



# **Modules International Programme School of Informatics**

Reutlingen University, Fakultät für Informatik

November 2025

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|-----------------------------------------------------------------------|---------------------------------------------------------------------------|-----------|
| Modul:                                                                | Aspects of Communication                                                  |           |
| Code:                                                                 | mkiB73                                                                    |           |
| Subtitle:                                                             |                                                                           |           |
| Course elements:                                                      | Seminar                                                                   |           |
| Semester:                                                             | Every semester                                                            |           |
| Module coordinator:                                                   | Prof. Dr. Benjamin Himpel                                                 |           |
| Lecturer:                                                             | Prof. Dr. Benjamin Himpel                                                 |           |
| Language:                                                             | German, English                                                           |           |
| Allocation to the curriculum:                                         | Media and Communication Informatics<br>Bachelor's compulsory 7th semester |           |
| Mode of teaching / semester hours<br>per week (SWS):                  | Lecture:                                                                  | 2 SWS     |
| Total hours:                                                          | Contact Hours:                                                            | 30 Hours  |
|                                                                       | Independent study:                                                        | 120 Hours |
| Credits:                                                              | 5 ECTS                                                                    |           |
| Prerequisites in accordance with<br>examination regulations (StuPro): | None                                                                      |           |
| Recommended prerequisites:                                            | None                                                                      |           |
| Mode of assessment:                                                   | Presentation, ungraded                                                    |           |

#### Module objectives:

This module is designed to introduce students to scientific and research-based methods of working as an accompaniment to their Bachelor's theses, so that they are able to view developed applications or applications in development in the context of research activity. In this context, research and development typically refer to applied research approaches of the type often found in industry. In addition to applied research, the module looks at more principles-based research and examines the differences between the two approaches.



## Learning outcomes:

### Knowledge:

- Be familiar with formats and methods in the field of applied research.
- Be familiar with licensing models.
- Be familiar with the scientific community and the opportunities for publishing research findings.
- Be able to use format templates.
- Be able to give feedback in the style of a peer review.
- Be able to contextualise scientific articles and studies from own area of development.
- Be able to evaluate own applications for future developments.
- Be able to research information on the subject of patents and utility models.

### Skills:

Students become familiar with methods of publishing conference papers, for example. The module covers the whole process from producing a paper to submitting it via electronic conference systems. In a fictitious conference setting, students submit their own conference paper and have it reviewed and evaluated by their fellow students. Additionally, students are encouraged to submit a paper to a real conference or other scientific publication formats.

### Competencies:

After completing this module, students will be able to do the following:

| LO# | Learning outcome (LO)                                                                                                                                     | Assessed through         |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| L01 | Assess their own developments and abilities in comparison to others.                                                                                      | Presentation, discussion |
| L02 | Give constructive feedback on developments.                                                                                                               | Discussion               |
| L03 | Produce a paper in a format that will enable it to be accepted at a conference.                                                                           | Presentation, discussion |
| L04 | Benefit from enhanced information-related skills, particularly with regard to information retrieval methods for patents and utility models, for instance. | Presentation             |
| L05 | Evaluate and apply licensing models for a range of artifacts.                                                                                             | Presentation, discussion |

## Content:

This module takes the format of a seminar. Students are required to participate by giving presentations and other papers in oral and written format (L01). Working on the basis of their own research work, usually carried out in relation to their Bachelor's thesis, students learn about options for publishing their findings (L03). By creating and using a conference system to assess papers, students learn the possibilities presented by the peer review system (L02). In this context, students use a conference system for a fictitious conference, providing a practical scenario in which they can not only review papers themselves, but also have their papers reviewed by others. Concluding the module is the subject of information retrieval, particularly where this concerns patent information (L04). Rounding off this component relating to information skills are subjects such as open access and licensing models including Creative Commons (L05). By giving presentations on methodological

processes and bringing together their findings, students report on the methods they have



used, their experiences, and how their findings can be used in the future (LO1).

#### Literature:

- Esselborn-Krumbiegel, Helga (2008): Von der Idee zum Text. Eine Anleitung zum wissenschaftlichen Schreiben. 3rd edition, revised. Paderborn, Munich, Vienna, Zurich: Schöningh (utb.de Bachelor-Bibliothek, 2334: Schlüsselkompetenzen, Kernkompetenzen).
- Kuhlen, Rainer; Semar, Wolfgang; Strauch, Dietmar (Hg.) (2014): Grundlagen der praktischen Information und Dokumentation. Handbuch zur Einführung in die Informationswissenschaft und -praxis. 6th edition, fully revised. Berlin: De Gruyter.
- Students will be informed of other sources of literature on the subjects of patient information, Creative Commons and software licences during the course of the module.



|                                                                    |                                      |          |  |
|--------------------------------------------------------------------|--------------------------------------|----------|--|
| Modul:                                                             | Business Modelling                   |          |  |
| Code:                                                              | WIBW                                 |          |  |
| Subtitle:                                                          |                                      |          |  |
| Course elements:                                                   | Lectures                             |          |  |
| Semester:                                                          | Every semester                       |          |  |
| Module coordinator:                                                | Prof Dr. Philipp Zeise               |          |  |
| Lecturer:                                                          | Prof. Dr. Philipp Zeise              |          |  |
| Language:                                                          | English                              |          |  |
| Allocation to the curriculum:                                      | Compulsory subject, 7th semester     |          |  |
| Mode of teaching / semester hours per week (SWS):                  | Lecture:                             | 4 SWS    |  |
| Total hours:                                                       | Contact Hours:                       | 60 Hours |  |
|                                                                    | Independent study:                   | 90 Hours |  |
| Credits:                                                           | 5 ECTS                               |          |  |
| Prerequisites in accordance with examination regulations (StuPro): | None                                 |          |  |
| Recommended prerequisites:                                         | None                                 |          |  |
| Mode of assessment:                                                | Lectures: Project work, presentation |          |  |

#### Module objectives:

This module aims to teach students methodological approaches to standard software systems and create an integrated picture of the knowledge they have acquired in the modules studied up to this point. It examines a company scenario from a range of perspectives. This process starts by analyzing and modeling business processes relating to sales and dispatch, material planning, purchasing and stock management, production planning, controlling, and financial accounting. Using a standard ERP system, students work through this scenario at user level on the basis of an example company. The next step involves the students modeling their own companies, adopting the perspective of a businessconsultant.



## Learning outcomes:

### Knowledge:

- Knowledge of a comprehensive methodological approach to introducing standard software systems in companies.
- Understanding of and ability to implement project planning and project management methods. Familiarity with and ability to implement technical project design including business process modeling, test case-driven customization and documentation methodology.
- Ability to adopt a complete overview of integrated company processes.

### Skills:

Students learn how to select and use strategic project methods in the context of introducing and using standard software. They are able to design project plans within complex environments and create multifunctional standard software. In doing so, they are able to incorporate areas where various areas of work intersect in order to prevent unoccupied time in the project schedule. This requires productive project work in a team setting. Students carry out a systematic analysis of error situations. Creating documentation relating to the project work within the team as the project is progressing hones cognitive, practical and communication skills that allow knowledge to be applied

### Competencies:

Systematic production of project findings according to a schedule. Handling stressful situations, methods for finding solutions in the complex project environment associated with a comprehensive standard system. Developing solutions for previously unrecognized technical problems within a business, using all the sources available.  
Teamwork and self-discipline when working with other students

## Content:

### Seminar format:

Business process models are derived from various product and production strategies, and described on the basis of a standard method that can be applied in practice. Students develop not only a basis for subsequent processing in the standard ERP system, but also sample navigation models for various logistics situations.

### Project work:

Standard software is used to map out various aspects of a model organization, in the areas of sales and dispatch, material planning, purchasing and stock management, production planning, controlling, and financial accounting.

This is carried out in small sub-projects, familiarizing students with the process of organizing project groups. Supplementing this process is methodological knowledge in the areas of project management, project processing and test strategies.

Each project group develops its own company model by means of customizing. The work is deemed to be successful if the modeled business processes can be carried out using the implemented company model. For this purpose, it is also necessary for the groups to create project documentation that adheres to professional standards.



### Forms of media:

Lectures with practical workshop sequences on the subjects of process modeling and processing. Introduction to the use of standard systems through basic scenarios.

Comprehensive project work organized by the students themselves, in groups of 4 to 5, covering the areas of customizing, project processing, documentation and test strategies. Students receive lecture notes in electronic format.

### Literature:

- Andre Maassen et.al. (2003): Grundkurs SAP R/3, Vieweg Verlag, 2nd edition
- SAP help system (online library)
- Michael Wobbermin (2000): Arbeitsbuch Buchhaltung, Jahresabschluß, Bilanzanalyse, Schäffer-Poeschel Verlag





|                                                                    |                                             |          |
|--------------------------------------------------------------------|---------------------------------------------|----------|
| Modul:                                                             | Software Engineering                        |          |
| Code:                                                              | WIB33                                       |          |
| Subtitle:                                                          |                                             |          |
| Course elements:                                                   | Lectures with integrated practical sessions |          |
| Semester:                                                          | Every semester                              |          |
| Module coordinator:                                                | Prof. Dr. Christian Decker                  |          |
| Lecturer:                                                          | Prof. Dr. Christian Decker                  |          |
| Language:                                                          | English                                     |          |
| Allocation to the curriculum:                                      | Compulsory subject, 3th semester            |          |
| Mode of teaching / semester hours per week (SWS):                  | Lecture:                                    | 4 SWS    |
| Total hours:                                                       | Contact Hours:                              | 60 Hours |
|                                                                    | Independent study:                          | 90 Hours |
| Credits:                                                           | 5 ECTS                                      |          |
| Prerequisites in accordance with examination regulations (StuPro): | None                                        |          |
| Recommended prerequisites:                                         | None                                        |          |
| Mode of assessment:                                                | Lectures: Written examination, presentation |          |

### Module objectives:

#### Software processes

- Fundamental knowledge of software processes and procedural models
- Knowledge of when acquired procedural models can be used
- Knowledge of fundamental process activities

#### Agile software development

- Comprehension of the management problem of software development
- Fundamental knowledge for later practice
- Knowledge of agile SW development with the example of XP

#### Requirements Engineering

- Knowledge of terms and elements of requirement recording
- Ability to display and formulate requirements systematically

#### System modeling

- Ability to describe the structure and behavior of SW systems in a schematic manner  
☐ using UMLAbility to perform a systems analysis.



#### Software draft with patterns

- Knowledge of a systematic approach to being able to describe system drafts
- Testing of ability to comprehend existing experience for drafts and to use it successfully
- Comprehension of testing as part of SW QA
- Knowledge of different testing methods and ability to explain the suitability and purpose

#### Fundamentals of project management

- Knowledge of basic terms, the methods and systematic procedure of management of SW projects

#### Use of tools

- Ability to plan and track projects using MS Project
- Selected practices: Research, estimation, application
- Ability to research and evaluate different practices of project management and use them as an example

### Learning outcomes:

#### Knowledge:

- Knowledge of products, methods, standards, processes and instruments designed for forward- thinking software engineering, creation of software-intensive products and software project management
- Knowledge of software process models, software design and fundamental workflows and roles in software engineering
- Knowledge of fundamental issues in project management
- Identification of requirements and formulation of specifications
- Systematic categorization and application of subject areas within software engineering and software project management.

#### Knowledge of the modeling, validation and testing of software systems Skills:

Students are able to take a systematic approach to categorizing and applying concepts, processes and methods. Using various projects, the students learn how to apply theoretical concepts and methods practically when working in project teams. They can work independently on topics in the field of software engineering and project management and apply them in conjunction with the imparted knowledge. In various subject areas, they learn practical work with tools and methods.

#### Competencies:

| Learning outcome (LO)                                                                                                                                                                                                                    | Assessed through    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| Are able to manage software projects in a planned and also agile manner and to select suitable methods according to the business environment and practical situation, in tandem with the business targets and can explain their choices. | Written examination |
| Ability to research and evaluate different practices of software engineering and project management independently and use them as an example. They employ learned instruments and/or tools and create a distinction to alternatives.     | Presentation        |



## Content:

Software represents an ever greater factor for the added value of products. The number of software-intensive products will continue to increase. The targeted, engineering development of software products and the management of software projects are the contents of this lecture. The following subject areas are addressed:

### Software processes

- Various software processes, particularly waterfall, incremental development and others
- Discussion of advantages and disadvantages
- Change management: Tolerance to changes and avoidance of changes

### Agile software development

- Derivation and inclusion of agile SW development
- Principles of Extreme Programming (XP)

### Requirements Engineering

- Motivation, reasons for the failure of SW projects
- Basic terms: System specification, specifications, requirement types
- Recording of the requirements with Use Case diagrams

### System modeling

- Inclusion in SW engineering
- UML diagrams: Use case, sequence, state, class diagram Introduction to OOA/D

### Software draft with patterns

- Architecture patterns, e.g. MVC, MVP
- Design pattern: Singleton, observer, decorator
- Object-oriented interface draft: Interface vs. Multi inheritance

### Testing

- Dynamic testing: Testing types and testing methods, e.g. Blackbox, Whitebox
- Test-driven development
- Static testing: User tests



#### Fundamentals of project management

- Stakeholders, project organization, procedural model, roles and responsibilities
- Specifications, initial project description, project order, project charter, scope statement
- Project report, milestone diagram, Quality Management Report
- Change Request management, sample Change

#### RequestsUse of tools

- Project planning with MS Project

#### Selected practices: Research, estimation, application, etc. with the following subtopics

- Requirements management
- Earned Value Analysis
- Business Case
- Target conflict matrix

#### Risk graph, ALARP

- Six Sigma
- V model <http://www.vmodellxt.de/>
- Agile software development / Scrum

#### Forms of media:

PDF of the slides from the lecture. Additional material to be announced during the lecture.

#### Literature:

- Ian Sommerville. *Software Engineering* (9th updated edition). Pearson, Deutschland, ISBN: 978-3-8632-6512-0



|                                                                    |                                                 |          |  |
|--------------------------------------------------------------------|-------------------------------------------------|----------|--|
| Modul:                                                             | Web Programming                                 |          |  |
| Code:                                                              | WIB35                                           |          |  |
| Subtitle:                                                          |                                                 |          |  |
| Course elements:                                                   | Lectures with integrated practical sessions     |          |  |
| Semester:                                                          | Every semester                                  |          |  |
| Module coordinator:                                                | Prof. Dr. Martin Schmollinger                   |          |  |
| Lecturer:                                                          | Matthias Gutbrod                                |          |  |
| Language:                                                          | English                                         |          |  |
| Allocation to the curriculum:                                      | Compulsory subject, 2nd semester                |          |  |
| Mode of teaching / semester hours per week (SWS):                  | Lecture:                                        | 2 SWS    |  |
|                                                                    | Practical Session:                              | 2 SWS    |  |
| Total hours:                                                       | Contact Hours:                                  | 60 Hours |  |
|                                                                    | Independent study:                              | 90 Hours |  |
| Credits:                                                           | 5 ECTS                                          |          |  |
| Prerequisites in accordance with examination regulations (StuPro): | None                                            |          |  |
| Recommended prerequisites:                                         | Principles of informatics, advanced programming |          |  |
| Mode of assessment:                                                | Lectures: Written examination, presentation     |          |  |

### Module objectives:

This module aims to introduce students to the technology, structure and programming associated with web applications. It requires students to have acquired the competencies taught in the Principles of Informatics module. The majority of applications employed by companies are web-based. The competencies that are taught in this module are essential in understanding the functions of these applications, and are therefore a crucial part of an IT specialist's career. The modules entitled Databases, Networks, Systems and Security, and Distributed Systems build on aspects of this module.

### Learning outcomes:

#### Knowledge:

- Knowledge of web application architectures.
- Ability to name basic technologies and describe how they relate to one another.



- Fundamental knowledge of programming languages and databases for implementing webapplications.
- Tools for developing web applications, and ability to understand and apply protection measuresfor them.
- Ability to name risks associated with web applications, as well as explain and apply appropriatecountermeasures.

#### Skills:

Students are able to develop their own web applications using basic technology. To do this, they use standard programming platforms, tools and systems. The focus where clients are concerned is on HTML/CSS and JavaScript. Programming on the server side is conducted using current frameworks such as PHP, Java or Node.js (JavaScript). Students are able to apply basic web application technologyand various approaches to web programming, with a database incorporated, and are able to put protection measures in place

#### Competencies:

This module helps students attain the technology skills they require and strengthens their knowledge of programming technology and software architectures. After completing this module, students will be familiar with web application architecture and will be able to design an environment of this nature. Theywill be familiar with the web technologies associated with various architectural layers and will be able to use these for application development purposes, with the assistance of selected tools. They will also be aware of security issues relating to web applications.

| LO# | Learning outcome (LO)                                                               | Assessed through                   |
|-----|-------------------------------------------------------------------------------------|------------------------------------|
| LO1 | Confidently explain, present and discuss web applicationarchitectures.              | Written examination/practical work |
| LO2 | Be able to employ the web technologies associated withvarious architectural layers. | Written examination/practical work |
| LO3 | Be able to develop web applications using the latest programming tools.             | Written examination/practical work |
| LO4 | Assess web applications with respect to security issues.                            | Written examination/practical work |

#### Content:

This module teaches students about the fundamental technologies associated with web applications. It addresses basic types of technology as well as selected methods of web application programming onthe client and server sides (e.g. JavaScript, Java, PHP). As well as this, it presents selected principles that are used to provide protection for web applications



### Forms of media:

The module consists of lectures in a seminar format, which include writing on the board, overhead projection and PC-based projection, plus practical sessions that apply the content of the lectures. Practical work is conducted using the latest software development tools. The course material is provided in electronic format.

