific environments
- The ability to work in diverse teams
- Self-initiative and curiosity
- The ability to make decisions and adapt to unforeseeable changing environments
- Recognizing the potential of innovations in different technological, economic, and social contexts
- The ability to view the own work in a social context appraising possible consequences on society

3 Dauer und Umfang

Der Arbeitsaufwand für das Masterstudium *Business Informatics* beträgt 120 ECTS-Punkte. Dies entspricht einer vorgesehenen Studiendauer von 4 Semestern als Vollzeitstudium.

ECTS-Punkte (Ects) sind ein Maß für den Arbeitsaufwand der Studierenden. Ein Studienjahr umfasst 60 ECTS-Punkte.

4 Zulassung zum Masterstudium

Die Zulassung zum Masterstudium *Business Informatics* setzt den Abschluss eines fachlich in Frage kommenden Bachelorstudiums bzw. Fachhochschul-Bachelorstudienganges oder eines anderen gleichwertigen Studiums an einer anerkannten in- oder ausländischen postsekundären Bildungseinrichtung voraus. Wenn die Gleichwertigkeit grundsätzlich gegeben ist und nur einzelne Ergänzungen auf die volle Gleichwertigkeit fehlen, können zur Erlangung der vollen Gleichwertigkeit zusätzliche Lehrveranstaltungen und Prüfungen im Ausmaß von maximal 30 ECTS-Punkten vorgeschrieben werden, die im Laufe des Masterstudiums zu absolvieren sind. Sie können im Modul *Freie Wahl* verwendet werden.

Ein Studium kommt fachlich in Frage, wenn die Kenntnisse, Fertigkeiten und Kompetenzen der Prüfungsfächer

WIN - Wirtschaftsinformatik im Umfang von mind. 24 Ects,
WIW - Wirtschaftswissenschaften im Umfang von mind. 18 Ects,
INT - Informationstechnologie im Umfang von mind. 27 Ects, und
STW - Strukturwissenschaften im Umfang von mind. 18 Ects

des Bachelorstudiums *Wirtschaftsinformatik* vermittelt werden.

Fachlich in Frage kommt jedenfalls das Bachelorstudium der *Wirtschaftsinformatik* der Technischen Universität Wien, dessen Absolventinnen und Absolventen ohne Auflagen zuzulassen sind.

Absolventinnen und Absolventen der Bachelorstudien *Medizinische Informatik*, *Software & Information Engineering* und *Medieninformatik und Visual Computing* der Technischen Universität Wien benötigen die Kenntnisse, Fertigkeiten und Kompetenzen der Module

WIW/GOE - Grundlagen der Ökonomie (9 Ects)
WIW/GBW - Grundlagen der Betriebswirtschaft (9 Ects)

des Bachelorstudiums *Wirtschaftsinformatik*.

Personen, deren Muttersprache nicht Englisch ist, haben die Kenntnis der englischen Sprache nachzuweisen. Für einen erfolgreichen Studienfortgang werden Englischkenntnisse nach Referenzniveau B2 des Gemeinsamen Europäischen Referenzrahmens für Sprachen empfohlen.

5 Aufbau des Studiums

Die Inhalte und Qualifikationen des Studiums werden durch *Module* vermittelt. Ein Modul ist eine Lehr- und Lerneinheit, welche durch Eingangs- und Ausgangsqualifikationen, Inhalt, Lehr- und Lernformen, den Regelarbeitsaufwand sowie die Leistungsbeurteilung gekennzeichnet ist. Die Absolvierung von Modulen erfolgt in Form einzelner oder mehrerer inhaltlich zusammenhängender *Lehrveranstaltungen*. Thematisch ähnliche Module werden zu *Prüfungsfächern* zusammengefasst, deren Bezeichnung samt Umfang und Gesamtnote auf dem Abschlusszeugnis ausgewiesen wird.

Prüfungsfächer und zugehörige Module

Das Masterstudium *Business Informatics* gliedert sich in folgende Prüfungsfächer mit den ihnen zugeordneten Modulen:

BIN - Business Informatics (21 Ects)

BIN/BEN - Business Engineering (15.0 Ects)
BIN/MOS - Modeling and Simulation (6.0 Ects)

BAE - Business Administration and Economics (15 Ects)

BAE/INE - Information Economics and Social Simulation (6.0 Ects)
BAE/MGT - Management (9.0 Ects)

INT - Information Technology (12 Ects)

INT/ASE - Advanced Software Engineering (6.0 Ects)
INT/MEN - Model Engineering (6.0 Ects)

FMF - Formal and Mathematical Foundations (12 Ects)

FMF/KBS - Knowledge-based Systems (6.0 Ects)
FMF/QOM - Quantative Operations Management (6.0 Ects)

The specialization modules *SBI - Specialization Track Business Informatics*, *SBA - Specialization Track Business Administration and Economics* and *SIT - Specialization Track Information Technology* focus on current research issues that are subject to research at Vienna University of Technology. The students have to choose 3 blocks of courses, 6 Ects each. These blocks are defined and maintained by the curriculum commission. The courses within a block concentrate on a specific research issue. Each block may contain up to 3 courses.

SBI - Specialization Track Business Informatics

SBI/BTD - Beyond the Desktop (6.0 Ects)
SBI/EC1 - Services and Communities (6.0 Ects)
SBI/EC2 - Web: Analysis and Search (6.0 Ects)
SBI/EC3 - Business Informatics: Current State and Future Trends (6.0 Ects)
SBI/KM1 - Knowledge Management (6.0 Ects)
SBI/KM2 - Information Extraction and Integration (6.0 Ects)
SBI/LAW - Advanced Aspects of IT-Law (6.0 Ects)
SBI/MO2 - e-Business Modeling (6.0 Ects)

SBA - Specialization Track Business Administration and Economics

SBA/AEE - Advanced Economics - Evolutionary Economics (6.0 Ects)
SBA/AEI - Advanced Economics - International Economics (6.0 Ects)
SBA/AEP - Advanced Economics - Project (6.0 Ects)
SBA/FR1 - Advanced Financial and Risk Management 1 (6.0 Ects)
SBA/FR2 - Advanced Financial and Risk Management 2 (6.0 Ects)
SBA/ORG - Organization (6.0 Ects)
SBA/ORM - Operations Research Methods (6.0 Ects)
SBA/STM - Strategic Management and Innovation (6.0 Ects)

SIT - Specialization Track Information Technology

SIT/DPR - Digital Preservation (6.0 Ects)
SIT/DS1 - Internet Computing (6.0 Ects)
SIT/DS2 - Technologies for Distributed Systems (6.0 Ects)
SIT/DS3 - Networking (6.0 Ects)

SIT/MO1 - Advanced Model Engineering (6.0 Ects)
SIT/SC1 - Secure Software Development and Organizational Aspects (6.0 Ects)
SIT/SC3 - Secure Systems Engineering (6.0 Ects)
SIT/SE1 - Requirements Engineering and Empirical Evaluation (6.0 Ects)
SIT/SE2 - Advanced Software Engineering and Project Management (6.0 Ects)
SIT/SE3 - Advanced Software Quality Management (6.0 Ects)

TSK - Transferable Skills (9 Ects)

Freie Wahl (max. 4.5 Ects)
Fachübergreifende Qualifikationen (4.5 Ects)

MTD - Master Thesis and Defense (33 Ects)

MTD/MAS - Master Thesis (30.0 Ects)
MTD/SEM - Seminar for Master Students (3.0 Ects)

Ergänzungsstudium „Innovation“

Zusätzlich zu den oben beschriebenen Prüfungsfächern im Umfang von 120 Ects kann das englischsprachige Prüfungsfach *Innovation* im Umfang von 30 Ects absolviert werden. In diesem Fall wird es ebenfalls auf dem Abschlusszeugnis ausgewiesen.

Innovation

Innovation and Creativity (6.0 Ects)
Innovation Planning (6.0 Ects)
Innovation Implementation (6.0 Ects)
Innovation Practice (12.0 Ects)

Die Module des Prüfungsfaches *Innovation* vermitteln Zusatzqualifikationen in Bereichen wie Firmengründung, Innovationsmanagement und Forschungstransfer. Aufgrund der beschränkten Teilnehmerzahl erfolgt die Vergabe der Plätze nach einem gesonderten Auswahlverfahren. Details sind dem Curriculum des Ergänzungsstudiums *Innovation* in Anhang E sowie den Modulbeschreibungen zu entnehmen.

Kurzbeschreibung der Module

Dieser Abschnitt charakterisiert die Module des Masterstudiums *Business Informatics*. Eine ausführliche Beschreibung ist in Anhang A zu finden. Die Module sind alphabetisch geordnet.

BAE/INE - Information Economics and Social Simulation (6.0 Ects) This module deals with various important concepts of information in economics and the social sciences and shows ways to simulate socio-economic systems. In socio-economic systems

heterogeneous individuals interact in networks, which heavily influence the learning and decision making processes of these individuals. These micropatterns of behaviour lead to macrobehaviour of the society, which can be simulated in a realistic way by employing agent based computational simulation. In the lecture parts of the module important concepts are introduced and ways to simulate socio-economic systems are presented. In the project part of the module students employ and deepen this knowledge by working on and experimenting with computational social simulation models, especially with agent based models.

BAE/MGT - Management (9.0 Ects) In this module, students are provided with fundamental knowledge and skills necessary to manage complex socio-technical systems. This comprises planning and control of generic management processes based on IT support, human resource management and leadership as well as the management of business relations in form of negotiations. Besides lectures and final exams, the courses include case studies, role plays, teamwork, and take-home exercises.

BIN/BEN - Business Engineering (15.0 Ects) This module deals with designing an enterprise in an e-business and e-commerce context. This covers the area of analyzing its performance (business intelligence), understanding the electronic markets and networks as well as planning and designing activities or the respective systems (e-commerce), modeling the internal processes and workflows (workflow modeling), designing new products and services and innovating products and services. Thus, the module covers all business engineering aspects from analysis, abstraction, modeling, design, planning up to implementation. The module is organized along lectures, class room tasks, assignments, and hands-on exercises (alone or in groups). When appropriate, tools are provided.

BIN/MOS - Modeling and Simulation (6.0 Ects) This module offers a compact introduction into the art of modeling and into the technique of simulation. Students learn how to perform a simulation study correctly following all necessary steps from data acquisition, (mathematical) modeling, implementation, validation, identification, and result analysis. Different modeling techniques (from differential and difference equations via cellular automata to soft computing-based modeling techniques and discrete event modeling) are compared and appraised with respect to data availability. Using standard and experimental simulation systems students work on case studies in various application areas (from economics via production to physics and health care).

FMF/KBS - Knowledge-based Systems (6.0 Ects) This module offers an introduction into important concepts of knowledge-based systems like problem solving techniques, formalisms to represent knowledge, and corresponding deduction concepts. Students acquire systematic knowledge about the fundamental principles underlying knowledge-based systems, both from a theoretical and from a practical implementation side. Students continue to train their capabilities to analyze problems, their abilities to argue and reason correctly in proofs, which result in solutions, and their abilities to implement solutions. Topics are presented in lectures, exercises are done and presented by students, larger problems are solved and implemented by students in the lab.

FMF/QOM - Quantative Operations Management (6.0 Ects) This module deals

with quantitative methods used in operations management as well as with decision analysis by mathematical models and econometric methods. Theoretical background is assessed by periodic exams. To adopt the skills, students work out examples and case studies, in class as well as at home.

Fachübergreifende Qualifikationen (4.5 Ects) Die Lehrveranstaltungen dieses Moduls dienen dem Erwerb fachübergreifender Qualifikationen wie zum Beispiel: Verhandlungsführung, Präsentation- und Kommunikationstechnik, systematische Recherche und Planung, Konfliktmanagement, Teamfähigkeit und Führung, Organisation und Management, Betriebsgründung und Finanzierung, Verständnis rechtlicher Rahmenbedinungen, Verbesserung von Fremdsprachenkenntnissen.

Freie Wahl (max. 4.5 Ects) Die Lehrveranstaltungen dieses Moduls dienen der Vertiefung des Faches sowie der Aneignung außerfachlicher Kenntnisse, Fähigkeiten und Kompetenzen.

INT/ASE - Advanced Software Engineering (6.0 Ects) This module builds on the foundation of knowledge from the bachelor module to deepen selected software engineering approaches for the development and evolution of advanced software systems. The focus is on technical software engineering approaches, such as component-based software engineering and software process automation, for evolving advanced software systems in distributed engineering teams. The module consists of project work in a small group over the course of a semester, in which a medium-size software engineering project is conducted with the goal of a usable and useful prototype with associated systematic documentation and the use of selected advanced software technologies.

INT/MEN - Model Engineering (6.0 Ects) This module places software models as the central artifact in software development. Thus, model engineering aims for model-driven software development closing the gap between modeling and programming. In this context, concepts and techniques of transformation engineering, language engineering, and model management are taught. The module includes lectures and labs. The content of the lecture is deepened in practical exercises, which are solved in small groups.

Innovation Implementation (6.0 Ects) This is the third module out of four. It focuses on the implementation of innovations. It comprises practical aspects such as legal, financial, and social issues, which are complementary to and often critical for the innovation process.

Innovation Planning (6.0 Ects) This is the second module out of four. Students will learn to formulate business plans, as well as to discuss selected innovation cases.

Innovation Practice (12.0 Ects) This is the fourth and last module. Within a project, students will work on a concrete innovation task.

Innovation and Creativity (6.0 Ects) This is the first module out of four, as such it represents the entry point to the innovation modules. Students should have interest in innovation, and prove their excellent progress in their bachelor and master studies. At the end of this module they should know the basic concepts of innovation as well as the respective creativity techniques. The module contains subjects such as innovation

theory and management, and focuses on the importance of innovation for businesses and society. It will also introduce creativity techniques and ways to explicitely formulate business ideas.

MTD/MAS - Master Thesis (30.0 Ects) Die Diplomarbeit ist eine wissenschaftliche Arbeit, die dem Nachweis der Befähigung dient, ein wissenschaftliches Thema selbstständig inhaltlich und methodisch vertretbar zu bearbeiten. Das Prüfungsfach Diplomarbeit, bestehend aus der wissenschaftlichen Arbeit und der kommissionellen Gesamtprüfung, wird mit 30.0 ECTS-Punkten bewertet, wobei der kommissionellen Gesamtprüfung 3.0 Ects zugemessen werden. Das Thema der Diplomarbeit ist von der oder dem Studierenden frei wählbar und muss im Einklang mit dem Qualifikationsprofil stehen.

MTD/SEM - Seminar for Master Students (3.0 Ects) This module supports research work of master students during their master thesis.

SBA/AEE - Advanced Economics - Evolutionary Economics (6.0 Ects) This module presents selected advanced topics in economic theory, which are particularly suited to be supported by simulation methods. Many of these topics can be summarized under the overarching concept of evolutionary economics. The respective lecture provides an introductory overview – both from a historical perspective as also from a technical perspective – of evolutionary economic theory. It builds on an already assumed knowledge of standard macroeconomics of the audience. The seminar complements this more general survey by providing a detailed study of a sample of particularly successful models of agent based modeling in the social sciences. In particular modeling techniques concerning heterogeneous model-building agents are discussed.

SBA/AEI - Advanced Economics - International Economics (6.0 Ects) This module builds on standard macroeconomic theory and extends it to cover questions of open economies. A concise introduction to the pure theory of international trade is offered via classical presentations, including a discussion of its applications and its critique. The complementing seminar has the goal to show how this theoretical knowledge is used in some macroeconomic simulation models actually applied for policy consulting. Students understand, condense, summarise and present scientific research papers. Each year a different economic policy focus (e.g., European labour markets, eurozone stability, etc.) is chosen for the seminar.

SBA/AEP - Advanced Economics - Project (6.0 Ects) This project is designed to allow students to apply all the knowledge they acquired so far in achieving a comprehensive larger task. The project has to consist of a part showing the ability to understand advanced economic theory, and of a part showing the expertise to transform economic or political economy problems into useful simulation models. Students work in small groups to conduct the simulation study. They have to give a (semi-public) presentation of the project and to document their work in a written project report.

SBA/FR1 - Advanced Financial and Risk Management 1 (6.0 Ects) In this module, students are provided with fundamental knowledge and skills necessary in the financial and risk management of industrial organizations. The module consists of integrated courses that contain lecture, interactive, and assignment sections.

SBA/FR2 - Advanced Financial and Risk Management 2 (6.0 Ects) In this module students are provided with advanced knowledge and skills necessary in the financial and risk management of industrial organizations. The module consists of integrated courses that contain lecture, interactive, and assignment sections.

SBA/ORG - Organization (6.0 Ects) What are organizations, how are they designed and how do they interact with their environment? These questions are simple but provoking. This module is aimed at giving students the possibility to discuss alternative answers to these question. It helps students to increase their abilities to understand complex organized behavior. It offers not only a series of different theoretical lenses useful for explaining organizations from multiple perspectives but also a set of tools to design and manage organizations. To a large extent the courses rely on experiential learning techniques including individual as well as team assignments, role plays and simulations in-class, group discussions, and presentations.

