Hochschule
Flensburg
University of
Applied Sciences

Module directory
Business Informatics (B.Sc.)

Flensburg University of Applied Sciences ● School of Business

Address	Kanzleistr. 91-93 24943 Flensburg, Germany
Phone	+49 (0) 461 805 1466
Fax	+49 (0) 461 805 1496
E-mail	dekanat.fb4@hs-flensburg.de
Contact	Prof. Dr. Jan Gerken, Coordinator of the degree programme Business Informatics [+49 (0) 461 0461 805 1471] Prof. Dr. Ulrich Welland, Vice Dean at the School of Business [+49 (0) 461 805 1522]
Version	Version_20210427
Relevant Study and Examination Regulations published on	3 Sep 2020 [*Nachrichtenblatt Hochschule* no. 06/2020]

Contents

Concept and implementation

Mission, vision & concept of the degree programme

Business Informatics graduates have a holistic perspective on both technology and economics which makes them key players in the everyday work and operations of a business creating digital products, processes and business models. This role requires a broad range of specific competencies and skills from the strategic design of a business and its business models to visualising and optimizing processes and the implementation of information and communication systems.

Our students acquire a profound basic knowledge in lectures and classes with a strong focus on application. Project work is a vital part of the studies. Students are expected to develop solutions for problems from as early as the second semester of the programme; this furthers their subject-related growth as well as the development of the so-called soft skills. The degree programme offers a broad range of business and technical knowledge, a specialisation is possible in the electives offered.

Business Informatics combines the traditional subjects Computer Science and Business Administration and then goes on to further develop this with key topics from academic research on digital transformation and put a focus on current topics such as Machine Learning and Big Data.

This degree programme combines the four pillars the *Gesellschaft für Informatik* (German Informatics Society) defines for bachelor's degree programmes in Business Informatics into one meaningful unit. The curriculum is designed to train software engineers and IT product managers while setting a focus on the current and future relevance of artificial intelligence and data-intensive applications.

Careers and job profiles

This degree programme is designed around a view of its graduates as designers and architects of digital transformation (and the processes related to it) inside and outside of companies. The curriculum is based on two job profiles addressing the challenges companies currently face and the underlying skills and qualifications our graduates need to meet them. These two job profiles are described in more detail in the following.

Job profile: Software Engineer

Software Engineering (SE) deals with the development of software systems in an engineering manner. The focal areas, also in the Business Informatics curriculum, are:

- Software Requirements: Identification, documentation and negotiation of requirements
- Software Design: Structuring a software system in an initial draft (architecture) and a detailed design (design)
  as well as a user interface design
- Software Construction: Implementing and integrating software
- Software Testing: Defining a testing strategy, test designs, testing and test analysis

Additional topics are processes and work methods in SE (e.g. agile development with Scrum and DevOps), management (e.g. configuration management and project management) and economy (e.g. costa nd resources estimate for the development of a software).

Software engineers often work in one of the areas mentioned above (e.g. as software developers, requirements engineers or testers). But they often also take on other tasks as part of a project (e.g. design, construction and testing). In order to meet the demands of their role, they have to possess skills in a variety of knowledge areas.

In the context of Business Informatics, software engineering deals with the development of complex business management application systems. As they have firm knowledge of relevant methods software engineers are also able to develop other types of systems.

Software engineers often start their careers in the field of Software Construction and then, after having gained experience on the job, move on to be team leads, test managers or product owners.

[1] https://www.computer.org/education/bodies-of-knowledge/software-engineering

Job profile: IT product manager

The German Federal Ministry for Economic Affairs (BMWi) wants Germany to become Europe's number one country for digital growth. The BMWi sees good progress having been made in the field of Industry 4.0 already and now wants to include services in the digital value creation chain as well (Services 4.0).

The impact digital technologies have on business models, sales strategies or services processes depends on the kind of service: Is it focused on a product, a person or knowledge. [1] The resulting job profile is as relevant as it is central. Product managers play a key role in the context of digital transformation, in the design of services as well as in that of products.

The main tasks product managers are in charge of are the development of IT-based products and services or the business models behind them, their go to market and their further development as well as the optimisation of existing products and services throughout the life cycle. Typical tasks and activities are support with technology and trend monitoring, client and market analyses, feasibility studies, requirements management, prototyping, implementation, marketing, benchmarking, continuous improvement as well as the creation and analysis of business cases.

In the context of the digital transformation and "XY.4.0" (IT) product managers will increasingly be expected to have the technical knowledge and skills arising at the interface between business administration and computer science. The role of an (IT) product manager, however, is not mainly a technical one but that of a strategist whose technical background enables them to contribute to the success of IT-based projects. With their skill profile (IT) product managers can fill out management positions as well as leading positions in projects or subject-specific areas. They know their product starting from a vision to development, marketing and to its optimisation in the product's life cycle. The tasks and jobs can include all steps starting with a minimal viable product (MVP) and going as far as marketability or the end of the lifecycle. With this in mind, the modules particularly relevant to this job profile - apart from the ones training technical skills - are the following:

- Digital Economy
- Introduction to Business Administration
- Business Process Management
- Accounting
- Investment and Finance
- Business Model Transformation
- IT Law
- Marketing
- Design Thinking & Lean Start Up
- Agile Product Development

[1] https://www.bmwi.de/Redaktion/DE/Artikel/Mittelstand/dienstleistungswirtschaft-03-innovation-technologie-forschungspolitik.html

Intended learning outcome of the degree programme

This degree programme aims to equip students with a holistic view combining the entrepreneurial design of digital transformation with the mechanisms of digitalisation processes outside businesses. Graduates understand, design and reflect on the increasing level of digital transformation. With their background in business administration and technical fields they analyse business processes and models and identify their potentials for digital transformation. They can conceptualise, implement and evaluate data-based systems. They design application systems and implement them. They are familiar with algorithms and methods supporting automation and analytical possibilities.