- Lecture notes, Exercise sheets with tasks.

### Literature:

- Ackermann, Philip (2016). JavaScript: Das umfassende Handbuch für Einsteiger, Fortgeschrittene und Profis. Rheinwerk Computing.
- Balzert, Heide (2017): Basiswissen Web-Programmierung. 2nd edition, Springer Campus.
- Theis, Thomas (2016): Einstieg in PHP 7 und MySQL. Rheinwerk Computing.
- Zeigermann, Oliver (2015) JavaScript für Java-Entwickler, 3rd edition, Entwickler.press



|                                                                    |                                                                           |          |
|--------------------------------------------------------------------|---------------------------------------------------------------------------|----------|
| Modul:                                                             | Corporate Finance                                                         |          |
| Code:                                                              | WIB52                                                                     |          |
| Subtitle:                                                          |                                                                           |          |
| Course elements:                                                   | Lectures                                                                  |          |
| Semester:                                                          | Every semester                                                            |          |
| Module coordinator:                                                | Prof. Dr. Josef Schürle                                                   |          |
| Lecturer:                                                          | Prof. Dr. Josef Schürle                                                   |          |
| Language:                                                          | English                                                                   |          |
| Allocation to the curriculum:                                      | Compulsory subject, 5th semester                                          |          |
| Mode of teaching / semester hours per week (SWS):                  | Lecture:                                                                  | 4 SWS    |
| Total hours:                                                       | Contact Hours:                                                            | 60 Hours |
|                                                                    | Independent study:                                                        | 90 Hours |
| Credits:                                                           | 5 ECTS                                                                    |          |
| Prerequisites in accordance with examination regulations (StuPro): | None                                                                      |          |
| Recommended prerequisites:                                         | Basic principles of business and management economics, company accounting |          |
| Mode of assessment:                                                | Lectures: Written examination, Practical sessions                         |          |

### Module objectives:

This module aims to provide students with more advanced knowledge of business administration. This means that students should be able to evaluate economic topics from a financial perspective and to make investment decisions from a risk / return point of view. In addition, students should understand the basic problems of financing and should know specific financing types as solution options.

### Learning outcomes:

#### Knowledge:

The students have mastered the basics of financial mathematics and can apply them to investment decisions under security and risk. They understand the characteristics of a financially optimal investment decision. The students know the basic problems of financing and possess a structured overview of concrete types of financing.



#### Skills:

The students apply methods of business and financial economics to concrete investment decisions and derive financially-grounded decision suggestions from them. They plan liquidity developments with complete financial plans and close financial loopholes using suitable financing instruments.

#### Competencies:

The students are able to evaluate investment alternatives in a structured manner on the basis of financial considerations and to derive decision-making suggestions from that. They possess a well-founded economic evaluation competence and also include risk aspects in evaluation questions. When solving financing problems, the students are able to evaluate the concrete framework conditions in a well-founded manner and to select a suitable alternative from a broad financing spectrum.

#### Content:

- Basic principles of financial mathematics (interest, pension and repayment calculation)
- Investment decisions under security (static / dynamic method, complete financial plan, capital value method, flat and non-flat interest rate curves)
- Investment decisions under insecurity (decision subject to risk, portfolio theory, CAPM, capital costs, application for corporate evaluation)
- Empirical analysis through application of the methods on available data from the company with classical and digital business models
- Basic principles of financing (basic problem of financing, internal / external financing, proprietary / third-party financing, systematic overview of financing types)

#### Forms of media:

Imparting of the theoretical basic principles using beamer presentation, supplemented by texts on board. Discussion of solutions to the exercises. Web research on the financial data of the companies and analysis of the corporate data as group work.

#### Literature:

- Becker (2015): Investition und Finanzierung: Grundlagen der betrieblichen Finanzwirtschaft. 7th edition. Wiesbaden: SpringerGabler.
- Drukarczyk / Lobe (2014): Finanzierung. 11. edition. Konstanz: UVK.
- Kruschwitz / Husmann (2012): Finanzierung und Investition. 7th edition. Berlin: De Gruyter.
- Kruschwitz (2010): Finanzmathematik. 5th edition. Berlin: De Gruyter.
- Kruschwitz (2014): Investitionsrechnung. 14. edition. Berlin: De Gruyter.
- Perridon / Steiner / Rathgeber (2016): Finanzwirtschaft der Unternehmung. 17. edition. Munich: Vahlen.
- Wöhe / Bilstein / Ernst / Häcker (2013): Grundzüge der Unternehmensfinanzierung. 11. edition. Munich: Vahlen



|                                                                    |                                               |          |  |
|--------------------------------------------------------------------|-----------------------------------------------|----------|--|
| Modul:                                                             | Business Consulting                           |          |  |
| Code:                                                              | WIB53                                         |          |  |
| Subtitle:                                                          |                                               |          |  |
| Course elements:                                                   | Lectures                                      |          |  |
| Semester:                                                          | Every semester                                |          |  |
| Module coordinator:                                                | Prof. Dr. Dennis Schlegel                     |          |  |
| Lecturer:                                                          | Prof. Dr. Dennis Schlegel                     |          |  |
| Language:                                                          | English                                       |          |  |
| Allocation to the curriculum:                                      | Compulsory subject, 5th semester              |          |  |
| Mode of teaching / semester hours per week (SWS):                  | Lecture:                                      | 4 SWS    |  |
| Total hours:                                                       | Contact Hours:                                | 60 Hours |  |
|                                                                    | Independent study:                            | 90 Hours |  |
| Credits:                                                           | 5 ECTS                                        |          |  |
| Prerequisites in accordance with examination regulations (StuPro): | None                                          |          |  |
| Recommended prerequisites:                                         | Knowledge of the English language to level B2 |          |  |
| Mode of assessment:                                                | Lectures: Written examination,                |          |  |

#### Module objectives:

The participants obtain the necessary qualification to apply basic consulting methods in business situations. The attained qualification permits the participants to make a contribution in everyday business work to the solution of financial practical problems, as well as at the interface between the specialist area and IT.

#### Learning outcomes:

##### Knowledge:

The students are aware of fundamental consulting methods and can classify them in a corporate context. In particular, they are aware of the standard methods of Business Process Management and project management and can evaluate the advantages and disadvantages of different concepts.



#### Skills:

The students are able to plan and execute consultancy tasks through a methodical approach. They can structure a project, plan data collection and prepare workshops.

#### Competencies:

The participants can apply the acquired specialist knowledge to concrete corporate problems. They can assume a mediator role between the specialist area and IT and compile possible solutions in a structured manner. They are able to hold structured interviews and to moderate workshops.

| LO# | Learning outcome (LO)                                        | Assessed through    |
|-----|--------------------------------------------------------------|---------------------|
| LO1 | Knowledge of basic consultancy methods                       | Written examination |
| LO2 | Ability to plan methodically and carry out consultancy tasks | Written examination |
| LO3 | Ability to apply the learned methods to concrete problems    | Written examination |

#### Content:

- Introduction to business consulting (e.g. consulting methods and industry)
- Strategy and performance management (e.g. strategy mapping and KPIs)
- Business process management (e.g. business background, process discovery, process analysis, process redesign)
- Project management (e.g. project organization, work breakdown structure, project timeline)

#### Forms of media:

Imparting of the basic theoretical and methodical principles through interactive lecture units, as well as joint reading materials and discussion of English-language original sources (e.g. periodical articles).

Independent tackling of exercises and case studies in groups or individual work within contact time.

#### Literature:

- Andler: Tools for Project Management, Workshops and Consulting. Publicis
- Dumas, La Rosa, Mendling and Reijers: Fundamentals of Business Process Management. Springer International Publishing
- Kaplan and Norton: How Strategy Maps Frame an Organization's Objectives, in: *Financial Executive*, Mar/Apr 2004, Vol. 20 Issue 2, pp.40-45.
- Kubr: Management Consulting. A Guide to the Profession. Geneva: International Labour Office
- Milani: Digital Business Analysis. Springer International Publishing



|                                                                    |                                  |          |
|--------------------------------------------------------------------|----------------------------------|----------|
| Modul:                                                             | Entrepreneurship                 |          |
| Code:                                                              | WIB55                            |          |
| Subtitle:                                                          |                                  |          |
| Course elements:                                                   | Lectures                         |          |
| Semester:                                                          | Every semester                   |          |
| Module coordinator:                                                | Prof. Dr. Jürgen Münch           |          |
| Lecturer:                                                          | Prof. Dr. Jürgen Münch           |          |
| Language:                                                          | English                          |          |
| Allocation to the curriculum:                                      | Compulsory subject, 5th semester |          |
| Mode of teaching / semester hours per week (SWS):                  | Lecture:                         | 4 SWS    |
| Total hours:                                                       | Contact Hours:                   | 60 Hours |
|                                                                    | Independent study:               | 90 Hours |
| Credits:                                                           | 5 ECTS                           |          |
| Prerequisites in accordance with examination regulations (StuPro): | None                             |          |
| Recommended prerequisites:                                         | None                             |          |
| Mode of assessment:                                                | Lectures: Projekt work           |          |

### Module objectives:

The "Entrepreneurship" module provides you with key principles, methods and knowledge of intra- and entrepreneurship and allows you to act in an entrepreneurial way when founding a startup and when participating in innovative organizations. You will obtain a comprehensive insight in key topics for entrepreneurs, such as the development and implementation of a product idea, the setup of an agile organization, the management of teams, the financing of startups and innovation projects, as well as the development, transformation and validation of business models. Here, technology-driven and software-based innovation and business ideas are in the foreground. Using a wealth of practical examples, knowledge and tools, you will discover how to implement technological possibilities and innovation potentials in sustainable business models.



## Learning outcomes:

### Knowledge:

The students know the key basic principles, methods and tools of innovation management and business modeling. They can determine and evaluate innovation potential. They can explain the steps required to turn innovation potential into sustainable, scalable business models. The students know the special characteristics of intrapreneurship and corporate entrepreneurship in organizations. The students are able to explain how to employ agile methods to deal with uncertainties and risks in a successful manner.

### Skills:

The students are able to apply the knowledge obtained to concrete cases and questions. They can develop business models from ideas, can make estimations of the economic viability of business models, validation individual components of business models and can implement the solutions connected to the business models in a prototypical fashion. They can define strategies and roadmaps for the development of products and services. The students are able to plan innovation and foundation processes in an independent manner. On completion of the module, the students are sensitive to entrepreneurial thought processes and the particular requirements and general conditions of innovation projects.

### Competencies:

The students can classify the acquired knowledge correctly, can explain interdependencies and can apply the acquired knowledge to their own or given innovation ideas in startups or established companies. The students can be present their own innovation ideas and their implementation in the form of pitches (e.g. succinct short presentations in front of potential investors).

## Content:

- Techniques, methods, tools and organizational aspects of intra- and entrepreneurship
- Innovation and foundation processes
- Lean Startup and Running Lean
- Problem Solution Fit
- Generation of business ideas
- Business modeling
- Customer development, problem validation and interviews
- Traction modeling, financial planning
- Product Market Fit
- Identification of key assumptions and hypotheses
- Business model validation and experimentation
- Minimum Viable Products
- Ideation and prototyping
- Pricing
- Branding
- Strategies for entrepreneurs and innovators
- Storytelling and pitching
- Scaling and growth hacking
- Lean Analytics and innovation metrics



- Cohort analysis
- Expansion strategies
- Design sprints
- Financing
- Models of venture capital companies
- Foundation promotion
- Capital procurement
- Corporate management and organization (e.g. with OKR, Lean Enterprise) □  
Practical casestudies

#### Forms of media:

- Lectures plus accompanying practical sessions
- Work on case studies and tasks in teams
- Lecture material in electronic form

#### Literature:

- Marya, A. (2012): Running Lean: Iterate from Plan A to a Plan That Works. 2nd edition, O'Reilly.
- Maurya, A. (2016): Scaling Lean: Mastering the Key Metrics for Startup Growth. Portfolio.
- Osterwalder, A., & Pigneur, Y. (2010): Business model canvas. John Wiley & Sons.
- Osterwalder, A., Pigneur, Y., Bernarda, G., Smith, A. (2015): Value Proposition Design: How to Create Products and Services Customers Want. John Wiley & Sons.
- Ries, E. (2011): The lean startup: How today's entrepreneurs use continuous innovation to create radically successful businesses. Crown Books.
- Ries, E. (2017): The Startup Way: How Entrepreneurial Management Transforms Culture and Drives Growth. Portfolio Penguin.
- Viki, T. und Toma, D. (2017): The Corporate Startup: How Established Companies Can Develop Successful Innovation Ecosystems. Vakmedianet Management bv.



Modul: Management und Controlling

Code: WIB52

Subtitle:

Course elements: Lectures

Semester: Every semester

Module coordinator: Prof. Armin Roth

Lecturer: Prof. Armin Roth

Language: English

Allocation to the curriculum: Compulsory subject, 5th semester

Mode of teaching / semester hours per week (SWS): Lecture: 4 SWS

Total hours: Contact Hours: 60 Hours  
Independent study: 90 Hours

Credits: 5 ECTS

Prerequisites in accordance with examination regulations (StuPro): None

Recommended prerequisites: Basic principles of business and management economics, company accounting

Mode of assessment: Lectures: Projekt work

### Module objectives:

This module presents and discusses the entire management process. It examines the "lifecycle" of a company from a managerial perspective, from the initial idea for the business to selling the company. The aim of the module is to heighten students' awareness of business concerns and teach them about the tasks involved in controlling and management, as well as the methods used to approach this.

### Learning outcomes:

#### Knowledge:

- Be familiar with and able to name the instruments, methods and processes used in company management.
- Be able to name and use strategic methods in management and controlling
- Be familiar with organizational rules



- Be familiar with the principles of corporate cultures
- Be able to describe change management
- Be familiar with and able to apply human resources management techniques
- Be able to describe and explain the basics of management models, management information systems and information management
- Be aware of and able to use key figure systems and reporting systems for performance measurement in the context concerned.

**Skills:**

Students have a clearer vision of the entire "lifecycle" of a company from a management and controlling perspective, from the initial idea for the business to selling the company.

Knowledge of processes and instruments involved in strategic and operational management is acquired by means of examples. Leadership models are created. Insights into human resources management foster students' abilities to deploy staff effectively.

**Competencies:**

Students assess the action parameters involved in management and discuss the various methods that can be used in management from the perspective of how well suited they are to practical application. They are able to reflect on this. Students are able to discuss the subject matter from a practical, managerial perspective and with a specific focus in mind.

| LO# | Learning outcome (LO)                                                          | Assessed through                                           |
|-----|--------------------------------------------------------------------------------|------------------------------------------------------------|
| L01 | Understand and be able to describe management and controlling processes        | Presentation; case study work, private study projects      |
| L02 | Be familiar with and able to assess management action parameters               | Presentation; case study work, private study projects      |
| L03 | Be able to describe and apply various management methods and controlling tools | Presentation;<br>Case study work<br>Private study projects |





## Content:

The management process (planning, organization, staff deployment, leadership and controlling) is used as a basis for considering each of the process steps and the latest tools and methods associated with them. Specifically, the following subject areas are addressed:

- Principles of company management
- Strategic management and controlling: Processes and tools
- Operational management and controlling: Processes and tools
- Organization
- Corporate culture
- Change management
- Human resources management
- Reporting/key figures systems involved in performance measurement
- Management information systems and information management
- Leadership/leadership models

## Forms of media:

Lectures, work in small groups, case studies, presentation and written work, simulation game.

## Literature:

- Staehle, W.: Management, Vahlen, latest edition.
- Steinmann, H.; Schreyögg, G.: Management, latest edition
- Horváth, P.: Controlling, latest edition
- Reichmann, T.: Controlling mit Kennzahlen und Managementberichten, latest edition, Munich.
- Roth, A.; Behme, W. (1997): Organisation und Steuerung von dezentralen Unternehmenseinheiten, Wiesbaden: Gabler.
- Roth, A. (2014): Ganzheitliches Performance Management, Munich: Haufe.
- Roth, A. (2016): Einführung und Umsetzung von Industrie 4.0, Heidelberg/Berlin: Springer.
- Schweitzer, M.; Küpper H.-U.: Systeme der Kosten- und Erlösrechnung, latest edition, Munich
- Weber, J.: Einführung in das Controlling, latest edition, Stuttgart
- Case study-related literature



|                                                                    |                                                                                                                                          |          |  |
|--------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|----------|--|
| Modul:                                                             | Distributed Systems                                                                                                                      |          |  |
| Code:                                                              | WIB56                                                                                                                                    |          |  |
| Subtitle:                                                          | Foundations for Programming Enterprise Applications                                                                                      |          |  |
| Course elements:                                                   | Lectures and hand on trainings                                                                                                           |          |  |
| Semester:                                                          | Every semester                                                                                                                           |          |  |
| Module coordinator:                                                | Prof. Dr. Martin Schmollinger                                                                                                            |          |  |
| Lecturer:                                                          | Prof. Dr. Martin Schmollinger                                                                                                            |          |  |
| Language:                                                          | English                                                                                                                                  |          |  |
| Allocation to the curriculum:                                      | Compulsory subject, 5th semester                                                                                                         |          |  |
| Mode of teaching / semester hours per week (SWS):                  | Lecture:                                                                                                                                 | 2 SWS    |  |
|                                                                    | Practical session:                                                                                                                       | 2 SWS    |  |
| Total hours:                                                       | Contact Hours:                                                                                                                           | 60 Hours |  |
|                                                                    | Independent study:                                                                                                                       | 90 Hours |  |
| Credits:                                                           | 5 ECTS                                                                                                                                   |          |  |
| Prerequisites in accordance with examination regulations (StuPro): | None                                                                                                                                     |          |  |
| Recommended prerequisites:                                         | Computer Science modules of the bachelor program “Business Informatics” (semesters 1-4). Especially advanced skills in Java programming. |          |  |
| Mode of assessment:                                                | Written test and successful participation at practical sessions                                                                          |          |  |

### Module objectives:

Today, modern enterprise applications are developed as distributed systems for the cloud. In the module, the basic knowledge, skills and competencies are conveyed to be a door opener to students to the area of enterprise application programming.