SBA/ORM - Operations Research Methods (6.0 Ects) This module covers important algorithmic techniques for problem solving and optimization from the domain of operations research. Included are in particular mixed integer programming methods and (meta-)heuristic algorithms as well as dedicated methods for the domain of transport optimization. A lecture covers the theoretical background, theoretical and practical exercises, including programming examples, deepen the knowledge.

SBA/STM - Strategic Management and Innovation (6.0 Ects) This module introduces strategic management and innovation theory. Students are enabled to perform strategic analysis as a basis for rational choice among and evaluation of alternative courses of action. Furthermore they gain understanding of the innovation process and success factors for the diffusion of innovations. The theoretical background and core concepts are provided in lectures and deepened in exercises, case studies, and reports.

SBI/BTD - Beyond the Desktop (6.0 Ects) Graphical user interfaces (GUI) with their traditional input and output devices are nowadays the most used interaction environments. Besides their unavoidable existence they still lack on flexibility in user interaction, especially if it comes to certain groups of users like children, elderly, or humans with special needs. Tangible user interfaces and objects, mobile platforms, ubiquitous computing, embedded sensors and displays, large multitouch systems, or gestural interaction are some example technologies, which have already started to change and enhance the ways of communication and interaction between people in our society. This module deals with these alternative technologies with their multimodal interfaces as add-ons or replacement for conventional mouse and keyboard based graphical user interfaces. After having lecture-based input on alternative ways for interaction with computers, students will choose one technology and design a prototype in a group, for a given setting with specified users before they present their results.

SBI/EC1 - Services and Communities (6.0 Ects) This module deals with the issues of business services, service systems, service design and marketing as well as with services in online communities. It introduces new approaches in e-commerce to integrate

customers into the process of developing new innovative services and products by applying social media. History and success criteria for social and other service systems are treated as well. The courses are organized along lectures, classroom tasks, assignments, and hand-on exercises. Sometimes tools are applied.

SBI/EC2 - Web: Analysis and Search (6.0 Ects) This module deals with the World Wide Web in terms of analysis of usage and structure of the search for Web-based information. The formal basis and methods of network theory are provided. This knowledge is then applied with the help of special tools and social network analysis software. Principles of information description and search technologies are described in the context of the World Wide Web. Current trends in personalisation and recommendation are illustrated. The module provides the participants with an understanding of network analysis, machine learning for Web data analysis, understanding of functionality and improvement of Web search techniques, and a discussion of current research topics in Web Science and Web Search. The didactic concept of this module comprises lectures, group discussions, project work, and project presentations.

SBI/EC3 - Business Informatics: Current State and Future Trends (6.0 Ects) This module deals with business informatics, its current-state-of-the-art, and future developments. It comprises technological as well methodological approaches. In one part, various international experts report about current 'hot topics' in the area of business informatics, thus giving the students a broad idea about the area's emerging fields. In the other part, the students will explore possible solutions for concrete tasks from the field of business informatics based on scientific methods and present their solutions to fellow students.

SBI/KM1 - Knowledge Management (6.0 Ects) This module deals with the management of implicit and explicit knowledge in enterprizes and other organizations. It considers organizational, cultural, strategic, and operational issues of knowledge management. The module covers strategic as well as operational knowledge management methods and tools. Students learn how to analyze, design, operate, and control the required knowledge in an organization.

SBI/KM2 - Information Extraction and Integration (6.0 Ects) This module deals with data extraction from the Web and integration of Web data into applications and processes. It comprises an overview about information extraction in general and covers in particular methods of Web querying and wrapper generation, as well as presenting wrapper languages, deep Web navigation traversal methods, and inductive, automated, and supervised approaches. Data extraction based on visual rendition, questions about robustness and adaptation, and further algorithmical and technical aspects are covered. Furthermore, a special focus of this module is how Web extraction and integration topics are addressed by state-of-the-art libraries, tools, and frameworks and used in real-life scenarios. Special emphasis is given to Web data cleansing, integration of Web data into competitive intelligence scenarios, mashups, web application testing, web process integration, and using extraction and document understanding technologies for enabling web accessibility. The course comprises both a lecture and an exercise part. The lecture part

is primarily intended to teach about methodologies as well as to illustrate concepts from practice including system live demonstrations. The goal of the exercises is to strengthen the knowledge of the participants, especially including practical usage of tools in the area of web data extraction.

SBI/LAW - Advanced Aspects of IT-Law (6.0 Ects) This module deals with advanced legal aspects in applied computer sciences and IT related project and contract issues. Students adopt a deeper and applied understanding of specific law sectors relevant for IT professionals in actual project scenarios. Students identify the specific relevance of certain legal issues in applied IT scenarios. Moreover students gain insight into everyday situations and are aware of the rights and duties of the parties involved, so that they may avoid legal drawbacks from the perspective of an IT professional. The majority of the lessons are held as presentations and discussions involving students. Moreover small practical exercises are elaborated by each student or in groups.

SBI/MO2 - e-Business Modeling (6.0 Ects) This module focuses on model-driven development of solutions for e-business partnerships. Thereby, the module investigates on methodologies and techniques on the different levels of an e-business partnership and the integration of these levels: (1) the value perspective manifested by a business model, (2) the process flow perspective manifested by choreographies among the parties, and (3) the execution perspective manifested by the deployment artifacts. A lecture series is accompanied by practical courses where the students have to demonstrate their skills by presenting solutions for given examples and develop a model-driven solution for a practical problem spanning all the different layers of inter-organizational systems for e-business.

SIT/DPR - Digital Preservation (6.0 Ects) The module aims to develop in participants an appreciation of the issues surrounding digital preservation within the context of infromation systems, business processes, scientific data management, security, and software development. Participants should leave with a coherent and practical understanding of activities surrounding digital preservation and, in particular, a developed understanding of selection and appraisal, workflow modeling, metadata definition, ingest process management, and a working knowledge of the issues surrounding audit and certification of digital repositories. The module raises awareness of sustainability issues and builds sustainability into the process of software development. Moreover, security issues are elaborated in terms of data and software security with respect to long term preservation. The participants of this module are encouraged to put their theoretical knowledge into practice implementing solutions for selected preservation issues.

SIT/DS1 - Internet Computing (6.0 Ects) This module provides technical knowledge of software architecture for and implementation of state-of-the-art distributed enterprize systems, specifically internet-based ones. The module consists of two separated parts. Software Architecture focuses on design-time choices for building distributed and internet-based systems. It covers architectural patterns, approaches to modeling and documenting software architecture, and novel approaches in the field such as model-driven architectures. Advanced Internet Computing is more geared towards systems based on

the notion of service-oriented architecture, and provides technical knowledge for implementing advanced internet-based systems. Both parts are held as VUs, with written exams covering the lecture parts and practical assignments for the lab parts. Assignments are done in small groups.

SIT/DS2 - Technologies for Distributed Systems (6.0 Ects) This module provides detailed knowledge of various middleware technologies for implementing state-of-the-art distributed systems. The module covers middleware for the data tier (e.g., object-relational mapping technology), the business logics tier (e.g., distributed objects, Web services and messaging technology), and the presentation tier. The module is centered on practical and implementation-level issues. The module consists of a single VL. The lecture part of the module covers more general and background information, and is graded using a written exam. The lab part of the module consists of assignments, which are done alone (no group work). Grading for the lab part is based on the assignments and the student's contributions in periodic review lessons. Review lessons are held for groups of 24 students.

SIT/DS3 - Networking (6.0 Ects) This module covers important topics of advanced networking, such as design, implementation, maintenance and management. Furthermore, issues of mobile and pervasive computing are covered and set in relation to the knowledge acquired in networking. This module aims at providing a lower-level view on the topics covered in the modules SPT/DS1 and SPT/DS2, but is fundamentally independent. The module consists of three parts. Advanced networking is covered in a lecture and a separate practical lab. The lecture is held in an interactive way, student contributions are expected and required. The lecture is graded using an oral exam. The lab is held as group work and graded in groups. Students are suggested to take the lecture and lab exercise in parallel. Pervasive and mobile computing is taught in an independent VL.

SIT/MO1 - Advanced Model Engineering (6.0 Ects) This module tackles the problem of model evolution in general, and model versioning in particular. Students who have successfully passed this module have a profound understanding of all aspects of model versioning, and may be able to apply technology at hand to model versioning tasks.

SIT/SC1 - Secure Software Development and Organizational Aspects (6.0 Ects) This module deals with advanced concepts of information security. Students will learn about managing software development projects so that secure software can be developed (secure software development life cycle) and organizational aspects of security, including information security audits, business continuity management, and data leakage prevention. Theoretical background will be presented in lectures and through e-learning. Students will work in groups on small projects and case studies. After completing this module students will have a stronger knowledge to assess, design, and build secure (software) systems.

SIT/SC3 - Secure Systems Engineering (6.0 Ects) IT security engineering has become a critical element of the overall performance of IT systems and IT projects. En-

hancing effective functional engineering by thorough security models, processes, and techniques is a major design and architecture issue in several application fields. In the lectures of this module students will learn advanced aspects of how to engineer secure systems and how to maintain security standards in large and complex IT infrastructures. Topics of this module include advanced aspects of planning, designing and implementing security mechanisms (e.g., Public Key Infrastructures, web application security, ...), best practice examples of implementing security in large IT infrastructures, and security testing in IT systems (test process, penetration testing, ...). Students gain knowledge in IT security through fundamentals and theory of advanced security aspects. Mechanisms are applied in practical lab work. Furthermore, students are involved in security experiments, current research issues and security competitions. Experiments in attacking and defending systems will be a didactic method.

SIT/SE1 - Requirements Engineering and Empirical Evaluation (6.0 Ects) The module covers advanced requirements engineering approaches, which provide the foundation for traceability of requirements along the software life cycle, and empirical evaluation approaches, which provide a framework for the evaluation of software engineering artifacts and processes. As a background students require a solid basic knowledge in formal modeling and software engineering. The module consists of a lecture and workshop on requirements engineering as well as a lecture and workshop on empirical evaluation approaches. After completing this module students will have a stronger knowledge to specify and validate software engineering artifacts and processes in scientific and/or industrial contexts.

SIT/SE2 - Advanced Software Engineering and Project Management (6.0 Ects) This specialization module complements the practical group work in the mandatory modules with a lecture and a research seminar. The lecture provides the theoretical concepts and methods as foundation for practical examples and allows reflecting experience from practical excercises in this module. In the research seminar students select a topic, conduct a systematic literature review, and present the results. The module builds on the foundation of knowledge from the baccalaureate modulea to explore and deepen selected scientific and industrial topics for the development and evolution of advanced software systems. Defining characteristics of advanced software systems are their complexity, large size, or high level of dependability. A main focus is on technical software engineering approaches, such as component-based software engineering and software process automation, for evolving advanced software systems in distributed engineering teams. In addition, advanced research topics in software engineering, such as open source software engineering processes and ecosystems for software engineering tools and frameworks, will be explored, including the benefits and limits of selected solution approaches.

SIT/SE3 - Advanced Software Quality Management (6.0 Ects) This module covers the areas advanced software testing, which provides methods for efficiently testing large software systems, and software quality management, which provides concepts for managing the quality of software processes. As a background students require a solid basic knowledge in formal modeling, software engineering, and software quality assurance. The module consists of a lecture and workshop on software testing, which provides

the theoretical concepts and application methods for efficiently testing large software systems, and a lecture and workshop on software quality management, which provides concepts for managing the quality of software processes. After completing this module students will have a stronger knowledge to test complex software systems and manage the quality of software processes and organizations in scientific and/or industrial contexts.

6 Lehrveranstaltungen

Die Stoffgebiete der Module werden durch Lehrveranstaltungen vermittelt. Die Lehrveranstaltungen der einzelnen Module sind in Anhang A in den jeweiligen Modulbeschreibungen spezifiziert. Lehrveranstaltungen werden durch Prüfungen im Sinne des Universitätsgesetzes beurteilt. Die Arten der Lehrveranstaltungsbeurteilungen sind in der Prüfungsordnung (siehe Abschnitt 7) festgelegt.

Änderungen an den Lehrveranstaltungen eines Moduls werden in der Evidenz der Module dokumentiert, mit Übergangsbestimmungen versehen und im Mitteilungsblatt der Technischen Universität Wien veröffentlicht. Die aktuell gültige Evidenz der Module liegt in der Rechtsabteilung auf.

7 Prüfungsordnung

Den Abschluss des Masterstudiums bildet die Diplomprüfung. Sie beinhaltet

(a) die erfolgreiche Absolvierung aller im Curriculum vorgeschriebenen Module, wobei ein Modul als positiv absolviert gilt, wenn die ihm zuzurechnenden Lehrveranstaltungen gemäß Modulbeschreibung positiv absolviert wurden,

(b) die Abfassung einer positiv beurteilten Diplomarbeit,

(c) die Erstellung eines Posters über die Diplomarbeit, das der Technischen Universität Wien zur nicht ausschließlichen Verwendung zur Verfügung zu stellen ist, und

(d) eine kommissionelle Abschlussprüfung. Diese erfolgt mündlich vor einem Prüfungssenat gem. § 12 und § 19 des Satzungsteil „Studienrechtliche Bestimmungen“ der Technischen Universität Wien und dient der Präsentation und Verteidigung der Diplomarbeit und dem Nachweis der Beherrschung des wissenschaftlichen Umfeldes. Dabei ist vor allem auf Verständnis und Überblickswissen Bedacht zu nehmen. Die Anmeldevoraussetzungen zur kommissionellen Abschlussprüfung gem. § 18 Abs. 1 des Satzungsteil „Studienrechtliche Bestimmungen“ der Technischen Universität Wien sind erfüllt, wenn die Punkte a und b erbracht sind.

Das Abschlusszeugnis beinhaltet

(a) die Prüfungsfächer mit ihrem jeweiligen Umfang in ECTS-Punkten und ihren Noten,

(b) das Thema der Diplomarbeit,

(c) die Note des Prüfungsfaches Diplomarbeit und

(d) eine auf den unter a und c angeführten Noten basierenden Gesamtbeurteilung gemäß § 73 Abs. 3 UG 2002,

(e) sowie die Gesamtnote.

Die Note eines Prüfungsfaches ergibt sich durch Mittelung der Noten jener Lehrveranstaltungen, die dem Prüfungsfach über die darin enthaltenen Module zuzuordnen sind, wobei die Noten mit dem ECTS-Umfang der Lehrveranstaltungen gewichtet werden. Bei einem Nachkommateil kleiner als oder gleich 0,5 wird abgerundet, andernfalls wird aufgerundet. Die Gesamtnote ergibt sich analog zu den Prüfungsfachnoten durch gewichtete Mittelung der Noten aller dem Studium zuzuordnenden Lehrveranstaltungen sowie der Noten der Diplomarbeit und der Abschlussprüfung.

Lehrveranstaltungen des Typs VO (Vorlesung) werden aufgrund einer abschließenden mündlichen und/oder schriftlichen Prüfung beurteilt. Alle anderen Lehrveranstaltungen besitzen immanenten Prüfungscharakter, d.h., die Beurteilung erfolgt laufend durch eine begleitende Erfolgskontrolle sowie optional durch eine zusätzliche abschließende Teilprüfung.

Der positive Erfolg von Prüfungen ist mit *sehr gut* (1), *gut* (2), *befriedigend* (3) oder *genügend* (4), der negative Erfolg ist mit *nicht genügend* (5) zu beurteilen.

8 Studierbarkeit und Mobilität

Studierende des Masterstudiums *Business Informatics* sollen ihr Studium mit angemessenem Aufwand in der dafür vorgesehenen Zeit abschließen können.

Es wird empfohlen, das Studium nach dem Semestervorschlag in Anhang C zu absolvieren. Für Studierende, die ihr Studium im Sommersemester beginnen, wird der modifizierten Semestervorschlag in Anhang D empfohlen.

Die Anerkennung von im Ausland absolvierten Studienleistungen erfolgt durch das studienrechtliche Organ. Zur Erleichterung der Mobilität stehen die in § 27 Abs. 1 bis 3 der *Studienrechtlichen Bestimmungen* der Satzung der Technischen Universität Wien angeführten Möglichkeiten zur Verfügung. Diese Bestimmungen können in Einzelfällen auch zur Verbesserung der Studierbarkeit eingesetzt werden.

9 Diplomarbeit

Die Diplomarbeit ist eine wissenschaftliche Arbeit, die dem Nachweis der Befähigung dient, ein wissenschaftliches Thema selbstständig inhaltlich und methodisch vertretbar zu bearbeiten. Das Prüfungsfach Diplomarbeit, bestehend aus der wissenschaftlichen Arbeit und der kommissionellen Gesamtprüfung, wird mit 30.0 ECTS-Punkten bewertet, wobei der kommissionellen Gesamtprüfung 3.0 Ects zugemessen werden. Das Thema der Diplomarbeit ist von der oder dem Studierenden frei wählbar und muss im Einklang mit dem Qualifikationsprofil stehen.