This equips the students with the academic basics and the broad academic qualification bachelor's degree programmes are meant to provide. In the bachelor's degree programme Business Informatics this is ensured through basic modules from business administration and computer science. The students' methodological skills are strengthened and they are qualified for a professional career with a strong focus on current topics and needs in industry. This is reflected in the degree programme's three majors: These majors are:

- Software Engineering,
- Digital Transformation and
- Data Science & Big Data.

The majors make Business Informatics students at Flensburg University of Applied Sciences to makers and designers as well as to critical thinkers in the area of digital transformation and enables them to be successful in their future work in the job profiles mentioned. The majors Software Engineering and Digital Transformation provide immediate skills and knowledge in the job profiles Software Engineering and (IT) Product Management. The Data Science & Big Data major is suitable for both job profiles. It enables our graduates to handle analytical systems and large amounts of data, both of which have an impact on Software Engineering and (IT) Product Management. The intended learning outcomes described below follow this:

Software Engineering

Eight of the ten qualifications most sought after by employers come from the field of software engineering (source: Solcom GmbH; Projektbarometer Q3/2019). Software Engineering deals with all aspects of the creation of software. This includes the definition, documentation and validation of requirements as well as programming and testing and deploying the application systems. Programming basics also play a role in the other two majors, e.g. e.g. for the provision and analysis of data and for the prototyping of new business models.

Students describe processes and methods from Software Engineering and use them to set up and supply application systems. They create models and transfer simple application cases into code. They apply the most commonly used programming paradigms in different programming languages. They analyse and critically reflect their own approach when developing software and see potentials for improvement.

Digital transformation

Companies are permanently faced with new trends and technologies. This entails ever-changing customer behaviour and competitive strategies as well as technology and product lifecycles becoming shorter all the time. The competition is getting tougher, while at the same time customers are less loyal, political contexts are insecure and societal values and norms change. Linear or static business models will continue to be under threat because not every company is able to react to these conditions with appropriate strategies, business models and new products or services as well as change management measures (e.g. culture change, recruiting new talent). According to the market research institute Gartner, only one third of the companies will successfully master the digital transformation.

In this context, students must have a fundamental understanding of changing value creation mechanisms in the digital transformation as well as of relevant impact factors within and outside the company. They should also know underlying concepts and methods to be able to identify trends and technologies and describe business models and products and apply the knowledge and skills they have acquired in the corresponding modules (e.g. Software Engineering, Big Date etc.). Graduates of this programme support companies with digital transformation projects and work on feasible work packages according to their qualification.

Data Science & Big Data

Almost all economic sectors will be impacted by artificial intelligence in the future. So as creators and designers of the digital transformation, Business Informatics graduates will increasingly be in charge of creating and designing data-based applications on an operative level as part of software engineering and software and on a strategic level ad part of (IT) product management. This requires a fundamental understanding of the relevant algorithms and technologies for data processing. So in addition to the majors Software Engineering and Digital Transformation students of this degree programme will also acquire solid qualification in the field of Big Data Science and Big Data that meets the requirements for the future development of artificial intelligence in the design of information systems.

Analytical methods are the focus of Data Science & Big Data thereby doing justice to the increasing distinction of the Data Science field. While Data Engineering is concerned with the compilation of data and infrastructure and Data Artists are crucial for the visualisation of information, Data Science mainly focusses on understanding, processing and analysing data. In this context, students must be familiar with methods from statistics and analytics, understand and apply them. They are able to develop analysis pipelines on a conceptual and technical level, use them and improve them in a step-by-step process as well as to visualise and interpret the results. This includes that students know artificial intelligence approaches, visualise them and select chosen approaches.

This major also addresses how to handle large amounts of data. Students are familiarised with theoretical concepts and their application to compile, process and store large amounts of data using current technologies.

Communication and cooperation skills

The increasingly project-oriented teaching approach of this degree programme make communication and cooperation skills a definite and inseparable part of the technical training. A group project is part of the first semester of the programme already. So, the students' communication and cooperation skills are strengthened right from the start of their studies. This strong focus on project work continues throughout the course of the programme. This way the students acquire and strengthen important social skills they will need for their future careers "on the job".

The graduates of this programmes will be expected to organise themselves in and contribute to new and ever-changing teams constantly as project-based work is becoming increasingly relevant and teams are re-organised and re-grouped.

Because of the project-based approach of this programme students are familiar with team development processes. They have to repeatedly organise themselves in new teams and experience Tuckman's stages of group development: forming–storming–norming–performing. This repeated experience enables students to find their place in teams later on and develop the resistance necessary to master the stages mentioned above successfully.

In addition to so-called soft skills, the student learn to apply cooperation tools in a meaningful manner. (Technical) Project management tools are being used today already as well as collaborative tools for software development. The application of these tools in projects requires the students to communicate and come to agreements right from the start of their project work. The collaborative work using tools to inspire and structure creativity promotes the communication process and teaches students to use these tools.

Personal skills and development

Studying Business Informatics supports the development of personal skills and the students' personal development putting a spotlight on digital transformation but not focussing on it solely.

As they are taught a holistic view on digital transformation graduates can understand and assess the impact of digital transformation and the societal changes it will entail. The students look at new technologies such as the topic "artificial intelligence" in depth which enables them to anticipate the impact these technologies will have. They truly understand the resulting opportunities and threats and can deduct societal, technological and economical implications.

They take decisions considering ethical and legal aspects. For example, they plan studies taking academic aspects into account. Overall the students' ability to solve problems and research information is strengthened, e.g. by selecting problem-oriented learning as a didactic means. The project-oriented training stresses the necessity to be an active member of a group and the design of its structure and content.

The students grow to be independent and self-reliant while at the same time they are enabled to use their communication and collaboration skills to work in and as a team to achieve a common project goal.

Explanations

Kinds of modules

The structure of this module directory follows the kinds of modules that exist at FUAS:

1. **Basic modules (BM)**: In these modules students acquire the basic knowledge and skills of their chosen degree programme; they do not specialise further. All basic modules are compulsory modules.
2. **Electives (EM):** These modules offer students the opportunity to specialise in another field in addition to their major. Each semester the Faculty Board will agree on a list of Electives to be offered for the following semester. This means that the Electives contained in this module directory are those valid at the time of printing.
3. **Modules to be completed at the end of the studies (ESM):** These modules form the end of the studies.