### Learning outcomes:

#### Knowledge:

Students understand the collaboration of applications or parts of applications in distributed environments.

Especially, they are aware of challenges that arise in distributed environments in contrast to non-distributed environments ("Fallacies of distributed computing"). They know different approaches to program and implement distributed systems and applications.

#### Skills:

Students are able to understand and estimate requirements and properties of existing or new distributed applications or systems. They know common implementation choices to adapt or create such applications or systems, and are capable to select and apply to them. Particularly, students learn current approaches to implement distributed applications.

This skill is deepened by programming exercises using a current programming language, appropriate frameworks and tools. Hence, students use the Java programming language (advanced knowledge is a prerequisite!), the Spring Boot framework, the build tool gradle and Visual Studio Code as IDE. Further, Docker is used as a precondition for the deployment to the cloud.

#### Competencies:

The higher-order learning objectives are to understand, design, develop and deploy complex applications in distributed environments. Particularly, students receive implementation and method competencies to reach these objectives. The achievement rate of these competencies will be tested by a written examination at the end of the semester and by reviewing their solutions to exercises in the practical sessions.

#### Content:

- Definitions and Terminology
- Processes and Threads
  - Threads in non-distributed systems
  - Thread implementations
  - Threads in distributed systems
- Java Threads
- Architecture Styles
- Spring Boot
- Microservices
- Communication Styles
  - From In-Process to Inter-Process Communication
  - Collaboration Style and Common Implementation Choices
- Foundations of the deployment of distributed applications to Cloud environments

#### Forms of media:

##### Lecture:

- Lecture about module content based on slides.

##### Practical Sessions:

- Develop solutions to programming exercises provided by a training booklet.
- Solutions are provided later on a Git server.
- Video clips explaining the installation and usage of programming tools.



## Literature:

- van Steen, Tanenbaum: Distributed Systems, Published by Martin van Steen (previously published by Prentice Hall) (2017)
- Newman, Building Microservices, O'Reilly (2015/2021)
- Heckler, Spring Boot Up & Running, O'Reilly (2021)
- Friesen, Java Threads and the Concurrency Utilities, APress (2015)
- Gonzales, Mastering Concurrency Programming with Java 9, Packt Publishing (2017)
- Bullington-McGuire et al., Docker for Developers, Packt (2020).



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|--------------------------------------------------------------------|-------------------------------------|----------|--|
| Modul:                                                             | Sustainability Management           |          |  |
| Code:                                                              |                                     |          |  |
| Subtitle:                                                          |                                     |          |  |
| Course elements:                                                   | Lectures                            |          |  |
| Semester:                                                          | Every semester                      |          |  |
| Module coordinator:                                                | Prof. Dr. David Feierabend          |          |  |
| Lecturer:                                                          | Prof. Dr. David Feierabend          |          |  |
| Language:                                                          | English                             |          |  |
| Allocation to the curriculum:                                      | Compulsory subject, 5th semester    |          |  |
| Mode of teaching / semester hours per week (SWS):                  | Lecture:                            | 4 SWS    |  |
| Total hours:                                                       | Contact Hours:                      | 60 Hours |  |
|                                                                    | Independent study:                  | 90 Hours |  |
| Credits:                                                           | 5 ECTS                              |          |  |
| Prerequisites in accordance with examination regulations (StuPro): | None                                |          |  |
| Recommended prerequisites:                                         | None                                |          |  |
| Mode of assessment:                                                | Presentation, Continuous Assessment |          |  |

### Module objectives:

This course provides an introduction to sustainability management, the role of information technology in supporting corporate sustainability practices, and the growing importance of environmental, social, and governance (ESG) reporting for businesses. Students will learn about key sustainability challenges and opportunities, sustainable business models, ESG reporting frameworks, and the latest technological developments and innovations in the field of sustainability management. Students will understand how information technology can support sustainability management practices in a variety of areas, from data management to business model-specific applications to reporting.

### Learning outcomes:

Knowledge:

- Students will know the definition and principles of sustainability and sustainability management.
- They will be able to explain the business case for sustainability and relate it to the UN Sustainable Development Goals (SDGs)
- Students will understand the key challenges and opportunities of sustainability for businesses
- Students are familiar with sustainable business models and practices. They are familiar with the principles of circular economy and sustainable supply chain management.
- You can evaluate various ESG reporting frameworks and requirements and are familiar with their implementation in information systems
- Have knowledge of current technological developments and innovations in sustainability management, such as smart energy systems, intelligent transportation systems, and sustainable finance

#### Skills:

- Definition and principles of sustainability and sustainability management
- The business case for sustainability
- The role of public policy and regulation in sustainability management
- The UN Sustainable Development Goals (SDGs) and how companies can contribute to them
- Stakeholder engagement and corporate social responsibility (CSR)
- Circular economy principles and practices
- ESG reporting & metrics systems
- Life cycle assessment and sustainability metrics
- Challenges in practice: sustainability reporting and data management
- Use cases and IT systems: environmental management systems, energy management, building design, transportation, etc.

#### Competencies:

- Students are able to classify their acquired knowledge in a professional manner, to explain correlations and to apply them in professional practice. In doing so, the lecture lays the foundations for an activity in the environment of sustainability management or in the development of IT systems to meet sustainability requirements.
- Students are able to familiarize themselves with new areas of sustainability in general and deal with the requirements of new ESG standards in particular.
- In addition, the students have models and frameworks to analyze sustainability issues in the company and to develop solutions.
- They are able to take on leadership roles in sustainability issues and to communicate the relevance and consequences of sustainability-oriented corporate management to stakeholders.

#### Contents

- Definition and principles of sustainability and sustainability management



- The business case for sustainability
- The role of public policy and regulation in sustainability management
- The UN Sustainable Development Goals (SDGs) and how companies can contribute to them
- Stakeholder engagement and corporate social responsibility (CSR)
- Circular economy principles and practices
- ESG reporting & metrics systems
- Life cycle assessment and sustainability metrics
- Challenges in practice: sustainability reporting and data management
- Use cases and IT systems: environmental management systems, energy management, building design, transportation, etc.

## Media forms

Lecture, exercises and case studies

## Literature

- Combe, C. (2022). Introduction to global sustainable management. SAGE.
- GRI Standards: <https://www.globalreporting.org/how-to-use-the-gri-standards/gri-standards-english-language/>
- Further readings will be announced during the lecture



|                                                                    |                                                  |          |  |
|--------------------------------------------------------------------|--------------------------------------------------|----------|--|
| Modul:                                                             | Internetworking                                  |          |  |
| Code:                                                              | mkiB35                                           |          |  |
| Subtitle:                                                          | Network and Protokols                            |          |  |
| Course elements:                                                   | Lectures                                         |          |  |
| Semester:                                                          | Every semester                                   |          |  |
| Module coordinator:                                                | Prof. Dr. Marcus Schöller                        |          |  |
| Lecturer:                                                          | Prof. Dr. Marcus Schöller                        |          |  |
| Language:                                                          | German, English                                  |          |  |
| Allocation to the curriculum:                                      | Compulsory subject, 3rd semester                 |          |  |
| Mode of teaching / semester hours per week (SWS):                  | Lecture:                                         | 4 SWS    |  |
| Total hours:                                                       | Contact Hours:                                   | 60 Hours |  |
|                                                                    | Independent study:                               | 90 Hours |  |
| Credits:                                                           | 5 ECTS                                           |          |  |
| Prerequisites in accordance with examination regulations (StuPro): | None                                             |          |  |
| Recommended prerequisites:                                         | None                                             |          |  |
| Mode of assessment:                                                | Lecture: Written examination, Practical sessions |          |  |

### Module objectives:

This module equips students with knowledge about the Internet's infrastructure and communication protocols. Students have already gained an initial insight into programming web applications in the Informatics 2 module. This is used as a basis for discussing the main Internet protocols on all layers and classifying them within the ISO/OSI reference model. At the same time, students are introduced to the hardware that is used in this context, all the way through to Ethernet wiring.

This module lays the foundations for subsequent modules, including Distributed Systems and IT Security in the 4th semester of the degree programme, as well as Mobile Computing and Cloud Computing in the 6th semester.

### Learning outcomes:

#### Knowledge:

- Be able to name the layers and tasks of the ISO/OSI reference model, as well as the



TCP/IP model.

- Be able to name typical Internet protocols (such as HTTP, FTP, SMTP, SNMP, DNS, TCP, UDP, IP, ICMP, DHCP, ARP, CSMA/CD, CSMA/CA, TDMA, Ethernet and WLAN), be able to describe their functions and protocol headers, and be able to categorise protocols into the reference model layers.
- Be able to explain the stop-and-wait algorithm and the sliding window algorithm.
- Be able to describe overload control methods in TCP.
- Be familiar with various types of framing (byte count method, sentinel method).
- Be able to name and describe basic terminology and processes associated with error detection (Hamming distance, parities, CRC).
- Be able to reproduce modulation types and typical coding methods (such as NRZ, NRZI and Manchester).
- Be familiar with performance parameters for networks.
- Be able to name typical transfer modes, network topologies and their properties. Be able to specify the hardware involved in an Internet infrastructure (such as routers, switches and hubs) and describe how it works.
- Be able to explain the hidden node problem and potential solutions (MACA and MACAW).

Skills:

- Be able to structure communication in multi-tier architectures, from the database server, to the application and web server, all the way through to the client.
- Be able to structure home and intranet computer connections to the Internet.
- Be able to program socket connections and simple client-server applications in Java.
- Be able to calculate examples of distance vector routing, link state routing and the spanning tree algorithm on the basis of a graph.
- Be able to outline routing between various subnets and calculate Ethernet subnetwork masks.
- Be able to log and evaluate Internet communication using a sniffer.

Competencies:

After completing this module, students will be able to do the following:

| LO# | Learning outcome (LO)                                                                                                                                                                                                                                                                                                                                                                           | Assessed through    |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| LO1 | Analyse known and new protocols and network technology, and categorise them within the ISO/OSI and TCP/IP reference models. As a result, collect and interpret data packets.<br>Understand the tasks of typical protocols at application level to such an extent that they are able to contextualise and evaluate the functions of other protocols. Design and evaluate simple infrastructures. | Written examination |
| LO2 | Evaluate the applications to which TCP or UDP is better suited. Discuss the properties and algorithms associated with protocols, and implement their own small-scale applications using socket programming.                                                                                                                                                                                     | Written examination |

|     |                                                                                                                                                                                                                      |                     |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| L03 | Understand typical network layer protocols and their tasks, and evaluate the applications associated with them. Design and calculate subnetworks. Use routers and apply various routing protocols based on examples. | Written examination |
| L04 | Be familiar with and apply typical processes and parameters for enclosing the payload in frames. Discuss the meaning of framing and describe the hardware associated with it.                                        | Written examination |
| L05 | Discuss the conversion of data (frames) into electronic signals and vice versa, and discuss commonly used transfer modes and network topologies, plus the properties and problems associated with them.              | Written examination |

## Content:

This module picks up at the point where students left off in Informatics 2 and Informatics 3, in which they gained their first experience of programming web applications. Starting from the application layer and working all the way through to management level, it presents and analyses typical Internet protocols, algorithms, processes and hardware.

The first stage involves presenting the TCP/IP and ISO/OSI reference model [Stein 2004] as well as typical application layer protocols, such as HTTP, FTP, SMTP, SNMP and DNS [Kurose, Ross 2012]. In this context, students are shown the Wireshark sniffing software [Wireshark 2013] and intercept their first examples of HTTP and FTP data between a server and a client. With the students' participation, typical network structures such as 3-tier and 4-tier architectures are developed and a typical home network with DSL and WLAN routers is structured (L01).

Students are then shown the TCP and UDP protocols, plus the differences between them. In this context, the module explains the three-way handshake, stop-and-wait transmission, and the sliding window algorithm, as well as TCP overload control [Tanenbaum 2003]. Socket programming is presented in Java in order to demonstrate practical applications [Calvert, Donahoo 2008] (L02).

On the next-lowest protocol layer, the module presents IP, ICMP, DHCP and ARP, and analyses them using Wireshark. This involves a description of routers as hardware, the formation of subnetworks, plus distance vector routing, link state routing and the spanning tree algorithm as routing methods [Tanenbaum 2003] (L03).

The module also looks at Ethernet frames, types of framing as well as basic error detection terminology and methods on the bit transmission layer, the data link layer and the Ethernet layer [Tanenbaum 2003]. It presents switches and hubs as types of hardware that can be used in this context, and demonstrates how they work [Kurose, Ross 2012] (L04).

Where transmitting data between various devices is concerned, the module discusses the main transmission methods and network topologies, along with their properties and basic modulation and coding methods [Stein 2004]. Additionally, performance parameters are defined for networks and calculated using typical examples [Tanenbaum 2003]. Finally, the module takes a brief look at wireless transmission using WLAN, the standards associated with this, and the hidden node problem plus its potential solutions [Tanenbaum 2003] (L05).



#### Forms of media:

- Teaching in seminar format with PC-based projection and slides, plus demonstration of analysing data sent via a network. The slides are made available to download at the start of the module.
- Information is written on the board to help students gain an understanding of communication via a network.

#### Literature:

- Calvert, Kenneth L.; Donahoo, Michael J. (2008): TCPIP sockets in Java. Practical guide for programmers. 2nd ed. Amsterdam, Heidelberg: Morgan Kaufmann (The Morgan Kaufmann Practical Guides Series).
- Kurose, James F.; Ross, Keith W. (2012): Computernetzwerke. Der Top-Down-Ansatz. 5th edition, updated. Munich: Pearson (Always Learning).
- Peterson, Larry L.; Davie, Bruce S. (2000): Computernetze. Ein modernes Lehrbuch. 1st edition. Heidelberg: Dpunkt-Verl.
- Tanenbaum, Andrew S. (2003): Computernetzwerke. 4th edition, revised. Munich: Pearson (Pearson Studium).
- Stein, Erich (2004): Taschenbuch Rechnernetze und Internet. Mit ... 105 Tabellen. 2nd edition, revised. Munich: Fachbuchverlag Leipzig.
- WireShark Network Sniffer: <<http://www.wireshark.org/>>



|                                                                    |                                                  |          |  |
|--------------------------------------------------------------------|--------------------------------------------------|----------|--|
| Modul:                                                             | Computer Graphics                                |          |  |
| Code:                                                              | mkiB46                                           |          |  |
| Subtitle:                                                          |                                                  |          |  |
| Course elements:                                                   | Lectures and Practical sessions                  |          |  |
| Semester:                                                          | Every semester                                   |          |  |
| Module coordinator:                                                | Prof. Dr. Uwe Kloos                              |          |  |
| Lecturer:                                                          | Prof. Dr. Uwe Kloos                              |          |  |
| Language:                                                          | German, English (if required)                    |          |  |
| Allocation to the curriculum:                                      | Compulsory subject, 4th semester                 |          |  |
| Mode of teaching / semester hours per week (SWS):                  | Lecture:                                         | 4 SWS    |  |
| Total hours:                                                       | Contact Hours:                                   | 60 Hours |  |
|                                                                    | Independent study:                               | 90 Hours |  |
| Credits:                                                           | 5 ECTS                                           |          |  |
| Prerequisites in accordance with examination regulations (StuPro): | None                                             |          |  |
| Recommended prerequisites:                                         | None                                             |          |  |
| Mode of assessment:                                                | Lecture: Written examination, Practical sessions |          |  |

### Module objective:

The aim of this module is to raise students' awareness of subjects relating to computer graphics, as well as enable them to develop and understand 3D graphics programs. Building on the media-related Graphics, Audio and Video modules and allowing students to use the skills they have acquired in these, this module examines computer-based 3D graphics processes. A pass in this module will ensure students can go on to develop graphics programs as well as understand and operate graphics applications in the next stage of their studies.

### Learning outcomes:

#### Knowledge:

- Students are familiar with the mathematical basis for calculating transformations of three-dimensional objects as well as various vector operations.

- They are familiar with the graphics pipeline and the various methods used within this pipeline.
- They are able to name local and global lighting techniques and know the differences between them.
- They are familiar with a range of texturing methods and are able to apply them to 3D objects.
- They are familiar with various modelling methods and are able to create complex 3D worlds on the basis of simple objects.
- They are able to name various methods of swapping objects in 3D worlds and are aware of the advantages and disadvantages of doing so.
- They know the difference between static images and dynamic animations, and are able to name and use various control mechanisms for generating an animation.

#### Skills:

Students calculate transformations independently, are able to evaluate the mathematical methods used in computer graphics, and are able to construct their own processes on this basis. Additionally, they are able to analyse a specific challenge in the area of computer graphics and evaluate existing algorithms in a way that allows them to select the methods which will produce an efficient solution. They also develop these solutions with performance taken into consideration, and are able to analyse and evaluate graphics applications with respect to this. As well as this, they are able to work with a standard graphics tool and create simple animations.