10 Akademischer Grad

Den Absolventinnen und Absolventen des Masterstudiums *Business Informatics* wird der akademische Grad *Diplom-Ingenieur/Diplom-Ingenieurin* – abgekürzt *Dipl.-Ing.* oder *DI* – verliehen (englische Übersetzung *Master of Science*, abgekürzt *MSc*).

11 Integriertes Qualitätsmanagement

Das integrierte Qualitätsmanagement gewährleistet, dass das Curriculum des Masterstudiums *Business Informatics* konsistent konzipiert ist, effizient abgewickelt und regelmäßig überprüft bzw. kontrolliert wird. Geeignete Maßnahmen stellen die Relevanz und Aktualität des Curriculums sowie der einzelnen Lehrveranstaltungen im Zeitablauf sicher; für deren Festlegung und Überwachung sind das Studienrechtliche Organ und die Studienkommission zuständig.

Die Studienkommission unterzieht das Curriculum in einem dreijährigen Zyklus einem Monitoring, unter Einbeziehung wissenschaftlicher Aspekte, Berücksichtigung externer Faktoren und Überprüfung der Arbeitsaufwände, um Verbesserungspotentiale des Curriculums zu identifizieren und die Aktualität zu gewährleisten.

Die semesterweise Lehrveranstaltungsbewertung liefert, ebenso wie individuelle Rückmeldungen zum Studienbetrieb an das Studienrechtliche Organ, für zumindest die Pflichtlehrveranstaltungen ein Gesamtbild für alle Beteiligten über die Abwicklung des Curriculums. Insbesondere können somit kritische Lehrveranstaltungen identifiziert und in Abstimmung zwischen studienrechtlichem Organ, Studienkommission und Lehrveranstaltungsleitung geeignete Anpassungsmaßnahmen abgeleitet und umgesetzt werden.

Jedes Modul besitzt eine/n Modulverantwortliche/n. Diese Person ist für die inhaltliche Kohärenz und die Qualität der dem Modul zugeordneten Lehrveranstaltungen verantwortlich. Diese wird insbesondere durch zyklische Kontrollen, inhaltliche Feinabstimmung mit vorausgehenden und nachfolgenden Modulen sowie durch Vergleich mit analogen Lehrveranstaltungen bzw. Modulen anderer Universitäten im In- und Ausland sichergestellt.

Lehrveranstaltungskapazitäten

Für die verschiedenen Typen von Lehrveranstaltungen (siehe Anhang B) dienen die folgenden Gruppengrößen als Richtwert:

	Gruppengröße	
Lehrveranstaltungstyp	je Leiter(in)	je Tutor(in)
VO	100	
UE mit Tutor(inn)en	30	15
UE	15	
LU mit Tutor(inn)en	20	8
LU	8	
SE,EX	10	
PR	10	

Für Lehrveranstaltungen des Typs VU werden für den Vorlesungs- bzw. Übungsteil die Gruppengrößen für VO bzw. UE herangezogen. Die Beauftragung der Lehrenden erfolgt entsprechend der tatsächlichen Abhaltung.

Lehrveranstaltungen mit ressourcenbedingten Teilnahmebeschränkungen sind in der Beschreibung des jeweiligen Moduls entsprechend gekennzeichnet; weiters sind dort die Anzahl der verfügbaren Plätze und das Verfahren zur Vergabe dieser Plätze festgelegt. Die Lehrveranstaltungsleiterinnen und Lehrveranstaltungsleiter sind berechtigt, mehr Teilnehmer und Teilnehmerinnen zu einer Lehrveranstaltung zulassen als nach Teilnahmebeschränkungen oder Gruppengrößen vorgesehen, sofern dadurch die Qualität der Lehre nicht beeinträchtigt wird.

Kommt es in einer Lehrveranstaltung ohne explizit geregelte Platzvergabe zu einem unvorhergesehenen Andrang, kann die Lehrveranstaltungsleitung in Absprache mit dem studienrechtlichen Organ Teilnahmebeschränkungen vornehmen und die Vergabe der Plätze nach folgenden Kriterien (mit absteigender Priorität) regeln:

- Es werden jene Studierenden bevorzugt aufgenommen, die die formalen und inhaltlichen Voraussetzungen erfüllen. Die inhaltlichen Voraussetzungen können etwa an Hand von bereits abgelegten Prüfungen oder durch einen Eingangstest überprüft werden.
- Unter diesen hat die Verwendung der Lehrveranstaltung als Pflichtfach Vorrang vor der Verwendung als Wahlfach und diese vor der Verwendung als Freifach.
- Innerhalb dieser drei Gruppen sind jeweils jene Studierenden zu bevorzugen, die trotz Vorliegens aller Voraussetzungen bereits in einem früheren Abhaltesemester abgewiesen wurden.

Die Studierenden sind darüber ehebaldigst zu informieren.

12 Inkrafttreten

Dieses Curriculum tritt mit 1. Oktober 2011 in Kraft.

13 Übergangsbestimmungen

Die Übergangsbestimmungen werden gesondert im Mitteilungsblatt verlautbart und liegen in der Rechtsabteilung der Technischen Universität Wien auf.

A Modulbeschreibungen

BAE/INE - Information Economics and Social Simulation

ECTS-Credits: 6.0

Summary: This module deals with various important concepts of information in economics and the social sciences and shows ways to simulate socio-economic systems. In socio-economic systems heterogeneous individuals interact in networks, which heavily influence the learning and decision making processes of these individuals. These micropatterns of behaviour lead to macrobehaviour of the society, which can be simulated in a realistic way by employing agent based computational simulation. In the lecture parts of the module important concepts are introduced and ways to simulate socio-economic systems are presented. In the project part of the module students employ and deepen this knowledge by working on and experimenting with computational social simulation models, especially with agent based models.

Learning Outcomes:

Knowledge:

- Concepts of information in economics and the social sciences
- Reasons for the complexity inherent in socio-economic systems and the limitations of common economic model, as well as those of simulation methods
- The method of agent based computational simulation, its use and limitations

Skills:

- Limitations of economic models as well as alternative modelling methods
- Employing agent based simulation to analyze socio-economic systems
- Using Netlogo to rapidly develop a simple simulation model and thus understanding a wide range of scientific socio-economic simulation models

Competences:

- Some experience in team working on scientific projects
- Being able to deepen knowledge on your own

Syllabus:

- Information economics: Introduction to information economics; the interdependence between information theory and economics, Henri Theil's contributions; the price system as information structure; critical mass models; simulation of information processes in social systems; information in artificial life models; early roots of current research topics by Hurwicz, Simon, and Newell; the concept of information in the macroeconomic policy debate; some economic models induced by new information technologies; information structures in production units; economics of language; social network theory
- Computational social simulation: Basic concepts of agent based simulation; comparison of agent based simulation with other simulation methods; some seminal examples of agent based simulations; introduction to simulation software; developing an agent based simulation; generating dynamic social networks; experimenting with agent based simulations; analyzing simulation results

Expected Prerequisites:

The contents of the module *BIN/MOS - Modeling and Simulation* and the contents of the bachelor module *WIW/GOE - Grundlagen der Ökonomie*.

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along lectures, a student project building the major part of the computational social simulation lecture, experiments with partly or fully pre-implemented models in groups to develop a simple agent based model.

Courses of Module:
3.0/2.0 VO Information Economics
3.0/2.0 VU Computational Social Simulation

BAE/MGT - Management

ECTS-Credits: 9.0

Summary: In this module, students are provided with fundamental knowledge and skills necessary to manage complex socio-technical systems. This comprises planning and control of generic management processes based on IT support, human resource management and leadership as well as the management of business relations in form of negotiations. Besides lectures and final exams, the courses include case studies, role plays, teamwork, and take-home exercises.

Learning Outcomes:

Knowledge:

- Knowledge necessary to manage complex socio-economic systems

- Applying the management process approach in different domains to establish open and closed loop management systems
- Tools and instrument necessary to manage human performance during the entire employee lifecycle
- Decision and negotiation analysis theories

Skills:

- Further development of analytical and synthetical skills in the evaluation of complex socio-economical problems
- Critical discussion and evaluation of alternative or conflicting theories and concepts
- Negotiation skills
- Skills in using management information systems including decision and negotiation support

Competences:

- Interactive parts of the courses deepen teamwork and conflict management competences.

Syllabus:

- IT-based management: In this course Kenneth Arrow's organizational control theory is used to distinguish control in the large and control in the small. Control in the large deals with the design and implementation of operating rules and control in the small deals with enforcement of these rules. It applies a process perspective that has the advantage that it can be used in different contexts and implemented in IT solutions. The following topics are taught: Generic management process model; cost management; risk management; sales management; production management; financial management; integrated ERP system.
- Human resource management and leadership: The main goal is to provide students with the theoretical foundations and basic instruments of Human Resource (HR) management and leadership. The following topics are taught: Introduction and theoretical foundations; organization of HR management; HR planning, recruitment, and selection; performance and reward management; training and development; leadership and management; HR controlling and specific topics of HR management.

- International negotiation: This course prepares students for business negotiations in different settings and contexts. The following topics are taught: Theories of the negotiation process and the application of these theories to a variety of settings; rational models of bargaining behavior that have been developed in economics and decision sciences; cognitive and behavioral theories that investigate how bargaining behavior may diverge from the predictions of rational models; developing bargaining skills by applying the theoretical concepts in a variety of negotiating exercises and cases; exposure to new communication and computer technologies that are used in negotiation analysis and support, and in the conducting of negotiations in e-business and beyond.

Expected Prerequisites: Basic knowledge in business administration and management (organization, innovation and marketing, finance and controlling, and production and logistics).

Those topics are taught in the bachelor modules *WIW/GBW - Grundlagen der Betriebswirtschaft* and *WIW/MGT - Managementwissenschaften*.

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along lectures, reading assignments, experimental learning techniques including case studies, role plays, teamwork, and take-home exercises, discussions of the applied theories and concepts from a meta perspective.

Courses of Module:
3.0/2.0 VU IT-based Management
3.0/2.0 VO Human Resource Management and Leadership
3.0/2.0 VU International Negotiations

BIN/BEN - Business Engineering

ECTS-Credits: 15.0

Summary: This module deals with designing an enterprise in an e-business and e-commerce context. This covers the area of analyzing its performance (business intelligence), understanding the electronic markets and networks as well as planning and designing activities or the respective systems (e-commerce), modeling the internal processes and workflows (workflow modeling), designing new products and services and innovating products and services. Thus, the module covers all business engineering aspects from analysis, abstraction, modeling, design, planning up to implementation. The module is organized along lectures, class room tasks, assignments, and hands-on exercises (alone or in groups). When appropriate, tools are provided.

Learning Outcomes:

Knowledge:

- Methodologies to analyze and model an enterprises' processes and data to prepare it for analysis

- Techniques to analyze the data to create hypotheses and bases for business decisions

Skills:

- Skills needed to understand complex business processes, interdependencies in data, and ways to interpret structures detected in data

Competences:

- Work in the multidisciplinary settings required to collect, transform, and interprete data
- Creating hypotheses and verify these based on the information acquired from different data sources, employing a range of different techniques

Syllabus:

- Business intelligence: Data warehousing; data mining and knowledge discovery; OLAP; reference architecture of business intelligence; fast analysis of shared multidimensional information (FASMI); semantic modeling of OLAP solutions and logic modeling (STAR, SNOWFLAKE); ETL process; predictive and descriptive rules (classification, regression, association, clustering)
- E-commerce: Basics of e-commerce and e-business and diffusion aspects; business models; IT-Governance; e-strategy and e-marketing; electronic markets and networks; interorganisational systems; recommender systems; auctions; planing and implementation of e-commerce systems
- Workflow modeling and implementation: Process modeling; workflow patterns; BPMN
- Innovation: Adoption and diffusion; invention, innovation and imitation; innovation examples; innovation process and management; objects and types of innovation; business ideas, planning and implementation

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along lectures, class room tasks, assignments, and hands-on exercises (alone or in groups). When appropriate, tools are provided.

Courses of Module:
6.0/4.0 VU Business Intelligence
3.0/2.0 VU E-Commerce
3.0/2.0 VU Workflow Modeling and Process Management
3.0/2.0 VU Innovation

BIN/MOS - Modeling and Simulation

ECTS-Credits: 6.0

Summary: This module offers a compact introduction into the art of modeling and into the technique of simulation. Students learn how to perform a simulation study correctly following all necessary steps from data acquisition, (mathematical) modeling, implementation, validation, identification, and result analysis. Different modeling techniques (from differential and difference equations via cellular automata to soft computing-based modeling techniques and discrete event modeling) are compared and appraised with respect to data availability. Using standard and experimental simulation systems students work on case studies in various application areas (from economics via production to physics and health care).

Learning Outcomes:

Knowledge:

- Different methods for modeling dynamical processes
- Choose of an appropriate model with respect to the available data
- Technical knowledge to compare different possible modeling approaches and to decide for the most appropriate approach with respect to data and modeling goal

Skills:

- Skills trained cognitive and practically to perform a simulation study correctly, from definition and modeling via software choice and implementation and via model identification and model validation up to experiment design, experiment execution, and result analysis

Competences:

- Communication with experts in various application areas in order to gather information for appropriate modeling and for appropriate simulation documentation
- Innovation in formulating dependencies in the model and for the design of communication of appropriate and creative results

Syllabus: The module consists of partly independent lecture parts, which introduce into the technique of a simulations study, which impart knowledge for different modeling approaches and for appropriate and practical implementations (supported by an e-learning system), and which emphasize on model validation and identification.

- Introduction into the technique of a simulation study sketching all steps from mathematical modeling via implementation and validation until experiment design and experiment execution

- Input/Output modeling (Black Box modeling)
- Discrete transfer functions and Markov models versus general nonlinear discrete models and classifications of the models with respect to nonlinear properties and data availability
- System dynamics, Forrester's modeling approach (industrial dynamics, system dynamics) sketched as qualitative and quantitative white-box modeling approach
- Soft computing techniques
- Cellular automata modeling: Modeling with spatial aspects and multidomain modeling by coupling cellular automata models with system dynamics models
- Discrete event modeling: Statistical features and asynchronous time base modeling (time event oriented modeling) into modeling of discrete dynamical systems
- Validation and identification: Procedures for model validation and algorithms for identification
- Advanced modelled and simulation tasks comparing different modeling techniques
- Complimentary modules as crash courses for modeling and simulation with MATLAB, Simulink, SimEvents, AnyLogic, and others (e.g., DSOL) and a review of mathematical algorithms (basics ODE solver, solutions of difference equations)

Expected Prerequisites: Medium knowledge in mathematical analysis and programming, basic knowledge in statistics and numerical algorithms.

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along lectures on modeling and simulation concepts, exercises on modeling and simulation examples with MATLAB, Simulink, Java, and AnyLogic using the web-based MMT E-Learning system to experiment with partly pre-implemented models to become familiar with model features and concepts by using personal notebooks, case studies, students' projects in groups on modeling and simulation.

Courses of Module:
6.0/4.0 VU Modeling and Simulation

FMF/KBS - Knowledge-based Systems

ECTS-Credits: 6.0

Summary: This module offers an introduction into important concepts of knowledge-based systems like problem solving techniques, formalisms to represent knowledge, and corresponding deduction concepts. Students acquire systematic knowledge about the fundamental principles underlying knowledge-based systems, both from a theoretical and from a practical implementation side. Students continue to train their capabilities

to analyze problems, their abilities to argue and reason correctly in proofs, which result in solutions, and their abilities to implement solutions. Topics are presented in lectures, exercises are done and presented by students, larger problems are solved and implemented by students in the lab.

Learning Outcomes:

Knowledge:

- Fundamental knowledge about the theoretical basic principles of knowledge-based systems
- Fundamental concepts, which are necessary (i) to understand the working principles and (ii) to implement knowledge-based systems
- Basic knowledge about the realization of knowledge-based systems
- Handling of formal descriptions and processing algorithms attached

Skills:

- Ability to formally analyze the discussed techniques and methods
- Ability to choose methods and techniques for a given task
- Ability to analyze simple task, to develop a solution and to implement the solution into a system
- Critical evaluation and reflection of solutions
- Presentation of solutions

Competences:

- Self-organization and personal responsibility
- Personal initiative and curiosity
- Creative development of own solutions

Syllabus:

- Lecture: Introduction a historical background; the architecture of a knowledge-based system; problem solving techniques like search (heuristic search, local search), constraint satisfaction problems, planning; formalisms for knowledge representation like description logics, rule-based formalisms; deduction concepts (corresponding to the knowledge representation formalisms) like deduction concepts for classical logic and description logics, recognize-act-cycle (RAC) including the necessary efficient data structures (RETE network); implementations of nonmonotonic behaviour in forward-chaining rule systems, in declarative programming paradigms like, e.g., answer-set programming; development of knowledge-based systems and modern examples.