This module directory uses the terms and terminology used and defined in the Principles of Assessment [Prüfungsverfahrensordnung] (PVO) of Flensburg University of Applied Sciences.

Type of module

Defines the character of a module. The different types of modules are:

1. **Compulsory modules (CM)**: These modules have to be completed by all students enrolled in a degree programme.
2. **Binding electives (BEM):** Students can choose a number of related modules from a number of module catalogues offered (here: major modules, supplementary modules).
3. **Non-binding electives (NEM):** Students can choose any given number of modules from a number of module catalogues offered. Non-binding electives do not affect the final grade.

Type of assessment

Defines the type of assessment required to successfully complete a module. The different types of modules are:

1. **Coursework (CW):** If graded “fail”, this type of assessment can be re-taken for an unlimited number of times; coursework can be assessed with a grade or a certificate of attendance. Grades awarded for coursework do not affect the final grade.
2. **Examination (Ex):** If graded “fail”, this type of assessment can only be re-taken for a limited number of times; examinations are assessed with a grade. Grades awarded for examinations affect the final grade according to their weight in the curriculum.
3. **Component of an examination (CEx):** In terms of how it is graded and how often it can be re-taken the same rules apply as for Ex. This examination is made up of several components. In accordance with art. 14 para. 2 of the Principles of Assessment [Prüfungsverfahrensordnung, PVO] if an assessment is made up of more than one part, each part has to be graded with “ausreichend” [sufficient] at least. Unless specified otherwise, the final grade for a subject is derived from the arithmetic average of the individual parts of that assessment.
4. **Assessment pre-requisite to an exam (APE):** Assessment whose successful completion is pre-requisite for the admission to a (subordinate) examination. If an APE is graded “fail”, it may be re-taken for an unlimited number of times.

Form of assessment

Defines the form assessments can take. The different types of modules are:

1. **Written exam (WE) in accordance with art. 11 of the PVO:** Written test usually to be completed at the end of a semester (at the end of a series of classes forming a module). The time a written exam is to be completed in is to be defined in minutes, e.g. WE 90.
2. **Oral exam (OE) in accordance with art. 12 of the PVO:** Oral exam usually to be completed at the end of a semester (at the end of a series of classes forming a module). An oral exam usually takes 30 minutes per candidate. In group examinations each candidate shall be examined for 15 minutes.
3. **Other form of assessment (OA) in accordance with art. 13 of the PVO:** Other forms of assessment can include term papers, presentations in class, practical exercises, case studies, projects, designs, computer programmes or a combination of these. For compulsory modules up to three possible forms have to be defined in the degree programme's Study and Examination Regulations in accordance with art. 3 para. 2. In the case of electives, the examiner in charge can announce the specific form of assessment to be completed to the students and the Examinations Office at the beginning of the lecture period.
   A combination of different forms of assessment is permitted. This module directory uses "&" to mark a logical conjunction and "|" to mark a logical disjunction. For example: (Presentation in class | term paper) & oral exam, means the assessment is made up of a presentation in class or a term paper in addition to an oral exam. Presentation in class | (term paper & oral exam), however, means the assessment is made up of either a presentation in class or a term paper and an oral exam.

Type of class

Describes the manner in which the contents of a module are taught. The following types of class exist in accordance with art. 3 para. 5 of FUAS' Principles of Assessment [Prüfungsverfahrensordnung, PVO]:

1. **Lecture (L)**: Coherent presentation of the teaching content
2. **Tutorial accompanying a lecture (T):** Applying and further understanding the teaching content in small groups
3. **Seminar (SE):** Studying specific subject areas with the help of presentations independently created by the participants and/or in discussions in small groups
4. **Laboratory (Lab):** Acquiring and further understanding of knowledge by solving hands-on experimental tasks in small groups
5. **Project (P)**: Working in teams to design and realise solutions for real-world problems
6. **Workshop (W):** Moderated dialogue in a small group in which tasks are discussed and approaches for solutions are found
7. **Long-distance (LDC) and virtual classes (VC):** Classes 1. - 6. above, held via digital communication between teaching staff and students
8. **Field trip (FT):** Field trip led by a member of teaching staff
9. **Other classes (OC):** Classes of another kind than those described under numbers 1. to 8.

Language of instruction and examination language

The following languages are mentioned in the module directory:

- German (**GER**)
- English (**EN**)

This module directory uses the following conventions to clarify which language is used:

GER **&** EN	The module is offered in both German and English, i.e. it is made up of German and English language parts.
GER **|** EN:	The module is taught either entirely in German or entirely in English. Which of the languages is used will be determined at the beginning of the lecture period.
Competence level:	The recommended competence level for classes taught in English follow the Common European Framework of Reference of Languages (CEFR).

The following table gives an overview of the language of instruction and examination language.

semester	module[1]	Language of instruction and examination language
Basic modules (BM)		
1	Introduction to Business Administration	GER
1	Digital Economy	GER
1	Mathematics	GER
1	Programming Basics	GER
1	Computer architecture/Operating systems	GER
1	Accounting 1	GER
2	Business Process Management	GER
2	Networks	GER
2	Programming User Interfaces	GER
2	Accounting 2	GER
2	Production and Logistics	GER
2	Statistics	GER
3	Advanced Programming	GER
3	Database Systems	GER
3	Enterprise Resource Planning	GER
3	Software Engineering	EN
3	Statistical Analysis	GER
3	Economics	GER
4	Data Science	GER
4	Data Management & Big Data	GER
4	Investment and Finance	GER
4	Web Engineering	EN
4	Research Methods	EN

(1) The modules are listed alphabetically; the same listing method is used for the module descriptions on the following pages.