#### Competencies:

After completing this module, students will be able to do the following:

| LO# | Learning outcome (LO)                                                                              | Assessed through              |
|-----|----------------------------------------------------------------------------------------------------|-------------------------------|
| L01 | Manually calculate transformations of 3D objects in homogeneous coordinates and vector operations. | Written examination, artifact |
| L02 | Understand and implement a freely available graphics library.                                      | Artifact                      |
| L03 | Apply acquired knowledge independently                                                             | L03                           |
| L04 | Analyse the processes used in graphics applications and evaluate their benefits and drawbacks.     | Written examination           |
| L05 | Use professional modelling and animation tools to create 3D models and animations.                 | Artifact                      |
| L06 | Assess problems and limitations arising from the development of graphics applications.             | Artifact                      |
| L07 | Assess own developments and abilities.                                                             | Artifact                      |
| L08 | Evaluate and grasp current developments in computer graphics.                                      | Artifact                      |

## Content:

This module introduces students to the subject of computer graphics and related areas (animation, visualisation). In each case, there is a theory component that examines and discusses selected topics in detail. This focuses on teaching standard algorithms and principles. This theoretical knowledge is then put into practice in small exercise units, and students develop their own graphics programs on the basis of a standardised graphics library. The module examines fundamental techniques and procedures, from model to image (transformations, projections, visibility testing, colouring and rasterisation). It also considers subject areas such as modelling, local and global lighting, and textures. During the practical stage, tools used in the industry are deployed so that students are given hands-on experience.

## Forms of media:

The teaching material consists of slide notes distributed in electronic format and made available via a central server, plus an introduction to OpenGL. The module consists of lectures plus accompanying practical sessions. Teaching is conducted in a seminar format, with theoretical content illustrated using multimedia examples. Either individually or in groups, students work through various exercises on the subject of computer graphics. Through practical exercises, the module starts by exploring the mathematical methods that form the basis of transformations. Following this, several exercise units gradually build up a complex graphical application based on an open-source graphics library. Basic procedures for modelling and animation techniques are also discussed and implemented in a practical project. The practical stage ensures that tools used in the industry are applied. The lecturer supervises the programming exercises and the animation project.

## Literature:

- Angel, Edward (2006): Interactive computer graphics. A top-down approach using OpenGL. 4th ed., internat. ed. Boston, Mass., Munich: Pearson Addison-Wesley.
- Bender, Michael; Brill, Manfred (2006): Computergrafik. Ein anwendungsorientiertes Lehrbuch. 2nd edition, updated. Munich, Vienna: Hanser.
- Nischwitz, Alfred; Haberäcker, Peter (2004): Masterkurs Computergrafik und Bildverarbeitung. Alles für Studium und Praxis; Bildverarbeitungswerkzeuge Beispiel-Software und interaktive Vorlesungen online verfügbar. 1st edition. Wiesbaden: Vieweg.
- Watt, Alan H. (2005): 3D computer graphics. 3rd ed. [repr.]. Harlow: Addison-Wesley.
- Students will be informed of other in-depth sources of literature during the course.



|                                                                    |                                  |          |  |
|--------------------------------------------------------------------|----------------------------------|----------|--|
| Modul:                                                             | Mobile Computing                 |          |  |
| Code:                                                              | mkiB44                           |          |  |
| Subtitle:                                                          |                                  |          |  |
| Course elements:                                                   | Lectures and practical sessions  |          |  |
| Semester:                                                          | Every semester                   |          |  |
| Module coordinator:                                                | Prof. Dr. Natividad Martinez     |          |  |
| Lecturer:                                                          | Prof. Dr. Natividad Martinez     |          |  |
| Language:                                                          | German, English                  |          |  |
| Allocation to the curriculum:                                      | Compulsory subject, 4th semester |          |  |
| Mode of teaching / semester hours per week (SWS):                  | Lecture:                         | 4 SWS    |  |
| Total hours:                                                       | Contact Hours:                   | 60 Hours |  |
|                                                                    | Independent study:               | 90 Hours |  |
| Credits:                                                           | 5 ECTS                           |          |  |
| Prerequisites in accordance with examination regulations (StuPro): | None                             |          |  |
| Recommended prerequisites:                                         | None                             |          |  |
| Mode of assessment:                                                | Lecture: Continuous assessment   |          |  |

### Module objectives:

Mobile Computing provides an introduction to the subject of distributed and mobile systems. The aim of this module is to familiarise students with the principles of mobile communication networks and enable them to use key pieces of technology when developing mobile applications. The module builds on knowledge that students have already learned on the subjects of web programming (in Distributed Systems) and computer networks (in Internetworking), and also relates to aspects of IT security.

### Learning outcomes:

#### Knowledge:

Students acquire knowledge of the ways in which protocols for mobile applications work, on the basis of the Internet. They learn which requirements these applications impose and how they are met by protocols and services on lower levels.



Additionally, they acquire basic knowledge of mobile computing and learn about typical scenarios and tasks in the process. They are able to describe execution platforms and are familiar with supporting technology.

They are familiar with the principles underpinning the Internet of Things, and the main properties of sensors and sensor networks.

#### Skills:

Students apply the knowledge they have acquired on the subject of mobile applications to independent work in which they create solutions to exercises. They learn how to use hardware and software-based analysis tools, and how to track communication processes at protocol level.

They compare various mobile operating systems and execution platforms with regard to defined requirements. They program solutions to problems on typical platforms, such as smartphones, tablet PCs, embedded systems, and so on. Additionally, they plan the integration of sensors and sensor networks, and develop applications (which may be environment-dependent).

#### Competencies:

After completing this module, students will be able to do the following:

| LO# | Learning outcome (LO)                                                                                                       | Assessed through    |
|-----|-----------------------------------------------------------------------------------------------------------------------------|---------------------|
| L01 | Analyse and evaluate various mobile technologies.                                                                           | Written examination |
| L02 | Develop proposals for solutions to example scenarios based on the mobile technologies they have become familiar with.       | Practical sessions  |
| L03 | Design a mobile application with certain requirements and basic conditions taken into account.                              | Project work        |
| L04 | Work in a team in order to find solutions to complex tasks.                                                                 | Project work        |
| L05 | Use state-of-the-art development environments and tools.                                                                    | Project work        |
| L06 | Research and evaluate information about current developments in mobile computing, and communicate it on a scientific level. | Report              |
| L07 | Capably present and discuss subject areas relating to the discipline of mobile computing, using specialist language.        | Presentation        |

#### Content:

Mobile Computing is divided into three main areas: mobile communication, programming mobile applications, and the Internet of Things. The discussion of this content is designed to cover an extremely wide scope and maintains a focus on applications. For this reason, a continuous assessment format has been chosen, allowing students' progress to be tracked using various artifacts. A theory-based introduction is provided for each area; a certification process is used to test students' understanding of this (L01), together with exercises (L02) that the students work through either alone or in groups. This is followed by practical laboratory tasks (L05) that are carried out in groups and combined as a project (L03, L04). The second half of the module requires students to prepare an assignment on a current topic within the discipline (L06) and present their findings (L07). The subject areas are:

1. Principles of mobile communication: wireless and mobile networks [Schiller].
2. Programming mobile applications: introduction to web app programming with HTML5 and native apps in Android, iOS, Windows Phone and QNX. Advanced programming in Android [Meier].
3. Introduction to the Internet of Things [Kalin] [Ewen].





### Forms of media:

The forms of media differ according to the content and the competencies that are being developed in students. Some subject areas use conventional slide notes that are projected and then explained, illustrated and expanded upon using the board. Either individually or in groups, students work on and present topics in a seminar format, using selected reference sources. The module consists of lectures plus accompanying practical sessions. Students receive information on the installation and system requirements, and must then develop system prototypes under the supervision of lecturers in the laboratory.

### Literature:

- McEwen, Adrian; Cassimally, Hakim (2013): Designing the Internet of Things. Online-Ausg. Hoboken: Wiley (EBL-Schweitzer). Available online at <http://swb.eblib.com/patron/FullRecord.aspx?p=1471865>.
- Meier, Reto (2012): Professional Android 4 application development. Indianapolis, Ind.: Wiley (Programmer to programmer).
- Poslad, Stefan (2009): Ubiquitous computing. Smart devices environments and interactions. 1. publ. Chichester: Wiley.
- Schiller, Jochen H. (2003): Mobile communications. 2nd ed. London: Addison-Wesley.
- Additionally, current articles from specialist journals and conferences as well as Internet resources.



|                                                                    |                                                                      |          |  |
|--------------------------------------------------------------------|----------------------------------------------------------------------|----------|--|
| Modul:                                                             | Internet of Things IoT)                                              |          |  |
| Code:                                                              | MKIB111                                                              |          |  |
| Subtitle:                                                          |                                                                      |          |  |
| Course elements:                                                   | Lecture, Practical course                                            |          |  |
| Semester:                                                          | Only in summer                                                       |          |  |
| Module coordinator:                                                | Prof. Dr. Natividad Martinez                                         |          |  |
| Lecturer:                                                          | Prof. Dr. Natividad Martinez                                         |          |  |
| Language:                                                          | Germann, English                                                     |          |  |
| Allocation to the curriculum:                                      | Media and Communication Informatics,<br>Bachelor's program, Elective |          |  |
| Mode of teaching / semester hours per week (SWS):                  | Lecture with integrated practical exercises, 4SWS                    |          |  |
| Total hours:                                                       | Contact Hours:                                                       | 60 Hours |  |
|                                                                    | Independent study:                                                   | 90 Hours |  |
| Credits:                                                           | 5 ECTS                                                               |          |  |
| Prerequisites in accordance with examination regulations (StuPro): | None                                                                 |          |  |
| Recommended prerequisites:                                         | Internetworking, Mobile Computing                                    |          |  |
| Studien-/Prüfungsleistungen/<br>Prüfungsform:                      | Project work                                                         |          |  |

### Module objectives:

The **Internet of Things (IoT)** refers to new ecosystems in which various objects equipped with embedded computing and communication capabilities can interact with each other and with users.

The aim of this module is to introduce students to the fundamentals of IoT technologies and applications and to apply them through the development of a dedicated IoT project. This includes familiarization with embedded systems and their software, sensors, communication protocols, operating systems, and software development environments.

### Learning outcomes

#### Knowledge:

- Principles and requirements of ubiquitous systems
- IoT architectures for data acquisition and aggregation
- Characteristics of sensors and actuators for interacting with the environment and users
- Basic hardware and software platforms for IoT systems

- Data integration through IoT-cloud connectivity
- Domain-specific business models enabled by IoT: Industry 4.0, Automotive, Healthcare
- Web of Things as an integrative communication platform

**Skills:**

Students are able to design and develop new systems and products using IoT technologies. They can plan cross-layer architectures, select and deploy appropriate hardware, software, and communication protocols, and integrate networked information.

**Competencies:**

Upon successful completion of the module, students will be able to:

| LO# | Learning Outcome (LO)                                                                                            | Assessed Through             |
|-----|------------------------------------------------------------------------------------------------------------------|------------------------------|
| L01 | Apply IoT application design principles                                                                          | Project work (documentation) |
| L02 | Define and analyze IoT system requirements                                                                       | Project work (documentation) |
| L03 | Develop a prototype IoT application (including sensors, hardware, software, communication, and data integration) | Project work                 |
| L04 | Use modern development environments and tools                                                                    | Project work                 |
| L05 | Work collaboratively in teams to solve complex tasks                                                             | Project work                 |
| L06 | Present and discuss IoT solutions using technical language                                                       | Project work (presentation)  |
| L07 | Evaluate the feasibility and business relevance of IoT solutions                                                 | Project work (peer review)   |

**Content:**

The lecture introduces the foundations of the Internet of Things (IoT). It includes seminarstyle instruction with integrated exercises that prepare students to design their own IoT solution within a team project (L05). Students learn about design principles and architectures for IoT (L01), the particular requirements of IoT systems (L02), and core technologies such as sensors and actuators, communication protocols, embedded systems, and integration of networked information (L03). In addition, they become familiar with typical development methods, environments, and tools (L04). Students present their project outcomes (L06) and evaluate the approaches of other teams through peer review (L07)

**Covered Topics:**

- Introduction to IoT: Design principles and requirements
- Data acquisition and interaction via sensors and actuators
- IoT architectures, communication networks, and protocols
- From computers to smart objects via embedded systems
- IoT applications and development methods
- IoT platforms for integration with other information systems
- Web of Things (WoT)

**Forms of media:**

Depending on content and learning objectives, various media are used. Some topics are taught



using slide presentations (projected via beamer) and explained or illustrated using the

blackboard. The module includes a lecture with integrated exercises. Students receive guidance on system installation and requirements, and develop prototype solutions in the lab under instructor supervision. They then apply the acquired competencies in a team project and present their results.

The lecture is part of the **“International Program”** of the Faculty of Computer Science and is conducted in English. Assessments may be submitted in **German and/or English**.

#### Literature:

- Greengard, Samuel (2015): *The Internet of Things* (MIT Press Essential Knowledge Series). ISBN: 9780262527736
- Mattern, F., Flörkemeier, Ch. (2010): *Vom Internet der Computer zum Internet der Dinge*. Informatik Spektrum, Vol. 33, no. 2, pp. 107–121
- Porter, M.E., Heppelmann, J.E. (2014): *How Smart, Connected Products Are Transforming Competition*. Harvard Business Review 92, no. 11, pp. 64–88
- Weiser, M.: *The Computer for the 21st Century*
- Additional current journal and conference articles, and online resources



|                                                                    |                                                  |          |  |
|--------------------------------------------------------------------|--------------------------------------------------|----------|--|
| Modul:                                                             | Cloud Computing                                  |          |  |
| Code:                                                              | mkiBXXX                                          |          |  |
| Subtitle:                                                          |                                                  |          |  |
| Course elements:                                                   | Lectures and ractical sessions                   |          |  |
| Semester:                                                          | Every semester                                   |          |  |
| Module coordinator:                                                | Prof. DrMarcus Schöller                          |          |  |
| Lecturer:                                                          | Martin Henke                                     |          |  |
| Language:                                                          | German, English                                  |          |  |
| Allocation to the curriculum:                                      | Elective Module, 6th semester                    |          |  |
| Mode of teaching / semester hours per week (SWS):                  | Lecture:                                         | 4 SWS    |  |
| Total hours:                                                       | Contact Hours:                                   | 60 Hours |  |
|                                                                    | Independent study:                               | 90 Hours |  |
| Credits:                                                           | 5 ECTS                                           |          |  |
| Prerequisites in accordance with examination regulations (StuPro): | None                                             |          |  |
| Recommended prerequisites:                                         | None                                             |          |  |
| Mode of assessment:                                                | Lecture: Written examination, Practical sessions |          |  |

### Module objectives:

Nowadays, mobile computing and cloud computing depend on one another. Participants in this module are required to gain comprehensive knowledge of designing, developing and operating distributed applications, with a focus on the basic forms that cloud services and their delivery models take. This requires them to possess the knowledge taught by the prerequisites listed above. The Distributed Systems module provides the general foundations for web programming and web services.

### Learning outcomes:

#### Knowledge:

Students who have successfully completed this module will possess knowledge of the principles and characteristics of cloud computing. They will be able to describe typical services and delivery models, and evaluate them on the basis of case studies. They will have developed an understanding of the technical, organisational, commercial, legal, social and security-related aspects of cloud computing.

#### Skills:

Students are able to analyse the requirements of server services as well as develop and evaluate appropriate deployment variants. These variants range from in-house server solutions to hybrid cloud models and all the way through to straightforward cloud solutions. To do so, they apply a range of methods they have learned. Based on these requirements, students are able to develop services that use the characteristics of the cloud. Additionally, students are able to install and operate servers and cloud systems, which enables them to perform a more in-depth comparison of the various deployment variants. As a result, students are able to perform full-scale analyses and evaluations, and thus make technical decisions for service provision purposes.

#### Competencies:

| LO# | Learning outcome                                                                                       | Assessed through    |
|-----|--------------------------------------------------------------------------------------------------------|---------------------|
| L01 | Possess and be able to apply an understanding of the various cloud business models (IaaS, PaaS, SaaS). | Written examination |
| L02 | Be able to correlate components with their tasks in a cloud architecture.                              | Written examination |
| L03 | Understand and be able to evaluate the operational aspects of a cloud infrastructure.                  | Written examination |
| L04 | Understand and be able to apply methods used in software development.                                  | Written examination |

#### Content:

Building on the Distributed Systems module, this module takes an in-depth look at some of the paths of development that led to cloud computing, specifically the use of TP monitors and application servers, the use of virtualisation technology, and grid computing.

The module presents the service models Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS) from a provider's perspective and a user's perspective. The focus is on software development for the cloud and how a cloud system is operated. Students are taught about the public cloud, private cloud, hybrid cloud and community cloud delivery models on the basis of case studies. This focuses on how the models relate to mobile applications. The module considers, evaluates and discusses the technical, organisational, commercial, legal, social and security-related aspects of cloud computing in detail.

#### Forms of media:

Lectures in seminar format; slides and writing on the board; case study work in small groups.