- Lab: Implementations of concepts, which are important for knowledge-based systems; implementations of knowledge-based systems; for these implementation task, languages from AI (e.g., Lisp) and logic-oriented approaches (e.g., answer-set programming) are used.

Expected Prerequisites: Basic knowledge about propositional and first-order logic; programming skills; understanding of algorithms; ability to argue formally and to construct simple proofs.

Those topics are taught in the bachelor modules *WIN/MOD - Modellierung*, *STW/MAT - Mathematik und Theoretische Informatik*, *INT/ADA - Algorithmen und Datenstrukturen* and *INT/PRO - Programmkonstruktion*.

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along lectures, exercises with presentation of the results and discussions, lab assignments to solve larger problems and implement solutions.

Courses of Module:
6.0/4.0 VU KBS for Business Informatics

FMF/QOM - Quantative Operations Management

ECTS-Credits: 6.0

Summary: This module deals with quantitative methods used in operations management as well as with decision analysis by mathematical models and econometric methods. Theoretical background is assessed by periodic exams. To adopt the skills, students work out examples and case studies, in class as well as at home.

Learning Outcomes:

Knowledge:

- Choose and formulate appropriate models for various operative decision problems
- Apply causal and time series forecasting
- Parameter estimation and model validation

Skills:

- Students learn to use model-based decision support and adopt an outline of the practical use in the operative division of organisations.
- Students are able to choose among appropriate methods for analytical and forecasting purposes, to work with different data sets and problem formulations, and to use the computer to apply discussed methods.
- Students adopt familiarity with elementary econometric methods (linear regression models, time series approaches), specification and testing.

Competences:

- Solving operations management problems, learning to pursue different solution strategies, flexibility, self-organisation, personal initiative and responsibility, capacity for teamwork, scientific interest

Syllabus:

- Introduction into econometric methods (simple and multiple linear regression methods, stochastic processes); econometric problems of the least squares method; forecasting techniques (regression, time series approaches, smoothing methods); assessment of different techniques; aconometric software selected applied problems
- Decision analysis, model-based decision support with focus on mathematical models; modelling process; simulation versus mathematical models, optimisation models; measuring productivity and efficiency (Data Envelopment Analysis); waiting line models; network planning and graph theory models; inter-temporal optimisation; modelling languages (GAMS); stochastic optimisation

Expected Prerequisites: Basic knowledge in analysis, linear algebra, probability theory and statistics. Applying differential calculus, convexity, Taylor expansion, partial derivatives, matrix algebra, working with random variables (normal, Poisson, exponential distributed)

The contents of the bachelor modules *STW/MAT - Mathematik und Theoretische Informatik* and *STW/STA - Statistik und Wahrscheinlichkeitstheorie*.

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along lectures, illustration by means of examples of use, examples and case studies students work on, in classroom as well as at home.

Courses of Module:
3.0/2.0 VU Econometrics for Business Informatics
3.0/2.0 VU Model-based Decision Support

Fachübergreifende Qualifikationen

ECTS-Credits: 4.5

Summary: Die Lehrveranstaltungen dieses Moduls dienen dem Erwerb fachübergreifender Qualifikationen wie zum Beispiel: Verhandlungsführung, Präsentation- und Kommunikationstechnik, systematische Recherche und Planung, Konfliktmanagement, Teamfähigkeit und Führung, Organisation und Management, Betriebsgründung und Finanzierung, Verständnis rechtlicher Rahmenbedinungen, Verbesserung von Fremdsprachenkenntnissen.

Learning Outcomes: Durch dieses Modul sollen Studierende Qualifikationen erwerben, die über die für das Studium typischen fachlichen Kenntnisse und Fertigkeiten hinausgehen und im Berufsalltag eine wesentliche Rolle spielen, wie zum Beispiel: Verhandlungsführung, Präsentation- und Kommunikationstechnik, systematische Recherche und Planung, Konfliktmanagement, Teamfähigkeit und Führung, Organisation und Management, Betriebsgründung und Finanzierung, Verständnis rechtlicher Rahmenbedinungen, Verbesserung von Fremdsprachenkenntnissen.

Courses of Module: Die Lehrveranstaltungen dieses Moduls sind im Umfang von mindestens 9.0 Ects aus dem von der Technischen Universität Wien verlautbarten Katalog von Lehrveranstaltung zum Erwerb von fachübergreifenden Qualifikationen sowie aus den folgenden Lehrveranstaltungen zu wählen. Dabei wird empfohlen, Gender-spezifische Lehrveranstaltungen zu besuchen.

1.5/1.0 SE Kommunikationstechnik
3.0/2.0 SE Didaktik in der Informatik
3.0/2.0 VU Kooperatives Arbeiten
3.0/2.0 VO Theorie und Praxis der Gruppenarbeit
3.0/2.0 VU Forschungsmethoden
3.0/2.0 VU Softskills für TechnikerInnen
3.0/2.0 VU Italienisch für Ingenieure I
3.0/2.0 VU Technical English Communication
3.0/2.0 VU Technical English Presentation
3.0/2.0 VU Technisches Französisch, Hohes Niveau I
3.0/2.0 VU Technisches Russisch I
3.0/2.0 VU Technisches Spanisch I
3.0/2.0 VO Frauen in Naturwissenschaft und Technik
3.0/2.0 VO Zwischen Karriere und Barriere
3.0/2.0 VU Kommunikation und Moderation
3.0/2.0 SE Kommunikation und Rhetorik
1.5/1.0 VO Präsentation, Moderation und Mediation
3.0/2.0 UE Präsentation, Moderation und Mediation
3.0/2.0 VU Präsentations- und Verhandlungstechnik
3.0/2.0 VU Rhetorik, Körpersprache, Argumentationstraining
1.5/1.0 VO EDV-Vertragsrecht
3.0/2.0 SE Rechtsinformationsrecherche im Internet
3.0/2.0 VO Einführung in die Wissenschaftstheorie I
3.0/2.0 VO Einführung in Technik und Gesellschaft
3.0/2.0 SE Folgenabschätzung von Informationstechnologien
3.0/2.0 VU Techniksoziologie und Technikpsychologie
3.0/2.0 SE Gruppendynamik
3.0/2.0 SE Coaching als Führungsinstrument 1
3.0/2.0 SE Coaching als Führungsinstrument 2

Freie Wahl

ECTS-Credits: max. 4.5

Summary: Die Lehrveranstaltungen dieses Moduls dienen der Vertiefung des Faches sowie der Aneignung außerfachlicher Kenntnisse, Fähigkeiten und Kompetenzen.

Courses of Module: Die Lehrveranstaltungen dieses Moduls können frei aus dem Angebot an wissenschaftlichen/künstlerischen Lehrveranstaltungen aller anerkannten in- und ausländischen Universitäten gewählt werden, sofern sie der Vertiefung des Faches oder der Aneignung außerfachlicher Kenntnisse, Fähigkeiten und Kompetenzen dienen. Der Umfang der frei wählbaren Lehrveranstaltungen ergänzt den Umfang der übrigen im Studium absolvierten Lehrveranstaltungen auf 90 Ects (oder mehr), wobei ihr Anteil daran 4.5 Ects nicht übersteigen darf.

INT/ASE - Advanced Software Engineering

ECTS-Credits: 6.0

Summary: This module builds on the foundation of knowledge from the bachelor module to deepen selected software engineering approaches for the development and evolution of advanced software systems. The focus is on technical software engineering approaches, such as component-based software engineering and software process automation, for evolving advanced software systems in distributed engineering teams. The module consists of project work in a small group over the course of a semester, in which a medium-size software engineering project is conducted with the goal of a usable and useful prototype with associated systematic documentation and the use of selected advanced software technologies.

Learning Outcomes:

Knowledge: Aim of the module is acquire in-depth knowledge on designing and building advanced software systems.

- Architecture styles, such as component-based software engineering
- Lifecycle management and documentation
- Automated software engineering

Skills:

- System-oriented flexible way of thinking: choosing, developing, and appropriately applying concepts, models, and tools in the context of an (industrial) ASE project
- Profound strategies for uncommon problems in ASE, such as sustainable advanced software design
- Applying techniques for abstraction and modeling

Competences:

- Problem solving and development in a distributed team environment
- Self-Organization and personal responsibilities
- Managerial and leadership skills in ASE projects
- Collaborative knowledge ownership and management in a medium-sized team
- Proactivity and curiosity on innovative and creative concepts and solution approaches
- Exploration of personal abilities and limits
- Experience in principal-agent relationships, including convincing presentations

Syllabus:

- Software engineering approaches for advanced software systems: Architecture styles, such as component-based software engineering; lifecycle management and documentation; user interface engineering
- Component-based engineering of complex software systems
- Automation in developing advanced software systems: Source code management; continuous integration and testing; advanced build management; persistence techniques (e.g., object-relational mapping)
- Aspects of enterprize architectures
- Overview on selected research and industrial topics in ASE, including open source software engineering, software engineering for mobile devices, migration project case studies, ecosystems for software engineering tools and frameworks

Expected Prerequisites:

The contents of the bachelor modules *INT/PRO - Programmkonstruktion* and *INT/SEP - Software Engineering und Projektmanagement*.

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along a workshop, in which a medium-size software engineering project is conducted with the goal of a usable and useful prototype with associated systematic documentation and the use of selected advanced software technologies, weekly meetings with a tutor, periodic presentations by students on challenges, solution approaches, project status, and project results.

Courses of Module:
6.0/4.0 PR Advanced Software Engineering

INT/MEN - Model Engineering

ECTS-Credits: 6.0

Summary: This module places software models as the central artifact in software development. Thus, model engineering aims for model-driven software development closing the gap between modeling and programming. In this context, concepts and techniques of transformation engineering, language engineering, and model management are taught. The module includes lectures and labs. The content of the lecture is deepened in practical exercises, which are solved in small groups.

Learning Outcomes:

Knowledge:

- Broad and integrated knowledge and understanding of scientific foundations of model engineering
- Mastering problem domains, which are characterized by less structured information
- A critical understanding of major theories, principles, and concepts for model-driven software engineering
- Knowledge and understanding of the current state of literature in this area

Skills:

- Application of knowledge and understanding to solve practical tasks in the field of model engineering
- Gathering, structuring, evaluating, and interpreting relevant information for particular tasks

Competences:

- Deepening of the own knowledge
- Formulating development-related positions and problem solutions
- Exchanging know-how with computer scientists and domain experts
- Responsibility in a team
- Assessment of the own skills and boundaries
- Dealing with critique
- Self-organization and self-responsibility to independently solve problems

Syllabus:

- Introduction to model engineering: Principles and goals; basic architecture of Model Engineering (ME); notions and definitions; preliminaries and results; approaches; tool support
- Metamodeling: Meta languages; metamodeling languages; metamodeling tools; language architecture of UML; language extension mechanisms (UML Profiles); domain-specific modeling languages; model serialization and persistence (XMI)
- Object constraint language: Formal specification languages; OCL language constructs; OCL libraries and tool support; OCL as query language and as constraint language; design by contract with OCL
- Model transformation: Model transformation patterns; model transformation languages; graph transformations; transformation standard
- Code generation: Descriptive vs. constructive models; platform specific code generation; template languages; design patterns for code generation
- Defining concrete syntax: Textual modeling language; graphical modeling language
- Model evolution: Notions and definitions; metamodel evolution and model co-evolution; metamodel evolution and transformation co-evolution; parallel model evolution

Expected Prerequisites:

The contents of the bachelor modules *INT/PRO - Programmkonstruktion*, *INT/SEP - Software Engineering und Projektmanagement*, and *WIN/MOD - Modellierung*.

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along lectures, labs, and practical exercises in small groups.

Courses of Module:
6.0/4.0 VU Model Engineering

Innovation Implementation

ECTS-Credits: 6.0

Summary: This is the third module out of four. It focuses on the implementation of innovations. It comprises practical aspects such as legal, financial, and social issues, which are complementary to and often critical for the innovation process.

Learning Outcomes:

Knowledge:

- Funding aspects of innovation
- Legal and financial issues of company creation

Skills:

- Company foundation
- Enterprise expansion

Competences:

- Handling of conflicts and crises

Syllabus: Students will learn what to take care of when founding a new company or when expanding an existing enterprise. The module comprises the following issues:

- Company foundation: Legal issues and funding
- Enterprise expansion: Organizational and technical aspects
- Finance and venture capital
- Decision making, conflict, and crisis management

Expected Prerequisites:

Knowledge:

- Innovation theory and management
- Creativity techniques
- Business model and plan
- Understand the commonalities and differences of a variety of innovation cases

Skills:

- Formulate and present business ideas
- Conduct innovation of processes, products, and services in and outside existing enterprises
- Methods and techniques to translate ideas into solid business plans

Competences:

- Methods and techniques to foster creativity
- Interaction and cooperation with highly creative people and teams, accepting also critiques
- Understand the non-linearity of innovation from a variety of innovation cases

The prerequisites are conveyed in the modules *Innovation and Creativity*, *Innovation Planning*.

Obligatory Prerequisites: Innovation and Creativity, *Innovation Planning*.

Teaching and Learning Methods and Adequate Assessment of Performance: Blended learning: Lectures, self-study, labs, seminars, expert panels, and work in project groups.

Courses of Module:
2.0/1.5 VU Legal issues and funding
2.0/1.5 VU Finance and venture capital
2.0/1.5 VU Management of conflicts

Innovation Planning

ECTS-Credits: 6.0

Summary: This is the second module out of four. Students will learn to formulate business plans, as well as to discuss selected innovation cases.

Learning Outcomes:

Knowledge:

- Business model and plan.
- Understand the commonalities and differences of a variety of innovation cases.

Skills:

- Conduct innovation of processes, products, and services in and outside existing enterprises.
- Methods and techniques to translate ideas into solid business plans.

Competences:

- Interaction with highly creative people and teams.
- Understand the non-linearity of innovation from a variety of innovation cases.

Syllabus: Students will learn to plan the translation of their innovation—within a company or a start-up. This will also include cases of successfull and non successfull innovations. Issues treated are:

- Management of teams
- Product and service description (USP)
- Market and competition

- Marketing, price, and distribution
- Realisation plan, financial planning
- Chances and risks

Expected Prerequisites:

Knowledge:

- Innovation theory and management
- Creativity techniques

Skills:

- Formulation of business ideas

Competences:

- Methods and techniques to foster creativity
- Interaction and cooperation with highly creative people and teams, accepting also critiques

The prerequisites are conveyed in the module *Innovation and Creativity*.

Obligatory Prerequisites: Innovation and Creativity.

Teaching and Learning Methods and Adequate Assessment of Performance: Blended learning: Lectures, self-study, labs, seminars, expert panels, and work in project groups.

Courses of Module:
3.0/2.0 VU Business Plan
3.0/2.0 VU Innovation Cases

Innovation Practice

ECTS-Credits: 12.0

Summary: This is the fourth and last module. Within a project, students will work on a concrete innovation task.

Learning Outcomes:

Knowledge:

- Consolidate and strengthen the innovation knowledge in a real innovation case implementation.

Skills:

- Experience and reflect social and organizational aspects.
- Practice innovation transfer and university-company cooperation.

Competences:

- Complex interaction with multiple stakeholders within and outside the university.
- Practice management of conflicts and crises.

Syllabus: The innovation project provides flexibility and ways to specialize:

- Specialization at the students' option.
- Small groups or individual work possible.
- Internship possible.
- Company cooperation possible.
- International cooperation possible.

Expected Prerequisites:

Knowledge:

- Innovation theory and management.
- Creativity techniques.
- Business model and plan.
- Understand the commonalities and differences of a variety of innovation cases.
- Understand the legal, financial, and organizational aspects of innovation implementation.

Skills:

- Formulate and present business ideas.
- Conduct innovation of processes, products, and services in and outside existing enterprises.
- Methods and techniques to translate ideas into solid business plans.
- Company foundation and enterprise expansion.

Competences:

- Methods and techniques to foster creativity.
- Interaction and cooperation with highly creative people and teams, accepting also critiques.
- Understand the non-linearity of innovation from a variety of innovation cases.
- Handling of conflicts and crises.

The prerequisites are conveyed in the modules *Innovation and Creativity*, *Innovation Planning*, *Innovation Implementation*.

Obligatory Prerequisites: Innovation and Creativity, *Innovation Planning*, *Innovation Implementation*.

Teaching and Learning Methods and Adequate Assessment of Performance: Highly interactive and proactive group work with a final presentation.

Courses of Module:
12.0/4.0 PR Innovation project

Innovation and Creativity

ECTS-Credits: 6.0

Summary: This is the first module out of four, as such it represents the entry point to the innovation modules. Students should have interest in innovation, and prove their excellent progress in their bachelor and master studies. At the end of this module they should know the basic concepts of innovation as well as the respective creativity techniques. The module contains subjects such as innovation theory and management, and focuses on the importance of innovation for businesses and society. It will also introduce creativity techniques and ways to explicitely formulate business ideas.