Semester	Module	Language of instruction and examination language
Basic modules (BM) - cont'd		
5	Business Model Transformation	GER
5	Introduction to Artificial Intelligence	GER
5	Software Project	EN
5	Marketing	GER
5	IT Law	GER
Electives (EM)		
4	Advanced Networking	GER
4	Agile Product Development	GER
4	Management Information Systems	GER
4	Mobile App Development	GER
4	Software Quality Assurance	EN
5	Management Information Systems - Project	GER
5	Design Thinking & Lean Start Up	GER
5	Internet of Things	GER
5	Methods of Futures studies	GER
5	Software Security	EN

Course plan

1st semester	hpw CP	24 30	Digital Economy	4 5	Computer architecture/Operating systems	4 5	Programming Basics	4 5	Accounting 1	4 5	Business Administration	4 5	Mathematics	4 5
2nd semester	hpw CP	24 30	Business Process Management	4 5	Networks	4 5	Programming User Interfaces	4 5	Accounting 2	4 5	Production and Logistics	4 5	Statistics	4 5
3rd semester	hpw CP	24 30	Enterprise Resource Planning	4 5	Database Systems	4 5	Software Engineering	4 5	Advanced Programming	4 5	Economics	4 5	Statistical Analysis	4 5
4th semester	hpw CP	24 30	Data Science	4 5	Data Management & Big Data	4 5	Web Engineering	4 5	Investment and Finance	4 5	Research Methods	4 5	Elective 1	4 5
5th semester	hpw CP	24 30	Business Model Transformation	4 5	Introduction to Artificial Intelligence	4 5	Software Project	4 5	Marketing	4 5	IT Law	4 5	Elective 2	4 5
6th semester	Hours CP	 30	**Internship**							540 18	**Bachelor's Thesis**			360 12

Percentage the module groups take in the programme structure:

Business Informatics (70 CP)	Electives (10 CP)	Computer Science (40 CP)	Business Administration (35 CP)	Others (25 CP)	180 CP
38.9%	5.6%	22.2%	19.4%	13.9%	100%

List of the contacts for each module:

Semester	module[1]	Contact
Basic modules (BM)		
1	Introduction to Business Administration	Dr. Klaus von Stackelberg
1	Digital Economy	Prof. Dr. Andreas Rusnjak
1	Mathematics	Prof. Dr. Ulrich Welland
1	Programming Basics	Prof. Dr. Sönke Cordts
1	Computer architecture/Operating systems	Prof. Dr. Ralf Lübben
1	Accounting 1	Prof. Dr. Lasse Tausch-Nebel
2	Business Process Management	Prof. Dr. Till Albert
2	Networks	Prof. Dr. Ralf Lübben
2	Programming User Interfaces	Prof. Dr. Sönke Cordts
2	Accounting 2	Prof. Dr. Thorsten Kümper
2	Production and Logistics	Prof. Dr. Volker Looks
2	Statistics	Prof. Dr. Thomas Severin
3	Advanced Programming	Prof. Dr. Sönke Cordts
3	Database Systems	Prof. Dr. Jan Gerken
3	Enterprise Resource Planning	Prof. Dr. Thomas Schmidt
3	Software Engineering	Prof. Dr. Kai Petersen
3	Statistical Analysis	Prof. Dr. Thomas Severin
3	Economics	Prof. Dr. Susan Kurth
4	Data Science	Prof. Dr. Jan Gerken
4	Data Management & Big Data	Prof. Dr. Ralf Lübben
4	Investment and Finance	Prof. Dr. Indra Erichsen
4	Web Engineering	Prof. Dr. Kai Petersen
4	Research Methods	Prof. Dr. Kai Petersen

(1) The modules are listed alphabetically; the same listing method is used for the module descriptions on the following pages.

Semester	Module	Contact
Basic modules (BM) - cont'd		
5	Business Model Transformation	Prof. Dr. Andreas Rusnjak
5	Introduction to Artificial Intelligence	Prof. Dr. Jan Gerken
5	Software Project	Prof. Dr. Kai Petersen
5	Marketing	Prof. Dr. Nelly Oelze
5	IT Law	Prof. Dr. Hasso Heybrock
Electives (EM)		
4	Advanced Networking	Prof. Dr. Ralf Lübben
4	Agile Product Development	Prof. Dr. Andreas Rusnjak
4	Management Information Systems	Prof. Dr. Thomas Schmidt
4	Mobile App Development	Prof. Dr. Sönke Cordts
4	Software Quality Assurance	Prof. Dr. Kai Petersen
5	Management Information Systems - Project	Prof. Dr. Thomas Schmidt
5	Design Thinking & Lean Start Up	Prof. Dr. Andreas Rusnjak
5	Internet of Things	Prof. Dr. Sönke Cordts
5	Methods of Futures studies	Prof. Dr. Till Albert
5	Software Security	Prof. Dr. Kai Petersen

Basic modules (BM)

Basic modules are designed to allow students to acquire the basic knowledge and skills of their chosen degree programme. They do not specialise further. Basic module are always compulsory modules.

If a degree programme accepts new students in every semester, basic modules are offered in every semester. If a degree programme only accepts new students once per year, basic modules are offered in that semester. (cf. “offered in”)

Introduction to Business Administration

Semester	Offered in	Duration	Type of assess-ment	ECTS	Workload
1	Once a year Winter se-mester	4 hpw	CM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other degree programmes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
None	Module can be used in: Energy Engineer-ing (bachelor's)	• Examination (Ex) • WE 120	Lecture	Dr. Klaus von Stackelberg

Intended learning outcomes

- students are confident in using the basic terms of business administration
- they understand how the individual corporate processes relate to each other
- they calculate the crucial business administrative parameters from given data sets
- they name and explain the role of value creation and management processes in the context of team and work in a company and outside it
- they analyse and structure common business questions and
- draft possible solutions for these questions

Contents

1. Introduction: Definition and concept of business administration, including a larger context of economics, humanities and cultural studies
2. Constructive decisions: Starting up a business, choosing the legal form and location, business networks, re-structuring and liquidation
3. Value creation and management processes as core processes: Innovation management, procurement, pro-duction, marketing/distribution
4. Management processes: Planning and management, organisation, management control
5. Support processes: Investment and finance, quality management

A list of recommended reading will be provided at the beginning of the semester.