#### Literature:

- Antonopoulos, Nick; Gillam, Lee (2010): Cloud Computing. Principles, Systems and Applications. London: Springer London (SpringerLink: Bücher, 0).
- Baun, Christian; Kunze, Marcel; Nimis, Jens; Tai, Stefan (2011): Cloud Computing. Web-basierte dynamische IT-Services. Berlin, Heidelberg: Springer Berlin Heidelberg (SpringerLink: Bücher).
- Buyya, Rajkumar (2011): Cloud computing. Principles and paradigms. Hoboken, NJ: Wiley (Wiley Series on Parallel and Distributed Computing).
- Velte, Anthony T.; Velte, Toby J.; Elsenpeter, Robert C. (2010): Cloud computing. A practical approach. New York, NJ: McGraw-Hill.



|                                                                           |                                                                                                         |          |
|---------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|----------|
| <b>Modul:</b>                                                             | Development of Smart Textiles                                                                           |          |
| <b>Code:</b>                                                              | MKIBXX                                                                                                  |          |
| <b>Subtitle:</b>                                                          |                                                                                                         |          |
| <b>Course elements:</b>                                                   | Lectures                                                                                                |          |
| <b>Semester:</b>                                                          | Each semester                                                                                           |          |
| <b>Module coordinator:</b>                                                | Prof. Dr. Natividad Martinez                                                                            |          |
| <b>Lecturer:</b>                                                          | Prof. Dr. Natividad Martinez (INF)<br>Prof. Dr.-Ing.Klaus Meier (TEX)<br>Prof. Dr. Torsten Textor (TEX) |          |
| <b>Language:</b>                                                          | English                                                                                                 |          |
| <b>Allocation to the curriculum:</b>                                      | Media and Communication Informatics<br>Bachelor's elective 2. 7th semster                               |          |
| <b>Mode of teaching / semester hours per week (SWS):</b>                  | Lecture:                                                                                                | 2SWS     |
|                                                                           | Practical training:                                                                                     | 2 SWS    |
| <b>Total hours:</b>                                                       | Contact Hours:                                                                                          | 60 Hours |
|                                                                           | Independent study:                                                                                      | 90 Hours |
| <b>Credits:</b>                                                           | 5 ECTS                                                                                                  |          |
| <b>Prerequisites in accordance with examination regulations (StuPro):</b> | None                                                                                                    |          |
| <b>Recommended prerequisites:</b>                                         | Software Engineering 1 + 2, Distributed Systems,<br>Mobile Computing                                    |          |
| <b>Studien-/Prüfungsleistungen/<br/>Prüfungsform:</b>                     | Documentation, presentation, project work                                                               |          |

### Module objectives:

The course 'Development of Smart Textiles' introduces the topic of intelligent and networked textiles (smart textiles). The aim of the module is for students to learn about the structure of smart textiles and to be able to carry out a development process for them. To this end, students work together in interdisciplinary teams.

### Learning outcomes

#### Knowledge:

Students acquire knowledge about the structure of smart textiles. They learn about the development cycle of functional patterns. They are able to organise a development project for a new product. They are able to define the requirements for the product and conduct an initial market study. They can organise a team and delegate tasks necessary for development. They learn to work with microcontrollers and realise a prototype. The input-processing-output principle is made tangible. They learn about further interaction



possibilities with smart textiles using mobile apps. They understand the importance of accurate documentation. They are able to organise an experimental plan and work according to it. They can present the results. Smart textiles are analysed in the context of the Internet of Things.

#### Skills:

Students apply the knowledge they have acquired about the development cycle to their own project. They develop their own software for microcontrollers (e.g. Arduino). They select suitable sensors and actuators for their project and develop appropriate algorithms. They design basic mobile applications to interact with SmartTextiles. Students work on the project in an interdisciplinary manner, learning to communicate with non-computer science team members.

#### Competencies:

After completing the module, students will be able to:

| LOE# | Learning Outcome (LO)                                                                                                                          | Assessed Through |
|------|------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| LO1  | Creating a project idea                                                                                                                        | Project work     |
| LO2  | Carrying out development for smart textiles                                                                                                    | Project work     |
| LO3  | Working in an interdisciplinary team to solve complex tasks                                                                                    | Project work     |
| LO4  | Developing microcontroller programmes and mobile apps                                                                                          | Project work     |
| LO5  | Independently searching for, evaluating and scientifically communicating information about current developments in the field of smart textiles | Elaboration      |
| LO6  | Competently presenting and discussing topics in the field of smart textiles using technical language                                           | Presentation     |

#### Content:

- Fundamentals of project management
- Generating ideas
- Feasibility analysis
- Experiment planning
- Fundamentals of
- Textile technology and textile finishing
- Computer science
- Fundamentals of microcontrollers and embedded systems
- Sensors and actuators in a textile context
- Fundamentals of development and interaction with mobile apps
- Development work on your own smart textile prod

#### Literature:

- Textiles and textile products – smart textiles – definitions, classification, applications and standardisation requirements; German version cen/tr 16298:2011, February 201
- Make: Wearable electronics: [design, prototype, and wear your own interactive garments] / Kate Hartman. - 1st ed. - Sebastopol, Calif.: Maker Media, 2014. - XVIII, 257 pages: ill., gra

#### Modul:

#### Secure Software Development





|                                                                           |                                                                                |          |  |
|---------------------------------------------------------------------------|--------------------------------------------------------------------------------|----------|--|
| <b>Code:</b>                                                              | MKIBW102                                                                       |          |  |
| <b>Subtitle:</b>                                                          |                                                                                |          |  |
| <b>Course elements:</b>                                                   | Lectures<br>Practical work                                                     |          |  |
| <b>Semester:</b>                                                          | Each semester                                                                  |          |  |
| <b>Module coordinator:</b>                                                | Prof. Dr. Christian Kücherer                                                   |          |  |
| <b>Lecturer:</b>                                                          | Many different persons                                                         |          |  |
| <b>Language:</b>                                                          | English                                                                        |          |  |
| <b>Allocation to the curriculum:</b>                                      | Media and Communication Informatics<br>Bachelor's elective 2. 6th/7th semester |          |  |
| <b>Mode of teaching / semester hours per week (SWS):</b>                  | Lecture:                                                                       | 2SWS     |  |
|                                                                           | Practical training:                                                            | 2 SWS    |  |
| <b>Total hours:</b>                                                       | Contact Hours:                                                                 | 60 Hours |  |
|                                                                           | Independent study:                                                             | 90 Hours |  |
| <b>Credits:</b>                                                           | 5 ECTS                                                                         |          |  |
| <b>Prerequisites in accordance with examination regulations (StuPro):</b> | None                                                                           |          |  |
| <b>Recommended prerequisites:</b>                                         | Informatics 3, Internetworking, IT-Security, Mobile Computing                  |          |  |
| <b>Mode of assessment:</b>                                                | Project work                                                                   |          |  |

### Module objectives:

The module *Secure Software Development* is based on the IT Security module and teaches strategies and procedures for developing and configuring secure systems. Based on the current threats to information technology systems taught in IT security the importance of the non-functional requirement of security as a cross-sectional topic in computer science. In this course, basic patterns are taught on how secure software can be created. Methods for the avoidance of security-critical vulnerabilities in software systems are considered. Highly available systems must be resistant to attacks that exploit security vulnerabilities in software. They also need diversity, redundancy, monitoring and other concepts. The basics of cryptography and the security infrastructure of the Internet are taught.

### Learning outcomes

#### Knowledge:

- Students know the challenges that are essential in the development of secure, fault-tolerant and highly available systems.
- They are familiar with various security patterns that are taken into account in software development to design and implement secure systems.



- Students can use cryptography, digital signatures and certificates to implement confidentiality, integrity and authentication.
- Students know the importance of security audits and security scanners.
- Students know the concepts of diversity, redundancy and fault tolerance

#### Skills:

- Students are able to avoid safety-critical errors when implementing software.
- Students are able to analyze existing systems at the source code and system architecture level with regard to safety-critical errors and correct them.
- Students can apply methods of fault tolerance and self-healing in software projects.

#### Competencies:

After completing the module, students will be able to:

| LOE# | Learning Outcome (LO)                                                                                     | Assessed Through               |
|------|-----------------------------------------------------------------------------------------------------------|--------------------------------|
| L01  | Principles of secure software development.                                                                | Project work                   |
| L02  | Application of security patterns                                                                          | Practical course               |
| L03  | Availability of applications, methods for high availability (availability engineering)                    | Written exam, practical course |
| L04  | Conducting security audits of a given system                                                              | Practical course               |
| L05  | Identification of security vulnerabilities in an application and approaches to hardening the application, | Practical course, written exam |

#### Content:

The lecture and exercise are divided into the learning units described above. First of all the principles of secure software development are discussed using practical examples (U2). This is done in the context of attack scenarios known from IT security. The examples used are a multi-layer Java web application with database such as the Java Pet Store. The students define the quality requirements for the application in accordance with ISO 25010 with a focus on security and availability and document them. Based on these requirements the necessary security patterns that need to be implemented in the application. Some of these are implemented by the students (U2).

A security audit is carried out on the basis of the now improved application (U4). In doing so, the application is also considered in terms of availability. This means that not only security-relevant properties are evaluated, but also the ability of the system as a whole to achieve the required availability is also assessed. The result is documented in a report documented together with a description of potential changes to improve the improvement of the application (U5).

The CAP theorem is discussed in this context. This states that for a system cannot guarantee the three properties of consistency, availability and failure tolerance at the same time. Methods are discussed on how high availability can be achieved through application design such as redundant microservices (U3).

Advanced topics include approaches that can be used to systematical ly improve the security and availability of applications. This includes, for example, the use of an ontology to determine requirements, or the introduction of suitable monitoring and logging.

#### Media Forms:

Seminar-style lecture, slides, blackboard. Practical course in the software development laboratory  
Documentation of experiences, procedures and results in the form of an internship report.



Literature:



|                                                                    |                                                                 |          |  |
|--------------------------------------------------------------------|-----------------------------------------------------------------|----------|--|
| Modul:                                                             | Instruction to Statistics and Biometrics                        |          |  |
| Code:                                                              | MTIB44                                                          |          |  |
| Subtitle:                                                          |                                                                 |          |  |
| Course elements:                                                   | Lectures                                                        |          |  |
| Semester:                                                          | Summer semester                                                 |          |  |
| Module coordinator:                                                | Prof. Dr. Oliver Burgert                                        |          |  |
| Lecturer:                                                          | Prof. Dr. Christian Thies                                       |          |  |
| Language:                                                          | German, English                                                 |          |  |
| Allocation to the curriculum:                                      | Medical Informatics (Bachelor), compulsory subject 6th semester |          |  |
| Mode of teaching / semester hours per week (SWS):                  | Lecture:                                                        | 4 SWS    |  |
| Total hours:                                                       | Contact Hours:                                                  | 60 Hours |  |
|                                                                    | Independent study:                                              | 90 Hours |  |
| Credits:                                                           | 5 ECTS                                                          |          |  |
| Prerequisites in accordance with examination regulations (StuPro): | None                                                            |          |  |
| Recommended prerequisites:                                         | MTIB11, MTIB12, MTIB13, MTIB14, MTIB21, MTIB22                  |          |  |
| Mode of assessment:                                                | Lecture: Inverted classroom<br>Private studies: project work    |          |  |

### Module objectives:

This module teaches the basic principles of statistics and how this discipline is applied in medical contexts. It places significant emphasis on relating mathematical concepts to practical scenarios. During the module, students create their own questionnaire and use methods they have learned to evaluate it. This involves considering not only theoretical concepts associated with statistics, but also the many practical issues that arise when creating a study or questionnaire. The module also looks at potential solutions.

### Learning outcomes:

Knowledge:

Methods of descriptive statistics and data visualisation.

- Statistical terms such as probability, variance, mean, median and quantile.
- Conditional probability, Bayes' theorem and probability distribution.
- Estimators, density functions and tests.
- Regression.

Skills:

After completing this module, students will be able to contextualise statistical measured values and perform statistics-based investigations themselves. They will be able to perform analyses in the statistics software R, and create a statistical evaluation for a study or questionnaire. They will be able to design and carry out a study.

Competencies:

After completing this module, students will be able to do the following:

| LO# | Learning outcome (LO)                                                                                         | Assessed through                    |
|-----|---------------------------------------------------------------------------------------------------------------|-------------------------------------|
| L01 | Understand and contextualise statistical terms. Avoid common errors when interpreting statistical statements. | Private study projects/project work |
| L02 | Apply statistical methods and implement them in Python and R independently.                                   | Private study projects/project work |
| L03 | Design and implement a study.                                                                                 | Project work                        |
| L04 | Present study findings, including statistical evaluations, in written format.                                 | Project work                        |
| L05 | Follow a specialist presentation on mathematics in English.                                                   | Private study projects              |

Content:

The module consists of two interwoven elements, the first of which presents and discusses the basic principles of statistics and data evaluation from a theoretical perspective and on the basis of practical examples. Its subject matter looks at methods of descriptive statistics and data visualisation, statistical terms such as probability, variance, mean, median, quantile, conditional probability, Bayes' theorem, probability distribution, estimators, density functions, tests and regression. It focuses heavily on how the concepts relate to practical scenarios and how they are applied, generally dispensing with mathematical proof (L01, L02, L05).

The second element, running parallel to the first, teaches students practical applications through statistics programs (L02). It presents how a clinical study is structured and performed, which includes the structure of questionnaires, how questions are formulated, and so on (L03). Students then carry out a study in order to familiarise themselves with the practical issues that may arise in a scenario of this type (L04).

Forms of media:

Statistical theory is taught using the flipped classroom concept, with students attending the Introduction to Statistics course at Udacity Open Online University. The teaching content provided in this is divided into sections that the students have to complete in two-week blocks. The sections cover mathematical arithmetic tasks, concept-based questions and programming tasks in the programming language Python. The content of the blocks is then implemented and put into practice using examples, in contact time sessions of 4 SWS. Students work on specific aspects of applying statistical methods in medical applications and look at frequently encountered errors. The time also includes teaching knowledge of R, questionnaire and



studydesign, and how to consider specific issues in medical statistics, in seminar format using PowerPoint presentations and information written on the board. Parts are preprogrammed on a computer in both elements of the module.

#### Literature:

- <http://www.r-project.org/>
- <https://www.udacity.com/course/st101>



|                                                                    |                                                                      |          |
|--------------------------------------------------------------------|----------------------------------------------------------------------|----------|
| Modul:                                                             | Medical Information Systems                                          |          |
| Code:                                                              | MTIB65                                                               |          |
| Subtitle:                                                          |                                                                      |          |
| Course elements:                                                   | Lectures, Practical sessions                                         |          |
| Semester:                                                          | Summer semester                                                      |          |
| Module coordinator:                                                | Prof. Dr. Christian Thies                                            |          |
| Lecturer:                                                          | Prof. Dr. Christian Thies                                            |          |
| Language:                                                          | German                                                               |          |
| Allocation to the curriculum:                                      | Medical Informatics (Bachelor), compulsory subject 6th semester      |          |
| Mode of teaching / semester hours per week (SWS):                  | Lecture:                                                             | 2 SWS    |
|                                                                    | Practical session                                                    | 2 SWS    |
| Total hours:                                                       | Contact Hours:                                                       | 60 Hours |
|                                                                    | Independent study:                                                   | 90 Hours |
| Credits:                                                           | 5 ECTS                                                               |          |
| Prerequisites in accordance with examination regulations (StuPro): | None                                                                 |          |
| Recommended prerequisites:                                         | MTIB26 MTIB27, MTIB41, MTIB42, MTIB43 MTIB44, MTIB45, MTIB26, MTIB27 |          |
| Mode of assessment:                                                | Lecture: Project work                                                |          |

### Module objectives:

This module represents the first time that the skills learned in previous modules are brought together. Students learn which resources are actually involved in creating an information system. This involves learning the need to perform careful modelling at all levels of abstraction. An important goal of the module is for students to recognise that, although an information system does consist of components that are easy to understand, bringing them together creates a highly complex situation that it is no longer possible to follow intuitively. Students are expected to recognise and accept the value of careful and sustainable planning during the requirements analysis, design, implementation and setup stages, and to accept that an intuitive procedure might lead to unusable software that cannot be maintained. Additionally, they should recognise the need for standardised development and lifecycle management. In addition to becoming familiar with technical aspects, students must become aware that information systems inevitably require a constant merging of personal and sensitive data that may be used for purposes other than clinical care.



The required level of data protection must be taken into account as early as the implementation planning stage; that is, from the outset.

### Learning outcomes:

#### Knowledge:

Students learn the architecture of medical information systems and the special features that arise from various domains. The module looks at service providers such as hospitals, medical practices, laboratories and non-medical practices. Where service financiers are concerned, this relates to the billing systems used at health insurance companies. In institutions, it involves catalogues such as ICD10/DRG SNOMED and MeSH.

In particular, the module focuses on the logical combination of all data for model-supported therapy and personalised medicine in the form of a central electronic patient record. For this purpose, it presents the relevant interfaces and communication techniques, as well as data modelling and application integration. In addition to software distribution, it introduces frameworks for data security, persistence and service-oriented architectures.

#### Skills:

Students learn and apply the planning and development of components for complex, interactive systems. This involves applying methods from the fields of software engineering, distributed systems, IT security, process analysis and interface design. In addition to implementing the technical aspects, students apply organisational measures drawn primarily from requirements analysis and subsequent operation. Working as a team, students learn how to plan a larger piece of software, distribute tasks, implement tasks and pool the findings. The key component is role-based authorisation management and the division of data in the database so that the main aspects of data protection can be supported as effectively as possible, as early as the system design stage. In this context, students learn how to integrate access restrictions and organise all the access functions accordingly. Another fundamental technique that students are required to learn is data mapping for configuring and implementing interfaces between components.