Learning Outcomes:

Knowledge:

- Innovation theory and management.
- Creativity techniques.

Skills:

- Formulation of business ideas.

Competences:

- Methods and techniques to foster creativity.
- Interaction with highly creative people and teams.

Syllabus: This modules aims to enable the students to foster and formulate ideas:

- Innovation theory, innovation management, innovation and society (3 Ects).
- Creativity techniques, dynamism, formulate ideas of innovation projects as prerequisite for business plans (3 Ects).

Expected Prerequisites:

Knowledge:

- Knowledge in Computer Science and/or Business Informatics.

Skills:

- Ability to work in groups.

Competences:

- Strong committment.

Obligatory Prerequisites: A two-stage admission procedure is conducted during the first semester of the respective main master study in informatics or business informatics.

Teaching and Learning Methods and Adequate Assessment of Performance: Blended learning: Lectures, self-study, labs, seminars, expert panels, and work in project groups.

Courses of Module:
3.0/2.0 VU Foundations of innovation
3.0/2.0 PR Creativity and ideas

MTD/MAS - Master Thesis

ECTS-Credits: 30.0

Summary: Die Diplomarbeit ist eine wissenschaftliche Arbeit, die dem Nachweis der Befähigung dient, ein wissenschaftliches Thema selbstständig inhaltlich und methodisch vertretbar zu bearbeiten. Das Prüfungsfach Diplomarbeit, bestehend aus der wissenschaftlichen Arbeit und der kommissionellen Gesamtprüfung, wird mit 30.0 ECTS-Punkten bewertet, wobei der kommissionellen Gesamtprüfung 3.0 Ects zugemessen werden. Das Thema der Diplomarbeit ist von der oder dem Studierenden frei wählbar und muss im Einklang mit dem Qualifikationsprofil stehen.

MTD/SEM - Seminar for Master Students

ECTS-Credits: 3.0

Summary: This module supports research work of master students during their master thesis.

SBA/AEE - Advanced Economics - Evolutionary Economics

ECTS-Credits: 6.0

Summary: This module presents selected advanced topics in economic theory, which are particularly suited to be supported by simulation methods. Many of these topics can be summarized under the overarching concept of evolutionary economics. The respective lecture provides an introductory overview – both from a historical perspective as also from a technical perspective – of evolutionary economic theory. It builds on an already assumed knowledge of standard macroeconomics of the audience. The seminar complements this more general survey by providing a detailed study of a sample of particularly successful models of agent based modeling in the social sciences. In particular modeling techniques concerning heterogeneous model-building agents are discussed.

Learning Outcomes:

Knowledge:

- Knowledge about alternative economic approaches to understand the economy
- Knowldge about classic evolutionary (economic) theory (Malthus, Darwin, Veblen, Schumpeter, Winter, Wilson) as well as modern approaches using computational social simulation – especially agent based simulation

Skills:

- Knowledge about the limitations of economic models as well as alternative modelling methods
- Ability to understand, condense, summarize, and present economic scientific research papers, especially in the field of computational economics

Competences:

- Deepening the own knowledge
- Enhancement of personal initiative and responsibility
- Developing scientific interest
- Ability to present scientific results

Syllabus:

- Evolutionary economics: Introduction and overview of evolutionary economics; some classics on evolution (Malthus, Darwin, Veblen, Schumpeter, Winter, Wilson); Richard Day's Malthus Model; Schumpeterean models in endogenous growth theory; Schumpeterean approaches of the Goodwin School; alternative new non-linear models of evolutionary theory; the origin of life – models of self-organization in

bio-chemistry and mathematics; the role of pattern recognition and internal model building; heterogeneous agent based simulation and new game theory (Minority Games); recent discussions on the foundations of evolutionary economics; policy implications of evolutionary economics

- Computational economics: A yearly changing set of current research papers on computational economics with an emphasis on agent based simulation is presented and discussed. Seminar reports have to be written by participants.

Expected Prerequisites:

The contents of the modules *BAE/INE - Information Economics and Social Simulation* and *BIN/MOS - Modeling and Simulation* as well as the contents of the bachelor module *WIW/GOE - Grundlagen der Ökonomie*.

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along lectures, seminars with presentation of the results and discussions.

Courses of Module:
3.0/2.0 VO Evolutionarly Economics
3.0/2.0 SE Computational Economics

SBA/AEI - Advanced Economics - International Economics

ECTS-Credits: 6.0

Summary: This module builds on standard macroeconomic theory and extends it to cover questions of open economies. A concise introduction to the pure theory of international trade is offered via classical presentations, including a discussion of its applications and its critique. The complementing seminar has the goal to show how this theoretical knowledge is used in some macroeconomic simulation models actually applied for policy consulting. Students understand, condense, summarise and present scientific research papers. Each year a different economic policy focus (e.g., European labour markets, eurozone stability, etc.) is chosen for the seminar.

Learning Outcomes:

Knowledge:

- Knowledge about the basics of international trade theory and policy
- Knowledge about important standard economic models of trade, as well as the theory's implications on trade policy
- Knowledge about actual macroeconomic simulation models (with a focus on European economy)

Skills:

- Ability to grasp the complexity of international economic problems
- Ability to understand, condense, summarize, and present economic scientific research papers, especially in the field of computational economics

Competences:

- Ability to deepen the own knowledge
- Enhancement of personal initiative and responsibility
- Developing scientific interest
- Ability to present scientific results

Syllabus:

- International trade theory and policy: Introduction to the basic questions and problems of international trade theory; labor productivity and comparative advantage (the Ricardian Model); specific factors and income distribution; resources and trade (the Hechscher-Ohlin Model); the standard trade model; economies of scale, imperfect competition, and international trade; international factor movements; the instruments of trade policy; the political economy of trade policy; trade policy in developing countries; controversies in trade policy
- Macroeconomic simulation models: A yearly changing set of advanced economic papers focusing on an urgent policy problem, and using macroeconomic simulation, is presented and discussed. Seminar reports have to be written by participants.

Expected Prerequisites:

The contents of the bachelor module *WIW/GOE - Grundlagen der Ökonomie*.

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along lectures, seminars with presentation of the results and discussions.

Courses of Module:
3.0/2.0 VO International Trade Theory and Policy 1
3.0/2.0 SE Macroeconomic Simulation Models

SBA/AEP - Advanced Economics - Project

ECTS-Credits: 6.0

Summary: This project is designed to allow students to apply all the knowledge they acquired so far in achieving a comprehensive larger task. The project has to consist of a part showing the ability to understand advanced economic theory, and of a part showing the expertise to transform economic or political economy problems into useful simulation

models. Students work in small groups to conduct the simulation study. They have to give a (semi-public) presentation of the project and to document their work in a written project report.

Learning Outcomes:

Knowledge:

- Knowledge about how to apply economic theory, empirics, and computational simulation techniques to investigate economic and political economic problems

Skills:

- Ability to support or conduct economic studies, which analyze (socio-)economic systems and processes using theory, empirics, and simulation

Competences:

- Ability to deepen the own knowledge
- Enhancement of personal initiative and responsibility
- Developing scientific interest, have had first scientific project experience and scientific team work experience
- Ability to present results of the project

Syllabus: The project task usually should be to model a macroeconomic dynamics of significant relevance for the European economy (e.g., European energy markets, global financial architecture, etc.). The project has to consist of a part showing the ability to understand advanced economic theory, and of a part showing the expertise to transform problems of political economy into useful simulation models.

Expected Prerequisites:

The contents of the modules *BAE/INE - Information Economics and Social Simulation*, *BIN/MOS - Modeling and Simulation* and *FMF/QOM - Quantative Operations Management*as well as the contents of the bachelor module *WIW/GOE - Grundlagen der Ökonomie*.

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along projects carried out in small groups to conduct a simulation study based on economic theory, empirics, and simulation results, a (semi-public) presentation of the project, and a written project report.

Courses of Module:
6.0/4.0 PR Advanced Economics Project

SBA/FR1 - Advanced Financial and Risk Management 1

ECTS-Credits: 6.0

Summary: In this module, students are provided with fundamental knowledge and skills necessary in the financial and risk management of industrial organizations. The module consists of integrated courses that contain lecture, interactive, and assignment sections.

Learning Outcomes:

Knowledge:

- Basic concepts of the International Financial Reporting Standard that are necessary in the financial and risk management of capital market oriented industrial organizations
- Planning and control concepts that are performed in the financial and risk management at the enterprise level of decentrally organized enterprises

Skills:

- Thinking within models

Competences:

- Social competence to see financial and risk management as purely economical as well as mathematical problem
- Individually solving different problems
- Self organization capability and self responsive thinking
- Team working and leadership capabilities
- Enhanced curiosity and interest by solving practical problems and case studies as well as intellectual questions and problems

Syllabus:

- Financial management and reporting: Compliance requirements (IFRS, Capital Accord and COSO Integrated Framework); IFRS basics (asset/liability approach, recognition and measurement principles, true and fair view doctrin, management concept related to risk management); financial performance management overview; IFRS-based enterprise planning (plan balance sheet, plan income statement and plan cash flow statement); integration of control strategies; integration of hedge accounting pecularities

- Risk model management: Compliance requirements (IFRS, Capital Accord and COSO Integrated Framework); construction, calibration and validation management process; CCV-Management related to market and credit risks; CCV-Management related to operational and business risks; management information system (conceptualization and specification)

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along lectures, reading assignments in self organized acquisition of new knowledge, interactive sections through case studies, teamwork, and take-home exercises on an e-learning platform.

Courses of Module:
3.0/2.0 VU Financial Management and Reporting
3.0/2.0 VU Risk Model Management

SBA/FR2 - Advanced Financial and Risk Management 2

ECTS-Credits: 6.0

Summary: In this module students are provided with advanced knowledge and skills necessary in the financial and risk management of industrial organizations. The module consists of integrated courses that contain lecture, interactive, and assignment sections.

Learning Outcomes:

Knowledge:

- Advanced concepts in the financial and risk management domains of industrial organizations that is needed at the top management level

Skills:

- Thinking within models

Competences:

- Social competence to see financial and risk management as purely economical as well as mathematical problem
- Individually solving different problems
- Self organization capability and self responsive thinking
- Team working and leadership capabilities
- Enhanced curiosity and interest by solving practical problems and case studies as well as intellectual questions and problems

Syllabus:

- Advanced financial planning and control: Compliance requirements (IFRS, Capital Accord and COSO Integrated Framework); recognition, measurement, and management of pension obligation; integration of dynamic hedging strategies; advanced planning and control concepts; management information system: conceptualization and specification

- Risk-based performance management: Compliance requirements (IFRS, Capital Accord and COSO Integrated Framework); capital and risk allocation strategies within decentrally organized enterprises with different risk categories; organizational structures of the risk-based performance management; employability and sustainability of risk based performance measures; management information system: conceptualization and specification

Expected Prerequisites:

The contents of the module *SBA/FR1 - Advanced Financial and Risk Management 1*.

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along lectures, reading assignments in self organized acquisition of new knowledge, interactive sections through case studies, teamwork, and take-home exercises on an e-learning platform.

Courses of Module:
3.0/2.0 VU Advanced Financial Planning and Control
3.0/2.0 VU Risk-based Performance Management

SBA/ORG - Organization

ECTS-Credits: 6.0

Summary: What are organizations, how are they designed and how do they interact with their environment? These questions are simple but provoking. This module is aimed at giving students the possibility to discuss alternative answers to these question. It helps students to increase their abilities to understand complex organized behavior. It offers not only a series of different theoretical lenses useful for explaining organizations from multiple perspectives but also a set of tools to design and manage organizations. To a large extent the courses rely on experiential learning techniques including individual as well as team assignments, role plays and simulations in-class, group discussions, and presentations.

Learning Outcomes:

Knowledge:

- Advanced knowledge in organization theory and advanced knowhow in the management of people and organizations

Skills:

- Ability to evaluate and design organizations (its structures and processes) from different perspectives
- Ability to critically discuss and evaluate alternative or conflicting theories and concepts
- Advanced management skills

Competences:

- Teamwork and conflict management competences

Syllabus:

- Managing people and organizations: This course deals with problems concerning the selection and management of various dimensions and components of organizational structure and culture. An appropriate organizational design allows organizations to continually adapt to a changing global environment and to balance internal needs and external pressures to survive in the long run. A key element is therefore to understand how organizations can be designed and managed for a better performance. The aim is to demonstrate the interconnectedness between structure and performance. Accordingly, it is important to bring an awareness of the intended as well as unintended consequences of organizational design and leadership decisions. The concepts involved focus on organizational strategy, design, culture, and change, as well as leadership and performance. Using Case-Study Method (Harvard) and actual cases from practice, students learn how to resolve problems related to organizational design and change. Students work individually and in teams, prepare case studies, and present problem solutions during class.
- Organization theory: The course offers a series of different theoretical lenses useful for explaining organizations from multiple perspectives to help students to increase their ability to understand complex organized behavior. We approach the different perspectives on organizations through reading and discussing seminal contributions in the field of organization theory. By analyzing and comparing underlying assumptions and theoretical positions of texts of economic theories, modern organization theories, organization theories of the interpretive and social constructionist paradigm as well as postmodern perspectives we develop a deeper understanding of different schools of thought. Students read the texts prior to lectures, write papers to selected texts, and share their thoughts with colleagues in class discussions.

Expected Prerequisites: Basic knowledge in the management of socio-economic systems as well as tools and instrument necessary of human resource management.

Those topics are taught in the module *BAE/MGT - Management*.

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along lectures, reading assignments in self organized acquisition of new knowledge, interactive sections through case studies, teamwork, and take-home exercises.

Courses of Module:
3.0/2.0 VU Managing People and Organizations
3.0/2.0 VU Organization Theory

SBA/ORM - Operations Research Methods

ECTS-Credits: 6.0

Summary: This module covers important algorithmic techniques for problem solving and optimization from the domain of operations research. Included are in particular mixed integer programming methods and (meta-)heuristic algorithms as well as dedicated methods for the domain of transport optimization. A lecture covers the theoretical background, theoretical and practical exercises, including programming examples, deepen the knowledge.

Learning Outcomes:

Knowledge:

- Knowledge of exact and heuristic optimization algorithms
- Prominent problems from the domain of transport optimization

Skills:

- Modeling operations research problems
- Designing and implementing suitable optimization algorithms

Competences:

- Development of new algorithmic approaches

Syllabus: Prominent problems in transport logistics, such as vehicle routing problems, facility location, assignment problems; constructive heuristics; local search based methods; simulated annealing; Tabu search; variable neighborhood search; very large scale neighborhood search methods; population based heuristics; evolutionary algorithms; mixed integer programming; branch-and-cut; branch-and-price

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along lectures, theoretical and practical exercises including programming examples.

Courses of Module:
3.0/2.0 VU Optimization Techniques in Transport Logistics
3.0/2.0 VU Heuristic Optimization Techniques

SBA/STM - Strategic Management and Innovation

ECTS-Credits: 6.0

Summary: This module introduces strategic management and innovation theory. Students are enabled to perform strategic analysis as a basis for rational choice among and evaluation of alternative courses of action. Furthermore they gain understanding of the innovation process and success factors for the diffusion of innovations. The theoretical background and core concepts are provided in lectures and deepened in exercises, case studies, and reports.

Learning Outcomes:

Knowledge:

- Strategic analysis and strategic management
- Innovation management and innovation strategies

Skills:

- Ability to formulate and evaluate strategic alternatives and skills in the usage of strategy formulation tools and techniques
- Ability to benchmark technological innovations and to plan innovation processes within enterprises
- Ability to critically discuss and evaluate alternative or conflicting theories and concepts

Competences:

- Discussion and feedback competencies

Syllabus:

- Organizational decision making investigates the design of organizational structures and processes from a decision-theoretic-economic perspective. Decision theory regards organizations as systems of distributed decision making where interdependent decisions are allocated with many individuals. Based on individual decision making we analyse how problems of coordination and motivation arize from this division of labor among organization members. The necessary methodological basics for the analysis of organizational problems is provided in form of lectures and readings. Building on decision, team, game and principal-agent theory specific problems of hierarchical organizations (especially problems of asymmetric information between economic agents on different hierarchical levels) are discussed theoretically as well as in exercises and experiments.

- Strategic management provides the fundamentals of strategic management as well as current developments in research and practice. One focus is the strategic management process (strategic analysis, strategy formulation, implementation and control) as well as tools to facilitate this process. On the other hand the causes of sustainable competitive advantage of firms are examined incorporating and critically discussing competing theoretical approaches of explanation. Students deepen their understanding by exercises on strategic management tools and reports on seminal contributions to the field.

- Innovation theory deals with innovation processes on enterprize level, innovation strategies, diffusion of innovation, critical factors for successful innovations and innovation management. The aim of the course is to raise awareness of incentive systems in the field of innovation. Based on case studies and discussions of theoretical approaches, students learn how to measure performance and establish instruments of innovation management.