Classes etc.

Lecturer	Name of the course	hpw
Dr. Klaus von Stackelberg	Introduction to Business Administration	4

Digital Economy

Semester	Offered in	Duration	Type of assess-ment	ECTS	Workload
1	Once a year Winter se-mester	4 hpw	CM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other de-gree pro-grammes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
None	Module can be used in: Business Admin-istration (bache-lor's)	• Examination (Ex) • OA: Group project & presentation in class & publication (if applica-ble)	Lecture with tutorials	Prof. Dr. Andreas Rusnjak

Intended learning outcomes

Students understand the relevance of digital technologies and information for the competitiveness of a business. In addition, they know trends and technologies and their importance for how societies and business act. They are familiar with concepts for the general description of business models and can apply them for the fields of industry x.0 and services x.0. In this context they also understand the correlations between business models and the tasks result for (IT) product management and where they can be placed in the common product-lifecycle models. More in-depth knowledge can be acquired in other modules.

Students form teams to work on case studies and continuously present their key results in accordance with the contents of the module. Students learn to visualise and conceptualise relevant entrepreneurial approaches by de-veloping alternative and additional ideas and solutions.

By working in teams students learn to become part of a group, express their opinion and debate it. They under-stand the problems and challenges of working in teams and how team dynamics can be used to attain goals. Stu-dents learn to understand their own role and their strengths in the context of teamwork by learning and applying strategies to solve conflict situations.

Working on case studies as individual projects allows the students to develop their ability to reflect their own ac-tions and identify their strengths and weaknesses. They know how to best apply their skills and resources and how to further develop them and they work on reducing or even overcoming their weaknesses. The definition of mile-stones and reporting deadlines prompts the students to organise themselves and work efficiently as well as to document knowledge and results and to present it to specific target groups.

Contents

1. Basics of the digital economy
2. Digital transformation: Important trends and technologies
3. Industry x.0

4. Services x.0
5. Digital business models

A list of recommended reading will be provided at the beginning of the semester.

Classes etc.		
Lecturer	**Name of the course**	**hpw**
Prof. Dr. Andreas Rusnjak	Digital Economy	4

Mathematics

Semester	Offered in	Duration	Type of assess-ment	ECTS	Workload
1	Once a year Winter se-mester	4 hpw	CM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other de-gree pro-grammes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
None	Module can be used in: Business Admin-istration (bache-lor's)	• Assessment pre-requi-site to an exam (APE) and Examination (Ex) • 3 tests in the course of the semester before the written exam (WE 120)	Lecture with sample calcula-tions	Prof. Dr. Ulrich Welland

Intended learning outcomes

- Students are familiar with the most important calculation methods in linear algebra, linear optimization and analysis.
- They can describe them in a meaningful manner and apply them.
- The students are able to develop first economic questions using mathematics, they are able to find model answers to these questions and interpret the results.

Contents

- Linear algebra: Vectors, matrices, systems of linear equations
- Linear optimization
- Analysis: Economic functions, differential and integral calculus, functions with more than one variable

A list of recommended reading will be provided at the beginning of the semester.
Study materials used in this module (scripts, excel files) can be purchased in the "AStA Papierladen" on campus and are available on Stud.IP.

Classes etc.

Lecturer	Name of the course	hpw
Prof. Dr. Ulrich Welland	Mathematics	4

Programming Basics

Semester	Offered in	Duration	Type of assessment	ECTS	Workload
1	Once a year Winter semester	4 hpw	CM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other degree programmes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
None		• Examination (Ex) • WE 120 at the computer	Online lecture Exercises Quizzes Inverted Classroom	Prof. Dr. Sönke Cordts

Intended learning outcomes

They understand the basic approach to imperative, procedural and object-oriented programming. They can develop simple classes with methods, data fields and properties and use them. They are able to break tasks down into smaller sub tasks and to express solutions with visual design methods. They can use UMLO class diagrams to turn real problem descriptions into visual UML models. They are able to develop code in the programming language C#, test the code and turn the classes they developed into a running program that can solve the problem at hand. On console-level students can program dialogues for input and output.

Contents

- **Introduction & motivation**
  How does a computer work?
  What is a programmer?
  What does a computer do?
  What does an interpreter do?
  What do I do to develop a software?
- **Practical introduction – First programme**
  How does a simple programme source code in C# look like?
  How to compile a C# source code?
  What is Integrated Development Environment (IDE)?
  How to embed a library?
- **Data types & operators**
  What are variables and data types?
  What data types are there?

What operators can be used for data types?

- **Different cases, loops & handling exceptions**
  What is a command?
  How can commands be executed independently of a condition?
  How can commands be repeated and executed depending on a condition?
  What is the scope of local variables?
  How to design code in an easy-to-grasp manner?
  How to deal with errors?
  What is an algorithm?
- **Object-orientation – methods & properties**
  What are classes, objects and instances?
  What are access modifiers?
  How can instances be created from classes?
  What are instance-based, class-based and constructor methods?
  What are properties?
  How does inheritance between classes work and how does that change the classes behaviour (polymorphism)?
  How do I get to C# code from a real problem (UML class diagrams)?
  What are generics?
  What are interfaces?
  What are delegates and events?