#### Competencies:

The aim is to develop complete systems thinking across device and application borders, but at the same time to deliver a concrete implementation of a stand-alone application. The module puts into practice the relationship between independently developed components and partial applications of other developers. This includes efficiently standardised and structured communication for each component function and interface. Students demonstrate that they have acquired these competencies over the course of the semester by developing individual components in small groups, working in accordance with software engineering rules and combining their functions with applications developed by other groups. The artifact created is the software and the associated documentation for all the software engineering measures.

| LO# | Learning outcome (LO)                                                                                               | Assessed through |
|-----|---------------------------------------------------------------------------------------------------------------------|------------------|
| L01 | Be able to develop complete systems thinking across device and application borders                                  | Project work     |
| L02 | Be able to deliver a concrete implementation of a stand-alone application                                           | Project work     |
| L03 | Learn the relationship between independently developed components and partial applications of other developers      | Project work     |
| L04 | Understand and be able to design interfaces, as well as implement them using standardised methods and document them | Project work     |





|     |                                                                                           |              |
|-----|-------------------------------------------------------------------------------------------|--------------|
| L05 | Be familiar with the key concepts of information systems and implement them in components | Project work |
|-----|-------------------------------------------------------------------------------------------|--------------|

### Content:

This module presents the components of medical information systems, such as patient data management, laboratory value storage, authorisation management, results management, rawdata storage, and so on. Groups are then formed, with each working on a component over the course of the semester. At specified deadlines, interim findings are presented on the basis of the V-Model used in software engineering.

The final stage involves all the components being installed on a project server.

### Forms of media:

The components of the module are taught in lecture format. During the development stages, joint practical sessions are held with the aim of clarifying specific technical questions. The milestone dates are the seminars. A workshop combining all the components completes the module.

### Literature:

- Haas, Peter (2005): Medizinische Informationssysteme und Elektronische Krankenakten. Berlin, Heidelberg: Springer Berlin Heidelberg (SpringerLink: Bücher).
- Vetter, Max (1994): Informationssysteme in der Unternehmung. Eine Einführung in die Datenmodellierung und Anwendungsentwicklung. 2nd edition, revised. Stuttgart: Teubner (Informatik und Unternehmensführung).
- Winter, Alfred (c2011): Health information systems. Architectures and strategies. 2nd ed. London: Springer.



|                                                                    |                                                     |           |
|--------------------------------------------------------------------|-----------------------------------------------------|-----------|
| Modul:                                                             | Bachelor's Thesis                                   |           |
| Code:                                                              | mkiB75                                              |           |
| Subtitle:                                                          |                                                     |           |
| Course elements:                                                   | Thesis                                              |           |
| Semester:                                                          | Every                                               |           |
| Module coordinator:                                                | Professors directors                                |           |
| Lecturer:                                                          | Professors from the degree programme                |           |
| Language:                                                          | To be discused                                      |           |
| Allocation to the curriculum:                                      | Comulsory subject 7th semester                      |           |
| Mode of teaching / semester hours per week (SWS):                  | Thesis                                              |           |
| Total hours:                                                       | Contact Hours:                                      | 0 Hours   |
|                                                                    | Independent study:                                  | 360 Hours |
| Credits:                                                           | 12 ECTS                                             |           |
| Prerequisites in accordance with examination regulations (StuPro): | Passes in all the module from the first 5 semesters |           |
| Recommended prerequisites:                                         | All modules from the first 6 semesters              |           |
| Mode of assessment:                                                | Bachelor's Thesis                                   |           |

### Module objectives:

By passing this module, students demonstrate that they are able to produce a piece of work on an issue faced in the field of media and communication informatics, and that they are able to do so independently, by a specified deadline, and using fundamental scientific methods.

The Bachelor's thesis contributes to the overall learning objectives relating to media and communication informatics in the following ways:

- Wide-ranging interdisciplinary specialist knowledge and extensive methodological skills: a Bachelor's thesis requires students to apply knowledge and methods from a range of disciplines. This covers informatics-related, software-related, media-related, psychological, didactic and business-related aspects, as well as others besides.
- Attractive career prospects: Bachelor's theses often deal with problems that are relevant to current business practice in informatics-related fields. A Bachelor's thesis can be written as an external piece of work in conjunction with a company.
- International perspective: Bachelor's theses may be written in English. They may also be



completed in conjunction with institutions in other countries.

## Learning outcomes:

### Knowledge:

- Research based on serious sources.
- Cite text passages correctly.
- Reference sources.
- Demonstrate in detail a subject area, its context and its most recent developments.
- Clearly formulate a research question and the objectives of a thesis.
- Precisely describe methods and procedures, and prepare artifacts.
- Prepare key points in a structured way.
- Make coherent arguments and back up statements.
- Demonstrate work in a convincing, understandable way.

### Skills:

Students conduct literature research on the basis of scientific sources. They prepare work on the latest findings in the subject area, taking a critical approach. They analyse problems, present hypotheses, define requirements and derive criteria for systematically evaluating alternatives. Students break down the problems they are working with into individual tasks, develop concepts for creating solutions, and critically assess the findings. They create prototypes or operational artifacts. Students communicate findings clearly and in a format that is suitable for academic purposes.

### Competencies:

| LO# | Learning outcome (LO)                                                                         | Assessed through |
|-----|-----------------------------------------------------------------------------------------------|------------------|
| LO1 | Independent scientific work on a subject area relating to media and communication informatics | Thesis document  |
| LO2 | Work on a straightforward problem and a small-scale artifact using basic methodology          | Thesis document  |
| LO3 | Write a scientific thesis independently                                                       | Thesis document  |
| LO4 | Present own work in a comprehensible, clearly structured and concise format                   | Thesis document  |

### Content:

Bachelor's theses generally examine practical problems and solutions – and in some cases theoretical ones – relating to media and communication informatics.

### Forms of media:

Subject-specific and methodological supervision of Bachelor's thesis through discussion and commentary on drafts.

### Literature:

- Deininger, Marcus (2005): Studien-Arbeiten. Ein Leitfaden zur Vorbereitung Durchführung und Betreuung von Studien- Diplom- Abschluss- und Doktorarbeiten am Beispiel



Informatik. 5th edition, revised. Zurich: vdf Hochschulverl. an der ETH.

- Ebel, Hans F.; Bliefert, Claus (2009): Bachelor-, Master- und Doktorarbeit. Anleitungen für den naturwissenschaftlich-technischen Nachwuchs. 4th edition, updated. Weinheim: Wiley-VCH.
- Esselborn-Krumbiegel, Helga (2008): Von der Idee zum Text. Eine Anleitung zum wissenschaftlichen Schreiben. 3rd edition, revised. Paderborn, Munich, Vienna, Zurich: Schöningh (utb.de Bachelor-Bibliothek, 2334: Schlüsselkompetenzen, Kernkompetenzen).
- Grieb, Wolfgang; Slemeyer, Andreas (2012): Schreibtipps für Studium, Promotion und Beruf in Ingenieur- und Naturwissenschaften. 7th edition. Berlin: VDE-Verl.
- Karmasin, Matthias; Ribing, Rainer (2012): Die Gestaltung wissenschaftlicher Arbeiten. Ein Leitfaden für Seminararbeiten Bachelor- Master- und Magisterarbeiten sowie Dissertationen. 7th edition, updated. Vienna: facultas.wuv (UTB, 2774: Schlüsselkompetenzen).



|                                                                    |                                             |           |
|--------------------------------------------------------------------|---------------------------------------------|-----------|
| Modul:                                                             | Media and Communication Informatics Project |           |
| Code:                                                              | mkiBW101                                    |           |
| Subtitle:                                                          |                                             |           |
| Course elements:                                                   | Practical sessions                          |           |
| Semester:                                                          | Every semester                              |           |
| Module coordinator:                                                | Pro. Dr. Peter Herrtkorn                    |           |
| Lecturer:                                                          | Professors from the degree programme        |           |
| Language:                                                          | German, English                             |           |
| Allocation to the curriculum:                                      | Comulsory subject 6th semester              |           |
| Mode of teaching / semester hours per week (SWS):                  | Practical sessions:                         | 2 SWS     |
| Total hours:                                                       | Contact Hours:                              | 30 Hours  |
|                                                                    | Independent study:                          | 120 Hours |
| Credits:                                                           | 5 ECTS                                      |           |
| Prerequisites in accordance with examination regulations (StuPro): | None                                        |           |
| Recommended prerequisites:                                         | None                                        |           |
| Mode of assessment:                                                | Practical sessions                          |           |

### Module objectives:

This module aims to help students apply the knowledge and skills they have acquired during the degree programme to problems relating to the field of media and communication informatics, working on the basis of a practical case study. The problems are generally drawn from both media-related subject areas and software implementations. In particular, this requires students to harness their communication and team skills, as they are tasked with working on the problems independently within work groups.

The first part of the project focuses on creating prototypes and the development process associated with this.

### Learning outcomes:

#### Knowledge:

Consolidation of knowledge acquired during studies in relation to the individual steps involved in the development process:



- Process models.
- Project planning and management methods. Requirements analysis techniques.
- Resource usage estimation process.
- Methods and processes involved in modelling, design and system implementation.
- Use of various test methods.
- Methods for documenting findings.

**Skills:**

Students analyse a set problem and apply methods and processes for define requirements, create models, design systems, implement systems and perform tests. They analyse problems, evaluate a range of potential solutions, and develop solutions independently. They work independently within a project team; this setting requires them to plan the project, divide up tasks and compile the findings at a later point. They are able to document the findings from their team's activities in an appropriate manner and present them to an expert audience in a comprehensible way.

**Competencies:**

After completing this module, students will be able to do the following:

| LO# | Learning outcome (LO)                                                                                                                                         | Assessed through       |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| LO1 | Apply methods and processes for systematic development of products and software systems.                                                                      | Artifact               |
| LO2 | Analyse a problem, devise and evaluate alternative solutions, develop methods on this basis, and put forward well-reasoned arguments in critical discussions. | Artifact               |
| LO3 | Document the solutions that have been developed and present them to an expert audience.                                                                       | Artifact, presentation |
| LO4 | Work as part of a team in order to define goals, pursue them and achieve them together.                                                                       | Artifact, presentation |
| LO5 | Use professional tools for the entire development process.                                                                                                    | Artifact               |

**Content:**

Project teams work on a topic chosen from a range of options provided by the lecturers. In coordination with the supervisors, they structure the project into appropriate development stages. In the process, they define a work plan and a schedule for the project; these also contain regular meetings with the supervisors. At each of the milestones, the findings are documented and presented, and the stage reached by prototypes is also demonstrated.

**Forms of media:**

Project work in a team with supervision by the lecturer. Specification, development, testing and documentation activities; presentation of findings. Technical work documents and the necessary hardware and software are provided. Students are required to obtain and work through the necessary project documentation themselves, using their own initiative.

**Literature:**

Students will be informed of literature sources during the projects and must research these themselves.



|                                                                       |                                                  |           |  |
|-----------------------------------------------------------------------|--------------------------------------------------|-----------|--|
| Modul:                                                                | Media and Communication Informatics<br>Project 2 |           |  |
| Code:                                                                 | mkiBW201                                         |           |  |
| Subtitle:                                                             |                                                  |           |  |
| Course elements:                                                      | Practical sessions                               |           |  |
| Semester:                                                             | Every semester                                   |           |  |
| Module coordinator:                                                   | Pro. Dr. Peter Herrtkorn                         |           |  |
| Lecturer:                                                             | Prof. Dr. Peter Hertkotn                         |           |  |
| Language:                                                             | German, English                                  |           |  |
| Allocation to the curriculum:                                         | Comulsory subject 6th semester                   |           |  |
| Mode of teaching / semester hours<br>per week (SWS):                  | Practical sessions:                              | 2 SWS     |  |
| Total hours:                                                          | Contact Hours:                                   | 30 Hours  |  |
|                                                                       | Independent study:                               | 120 Hours |  |
| Credits:                                                              | 5 ECTS                                           |           |  |
| Prerequisites in accordance with<br>examination regulations (StuPro): | None                                             |           |  |
| Recommended prerequisites:                                            | Media and Communication Informatics Prject 1     |           |  |
| Mode of assessment:                                                   | Practical sessions                               |           |  |

### Module objectives:

This module aims to help students apply the knowledge and skills they have acquired during the degree programme to problems relating to the field of media and communication informatics, working on the basis of a practical case study. The problems are generally drawn from both media-related subject areas and software implementations. In particular, this requires students to harness their communication and team skills, as they are tasked with working on the problems independently within work groups.

During the second part of the project, the focus is on developing product prototypes and introducing the product to an operating environment.

### Learning outcomes:

#### Knowledge:

- Be familiar with methods for developing prototypes into a product.
- Be familiar with processes for evaluating user-friendliness. Be familiar with aspects that



need to be taken into account when introducing products or installing software systems in operating environments.

- Be familiar with methods for presenting and marketing products.
- Be able to research information on the subject of licences and patents.

#### Skills:

Students apply methods and processes for developing prototypes until they reach product maturity. They conduct tests for evaluating user-friendliness and, on this basis, derive modifications for product development. They introduce products to existing operating environments and set up suitable support structures. They create product presentations and research licensing conditions, as well as industrial property rights. They work independently within a project team, are able to document the findings from their team's activities in an appropriate manner, and are able to present them to an expert audience in a comprehensible manner.

#### Competencies:

After completing this module, students will be able to do the following:

| LO# | Learning outcome (LO)                                                                                  | Assessed through       |
|-----|--------------------------------------------------------------------------------------------------------|------------------------|
| LO1 | Apply methods and processes for developing a prototype until it reaches the point of product maturity. | Artifact               |
| LO2 | Conduct tests for evaluating the user-friendliness of a product.                                       | Artifact               |
| LO3 | Introduce a product to existing operating environments.                                                | Artifact, presentation |
| LO4 | Document findings and present them to an expert audience.                                              | Artifact, presentation |
| LO5 | Work as part of a team in order to define goals, pursue them and achieve them together.                | Artifact, presentation |
| LO6 | Use professional tools for installation, operation and product presentation purposes.                  | Artifact               |

#### Content:

Project teams continue developing the prototypes they began during the first part of the Media and Communication Informatics Project, up to the point at which the products reach maturity. In coordination with the supervisors, they structure the project into appropriate development stages. In the process, they define a work plan and a schedule for the project; these also contain regular meetings with the supervisors. At each of the milestones, the findings are documented and presented, and the stage reached by the product is also demonstrated.

#### Forms of media:

Project work in a team with supervision by the lecturer. Specification, development, testing and documentation activities; presentation of findings. Technical work documents and the necessary hardware and software are provided. Students are required to obtain and work through the necessary project documentation themselves, using their own initiative.

#### Literature:

Students will be informed of literature sources during the projects and must research these themselves.





Master:

Modul: Master: Management Consulting

Code: wiMXXX

Subtitle:

Course elements: Lectures

Semester: Winter semester

Module coordinator: Pro. Dr. Dennis Schlegel

Lecturer: Prof. Dr. Dennis Schlegel

Language: English, German

Allocation to the curriculum: Compulsory elective subject 1st and 2nd semester

Mode of teaching / semester hours per week (SWS): Lectures: 4 SWS

Total hours: Contact Hours: 60 Hours  
Independent study: 90 Hours

Credits: 5 ECTS

Prerequisites in accordance with examination regulations (StuPro): None

Recommended prerequisites: Knowledge of the English language at level B2

Mode of assessment: Lectures: Continuous assessment

### Module objectives:

Internal and external consultants are playing an increasingly important role in the economy, especially in IT projects. On the one hand, starting a career with a management consultancy or working as a freelancer is therefore an attractive career option for ambitious graduates. On the other hand, knowledge of the business model and working methods of consultants is also essential for the effective management of projects and coordination of external service providers when working in another sector. In addition, consulting methods are also used in pure in-house projects.

The aim of the module is to prepare participants for a job in the consulting environment. This includes positions on the consulting side (e.g. management consultant, in-house consultant, freelancer) as well as positions on the client side (e.g. project manager). Learning outcomes:

#### Knowledge:

Students are able to explain important basics of consulting, analyze the business model of a



consulting company and assess essential methods and techniques in a consulting project  
Skills:

As a member of a consulting team, students are able to structure and plan a project. Students are able to independently select and apply suitable methods and tools for analysis and problem solving in a consulting context.

Competencies:

Students are able to coordinate as a team and communicate appropriately. They are also able to present their results in English.

| LE# | Learning outcome (LE)            | Tested by               |
|-----|----------------------------------|-------------------------|
| LE1 | Knowledge of theoretical models  | Written test            |
| LE2 | Application of methods and tools | Case study/presentation |
| LE3 | Situational communication        | Case study/presentation |

Content:

The module includes lecture units to convey the theoretical content and models, short exercises and an integrated case study, which is completed during the attendance period. In this case study, students work through various phases of a simulated consulting project as part of a team of consultants. The lecture content includes the following topics:

- Consulting industry and business model
- Consultant selection and project acquisition
- Methods and tools in consulting
- Strategic analysis and strategy selection
- Organizational and process analysis
- Outsourcing and shared services
- Robotic Process Automation
- Change management
- IT consulting
- Project management

Forms of media:

- Lecture
- Case studies
- Guest lectures

Literature:

- Andler: Tools for Project Management, Workshops and Consulting. Erlangen: Publicis
- Baldegger: Organization. In: Management in a Dynamic Environment. Wiesbaden: Gabler
- Chereau, Meschi: Strategic Consulting. Tools and methods for successful strategy missions. Cham: Palgrave Macmillan
- Ennfsfellner et al, Exzellenz in der Unternehmensberatung, Wiesbaden: Springer.