Expected Prerequisites: Basic knowledge in the management of socio-economic systems and mathematics. Skills in analytical and synthetical evaluation of complex socio-economical phenomena, the ability to critically discuss and evaluate alternative or conflicting theories and concepts, and basic management skills.

Those topics are taught in the module *BAE/MGT - Management*.

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along lectures, reading assignments, seminal contributions in form of short reports, exercises and analysis of case studies, experiments, group discussions.

Courses of Module:
3.0/2.0 VO Innovation Theory
3.0/2.0 VU Strategic Management

SBI/BTD - Beyond the Desktop

ECTS-Credits: 6.0

Summary: Graphical user interfaces (GUI) with their traditional input and output devices are nowadays the most used interaction environments. Besides their unavoidable existence they still lack on flexibility in user interaction, especially if it comes to certain groups of users like children, elderly, or humans with special needs. Tangible user interfaces and objects, mobile platforms, ubiquitous computing, embedded sensors and displays, large multitouch systems, or gestural interaction are some example technologies, which have already started to change and enhance the ways of communication and interaction between people in our society. This module deals with these alternative technologies with their multimodal interfaces as add-ons or replacement for conventional mouse and keyboard based graphical user interfaces. After having lecture-based input on alternative ways for interaction with computers, students will choose one technology

and design a prototype in a group, for a given setting with specified users before they present their results.

Learning Outcomes:

Knowledge:

- Knowledge about design and development of architectures, technologies, and systems as alternatives to graphical user interfaces
- Knowledge about use contexts and case studies of such alternatives

Skills: Design and prototyping of a system based on one of the following technologies:

- Tangible user interfaces and design of tangible objects
- Mobile platforms
- Ubiquitous computing
- Embedded sensors and displays
- Large multitouch systems
- Gestural interfaces

Competences:

- Innovation in design and prototyping of alternative interaction interfaces
- Team work

Syllabus:

- Alternatives to graphical user interfaces (GUI): architectures, technologies, systems, use contexts, case studies: Tangible user interfaces and design of tangible objects; mobile platforms; ubiquitous computing; embedded sensors and displays; large multitouch systems; gestural interfaces
- Design and prototyping of a system based on one of the technologies listed above

Expected Prerequisites: Knowhow and skills about design methodologies for design and prototyping as well as programming skills.

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along lectures, design and presentation of a prototype in a group.

Courses of Module:
6.0/4.0 VU Beyond the Desktop

SBI/EC1 - Services and Communities

ECTS-Credits: 6.0

Summary: This module deals with the issues of business services, service systems, service design and marketing as well as with services in online communities. It introduces new approaches in e-commerce to integrate customers into the process of developing new innovative services and products by applying social media. History and success criteria for social and other service systems are treated as well. The courses are organized along lectures, classroom tasks, assignments, and hand-on exercises. Sometimes tools are applied.

Learning Outcomes:

Knowledge:

- Methods and tools for service marketing and design
- Formal representation of services
- Automation of service composition

Skills:

- Analysis of complex service systems
- Modeling of service systems

Competences:

- Team work
- Creativity techniques
- System thinking

Syllabus:

- Service design, management, and composition: Service science; service design; service marketing; service-dominant logic; service modeling; service ontologies; service systems; virtual enterprizes; business rules and objectives; service legal agreements; service discovery and composition
- Social media: History and usage of social media; mechanisms for community building; implications of social media for personal and commercial use; information privacy; Web 2.0 technologies

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along lectures, classroom tasks, assignments, and hands-on exercises. Sometimes tools are applied.

Courses of Module:
3.0/2.0 VU Service Design, Management and Composition
3.0/2.0 VU Social Media

SBI/EC2 - Web: Analysis and Search

ECTS-Credits: 6.0

Summary: This module deals with the World Wide Web in terms of analysis of usage and structure of the search for Web-based information. The formal basis and methods of network theory are provided. This knowledge is then applied with the help of special tools and social network analysis software. Principles of information description and search technologies are described in the context of the World Wide Web. Current trends in personalisation and recommendation are illustrated. The module provides the participants with an understanding of network analysis, machine learning for Web data analysis, understanding of functionality and improvement of Web search techniques, and a discussion of current research topics in Web Science and Web Search. The didactic concept of this module comprises lectures, group discussions, project work, and project presentations.

Learning Outcomes:

Knowledge:

- Understanding of the theoretical concepts of network analysis
- Understanding the complexity of the WWW
- Application of machine learning approaches to Web data analysis
- Approaches to improve search results
- Identification and discussion of open research topics

Skills:

- Usage of network analysis tools
- Solving of practical data analysis problems
- Identifying pitfalls in information presentation
- Interdisciplinary thinking

Competences:

- Problem solving in group situations
- Self-organization and time management
- Reflection, assessment, analysis and presentation of alternatives
- Presentation and discussion of practical data analysis problems

Syllabus:

- Web science: Graph theory; centrality measures; network models; power laws and scale-free graphs; social network analysis; information networks and the World Wide Web
- Information search on the Internet: Information retrieval basics; history and anatomy of Web search engines; search engine evaluation; search engine optimization; recommender systems; special purpose search engines

Expected Prerequisites: Algebra and analysis, statistical data analysis

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along lectures, group discussions, project work, and project presentations.

Courses of Module:
3.0/2.0 VU Web Science
3.0/2.0 VU Information Search on the Internet

SBI/EC3 - Business Informatics: Current State and Future Trends

ECTS-Credits: 6.0

Summary: This module deals with business informatics, its current-state-of-the-art, and future developments. It comprises technological as well methodological approaches. In one part, various international experts report about current 'hot topics' in the area of business informatics, thus giving the students a broad idea about the area's emerging fields. In the other part, the students will explore possible solutions for concrete tasks from the field of business informatics based on scientific methods and present their solutions to fellow students.

Learning Outcomes:

Knowledge:

- Overview as well as in-depth knowledge in business informatics areas
- Research and writing a scientific report

Skills:

- Interaction with international experts as well as capability to grasp essential ideas in business informatics (using literature, in-depth discussions, and group work)

Competences:

- Interaction with highly creative people

- Enhancing presentation skills

Syllabus: In one part of the module, international academics present their views on the current state of the art and future trends in the field. Using concrete tasks from the field of business informatics students will explore possible solutions (experimental, implementational or in-depth review and analysis of literature) based on scientific methods in the second part of the module.

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along lectures, interactive group work, including literature studies and presentations.

Courses of Module:
2.0/2.0 VO Lecture Series Trends in Business Informatics
4.0/3.0 PR Business Informatics: Technologies and Applications

SBI/KM1 - Knowledge Management

ECTS-Credits: 6.0

Summary: This module deals with the management of implicit and explicit knowledge in enterprizes and other organizations. It considers organizational, cultural, strategic, and operational issues of knowledge management. The module covers strategic as well as operational knowledge management methods and tools. Students learn how to analyze, design, operate, and control the required knowledge in an organization.

Learning Outcomes:

Knowledge:

- Strategic decision making
- Knowledge-based organizations
- Organizational learning
- Competence management
- Knowledge representation
- Machine learning

Skills:

- Strategic analysis
- Knowledge sharing
- Knowledge modeling

Competences:

- Group work
- Knowledge sharing
- Innovation of knowledge processes

Syllabus: Objectives and problems of knowledge management in enterprizes and other organizations; process model for knowledge management; competence management; methods and systems for knowledge management; knowledge acquisition and engineering; knowledge representation; social software systems; machine learning

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along lectures, assignments, and hands-on exercises (alone or in groups). When appropriate, tools are provided.

Courses of Module:
3.0/2.0 VO Knowledge Management
3.0/2.0 UE Knowledge Managment

SBI/KM2 - Information Extraction and Integration

ECTS-Credits: 6.0

Summary: This module deals with data extraction from the Web and integration of Web data into applications and processes. It comprises an overview about information extraction in general and covers in particular methods of Web querying and wrapper generation, as well as presenting wrapper languages, deep Web navigation traversal methods, and inductive, automated, and supervised approaches. Data extraction based on visual rendition, questions about robustness and adaptation, and further algorithmical and technical aspects are covered. Furthermore, a special focus of this module is how Web extraction and integration topics are addressed by state-of-the-art libraries, tools, and frameworks and used in real-life scenarios. Special emphasis is given to Web data cleansing, integration of Web data into competitive intelligence scenarios, mashups, web application testing, web process integration, and using extraction and document understanding technologies for enabling web accessibility. The course comprises both a lecture and an exercise part. The lecture part is primarily intended to teach about methodologies as well as to illustrate concepts from practice including system live demonstrations. The goal of the exercises is to strengthen the knowledge of the participants, especially including practical usage of tools in the area of web data extraction.

Learning Outcomes:

Knowledge:

- Knowledge about efficiently extracting factual data from the Web as biggest database

- Overview of today's approaches and languages to query and extract data, and methods how to generate and maintain Web wrappers based on, e.g., machine learning techniques and heuristics

Skills:

- Understand and tackle important problems and questions of data extraction
- Overview about state-of-the-art tools in the area of data extraction
- Understanding about real-life scenarios in various vertical domains and the components needed therefore

Competences:

- Creating problem solutions and being creative how to re-use and re-package factual Web data
- Group talks

Syllabus: Information extraction: setting, history, IE vs. IR; structured data extraction and Web wrapping methodologies; XML transformation and query languages and document object model; Web wrapper languages such as the Elog Extraction Language; inductive wrapper generation (using machine learning); automatic data extraction and Web data mining approaches; robust data extraction from tree structures; deep Web navigation approaches and extraction from dynamic sites; supervised wrapper generation; academic, open-source, and commercial wrapper generation tools; scenario generation with extraction and integration frameworks in vertical domains; data extraction from PDF documents; data extraction from freetexts, Web data cleansing and record linkage; creation of a Web document ontology; data integration, mediation, and mapping; application domains of Web data extraction; functional Web 2.0 application testing; Web process automation and SOA; Web ETL connectors (Web data for business intelligence); Web accessibility using automated extraction and understanding

Expected Prerequisites: XML-Technologies

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along lectures, exercises by using several tools (like XML querying tools, wrapper generation frameworks (e.g., students will get a chance to work with Lixto, but can choose to work with other tools instead as well), record linkage tools, and web application testing tools), and student group talks,

Courses of Module:
3.0/2.0 VU Web Data Extraction and Integration
3.0/2.0 VU Applied Web Data Extraction and Integration

SBI/LAW - Advanced Aspects of IT-Law

ECTS-Credits: 6.0

Summary: This module deals with advanced legal aspects in applied computer sciences and IT related project and contract issues. Students adopt a deeper and applied understanding of specific law sectors relevant for IT professionals in actual project scenarios. Students identify the specific relevance of certain legal issues in applied IT scenarios. Moreover students gain insight into everyday situations and are aware of the rights and duties of the parties involved, so that they may avoid legal drawbacks from the perspective of an IT professional. The majority of the lessons are held as presentations and discussions involving students. Moreover small practical exercises are elaborated by each student or in groups.

Learning Outcomes:

Knowledge:

- Appropriate understanding of the relevance and methodology of the law
- Ability to implement technical solutions according to legal requirements

Skills:

- Ability to look up and interpret legal regulations
- General understanding of specific topics related to computer science from the view of the Austrian legal system

Competences:

- Acquisition of a sense for legal issues in different sectors
- Generation of a general awareness for legal pitfalls
- Acquisition of basic legal knowledge for personal everyday concerns

Syllabus: Aspects of law, methodology, repetition of legal basics; Aspects of EU and public international law; basic contract formation via internet (ABGB); e-commerce law (ECG); the critical role of legal and contractual issues in (large) IT projects; e-government law (E-GovG, ZustG); data privacy law (DSG); example: legal aspects in the medical sector (AerzteG, KAKuG, GTelG); methodology of European new approach directives (medical devices); aspects of intellectual property (IP) and copyright law; trademark law, software copyright law; introduction to patent law; open source licenses (GPL, LGPL, EuPL); IP-related contracting (licensing agreements, NDA, MoU, teaming agreement); designing IT- project contracts; computer crime legislation; digital forensics, digital preservation of evidence; security engineering and related legal issues

Expected Prerequisites: Basic knowledge of legal systematics and methods

The contents of the bachelor module *WIN/RSI - Recht und Sicherheit*.

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along lectures, exercises, research of solutions to legal issues by each student, drafting a license contract in small groups.

Courses of Module:
6.0/4.0 VU Advanced Aspects of IT-Law

SBI/MO2 - e-Business Modeling

ECTS-Credits: 6.0

Summary: This module focuses on model-driven development of solutions for e-business partnerships. Thereby, the module investigates on methodologies and techniques on the different levels of an e-business partnership and the integration of these levels: (1) the value perspective manifested by a business model, (2) the process flow perspective manifested by choreographies among the parties, and (3) the execution perspective manifested by the deployment artifacts. A lecture series is accompanied by practical courses where the students have to demonstrate their skills by presenting solutions for given examples and develop a model-driven solution for a practical problem spanning all the different layers of inter-organizational systems for e-business.

Learning Outcomes:

Knowledge:

- Overview of the different aspects of building an inter-organizational system for an e-business partnership
- Understanding of current state of the art in major theories, principles, and concepts for describing an inter-organizational e-business system
- Qualification to adopt and extend existing modeling languages to domain specific needs

Skills:

- Developing domain specific languages for e-business
- Ability to apply the business knowledge and understanding to describe inter-organizational systems

Competences:

- Formulating e-business related positions and problem solutions interfacing the scopes of domain experts and computer scientists
- Self-assessment the own skills and boundaries

- Ability to critique the own work

Syllabus: Introduction into inter-organizational systems for e-business; languages for business models; languages for inter-organizational business processes (i.e., choreographies); languages for business document models; transformation approaches between choreographies and intra-organizational processes; transformation to deployment artifacts (SOA and/or workflow systems)

Expected Prerequisites:

The contents of the module *INT/MEN - Model Engineering*.

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along lectures and practical courses for developing a model-driven solution for a practical problem spanning all the different layers of inter-organizational systems for e-business in small groups.

Courses of Module:
6.0/4.0 VU e-Business Modeling

SIT/DPR - Digital Preservation

ECTS-Credits: 6.0

Summary: The module aims to develop in participants an appreciation of the issues surrounding digital preservation within the context of infromation systems, business processes, scientific data management, security, and software development. Participants should leave with a coherent and practical understanding of activities surrounding digital preservation and, in particular, a developed understanding of selection and appraisal, workflow modeling, metadata definition, ingest process management, and a working knowledge of the issues surrounding audit and certification of digital repositories. The module raises awareness of sustainability issues and builds sustainability into the process of software development. Moreover, security issues are elaborated in terms of data and software security with respect to long term preservation. The participants of this module are encouraged to put their theoretical knowledge into practice implementing solutions for selected preservation issues.

Learning Outcomes:

Knowledge:

- Understanding the complexity of digital preservation
- Approaches in digital preservation
- Knowledge about interoperability and maintainability
- Knowledge about system architectures and process design
- Knowledge about auditing, governance, and compliance

- Knowledge about authenticity and provenance
- Understanding the impact of preservation issues (e.g., regarding security and software design)
- Overview on open research topics in digital preservation

Skills:

- Practical solving of selected preservation problems
- Interdisciplinary problem solving

Competences:

- Long-term thinking
- Self-organization
- Find and shape creative solutions

Syllabus: Data models; standards; preservation strategies: encapsulation, emulation, migration; sustainable software and software systems; system architectures; audit and certification, trust; Web archiving; current research issues

Expected Prerequisites: Basic programming skills

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along lectures and lab exercises on selected topics in project work.

Courses of Module:
3.0/2.0 VO Digital Preservation
3.0/2.0 UE Digital Preservation

SIT/DS1 - Internet Computing

ECTS-Credits: 6.0

Summary: This module provides technical knowledge of software architecture for and implementation of state-of-the-art distributed enterprize systems, specifically internet-based ones. The module consists of two separated parts. Software Architecture focuses on design-time choices for building distributed and internet-based systems. It covers architectural patterns, approaches to modeling and documenting software architecture, and novel approaches in the field such as model-driven architectures. Advanced Internet Computing is more geared towards systems based on the notion of service-oriented architecture, and provides technical knowledge for implementing advanced internet-based systems. Both parts are held as VUs, with written exams covering the lecture parts and practical assignments for the lab parts. Assignments are done in small groups.