Recommended reading

Albahari, J. u.a.: C# 7.0 – kurz & gut; O'Reilly, 5th ed.; Sebastopol; 2018

Balzert, H.: Lehrbuch der Softwaretechnik – Entwurf, Implementierung, Installation und Betrieb, 3rd ed.; Spektrum Verlag; Heidelberg; 2011

Baltes-Götz, B.: Einführung in das Programmieren mit C# 7.3; ZIMK – Universität Trier; Trier; 2019

Bloch, J.: Effective Java, 3rd ed..; Addison-Wesley; Boston; 2017

Doberenz, W.: Visual C# 2015; Hanser Verlag; Munich; 2015

Kühnel, B.: C# 8 mit Visual Studio 2019, 8th ed.; Rheinwerk Verlag GmbH; Bonn; 2019

Lorig, D.: C# Programmieren Lernen ohne Vorkenntnisse; CreateSpace; o.A.; 2017

Mayo, J.: C# - Succinctly; Syncfusion Inc.; Morrisville, North Carolina; 2015

Rossel, S.: Object-Oriented Programming in C# - Succinctly Part 2; Syncfusion Inc.; Morrisville, North Carolina; 2016

Skeet, J.: C# in Depth, Third Edition; Manning Publications; Shelter Island; 2014

Solis, D. u.a.: Illustrated C# 7; Apress; New York; 2018

Theis, T.: Einstieg in C# mit Visual Studio 2019, 6th ed.; Rheinwerk Verlag GmbH; Bonn; 2019
Wurm, B.: Schrödinger programmiert C#; Rheinwerk Verlag GmbH; Bonn; 2016

Classes etc.		
Lecturer	**Name of the course**	**hpw**
Prof. Dr. Sönke Cordts	Programming Basics	4

Computer architecture/Operating systems

Semester	Offered in	Duration	Type of assessment	ECTS	Workload
1	Once a year Winter semester	4 hpw	CM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other degree programmes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
None		• Examination (Ex) • Lab tests[1] & WE 120 Obligatory for the module to be recognised	Lecture and lab tutorial	Prof. Dr.-Ing. Ralf Lübben

Intended learning outcomes

- Students understand how figures and symbols are represented in computer architectures.
- They are introduced to the most relevant logic gates in a computer.
- They are familiar with the basic terms in computer architecture and operating systems.
- They know all basic components of computers and operating systems and know how they work together.
- They can assess modern computer systems.

Contents

1. **Numeral systems and digital connections**
2. **Computer architecture**
   - Processors
   - RISC - CISC
   - Pipelining
   - Memory organisation
   - Storage media
3. **Operating systems**
   - Tasks, applications and forms
   - Processes
   - Scheduling
   - Threads
   - Virtual memory
   - File systems

A list of recommended reading will be provided at the beginning of the semester.

Classes etc.		
Lecturer	**Name of the course**	**hpw**
Prof. Dr.-Ing. Ralf Lübben	Computer architecture/Operating systems	4

Accounting 1: Principles

Semester	Offered in	Duration	Type of assess-ment	ECTS	Workload
1	Once a year Winter se-mester	4 hpw	CM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other de-gree pro-grammes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
None	Module can be used in: Business Admin-istration (bache-lor's)	• Examination (Ex) • WE 120	Lecture with tutorials	Prof. Dr. Lasse Tausch-Nebel

Intended learning outcomes

- Students apply terms and concepts from accounting and finance
- They understand the correlations between the different areas of accounting
- They can determine whether there is a legal obligation to keep books
- They understand the methodology of financial accounting and apply this to different business transactions and determine the closing entries necessary to create a complete annual financial statement including the balance sheet and a profit and loss account

Contents

- Target audience, tasks and objectives of cost accounting
- Operands in accounting and finance (deposit, earnings, revenue, capacity etc.)
- Legal basis for financial accounting
- Basic elements of financial accounting (stocktaking, inventory, balance sheet, profit & loss)
- Methodology of financial accounting
- Booking selected ongoing business transactions
- Closing entries for the annual financial statement

A list of recommended reading will be provided at the beginning of the semester.

Classes etc.

Lecturer	Name of the course	hpw
NN	Accounting 1: Principles	4

Business Process Management

Semester	Offered in	Duration	Type of assess-ment	ECTS	Workload
2	Once a year Summer se-mester	4 hpw	CM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other de-gree pro-grammes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
None		• Examination (Ex) • OA: Project	Lecture	Prof. Dr. Till Al-bert

Intended learning outcomes

- Knowledge expansion – students who complete this module successfully understand the relevance of process orientation in modern management approaches.
- More in-depth understanding – they understand the relevance of models for the analysis and design of busi-ness processes.
- Skills – tool skills – They are able to visualise processes in structure models, process chains and cost account-ing models and assess them.
- Skills - communicative skills – The students understand the importance of empowering staff for a simple, flexi-ble process management and they use case studies to actively design processes including the actors involved.
- Skills – systemic skills – Students analyse and define individual processes and business process management system.

Contents

- Business Process Management: short historic introduction, relevance, characteristics, limits
- Different kinds of process documentation for different stakeholders
- Defining digitalisation levels and describing optimisation approaches
- Business Process Optimization (BPO) and Re-engineering (BPR)
- Applying the learnings of the classes in a case study throughout the semester

A list of recommended reading will be provided at the beginning of the semester.

Classes etc.

Lecturer	Name of the course	hpw
Prof. Dr. Till Albert	Business Process Management	4

Networks

Semester	Offered in	Duration	Type of assessment	ECTS	Workload
2	Once a year Summer semester	4 hpw	CM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other degree programmes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
None		• Examination (Ex) • Lab tests[1] & WE 120 Obligatory for the module to be recognised	Lecture and lab tutorial	Prof. Dr.-Ing. Ralf Lübben

Intended learning outcomes

- Students know the basics of network technologies and network architectures.
- They can set up and configure simple networks.
- They know the individual layers of the OSI model and are able to describe them.
- They know the relevant protocols used in these layers.

Contents

- Network basics and architecture
- Transfer methods and media
- Switching, Ethernet technologies and standards
- Routing & IP protocol family: Internet Protocol version 4, Internet Protocol version 6
- Transport protocols: Transmission Control Protocol
- Application protocols: Hypertext Transfer Protocol, Domain Name System, Dynamic Host Configuration Protocol
- Wireless Local Area Networks

A list of recommended reading will be provided at the beginning of the semester.

Classes etc.