- Kubr: Management Consulting. A Guide to the Profession. Geneva: International Labour Office
- Lippold: Grundlagen der Unternehmensberatung. Strukturen – Konzepte – Methoden. Wiesbaden: SpringerGabler
- Milani: Digital Business Analysis. Cham: Springer International Publishing
- Tiemeyer: Handbuch IT-Projektmanagement. München: Hanser
- Wieczorrek, Mertens: Management von IT-Projekten. Heidelberg: Springer



|                                                                    |                                                     |          |  |
|--------------------------------------------------------------------|-----------------------------------------------------|----------|--|
| Modul:                                                             | Digital Stratgy                                     |          |  |
| Code:                                                              | WIMB15                                              |          |  |
| Subtitle:                                                          |                                                     |          |  |
| Course elements:                                                   | Lectures                                            |          |  |
| Semester:                                                          |                                                     |          |  |
| Module coordinator:                                                | Prof. Dr. Alexander Rossmann                        |          |  |
| Lecturer:                                                          | Guest lectures by xecutives from corporate practice |          |  |
| Language:                                                          | German                                              |          |  |
| Allocation to the curriculum:                                      | Compulsory elective subject, 1st/2nd semester       |          |  |
| Mode of teaching / semester hours per week (SWS):                  | Lecture                                             | 4 SWS    |  |
| Total hours:                                                       | Contact time:                                       | 60 Hours |  |
|                                                                    | Indipendent study:                                  | 90 Hours |  |
| Credits:                                                           | 5 ECTS                                              |          |  |
| Prerequisites in accordance with examination regulations (StuPro): | None                                                |          |  |
| Recommended prerequisites:                                         | None                                                |          |  |
| Mode of assessment:                                                | Lectures: Term paper, presntation                   |          |  |

### Module objectives:

The elective Digital Strategy teaches fundamental concepts and methods for the development, analysis and evaluation of digital strategies. Digital transformation is omnipresent in the economy. Companies must adapt to digital change in the form of digital strategies or proactively shape it themselves. In addition to the basic concepts of digital strategies, the effects of digital strategies on the digital transformation, on enterprise and product architectures, on innovation processes and on strategy implementation are dealt with using relevant application examples.

### Learning outcomes

#### Knowledge:

Students know the different ways of dealing with the basic concepts of digital strategies. They know the interactions of digital strategies with other strategy concepts (e.g. corporate strategy, IT strategy) and can design essential components for the implementation of digital strategies.

#### Skills:

Students can analyze, evaluate and create strategy models for companies.

#### Competencies:

After completing the module, students are able to make recommendations for the use of digital strategies depending on given use cases and to communicate this knowledge systematically. Students can design and model digital strategies and use the associated methods and instruments.

#### Content:

The Digital Strategy module teaches forward-looking models and methods for digital strategies in companies through the lecture and integrated exercises. The lecture is supplemented by the study of theoretical principles, practical case studies from the field, tools, instruments and processes. The aim of the course is to effectively prepare students for designing digital strategies. To this end, digital strategies are discussed conceptually and methodically and then concretized using company examples. A particular focus is on the transformation of the automotive industry towards the software-defined vehicle.

Specifically, the focus is on the following content:

- Conceptual definition of digital strategies
- Differentiation of digital strategy from corporate and IT strategy
- Strategy content and strategy processes
- Design of the digital strategy: digital business models, digital customer interfaces, internal company decisions and operations
- Digital maturity and the design of digital companies: Digital business design, customer data, operational backbone, digital platforms, developers and ecosystems
- Strategy processes, from idea to implementation: innovation ideas, digital vision and mission, digital business operating model, integration of strategy elements into the digital corporate strategy
- Strategic portfolio, strategic planning and strategic controlling
- 

#### Forms of media:

Lectures with integrated exercises, scripts in the form of presentations, whiteboard and PPT exercises, demonstrations, exercises, case studies.

#### Literature:

- Bones, C., Hammersley, J., & Shaw, N. (2018). *Optimizing Digital Strategy: How to make informed, tactical decisions that deliver growth*. Kogan Page Publishers.
- Forsgren, N., & Humble, J. (2018). *ACCELERATE: Building and Scaling High performing Technology Organization*. MR. DLA.
- Kim, G., Humble, J., Debois, P., Willis, J., & Forsgren, N. (2021). *The DevOps handbook: How to create world-class agility, reliability, & security in technology organizations*. It Revolution.
- Lankhorst, M. et. al. (2018). *Enterprise Architecture at Work: Modelling, Communication and Analysis*. Springer
- Ross, J. W., Beath, C. M., & Mocker, M. (2019). *Designed for digital: How to architect your business for sustained success*. Mit Press.
- Kotusev, S. (2018). *The practice of enterprise architecture: A modern approach to business and IT alignment*. Sk Publishing.
- Westerman, G., Bonnet, D., & McAfee, A. (2014). *Leading digital: Turning technology into business transformation*. Harvard Business Press.

Weitere Literatur wird in der Vorlesung bekannt gegeben



Modul: Master: Innovation for Sustainable Business

Code: wiM19

Subtitle:

Course elements: Lectures

Semester: Every semester

Module coordinator:

Language: English

Allocation to the curriculum:

|                                                   |           |       |
|---------------------------------------------------|-----------|-------|
| Mode of teaching / semester hours per week (SWS): | Lectures: | 4 SWS |
|---------------------------------------------------|-----------|-------|

|              |                    |          |
|--------------|--------------------|----------|
| Total hours: | Contact Hours:     | 60 Hours |
|              | Independent study: | 90 Hours |

Credits: 5 ECTS

Prerequisites in accordance with examination regulations (StuPro): None

Recommended prerequisites:

Mode of assessment: Lectures: Continuous assessment

Module objectives:

This module delves into the interrelationships of innovation, business models and sustainability. Students will learn about the latest theories and practices related to sustainable innovation and business models and how they can be applied in different organizational contexts. Technology and innovation are considered in their central role for digital transformation and enabling sustainable business

Learning outcomes:

Knowledge:

- Students will understand the concept of Sustainable Business and the importance of innovation and business model for it.
- They learn the latest practical trends and research results in the field of sustainable business
- Students will know different types of sustainable business models as well as real

companies with these business models

- They will understand the challenges and opportunities associated with sustainable innovation in different industries.
- Students will understand the importance of stakeholder engagement for Sustainable Businesses

#### Skills:

- Students will be able to critically analyze the environmental and social impacts of business activities using real-world examples.
- Students can evaluate the sustainability of existing business models and identify opportunities for sustainable innovation
- They assess innovative business ideas for their economic, ecological and social viability

#### Competencies:

- They are able to apply sustainability principles to real business challenges
- Students have the ability to design sustainable business models that balance economic, social and environmental factors
- Students will be able to develop and communicate business cases in the topic area of sustainable business
- They can develop sustainable innovation strategies in different organizational contexts

#### Content:

- Theoretical foundations for sustainable business
- Principles of sustainable business systems, e.g. circular economy/closed loop systems
- Innovation as a driver of new business models
- Frameworks for the development of sustainable business models, e.g. Triple Layered Business Model Canvas
- Archetypes of sustainable business models
- The role of information technology as an enabler of sustainable business models
- Case studies on sustainable businesses

#### Forms of media:

Interactive lecture and exercises, guest lectures and case studies

#### Literature:

- De Angelis, R. (2018). Business models in the circular economy: Concepts, examples and theory. Springer.
- Lüdeke-Freund, F., Carroux, S., Joyce, A., Massa, L., & Breuer, H. (2018). The sustainable business model pattern taxonomy—45 patterns to support sustainability-oriented business model innovation. *Sustainable Production and Consumption*, 15, 145-162.



|                                                                    |                                                                             |          |
|--------------------------------------------------------------------|-----------------------------------------------------------------------------|----------|
| Modul:                                                             | Huc Master: Interactive Systems                                             |          |
| hucM101                                                            | hucM101                                                                     |          |
| Subtitle:                                                          |                                                                             |          |
| Course elements:                                                   | Lectures                                                                    |          |
| Semester:                                                          | Every semester                                                              |          |
| Module coordinator:                                                | Prof. Dr. Gabriela Tullius                                                  |          |
| Lecture                                                            | Prof. Dr. Gabriela Tullius                                                  |          |
| Language:                                                          | German, English                                                             |          |
| Allocation to the curriculum:                                      | Human-Centered Computing (Master), compulsory subject, 1st semester         |          |
| Mode of teaching / semester hours per week (SWS):                  | Lectures:                                                                   | 4 SWS    |
| Total hours:                                                       | Contact Hours:                                                              | 60 Hours |
|                                                                    | Independent study:                                                          | 90 Hours |
| Credits:                                                           | 5 ECTS                                                                      |          |
| Prerequisites in accordance with examination regulations (StuPro): | None                                                                        |          |
| Recommended prerequisites:                                         | None                                                                        |          |
| Mode of assessment:                                                | Lectures: Participation, private study projects, project work, presentation |          |

#### Module objectives:

Interactive Systems contributes to the overall huc learning objectives in the following ways: Comprehensive methodological skills: Students become familiar with methodology in the fields of software technology, informatics, design, psychology and information science, and learn how to apply and evaluate it analytically. Social and communication skills: Discussing various approaches and possibilities in a team setting is a key feature of the module. Students at Master's level are expected to be able to analyse and, where applicable, bring together different elements and approaches. They hone these skills by giving their own presentations as well as formulating theses and discussing them. Attractive career prospects: Interactive systems, their design and the usability experience in particular are playing an increasingly important role in the industry.





## Learning outcomes:

### Knowledge:

Be familiar with and able to evaluate methods for designing user interfaces.

- Be able to design and evaluate applications based on the user-centred design process.
- Be able to apply criteria for analysing and evaluating user interfaces.
- Be able to evaluate the use of guidelines and standards in designing interactive systems.
- Be able to classify, analyse and apply different usability engineering techniques.
- Be able to design and evaluate a user interface from an ergonomic and an aesthetic perspective.
- Be able to understand the user experience as an all-embracing extension of usability.
- Be able to understand, analyse and contextualise research work in the field of interactive systems, and establish how it relates to the student's own work.

### Skills:

Students analyse the user group, the context and the task of the user. To do so, they apply a range of methods they have learned. Students describe criteria for analysing interactive systems in a wide range of different areas. They evaluate user interfaces based on scientific criteria and are able to develop graphical window systems, for example, as well as other interactive systems using appropriate interaction objects. This area of study considers both output and input elements. Students also design applications with respect to accessibility (in the context of interactive systems) and are able to evaluate applications with this in mind. Students design mockups and prototypes for immediate or later implementation as attractive products that are fit for purpose. In the process, they consider and evaluate the product as a whole from the perspective of the user experience and user needs. Elements of concept testing, persuasive design and gamified design are applied here. Students choose a design that is appropriate for the input and output modalities in question.

### Competencies:

After completing this module, students will be able to do the following:

| L0# | Learning outcome (LO)                                                                                                                                                                        | Assessed through                                    |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|
| L01 | Demonstrate their familiarity with methodology in the fields of software technology, informatics, design, psychology and information science, and how to apply and evaluate it analytically. | Private study projects, presentation                |
| L02 | Analyse and evaluate interactive systems according to the applicable ISO standard.                                                                                                           | Private study projects, project work                |
| L03 | Identify and apply approaches to the user experience.                                                                                                                                        | Hausarbeit, Projektarbeit                           |
| L04 | Analyse, synthesise (e.g. design patterns) and apply research work conducted in the field of interactive systems.                                                                            | Private study, projects, presentation, project work |

|     |                                                                                                                                                                                                                                                                                                                                          |                                                    |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|
| L05 | Social and communication skills: Discussing various approaches and possibilities in a team (comprising all the module attendees in this case) is a key feature of the Interactive Systems module. Students at Master's level are expected to be able to analyse and, where applicable, bring together different elements and approaches. | Presentation, private study projects, project work |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|

This module focuses on approaches to developing interactive products from a wide range of different perspectives. It considers not only micro-HCI, but also macro-HCI. Examples include multi-touch systems, desktop PCs, various types of mobile device, as well as interactive 3D environments and robots of all kinds. Interactive systems have a variety of applications, such as interaction with large data quantities, in a three-dimensional space and in multimodal contexts. This covers an extensive spectrum from CCI (child computer interfaces) all the way through to medical applications. The module addresses issues relating to design in the context of use and, in particular, the needs of different interactive products plus their formal descriptions (L01). It starts by discussing general questions concerning user and task modelling, and by analysing a range of techniques on the basis of current research literature (L01). Various design issues, standards, methods and approaches are discussed in the context of creating interactive products. Usability engineering and the user experience represent two cornerstones of the module. There is a focus on not only embedding usability-based thinking in the software creation process and general business practice, but also evaluating interactive products and assuring their quality. As part of this, the application of ISO standards such as ISO 9241 is explained and demonstrated on the basis of selected examples (L02), as is the use of design patterns – something that is becoming increasingly important to this field (see Tidwell 2011; L04). The module also discusses the user experience, still a relatively new subject area, from the perspective of user needs (L03). This considers approaches to research drawn from the fields of concept testing and joy of use. The aim is for students to embed these approaches into and synthesise them with related areas of work and their own work (L04). Students are encouraged to identify research issues as well as formulate and work on theses in the subject area by regularly studying articles from relevant scientific conferences and journals (L05).

#### Content:

Project teams work on a topic chosen from a range of options provided by the lecturers. In coordination with the supervisors, they structure the project into appropriate development stages. In the process, they define a work plan and a schedule for the project; these also contain regular meetings with the supervisors. At each of the milestones, the findings are documented and presented, and the stage reached by prototypes is also demonstrated.

#### Forms of media:

Teaching in seminar format with supervision by lecturer. Students work on a range of subjects with the aid of suitable scientific literature. Subject areas and projects are generally worked on in small teams. The aim of this is for team members to exchange thoughts and ideas; the team setting helps students to do so. Students acquire extracts from literature themselves.

#### Literature:

- Bowman, Doug A. (2005): 3D user interfaces. Theory and practice. Boston, Mass., Munich: Addison-Wesley.
- Jones, Matthew; Marsden, Gary (2006): Mobile interaction design. Chichester, Weinheim: Wiley.
- Markopoulos, Panos (2008): Evaluating children's interactive products. Principles



and practices for interaction designers. San Francisco, Calif., Amsterdam, Heidelberg: Morgan Kaufmann; Elsevier Science (The Morgan Kaufmann series in interactive technologies).

- Mayhew, Deborah J. (1999): The usability engineering lifecycle. A practitioner's handbook for user interface design. San Francisco, Calif.: Morgan Kaufmann (The Morgan Kaufmann series in interactive technologies).
- Preece, Jenny; Rogers, Yvonne; Sharp, Helen (2002): Interaction design. Beyond human-computer interaction. New York, NY: Wiley.
- Sarodnick, Florian; Brau, Henning (2006): Methoden der Usability Evaluation. Wissenschaftliche Grundlagen und praktische Anwendung. 1st edition, Bern: Huber (Praxis der Arbeits- und Organisationspsychologie).
- Shneiderman, Ben; Plaisant, Catherine (2005): Designing the user interface. Strategies for effective human-computer interaction. 4th ed. Boston, Mass., Munich: Pearson/Addison-Wesley. ed. Beijing, Cologne: O'Reilly.
- Tullis, Tom; Albert, Bill (2013): Measuring the User Experience. Collecting, Analyzing, and Presenting Usability Metrics. Online edition. Amsterdam: Elsevier
- ISO standards (e.g. from the 9241 series).
- Conference papers and ACM/IEEE journals, e.g. SIGCHI.



|                                                                    |                                                                     |          |
|--------------------------------------------------------------------|---------------------------------------------------------------------|----------|
| Modul:                                                             | Huc Master: Formal Methods of Human-Centered Computing              |          |
| hucM101                                                            | hucM104                                                             |          |
| Subtitle:                                                          |                                                                     |          |
| Course elements:                                                   | Lectures                                                            |          |
| Semester:                                                          | Every semester                                                      |          |
| Module coordinator:                                                | Prof. Dr. Benjamin Himpel                                           |          |
| Lecture                                                            | Tim Mangliers                                                       |          |
| Language:                                                          | German, English                                                     |          |
| Allocation to the curriculum:                                      | Human-Centered Computing (Master), compulsory subject, 1st semester |          |
| Mode of teaching / semester hours per week (SWS):                  | Lectures:                                                           | 4 SWS    |
| Total hours:                                                       | Contact Hours:                                                      | 60 Hours |
|                                                                    | Independent study:                                                  | 90 Hours |
| Credits:                                                           | 5 ECTS                                                              |          |
| Prerequisites in accordance with examination regulations (StuPro): | None                                                                |          |
| Recommended prerequisites:                                         | None                                                                |          |
| Mode of assessment:                                                | Lectures: Private study projects, presentation                      |          |

### Module objectives:

This module aims to teach students the basic principles of formal mathematical methods used in human-centered computing. Students will be able to design and apply empirical methods. They will also be able to analyse and discuss complex mathematical texts in the field of artificial intelligence. Finally, students will have the ability to familiarise themselves with a mathematical topic in the area of human-centered computing, formulate information on it from a sound scientific standpoint, and present it in a comprehensible, appropriate format. After taking this module, students will have the mathematical skills required to obtain a Master's degree.

### Learning outcomes:

#### Knowledge:

Students know the basic principles of empirical research design and are able to distinguish between qualitative and quantitative methods. Students know the basic



principles of probability calculation and statistical modelling, including both descriptive statistics and causal inference, and particularly linear regression. Students ascertain the principles of artificial intelligence environments, particularly those relating to machine thinking.