Learning Outcomes:

Knowledge:

- Overview of software architectures for distributed systems
- Trade-offs of different architectural styles
- Architectural patterns
- Novel approaches towards software architecture, such as model-driven architecture
- Design and implementation of advanced service-based systems
- Specifications for internet-based systems
- Practical tool knowledge for modeling software architecture and implementing service-based systems

Skills:

- Structured realization of complex software systems
- Decision making between competitive architectures and designs
- Best practices and software architectures
- Engineering of service-based systems
- Learning to decide between different styles of Web services, e.g., SOAP-based and RESTful Web services
- State of the art overview of research topics in software architecture and service-based systems

Competences:

- Self-organization and time-management
- Team-organization, team-communication, conflict resolution
- Taking the responsibility for technical decisions
- Process awareness and structured solution approaches
- Critical reflection, assessment, analysis, and reasoning of alternatives

Syllabus:

- Software architecture: Architectural design, architectural styles, architectural views; architectural patterns; design and documentation of large software systems; layering of n-tier systems; model-driven development with the Unified Modeling Language in distributed systems;

- Internet computing: Service oriented computing and service-oriented architectures; enterprize application integration and middleware; Web services: composition, workflows, transactions; RESTful Web services and mashups; metadata and discovery; hot research topics in internet computing

Expected Prerequisites: Programming skills; knowledge in Web service technology

INT/PRO - Programmkonstruktion, *INT/SEN - Systems Engineering*, *WIN/EWA - Entwicklung von Web-Anwendungen*, *SIT/DS2 - Technologies for Distributed Systems*

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along reading lecture materials before each lecture, lectures, and lab assignments supported by teaching assistants.

Courses of Module:
3.0/2.0 VU Advanced Internet Computing
3.0/2.0 VU Software Architecture

SIT/DS2 - Technologies for Distributed Systems

ECTS-Credits: 6.0

Summary: This module provides detailed knowledge of various middleware technologies for implementing state-of-the-art distributed systems. The module covers middleware for the data tier (e.g., object-relational mapping technology), the business logics tier (e.g., distributed objects, Web services and messaging technology), and the presentation tier. The module is centered on practical and implementation-level issues. The module consists of a single VL. The lecture part of the module covers more general and background information, and is graded using a written exam. The lab part of the module consists of assignments, which are done alone (no group work). Grading for the lab part is based on the assignments and the student's contributions in periodic review lessons. Review lessons are held for groups of 24 students.

Learning Outcomes:

Knowledge:

- Understand the benefits and limits of different distributed systems technologies and practice their implementation
- Technical knowledge about middleware for distributed systems development
- Design and implementation of basic Web services

Skills:

- Structured realization of complex software systems
- Handling of technologies, software-tools, and standards

- Engineering of distributed systems
- Abstraction of different implementation technologies
- Comparing and evaluating different implementation technologies, selecting the right tool for the right job

Competences:

- Self-organization and time-management
- Team-organization, team-communication, conflict resolution
- Taking the responsibility for technical decisions
- Process awareness and structured solution approaches
- Critical reflection, assessment, analysis, and reasoning of alternatives

Syllabus: Object-relational mapping; distributed object middleware, such as Enterprize Java Beans; middleware services: transactions and security; message-oriented middleware; Web services; middleware configuration and metadata; presentation tier technologies

Expected Prerequisites: Programming skills in Java and distributed systems; ability to build extensible software solutions, and understanding of what goes on 'in the background' when programming middleware is used.

INT/PRO - Programmkonstruktion, *INT/SEN - Systems Engineering*

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along reading lecture materials before each lecture, lectures, and lab assignments.

Courses of Module:
6.0/4.0 VU Distributed Systems Technologies

SIT/DS3 - Networking

ECTS-Credits: 6.0

Summary: This module covers important topics of advanced networking, such as design, implementation, maintenance and management. Furthermore, issues of mobile and pervasive computing are covered and set in relation to the knowledge acquired in networking. This module aims at providing a lower-level view on the topics covered in the modules SPT/DS1 and SPT/DS2, but is fundamentally independent. The module consists of three parts. Advanced networking is covered in a lecture and a separate practical lab. The lecture is held in an interactive way, student contributions are expected and required. The lecture is graded using an oral exam. The lab is held as group work and

graded in groups. Students are suggested to take the lecture and lab exercise in parallel. Pervasive and mobile computing is taught in an independent VL.

Learning Outcomes:

Knowledge:

- Knowledge about important specifications and standards for networking
- Knowledge about networking and pervasive systems
- Knowledge about pervasive, global and mobile systems

Skills:

- Engineering and managing complex networks
- Knowing the benefits and limitations of pervasive technology
- Design, realization, management, and operation of networks and distributed systems

Competences:

- Self-organization and time-management
- Team-organization, team-communication, conflict resolution
- Taking the responsibility for technical decisions
- Process awareness and structured solution approaches
- Critical reflection, assessment, analysis, and reasoning of alternatives
- Assessing the real-world applicability of solutions

Syllabus: Switching and routing: techniques and configuration; management and monitoring protocols; network management operations and service provision; network management policies; network management corporate and business aspects; principles of measurement; Radio Frequency Identifier (RFID); sensors and actors: hard and software; field bus systems; Industry Scientific and Medicine (ISM) radio band

Expected Prerequisites: Basic knowledge about networking (e.g., Ethernet, IP, MAC) and physical wiring.

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along lectures and lab assignments.

Courses of Module:
2.0/2.0 VO Mobile and Pervasive Computing
2.0/2.0 VO Network Engineering
2.0/1.0 LU Network Engineering

SIT/MO1 - Advanced Model Engineering

ECTS-Credits: 6.0

Summary: This module tackles the problem of model evolution in general, and model versioning in particular. Students who have successfully passed this module have a profound understanding of all aspects of model versioning, and may be able to apply technology at hand to model versioning tasks.

Learning Outcomes:

Knowledge:

- Broad and integrated knowledge and understandings of scientific foundations of model versioning
- Critical understanding of major theories, principles, and concepts for applying model versioning in model-driven software engineering
- Knowledge and understanding of the current state of literature in this area

Skills:

- Application of the own knowledge and understanding to solve practical tasks in the field of model versioning
- Gathering, structuring, evaluating, and interpreting relevant information for the particular tasks

Competences:

- Deepening the own knowledge
- Formulating development-related positions and problem solutions
- Exchanging know-how with computer scientists and domain experts
- Team responsibility
- Assessment of the own skills and boundaries
- Ability to criticize the own work
- Self-organization and self-responsibility to independently solve problems

Syllabus: The module tackles the problem of model versioning dealing with the following topics: Process of model versioning; conflict categorization; model comparison and model merge; precise conflict detection; conflict resolution; state of the art review; requirements and challenges

Expected Prerequisites:

The contents of the module *INT/MEN - Model Engineering*.

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along lectures, practical labs in groups of two, seminars, a workshop fór presenation of the results.

Courses of Module:
3.0/2.0 VU Advanced Model Engineering
3.0/2.0 SE Advanced Model Engineering

SIT/SC1 - Secure Software Development and Organizational Aspects

ECTS-Credits: 6.0

Summary: This module deals with advanced concepts of information security. Students will learn about managing software development projects so that secure software can be developed (secure software development life cycle) and organizational aspects of security, including information security audits, business continuity management, and data leakage prevention. Theoretical background will be presented in lectures and through e-learning. Students will work in groups on small projects and case studies. After completing this module students will have a stronger knowledge to assess, design, and build secure (software) systems.

Learning Outcomes:

Knowledge:

- Knowledge about information security
- Knowledge about information security audits
- Knowledge about typical security problems and how they are best addressed

Skills:

- A flexible way of thinking from the "bad guy's perspective"
- Experience on how to attack and how to secure systems
- Applying knowledge about applying cryptographic techniques correctly

Competences:

- Managing a team of software developers that develop secure software
- Managerial and leadership skills to promote information security in business and research environments (security evangelist)

- Presentation of scientific and professional challenges, solution approaches, and their evaluation

Syllabus: Security policies; Cobit, ISO 2700x; CERT operations; physical security; risk management and analysis; cost and benefit analysis; security models; system security; vulnerabilities; identification, authentication, authorization, auditing; memory corruption, buffer Overflows (stack, heap); return based programming; shellcode; Windows security; security principles (Windows 95 to Windows 7); secure development life cycle, security touchpoints; race conditions, TOC-TOE; computational complexity attacks; reverse engineering and prevention; malicious code analysis; code obfuscation

Expected Prerequisites: Basic knowledge in the area of security

WIN/RSI - Recht und Sicherheit

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along lectures, recording and podcasts of interesting talks (e.g., tech talks, CERIAS seminars), practical assignments by support of teaching assistants and an e-learning system, small projects, case studies.

Courses of Module:
3.0/2.0 VU Software Security
3.0/2.0 VU Organizational Aspects of IT-Security

SIT/SC3 - Secure Systems Engineering

ECTS-Credits: 6.0

Summary: IT security engineering has become a critical element of the overall performance of IT systems and IT projects. Enhancing effective functional engineering by thorough security models, processes, and techniques is a major design and architecture issue in several application fields. In the lectures of this module students will learn advanced aspects of how to engineer secure systems and how to maintain security standards in large and complex IT infrastructures. Topics of this module include advanced aspects of planning, designing and implementing security mechanisms (e.g., Public Key Infrastructures, web application security, ...), best practice examples of implementing security in large IT infrastructures, and security testing in IT systems (test process, penetration testing, ...). Students gain knowledge in IT security through fundamentals and theory of advanced security aspects. Mechanisms are applied in practical lab work. Furthermore, students are involved in security experiments, current research issues and security competitions. Experiments in attacking and defending systems will be a didactic method.

Learning Outcomes:

Knowledge:

- Conducting requirement studies, situation analysis, and risk identification for large IT infrastructures

- Practical skills to identify security gaps and conducting security assessments including technical vulnerability scans in large IT infrastructures
- Designing and implementing enterprize security architectures (e.g. RBAC, AAA, logging, security domains, information security policy, monitoring and incident response)

Skills:

- Identifiying security pitfalls in enterprize architectures
- Economics of security and right sizing security architectures (security- vs. business risks)
- Compromising information security and data integrity ("hacking", social engineering)

Competences:

- Methods for interdisciplinary threat- and risk identification
- Effective incident response in complex technological and organizational contexts
- Enforcing best practice security engineering behavior in early phases of IT-projects (security engineering as part of systems engineering)

Syllabus: Based on the concepts and security mechanisms this module broadens and deepens the knowledge of IT security by teaching theoretical aspects and best practice solutions as well as giving practical exercises.

Advanced aspects of the planning and implementation of security mechanisms: Requirement studies, situation analysis and risk identification, security architecture principles, advanced aspects for implementing, software security, Web application security, mobile security, network security, public key infrastructures, service level agreements, quality of service; attacking IT systems, e.g., injection attacks, buffer overflows, different kinds of denial of service attacks, effects of the combination of attacks for IT systems; best practice examples of implementing security in large IT infrastructures; security testing in large IT infrastructures, e.g., test process, penetration testing.

Expected Prerequisites:

WIN/RSI - Recht und Sicherheit

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along lectures, exercises in group work, e-learning.

Courses of Module:
3.0/2.0 VU Advanced Security for Systems Engineering
3.0/2.0 VU IT security in Large IT infrastructures

SIT/SE1 - Requirements Engineering and Empirical Evaluation

ECTS-Credits: 6.0

Summary: The module covers advanced requirements engineering approaches, which provide the foundation for traceability of requirements along the software life cycle, and empirical evaluation approaches, which provide a framework for the evaluation of software engineering artifacts and processes. As a background students require a solid basic knowledge in formal modeling and software engineering. The module consists of a lecture and workshop on requirements engineering as well as a lecture and workshop on empirical evaluation approaches. After completing this module students will have a stronger knowledge to specify and validate software engineering artifacts and processes in scientific and/or industrial contexts.

Learning Outcomes:

Knowledge: Requirements engineering for complex software systems

- Role-specific elicitation, specification, and documentation of requirements
- Requirements negotiation
- Requirements management and tracebility
- Requirements methods and tools
- Links of requirements engineering to software engineering research topics, e.g., agile methods, product lines, and quality assurance

Methods of empirical software technology

- Understanding for empirical work in software engineering research
- Knowledge on empirical strategies and when to use them: controlled experiments, case studies, surveys
- Ability to systematically create and test hypotheses on systems and processes in software engineering

Skills:

- Application of requirements engineering methods and tools
- Applying formal techniques for abstraction and modeling (requirements specification and tracing, quality assurance of requirements models)
- Ability to create and test simple and advanced hypotheses on systems and processes in software engineering
- Planning of an empirical evaluation study

Competences:

- Self-organization and personal responsibilities
- Proactivity and curiosity on innovative and creative concepts and solution approaches

Syllabus: Requirements engineering for complex software systems: Overview on needs and approaches for requirment engineering; role-specific elicitation, specification, and documentation of requirements; requirements negotiation; requirements management and tracebility; requirements methods and tools; quality assurance of requirements models; application of requirements engineering methods and tools; links of requirements engineering to software engineering research topics, e.g., agile methods, product lines, and quality assurance

Methods of empirical software technology: motivation for empirical work in software engineering research; overview on empirical strategies and when to use them: controlled experiments, case studies, surveys; approaches to systematically create and test hypotheses on systems and processes in software engineering; create and test simple and advanced hypotheses on systems and processes in software engineering; planning of an empirical evaluation study.

Expected Prerequisites:

INT/SEP - Software Engineering und Projektmanagement

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along lectures, workshops, lecture presentations, tool demonstrations, student presentations, projects in small groups, final written/oral exam.

Courses of Module:
3.0/2.0 VU Requirements Analysis and Specification
3.0/2.0 VU Methods of Empirical Software Engineering

SIT/SE2 - Advanced Software Engineering and Project Management

ECTS-Credits: 6.0

Summary: This specialization module complements the practical group work in the mandatory modules with a lecture and a research seminar. The lecture provides the theoretical concepts and methods as foundation for practical examples and allows reflecting experience from practical excercises in this module. In the research seminar students select a topic, conduct a systematic literature review, and present the results. The module builds on the foundation of knowledge from the baccalaureate modulea to explore and deepen selected scientific and industrial topics for the development and evolution of advanced software systems. Defining characteristics of advanced software systems are their complexity, large size, or high level of dependability. A main focus is on technical software engineering approaches, such as component-based software engineering and

software process automation, for evolving advanced software systems in distributed engineering teams. In addition, advanced research topics in software engineering, such as open source software engineering processes and ecosystems for software engineering tools and frameworks, will be explored, including the benefits and limits of selected solution approaches.

Learning Outcomes:

Knowledge: Aim of the module is acquire in-depth knowledge on designing and building advanced software systems.

- Overview on characteristics of advanced software systems: System size and complexity, system dependability, quality of service, extended software lifecycle, mission and safety criticality
- Software engineering approaches for advanced software systems: Architecture styles, such as component-based software engineering, lifecycle management and documentation, automated software engineering
- Overview on research and industrial topics in software engineering, including the benefits and limits of selected solution approaches

Skills:

- System-oriented flexible way of thinking: choosing, developing, and appropriately applying concepts, models, and tools in the context of an (industrial) advanced software engineering project
- Profound strategies for uncommon problems in advanced software engineering, such as sustainable advanced software design
- Applying formal techniques for abstraction and modeling: Component-based and service-based advanced software engineering, quality assurance for advanced software engineering

Competences:

- Self-organization and personal responsibilities
- Proactivity and curiosity on innovative and creative concepts and solution approaches
- Exploration of personal abilities and limits
- Experience in principal-agent relationships, including convincing presentations

Syllabus:

- Overview on characteristics of advanced software systems: system size and complexity, system dependability, quality of service, extended software lifecycle, mission and safety criticality; software engineering approaches for advanced software systems: architecture styles, lifecycle management and documentation, user interface engineering; component-based engineering of complex software systems; automation in developing advanced software systems: source code management, continuous integration and testing, advanced build management, persistence techniques (e.g., object-relational mapping); aspects of enterprize architectures; overview on selected research and industrial topics in advanced software engineering, including open source software engineering, software engineering for mobile devices, migration project case studies, ecosystems for software engineering tools and frameworks

Expected Prerequisites: Practical knowledge of an object-oriented programming languange (e.g., Java).

INT/SEP - Software Engineering und Projektmanagement, *INT/PRO - Programmkonstruktion*, *INT/SEN - Systems Engineering*

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along lectures and a research seminar, in which students select a topic, conduct a systematic literature review, and present the results.

Courses of Module:
3.0/2.0 VO Advanced Software Engineering
3.0/2.0 SE Seminar Software Engineering

SIT/SE3 - Advanced Software Quality Management

ECTS-Credits: 6.0

Summary: This module covers the areas advanced software testing, which provides methods for efficiently testing large software systems, and software quality management, which provides concepts for managing the quality of software processes. As a background students require a solid basic knowledge in formal modeling, software engineering, and software quality assurance. The module consists of a lecture and workshop on software testing, which provides the theoretical concepts and application methods for efficiently testing large software systems, and a lecture and workshop on software quality management, which provides concepts for managing the quality of software processes. After completing this module students will have a stronger knowledge to test complex software systems and manage the quality of software processes and organizations in scientific and/or industrial contexts.