Lecturer	Name of the course	hpw
Prof. Dr.-Ing. Ralf Lübben	Networks	4

Programming User Interfaces

Semester	Offered in	Duration	Type of assessment	ECTS	Workload
2	Once a year Summer semester	4 hpw	CM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other degree programmes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
Programming Basics	Type of module Business Informatics (bachelor's)	• Examination (Ex) • OA: 90% software application 10% Peer review 0% assessment at the computer (30 mins), a "pass" is sufficient	Lectures on campus/online Exercises Quizzes Inverted Classroom	Prof. Dr. Sönke Cordts

Intended learning outcomes

The students are able to create a graphic user interface for a simple to medium difficult task using a markup language and they can program the application logic in C#. They are familiar with the most important graphic widgets and classes of the .NET network (Windows Presentation Foundation, WPF) and they can decide which classes can be used for given problems. They know the most important concepts for graphic user interfaces, can name and apply them (events, message loop, code behind, controls, widgets). They can design and create their own simple applications (mockups, UML) on their own.

Contents

1. **Introduction & motivation**
   What are the pre-requisites you should fulfil?
   What are GUI and TUI?
   What is the "Windows Presentation Foundation" (WPF)?
   What is a message loop?
   How are events passed on in the WPF?
   What tools do developers need?
2. **Practical introduction – First WPF app**
   Creating a WPF application as a console project
   Creating a WPF application as a "WPF app" project

How to debug XAML code

3. **XAML**
   What are XML name spaces?
   Creating an interface via XAML
   Creating an interface in codebehind
   What are self-closing elements?
   How to access superordinate complex XML elements
   What are markup extensions?
   What are resources?
4. **Basic classes**
   What are controls?
   What can the basic class Visual be used for?
   What can the basic class UIElement be used for?
   What can the basic class FrameworkElement be used for?
   What can the basic class Control be used for?
5. **Layout controls**
   What are layout controls?
   What are the properties of the Panel class?
   What are the properties of the Stack Panel class?
   How does the Wrap Panel class work?
   How does the Canvas class work?
   How does the Grid class work?
   How does the Dock Panel class work?
6. **Controls**
   What simple graphical shapes are there?
   Which kind of buttons are there?
   Which kind of sliders are there?
   Which elements are there for text?
   Which multi-element controls are there?
   What other controls (menu, calendar etc.) are there?
7. **Navigation**
   How to navigate to another window
   Methods navigation
   Passing parameters to a page via constructor
8. **Data and Command Binding**
   What is data binding?
   How to change the appearance using templates
   How to pass on data source changes automatically
   Can you bind methods to events?
   What are design patterns?
   Model-View-ViewModel (MVVM) by Gossman (2005)

Recommended reading

Andrade, C. u.a.: Professional WPF Programming; Wiley Publishing; Indianapolis; 2007

Baltes-Götz, B.: Einführung in das Programmieren mit C# 6; ZIMK – Universität Trier; Trier; 2017 (chapter 11)

Cordts, S. u.a.: WPF in C# für Anfänger; mana-Buch; Heide; 2019

Cordts, S.: Grafische Anwendungen in C# mit der WPF für Anfänger, Onlinekurs; www.udemy.com; 2019

Huber, T.: Windows Presentation Foundation; Rheinwerk Verlag GmbH; Bonn; 2016

James, B.: WPF Succinctly; Syncfusion; Morrisville; 2013

Kühnel, B.: C# mit Visual Studio 2015; Rheinwerk Verlag GmbH; Bonn; 2016 (chapters 18 – 31)

MacDonald, M.: Pro WPF 4.5 in C#; Apress, 4th ed.; New York; 2012

Marquardt, B.: Windows Presentation Foundation - Crashkurs; Microsoft Press; Unterschleißheim; 2007

Nathan, A.: WPF 4.5 Unleashed; SAMS, Pearson Education; Indianapolis; 2014

Sells, C. u.a.: Programming WPF; O'Reilly; Sebastopol; 2007

Theis, T.: Einstieg in C# mit Visual Studio 2017, 5th ed.; Rheinwerk Verlag GmbH; Bonn; 2017 (chapter 12)

Weil, A.: Learn WPF MVVM - XAML, C# and the MVVM pattern; lulu.com; o.A.; 2018

Classes etc.

Lecturer	Name of the course	hpw
Prof. Dr. Sönke Cordts	Programming User Interfaces	4

Accounting 2: Management Accounting

Semester	Offered in	Duration	Type of assessment	ECTS	Workload
2	Once a year Summer semester	4 hpw	CM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other degree programmes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
None	Module can be used in: Business Administration (bachelor's)	• Examination (Ex) • WE 120	Lecture with tutorials	Prof. Dr. Thorsten Kümper

Intended learning outcomes

The cost accounting section enables students to

- explain and apply cost accounting terminology
- produce simple cost curves, plot their graphs and discuss them
- calculate the most relevant cost types and discuss them critically
- choose adequate cost codes for cost centres and calculate overheads
- apply the basic rules of single unit product costing and review them critically and create a cost unit period costing calculation
- classify and describe cost accounting systems

The management control section enables students to

- identify and evaluate the role and tasks management control has in a company
- review the possible applications of but also limitations to management control and its tools
- apply the most relevant tools of management control

Contents

Cost accounting

- Basics of cost accounting (definition and functions of costs etc.)
- Cost elements, cost centre and cost unit accounting (single unit product and cost unit period costing)
- Overview of cost accounting systems

Management control

- Basics and context of management control

- Operative tools of management control
- Strategic tools of management control
- Management control objects
- Development of management control

A list of recommended reading will be provided at the beginning of the semester.

Classes etc.		
Lecturer	**Name of the course**	**hpw**
NN (Cost accounting) Prof. Dr. Thorsten Kümper (Management control)	Accounting 2: Management Accounting	2 2

Production and Logistics

Semester	Offered in	Duration	Type of assessment	ECTS	Workload
2	Once a year Summer semester	4 hpw	CM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other degree programmes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
None	Module can be used in: Business Administration (bachelor's)	• Examination (Ex) • WE 120	Lecture (L) including case studies to create a better understanding of the contents	Prof. Dr. Marcus Brandenburg, Prof. Dr. Volker Looks

Intended learning outcomes

- Students know and understand the basics of procurement, production, logistics and supply chain management.
- They apply conceptual reference frameworks and mathematical models in these fields.
- Students analyse internal and external data, information and capital flow.
- They make suggestions for how to improve processes and functions in the value creation network.
- Students assess production and logistics systems on the basis of financial and other performance parameters.