#### Skills:

Students plan and design empirical research studies. In the process, they analyse and evaluate the data that has been collected.

Students calculate statistical parameters using specified data sets and apply linear regression in order to find solutions to simple examples.

Students evaluate which machine thinking method is most appropriate for solving a given problem.

Students design a practical application for a selected formal method of human-centered computing.

#### Competencies:

After completing this module, students will be able to do the following:

| LO# | Learning outcome (LO)                                                                                               | Assessed through       |
|-----|---------------------------------------------------------------------------------------------------------------------|------------------------|
| LO1 | Plan an empirical study and evaluate the findings.                                                                  | Presentation           |
| LO2 | Provide reasoning for the suitability of different empirical methods to a certain research design approach.         | Presentation           |
| LO3 | Work independently to identify information on the subject of formal methods and analyse complex mathematical texts. | Private study projects |
| LO4 | Work in a team in order to find solutions to complex tasks.                                                         | Private study projects |
| LO5 | Structure information on a subject relating to the discipline of formal methods in an accurate, understandable way. | Private study projects |
| LO6 | Capably present and discuss a subject area relating to the discipline of formal methods, using specialist language. | Presentation           |

#### Content:

The lectures use the flipped classroom teaching principle. Based on this, students receive material before the classroom sessions and are required to familiarise themselves with it (LO3). Students receive an introduction to the materials as well as questions and background information for discussions, and should work through this. Classroom sessions are conducted in a seminar format. They start by answering any unresolved questions and then move on to a discussion of the topic in question, with presentations where applicable (LO1, LO2). During the second half of the lecture, students select a topic from the area of formal methods of human-centered computing and familiarise themselves with it independently, under the supervision of the lecturer (LO3, LO4). This enables them to prepare work containing theoretical and practical components (LO4, LO5). This work is also demonstrated in presentations (LO6). There are two subject areas from which the topics are drawn:

1. Empirical methods of human-centered computing. This looks at the basic principles of research design [Creswell 2003]. Following a review of the basic principles involved in probability calculation [Meinel 2009],



students are introduced to more advanced statistics and causal inference concepts [Freedman2005 and2010]

2. Selected areas of artificial intelligence, particularly machine learning; thisincludes artificial neural networks and fuzzy logic [Lippe 2006]

### Forms of media:

Before the classroom sessions, students receive material in the e-learning platform (chapters from literature sources or selected texts, as well as other multimedia references) and are required to familiarise themselves with it; they also receive an introduction and background information for discussions. Classroom sessions are conducted in a seminar format with a board, an overhead projector or presentation methods. During the second half of the lecture, the work that has been prepared in private study projects is combined in a document and presented using slides on a projector linked to a PC.

### Literature:

- Creswell, John W. (2003): Research design. Qualitative quantitative and mixedmethods approaches. 2nd ed. Thousand Oaks, Calif.: Sage.
- Freedman, David (2005): Statistical models. Theory and practice. 1st publ. Cambridge: Cambridge University Press.
- Freedman, David; Collier, David; Sekhon, Jasjeet Singh; Stark, Philip B. (2010):Statistical models and causal inference. A dialogue with the social sciences. Online edition. Cambridge, New York: Cambridge University Press.
- Lippe, Wolfram-Manfred (2006): Soft-Computing. Mit Neuronalen Netzen Fuzzy- Logic und Evolutionären Algorithmen. Berlin, Heidelberg: Springer BerlinHeidelberg (SpringerLink: Bücher).
- Meinel, Christoph; Mundhenk, Martin (2009): Mathematische Grundlagen derInformatik. Mathematisches Denken und Beweisen; eine Einführung. 4th edition revised. Wiesbaden: Vieweg + Teubner (Studium).

Additionally, current articles from specialist journals and conferences aswell as Internet resources.



|                                                                           |                                                      |          |
|---------------------------------------------------------------------------|------------------------------------------------------|----------|
| <b>Modul:</b>                                                             | Software Systems Engineering                         |          |
| <b>Code:</b>                                                              | HUCM103                                              |          |
| <b>Subtitle:</b>                                                          |                                                      |          |
| <b>Course elements:</b>                                                   | Lecture                                              |          |
| <b>Semester:</b>                                                          | Every semester                                       |          |
| <b>Module coordinator:</b>                                                | Prof. Dr. Christian Kücherer                         |          |
| <b>Lecturer:</b>                                                          | Prof. Dr. Christian Kücherer                         |          |
| <b>Language:</b>                                                          | German, Englisch (if required)                       |          |
| <b>Allocation to the curriculum:</b>                                      | Human-Centered Computing Master, 1st semester        |          |
| <b>Mode of teaching / semester hours per week (SWS):</b>                  | Lecture:                                             | 4 SWS    |
| <b>Total hours:</b>                                                       | Contact Hours:                                       | 60 Hours |
|                                                                           | Independent study:                                   | 90 Hours |
| <b>Credits:</b>                                                           | 5 ECTS                                               |          |
| <b>Prerequisites in accordance with examination regulations (StuPro):</b> | None                                                 |          |
| <b>Recommended prerequisites:</b>                                         | of software development, basics software engineering |          |
| <b>Mode of assessment:</b>                                                | Term paper, Presentation                             |          |
| <b>Module objectives:</b>                                                 |                                                      |          |

The aim of the module is to place the topics of software engineering and systems engineering in the scientific context of systems science. Problem-solving techniques of systems engineering and methodological approaches of system and software modelling are combined to form software systems engineering. The lecture conveys the basics and knowledge of modelling of software and technical systems in semi-formal notation languages such as UML and SysML.

## Learning outcomes

### Knowledge:

Knowledge of systems theory and systems thinking on a scientific basis. Students can model the structure and behaviour of software and systems and describe them using models. They are familiar with different procedures for system modelling and can apply these to practical examples and real systems.

### Skills:



Construct systemic models for general and special issues in current fields of computer science. fields of computer science.

Competencies:

| LOE# | Learning Outcome (LO)                                                                                                                            | Assessed Through   |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| LO1  | Competence in systemic modelling in different scientific contexts and systematics with regard to a concrete question with a systemic background. | Written term paper |
| LO2  | Competence in the clear presentation of systemic modelling modelling of scientific contexts, questions and contexts, questions and backgrounds.  | Presentation       |

Content:

The basic lecture content draws its topics from systems engineering.

The following are covered in detail:

- Systems science, systems thinking and systems theory.
- Systems, software systems and systemic modelling.
- Problems, problem solving and the problem-solving process.
- The knowledge and skills imparted are applied by the students in the term paper and presentation.
- the presentation to knowledge domains of computer science.

Topics from the following subject areas are systemically considered and systemically modelled:

- Cognitive informatics and bioinformatics.
- Medical informatics and telemedicine.
- Systems Engineering and Software Engineering.
- Mobile and cloud computing.
- Software architectures and architecture patterns.

Media Forms:

Literature:





|                                                                           |                                               |          |
|---------------------------------------------------------------------------|-----------------------------------------------|----------|
| <b>Modul:</b>                                                             | IT-Management                                 |          |
| <b>Code:</b>                                                              | HUCM201                                       |          |
| <b>Subtitle:</b>                                                          |                                               |          |
| <b>Course elements:</b>                                                   | Lectures                                      |          |
| <b>Semester:</b>                                                          | Every semester                                |          |
| <b>Module coordinator:</b>                                                | Prof. Dr. Christian Kücherer                  |          |
| <b>Lecturer:</b>                                                          | Karl-Michael Gauch                            |          |
| <b>Language:</b>                                                          | German, Englisch (if required)                |          |
| <b>Allocation to the curriculum:</b>                                      | Human-Centered Computing Master, 2nd semester |          |
| <b>Mode of teaching / semester hours per week (SWS):</b>                  | Lecture:                                      | 2 SWS    |
|                                                                           | Seminar:                                      | 2 SWS    |
| <b>Total hours:</b>                                                       | Contact Hours:                                | 60 Hours |
|                                                                           | Independent study:                            | 90 Hours |
| <b>Credits:</b>                                                           | 5 ECTS                                        |          |
| <b>Prerequisites in accordance with examination regulations (StuPro):</b> | None                                          |          |
| <b>Recommended prerequisites:</b>                                         | None                                          |          |
| <b>Mode of assessment:</b>                                                | Project work                                  |          |

#### Module objectives:

The module supplements the development-oriented courses of the degree programme with the operational and organisational components of IT. It demonstrates the increasingly important interlocking of software development on the one hand and IT operations on the other. Ensuring the availability, robustness, integrity and adaptability of IT services under IT services under technical, business, legal and social conditions are overarching conditions are overarching topics for other modules.

#### Learning outcomes

Knowledge:

Skills:

The students acquire application-orientated knowledge for planning, management and control of the IT area in companies. They acquire knowledge of the strategies, objectives and tasks and objects of IT management in the company - especially with regard to structural and procedural organisation of the IT



department. Using case studies, students develop and evaluate exemplary concepts for the organisation and operation of an IT landscape.

On completion of the module, students will be able to adopt and evaluate current IT management concepts.

Additional objectives in the seminar part: Learning how to work independently on a topic and give a suitable presentation in writing and speech. Learning to discuss a topic objectively through a presentation.

#### Competencies:

On completion of the module, students will be able to::

| LOE# | Learning Outcome (LO)                                                                                                                                                                                                                                                      | Assessed Through         |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| LO1  | Categorise and understand methods of IT management understand                                                                                                                                                                                                              | Term paper, presentation |
| LO2  | Work from current research areas of service service operation and service provision analyse and synthesise                                                                                                                                                                 | Term paper, presentation |
| LO3  | Categorise the work in the context of IT management and recognise the effects                                                                                                                                                                                              | Homework, presentation   |
| LO4  | Social and communicative competence: Discussing Discussion in a team of different approaches and and research approaches is expected of students at Master's level. Different elements and algorithms are recognised and can be recognised and can be merged if necessary. | Term paper, presentation |

#### Content:

The lecture part of the course deals with the systematic, professional approach to the management of IT services. It is based on the IT Infrastructure Library (ITIL) and the IT life cycle described therein. The focus is on the areas of service Support (Incident Management, Service Desk, Problem Management, Configuration Management, Change Management, Release Management) and Service Delivery (Availability Management, Continuity Management, Capacity Management, Financial Management, Security Management, Service Level Management). Current practical examples are included.

The seminar offers fundamental and current topics on information security, whereby The latter are based on the latest status report on IT security from the BSI and relevant IT industry reports.

#### Media Forms:

#### Literature:



|                                                                           |                                                      |          |
|---------------------------------------------------------------------------|------------------------------------------------------|----------|
| <b>Modul:</b>                                                             | HUC Master project: Internet of Things (IOT)         |          |
| <b>Code:</b>                                                              | HucM                                                 |          |
| <b>Subtitle:</b>                                                          |                                                      |          |
| <b>Course elements:</b>                                                   | Lectures Labora                                      |          |
| <b>Semester:</b>                                                          | Each semester                                        |          |
| <b>Module coordinator:</b>                                                | Prof. Dr. Natividad Martinez                         |          |
| <b>Lecturer:</b>                                                          | Prof. Dr. Natividad Martinez                         |          |
| <b>Language:</b>                                                          | English                                              |          |
| <b>Allocation to the curriculum:</b>                                      | Master Human Centered Compu                          |          |
| <b>Mode of teaching / semester hours per week (SWS):</b>                  | Lecture with integrated exercises + Project<br>4 SWS |          |
| <b>Total hours:</b>                                                       | Contact Hours:                                       | 60 Hours |
|                                                                           | Independent study:                                   | 90 Hours |
| <b>Credits:</b>                                                           | 5 ECTS                                               |          |
| <b>Prerequisites in accordance with examination regulations (StuPro):</b> | None                                                 |          |
| <b>Recommended prerequisites:</b>                                         | Internetworking, Mobile Computing                    |          |
| <b>Studien-/Prüfungsleistungen/ Prüfungsform:</b>                         | Project work                                         |          |

### Module objectives:

The Internet of Things (IoT) describes new ecosystems in which various objects equipped with embedded computing and communication capabilities can interact with each other and with the user. This module aims to present students with the fundamental technologies and applications of the Internet of Things and to apply this knowledge through the development of an IoT project. This includes learning about embedded hardware and software, sensors, communication protocols, operating systems, and software development environ.

### Learning outcomes

#### Knowledge:

- Principles and requirements of ubiquitous systems
- IoT architectures for data acquisition and aggregation
- Characteristics of sensors and actuators for interacting with the environment and users
- Basic hardware and software platforms for IoT systems
- Data integration through IoT-cloud connectivity

- Domain-specific business models enabled by IoT: Industry 4.0, Automotive, Healthcare
- Web of Things as an integrative communication platform

Skills:

Students are able to design and develop new systems and products using IoT technologies. They can plan cross-layer architectures, select and deploy appropriate hardware, software, and communication protocols, and integrate networked information.

Competencies:

Upon completion of the module, students will be able to

| LOE# | Learning Outcome (LO)                                                                                                          | Assessed Through     |
|------|--------------------------------------------------------------------------------------------------------------------------------|----------------------|
| LO1  | Apply design principles of IoT applications                                                                                    | Report, project work |
| LO2  | Define and analyze IoT system requir                                                                                           | Report, project work |
| LO3  | Create a prototype IoT application (sensors, hardware, software, communication, and integration of connected informationements | Project work         |
| LO4  | Use modern development environments and tools                                                                                  | Project work         |
| LO5  | Work in teams to solve complex task                                                                                            | Project work         |
| LO6  |                                                                                                                                | Presentation         |
| LO7  | Evaluate IoT solutions in terms of feasibility and business relevance                                                          | Peer review          |

Content:

The lecture introduces the fundamentals of the Internet of Things (IoT). It includes seminar-style introductions to the topics with small exercises that enable students to design their own IoT solution in a team project (LE5). In addition to IoT design principles and architectures (LE1), students will learn the specific requirements of IoT systems (LE2). The core technologies (sensors and actuators, communication protocols, embedded systems, and integration of connected information) are presented and prototypically applied in the project (LE3). Students also learn typical development methods, environments, and tools (LE4). They will present the outcomes and findings of their project (LE6) and evaluate other teams' approaches using peer-review methods (LE7)

**Topics covered in the module include:**

- Introduction to IoT: Design principles and requirements
- Data acquisition and interaction via sensors and actuators
- IoT architectures, communication networks, and protocols
- From computers to smart objects via embedded systems
- IoT applications and development methods
- IoT platforms for integration with other information systems
- Web of Things (WoT)

Forms of media:

Depending on content and competencies, different media forms will be selected. Some topics will be covered classically with slide scripts projected via beamer and further explained or visualized on the blackboard. The module consists of a lecture with integrated exercises. Students will receive guidance on required installations and system requirements, which they will prototype under supervision in the lab. Afterwards, they will apply the learned skills in their own project and present the resu



#### Literature:

- Greengard, Samuel (2015): *The Internet of Things* (MIT Press Essential Knowledge Series). ISBN: 9780262527736
- Mattern, F., Flörkemeier, Ch. (2010): *Vom Internet der Computer zum Internet der Dinge*. Informatik Spektrum, Vol. 33, no. 2, pp. 107–121
- Porter, M.E., Heppelmann, J.E. (2014): *How Smart, Connected Products Are Transforming Competition*. Harvard Business Review 92, no. 11, pp. 64–88
- Weiser, M.: *The Computer for the 21st Century*
- Plus current journal articles, conference papers and online resources



|                                                                    |                                                                   |       |  |
|--------------------------------------------------------------------|-------------------------------------------------------------------|-------|--|
| Modul:                                                             | HUC Master Project: Virtual Reality Lab                           |       |  |
| Code:                                                              | HucM205                                                           |       |  |
| Subtitle:                                                          |                                                                   |       |  |
| Course elements:                                                   | Project                                                           |       |  |
| Semester:                                                          | Each semester                                                     |       |  |
| Module coordinator:                                                | Prof. Dr. Gabriela Tullius<br>Prof. Dr. Uwe Kloos                 |       |  |
| Lecturer:                                                          | Prof. Dr. Gabriela Tullius<br>Prof. Dr. Uwe Kloos                 |       |  |
| Language:                                                          | English, German                                                   |       |  |
| Allocation to the curriculum:                                      | Human-Centered Computing Master                                   |       |  |
| Mode of teaching / semester hours per week (SWS):                  | Lecture:                                                          | 2SWS  |  |
|                                                                    | Practical training:                                               | 2 SWS |  |
| Total hours:                                                       | Project.                                                          | 4 SWS |  |
| Credits:                                                           | 15 ECTS                                                           |       |  |
| Prerequisites in accordance with examination regulations (StuPro): | None                                                              |       |  |
| Recommended prerequisites:                                         | Software Engineering 1 + 2, Distributed Systems, Mobile Computing |       |  |
| Studien-/Prüfungsleistungen/<br>Prüfungsform:                      | Project:Project work                                              |       |  |

#### Module objectives:

Virtual and augmented reality, interactivity and working with three-dimensional content are the cornerstones of the VRlab project. For this purpose, a modern laboratory with technically different XR systems that make it possible to work with different technologies. These include various tracking systems, AR systems, HMDs and autostereoscopic systems, topics that are directly related to XR technologies are dealt with here.

Furthermore, a variety of new interaction systems (touch-based, gesture-based, based) are available with which new interaction concepts can be developed, investigated and tested. A dedicated lighting installation allows the investigation of various lighting scenarios in the context of the XR projects