Learning Outcomes:

Knowledge:

- Advanced topics of software testing

- Test automation
- Testing methods for industrial test automation environments
- Overview on quality management processes in the software development process
- Understanding of key factors for successful management of a software development process
- Overview on methods for quality planning, control and improvement for products and processes

Skills:

- System-oriented flexible way of thinking: choosing and appropriately applying approaches for evaluating software systems and processes
- Ability to apply testing methods in an industrial test automation environment
- Applying formal techniques for abstraction and modeling: Test case definition, selection, and prioritization; quality assurance for software process models
- Analysis of case studies on quality management from real-world settings
- Analysis and mitigation of risks in software development processes and organizations

Competences:

- Self-organization and personal responsibilities
- Proactivity and curiosity on innovative and creative concepts and solution approaches
- Exploration of personal abilities and limits
- Experience in principal-agent relationships, including convincing presentations

Syllabus:

- Software testing: Overview on testing principles, methods and tools; test case definition, selection, and prioritization; test automation; testing methods for industrial test automation environments; research topics of software testing
- Advanced software quality management: Overview on quality management processes in the software development process; key factors for successful management of a software development process; methods for quality planning, control and improvement for products and processes; analysis of case studies on quality management from real-world settings; analysis and mitigation of risks in software development processes and organizations

Expected Prerequisites: Practical knowledge of an object-oriented programming languange (e.g., Java)

INT/SEP - Software Engineering und Projektmanagement, *INT/PRO - Programmkonstruktion*

Teaching and Learning Methods and Adequate Assessment of Performance: The module is organized along lectures and workshops.

Courses of Module:
3.0/2.0 VO Software Testing
3.0/2.0 SE Advanced Software Quality Management

B Lehrveranstaltungstypen

VO: Vorlesungen sind Lehrveranstaltungen, in denen die Inhalte und Methoden eines Faches unter besonderer Berücksichtigung seiner spezifischen Fragestellungen, Begriffsbildungen und Lösungsansätze vorgetragen werden. Bei Vorlesungen herrscht keine Anwesenheitspflicht.

UE: Übungen sind Lehrveranstaltungen, in denen die Studierenden das Verständnis des Stoffes der zugehörigen Vorlesung durch Anwendung auf konkrete Aufgaben und durch Diskussion vertiefen. Entsprechende Aufgaben sind durch die Studierenden einzeln oder in Gruppenarbeit unter fachlicher Anleitung und Betreuung durch die Lehrenden (Universitätslehrerinnen und -lehrer sowie Tutorinnen und Tutoren) zu lösen. Übungen können auch mit Computerunterstützung durchgeführt werden.

LU: Laborübungen sind Lehrveranstaltungen, in denen Studierende in Gruppen unter Anleitung von Betreuerinnen und Betreuern experimentelle Aufgaben lösen, um den Umgang mit Geräten und Materialien sowie die experimentelle Methodik des Faches zu lernen. Die experimentellen Einrichtungen und Arbeitsplätze werden zur Verfügung gestellt.

PR: Projekte sind Lehrveranstaltungen, in denen das Verständnis von Teilgebieten eines Faches durch die Lösung von konkreten experimentellen, numerischen, theoretischen oder künstlerischen Aufgaben vertieft und ergänzt wird. Projekte orientieren sich an den praktischberuflichen oder wissenschaftlichen Zielen des Studiums und ergänzen die Berufsvorbildung bzw. wissenschaftliche Ausbildung.

VU: Vorlesungen mit integrierter Übung vereinen die Charakteristika der Lehrveranstaltungstypen VO und UE in einer einzigen Lehrveranstaltung.

SE: Seminare sind Lehrveranstaltungen, bei denen sich Studierende mit einem gestellten Thema oder Projekt auseinander setzen und dieses mit wissenschaftlichen Methoden bearbeiten, wobei eine Reflexion über die Problemlösung sowie ein wissenschaftlicher Diskurs gefordert werden.

EX: Exkursionen sind Lehrveranstaltungen, die außerhalb des Studienortes stattfinden. Sie dienen der Vertiefung von Lehrinhalten im jeweiligen lokalen Kontext.

C Semestereinteilung der Lehrveranstaltungen

1. Semester (WS)

6.0/4.0 PR Advanced Software Engineering
6.0/4.0 VU Model Engineering
6.0/4.0 VU Modeling and Simulation
3.0/2.0 VU E-Commerce
3.0/2.0 VU IT-based Management
3.0/2.0 VO Human Resource Management and Leadership
3.0/2.0 VU International Negotiations

2. Semester (SS)

6.0/4.0 VU KBS for Business Informatics
3.0/2.0 VU Workflow Modeling and Process Management
3.0/2.0 VU Innovation
3.0/2.0 VU Econometrics for Business Informatics
3.0/2.0 VU Model-based Decision Support
3.0/2.0 VO Information Economics
3.0/2.0 VU Computational Social Simulation

A specialization module of 6 Ects

3. Semester (WS)

6.0/4.0 VU Business Intelligence
30.0/15.0 PR Master Thesis

Lectures of 3 Ects in the module *TSK/FEL Free Electives*

Lectures of 3 Ects in the module *TSK/SOS Social Skills*

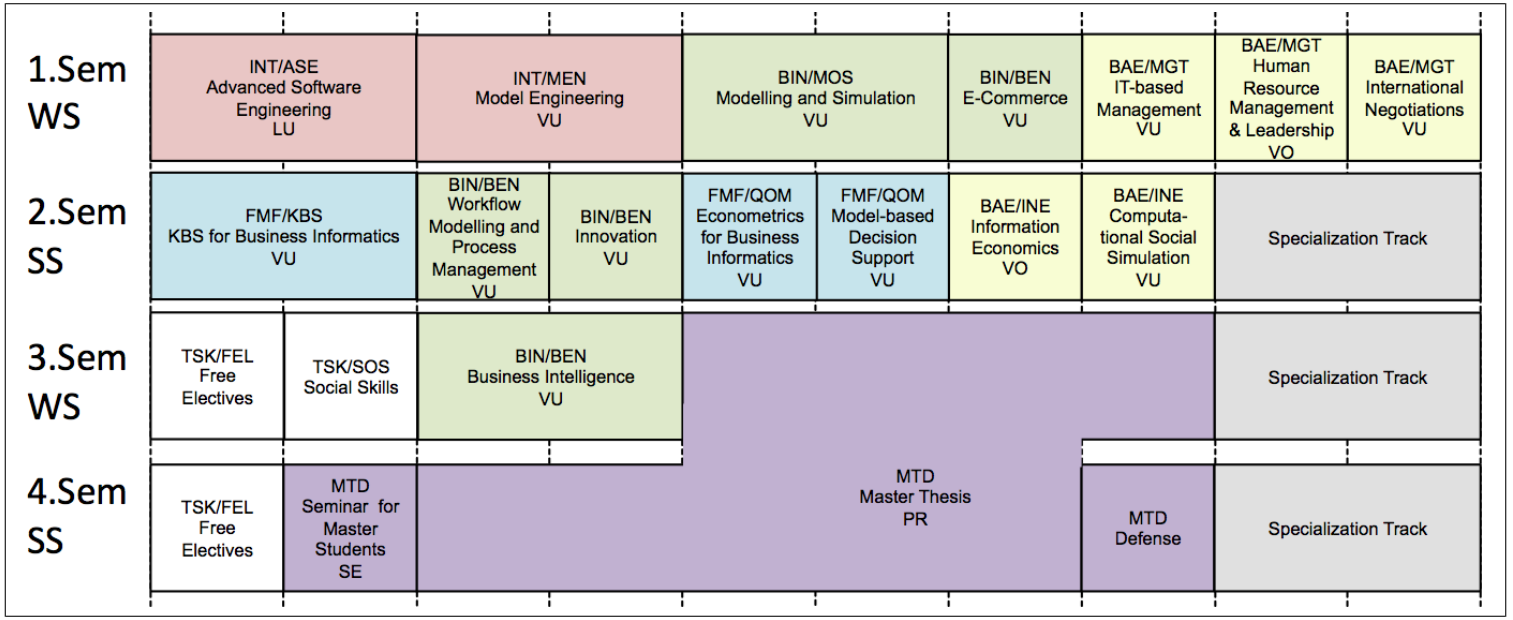
A specialization module of 6 Ects

4. Semester (SS)

3.0/2.0 SE Seminar for Master Students
30.0/15.0 PR Master Thesis

Lectures of 3 Ects in the module *TSK/FEL Free Electives*

A specialization module of 6 Ects


1.Sem WS
INT/ASE Advanced Software Engineering LU
INT/MEN Model Engineering VU
BIN/MOS Modelling and Simulation VU
BIN/BEN E-Commerce VU
BAE/MGT IT-based Management VU
BAE/MGT Human Resource Management & Leadership VO
BAE/MGT International Negotiations VU
2.Sem SS
FMF/KBS KBS for Business Informatics VU
BIN/BEN Workflow Modelling and Process Management VU
BIN/BEN Innovation VU
FMF/QOM Econometrics for Business Informatics VU
FMF/QOM Model-based Decision Support VU
BAE/INE Information Economics VO
BAE/INE Computa-tional Social Simulation VU
Specialization Track
3.Sem WS
TSK/FEL Free Electives
TSK/SOS Social Skills
BIN/BEN Business Intelligence VU
Specialization Track
4.Sem SS
TSK/FEL Free Electives
MTD Seminar for Master Students SE
MTD Master Thesis PR
MTD Defense
Specialization Track

D Semestereinteilung für schiefeinsteigende Studierende

1. Semester (SS)

6.0/4.0 VU KBS for Business Informatics
3.0/2.0 VU Econometrics for Business Informatics
3.0/2.0 VU Model-based Decision Support
3.0/2.0 VU Workflow Modeling and Process Management
3.0/2.0 VU Innovation

A specialization module of 6 Ects

Lectures of 3 Ects in the module *TSK/FEL Free Electives*

Lectures of 3 Ects in the module *TSK/SOS Social Skills*

2. Semester (WS)

6.0/4.0 PR Advanced Software Engineering
6.0/4.0 VU Model Engineering
3.0/2.0 VU E-Commerce
6.0/4.0 VU Modeling and Simulation
3.0/2.0 VU IT-based Management
3.0/2.0 VO Human Resource Management and Leadership
3.0/2.0 VU International Negotiations

3. Semester (SS)

3.0/2.0 VO Information Economics
3.0/2.0 VU Computational Social Simulation
30.0/15.0 PR Master Thesis

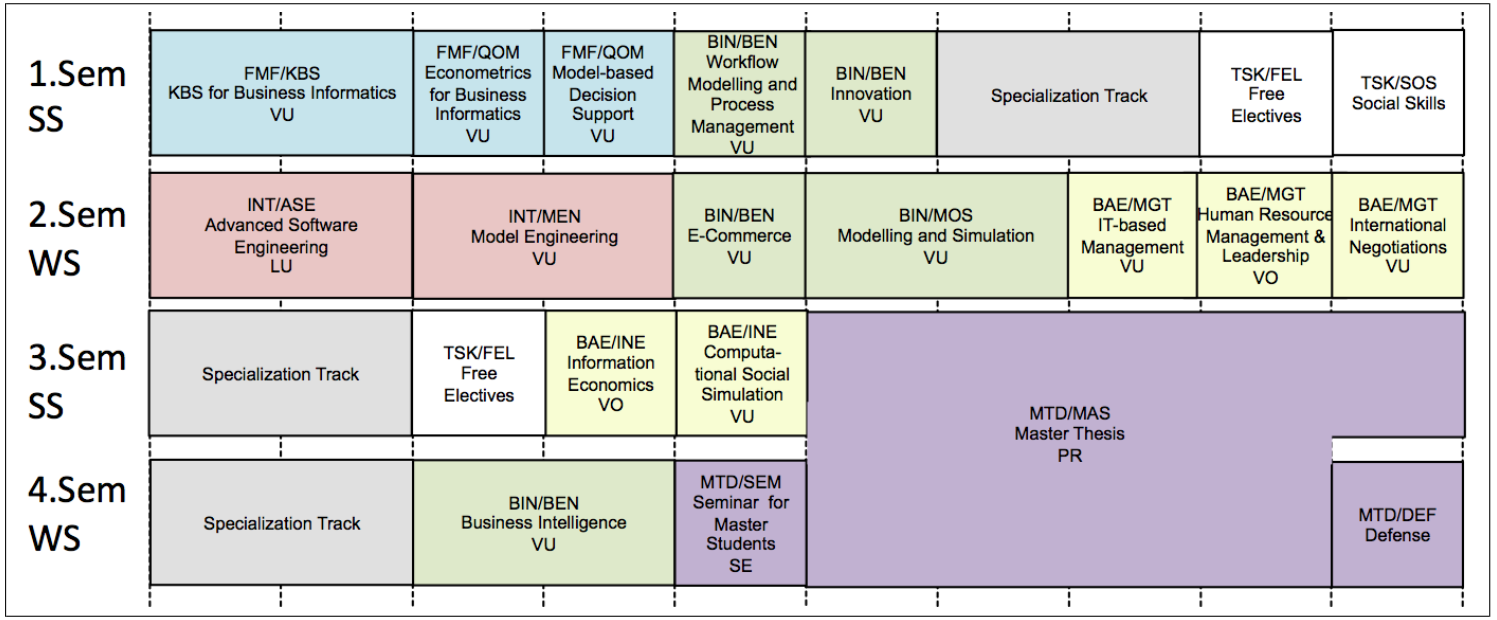
A specialization module of 6 Ects

Lectures of 3 Ects in the module *TSK/FEL Free Electives*

4. Semester (WS)

6.0/4.0 VU Business Intelligence
3.0/2.0 SE Seminar for Master Students
30.0/15.0 PR Master Thesis

A specialization module of 6 Ects


1.Sem SS
FMF/KBS KBS for Business Informatics VU
FMF/QOM Econometrics for Business Informatics VU
FMF/QOM Model-based Decision Support VU
BIN/BEN Workflow Modelling and Process Management VU
BIN/BEN Innovation VU
Specialization Track
TSK/FEL Free Electives
TSK/SOS Social Skills
2.Sem WS
INT/ASE Advanced Software Engineering LU
INT/MEN Model Engineering VU
BIN/BEN E-Commerce VU
BIN/MOS Modelling and Simulation VU
BAE/MGT IT-based Management VU
BAE/MGT Human Resource Management & Leadership VO
BAE/MGT International Negotiations VU
3.Sem SS
Specialization Track
TSK/FEL Free Electives
BAE/INE Information Economics VO
BAE/INE Computa-tional Social Simulation VU
MTD/MAS Master Thesis PR
4.Sem WS
Specialization Track
BIN/BEN Business Intelligence VU
MTD/SEM Seminar for Master Students SE
MTD/DEF Defense

E Innovation – Supplementary Curriculum

Qualification profile

The supplementary master curriculum *Innovation* offers an advanced, scientific, and methodologically sound complementary education that is targeted towards sustainable knowledge and has a strong focus on practice. The graduates will be competent and internationally competitive in the following fields of informatics and business informatics:

- Entrepreneurship and company foundation
- Intrapreneurship and innovation management
- University engagement and research transfer

According to professional requirements, the innovation curriculum conveys qualifications on top of a regular informatics or business informatics master study with respect to the following categories.

Functional and methodological knowledge The innovation curriculum conveys the following knowledge:

- Innovation management
- Business model and plan
- Legal and economical aspects of innovation
- Financial aspects of innovation
- Social and organizational aspects of innovation

Cognitive and practical skills By investigating innovation methods practically and theoretically, the following skills are acquired:

- Company foundation and expansion
- Innovation of processes, products, and services in existing enterprizes
- Innovation transfer and university-company cooperation

Social, innovation and creative competence The focus of the innovation curriculum is on fostering creativity and high innovation potentials, in particular:

- Methods and techniques to foster creativity
- Interaction with highly creative people and teams
- Handling of conflicts and crises

Prerequisites

The innovation curriculum is planned exclusively as supplementary education to a regular master study in informatics or business informatics. Admission requires a bachelor, master or diploma degree in informatics or business informatics.

The study is restricted to 20 exceptionally qualified and highly motivated students. A two-stage admission procedure is conducted during the first semester of the regular master study in informatics or business informatics. First, a written application (in English, containing curriculum of studies, practical experience, additional qualifications, and a motivation letter) has to be submitted by October 31. Second, during December and January, interviews will be held with the most promising candidates. Candidates are finally selected based on their knowledge, skills, and potential by an evaluation committee (appointed by the dean for studies).

Modules

The innovation curriculum is implemented as four obligatory modules with a total of 30 Ects, to be completed during the second to fourth semester of the regular master study in informatics or business informatics. Specialisation is possible by choosing the topic of the innovation project.

Semester	Regular study	Innovation curriculum
1	30.0 Ects	admission procedure
2	30.0 Ects	6.0 Ects Module *Innovation and Creativity*
		6.0 Ects Module *Innovation Planning*
3	30.0 Ects	6.0 Ects Module *Innovation Implementation*
4	30.0 Ects	12.0 Ects Module *Innovation Practice*
Total	120.0 Ects	30.0 Ects

For a detailed description of the modules, see section 5 and appendix A.