Contents

- Procurement – strategic and operative procurement
- Production – 5S method and shop floor management, maintenance and quality management, production structures and organisation, production control
- Logistics – warehouse and inventory management, transport, procurement and distribution logistics
- Supply Chain Management – supply chain structure, process orientation in supply chains

Recommended reading

- Kummer S, Grün O, Jammernegg W (2013): Grundzüge der Beschaffung, Produktion und Logistik. 3rd ed, Pearson Verlag, Munich.
- Kummer S, Grün O, Jammernegg W (2013): Grundzüge der Beschaffung, Produktion und Logistik – Das Übungsbuch. 2nd ed, Pearson Verlag, Munich.
- Günther HO, Tempelmeier H (2012): Produktion und Logistik. 9th ed, Springer Verlag, Berlin.
- Günther HO, Tempelmeier H (2010): Übungsbuch Produktion und Logistik. 7th ed, Springer Verlag, Berlin.

a list of additional recommended reading will be provided at the beginning of the semester

Classes etc.		
Lecturer(s)	**Name of the course**	**hpw**
Prof. Dr. Marcus Brandenburg Prof. Dr. Volker Looks	Production and Logistics	4

Statistics

Semester	Offered in	Duration	Type of assessment	ECTS	Workload
2	Once a year Summer semester	4 hpw	CM	5	150 hours: 60 hours in class 90 hours revision outside class

Pre-requisites	Reusability (incl. other degree programmes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
None	None	• Examination (Ex) • WE 120	Lecture and exercises	Prof. Dr. Thomas Severin

Intended learning outcomes

The students know statistics parameters, can determine and interpret them. They are familiar with the basic methods of statistical data collection, data description and statistical inference and can interpret the results.

They know statistical methods used in other modules (e.g. Business Administration, Marketing, Data Science).

Contents

Basics of descriptive statistics, simple linear regression, parameters and index numbers, combinatorics, probability, fundamentals of inductive statistics (distribution, estimation, hypothesis testing).

A list of recommended reading will be provided at the beginning of the semester.

Classes etc.

Lecturer	Name of the course	hpw
Prof. Dr. Thomas Severin	Statistics	4

Advanced Programming

Semester	Offered in	Duration	Type of assess-ment	ECTS	Workload
3	Once a year Winter se-mester	4 hpw	CM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other de-gree pro-grammes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
Programming Basics		• Examination (Ex) • WE 120 at the com-puter	Lectures on campus/online Exercises Quizzes Inverted Class-room	Prof. Dr. Sönke Cordts

Intended learning outcomes

The students can design and implement algorithms on their own. To do so, they use commonly used design methods (pseudo code, UML activity diagram, PAP, structograms). When implementing an algorithm, they can assess which data structure is appropriate to solve a given problem. They know how algorithms can be compared and what complexity classes are. They understand advances programming concepts necessary for the implementation of own data structures (iterators, reference and value parameters, indexers, generics). They can access relational data bases using database access techniques and understand the different concepts behind these techniques.

Contents

1. **Introduction & motivation**
   What are data structures, types and classes?
   What is an algorithm?
   What are the current topics in programming?
2. **Data structures**
   Which generally applicable data structures are there?
   Linked lists
   Binary tree
   Graphs
   Hash table
3. **Algorithms**

Complexity classes and Big O notation
Binary search
Fuzzy search in strings

4. **Data base access**
   Which data base access techniques are there (CLI, ORM, Embedded)?
   Call Level Interface (JDBC, ADO.NET)
   Object Relational Mapping (JPA, Entity Framework)
   Language-Integrated Query (LINQ)
5. **Current topics in programming**

Recommended reading

Bhargava, A.: Algorithmen kapieren – visuell lernen und verstehen; mitp Verlag; Frechen; 2019

Cordts, S.: Algorithmen und Datenstrukturen; mana-Buch Verlag; Heide; 2018

Horvick, R.: Data Structures – Succinctly Part 1; Syncfusion Inc.; Morrisville, North Carolina; 2014

Horvick, R.: Data Structures – Succinctly Part 2; Syncfusion Inc.; Morrisville, North Carolina; 2014

Janarthanam, S.: Chatbots and Conversational UI Development; Packt Publishing; Birmingham; 2017

Knuth, Donald: The Art of Computer Programming 1 - 4; Addison Wesley; o.A; 2011

Lafore, R.: Data Structures & Algorithms in Java; Sams Publishing; Indianapolis, Indiana; 2003

Lee, H.: Voice User Interface Projects; Packt Publishing; Birmingham; 2018

Marguerie, F. u.a.: LINQ in Action; Manning Publishing; Greenwich; 2008

Ottmann, T., Widmayer, P.: Algorithmen und Datenstrukturen; 6th ed.; Springer Vieweg; Heidelberg; 2017

Rimscha, M.v.: Algorithmen kompakt und verständlich, 4th ed.; Springer Vieweg Verlag; Wiesbaden; 2018

Saake, G.; Sattler, K.-U.: Algorithmen und Datenstrukturen; dpunkt.verlag GmbH; Heidelberg; 2014

Schwichtenberg, H.: Effizienter Datenzugriff mit Entity Framework Core; Carl Hanser Verlag; Munich; 2018

Sedgewick, R.; Wayne, K.: Algorithmen, 4th updated ed.; Pearson Deutschland GmbH; 2014

Classes etc.

Lecturer	Name of the course	hpw
Prof. Dr. Sönke Cordts	Advanced Programming	4

Database Systems

Semester	Offered in	Duration	Type of assessment	ECTS	Workload
3	Once a year Winter semester	4 hpw	CM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other degree programmes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
None	None	• Examination (Ex) • WE 120 (possibly at the computer in parts or entirely)	Lecture (L) & Lab	Prof. Dr. Jan Gerken

Intended learning outcomes

- The students can name the tasks data base systems are meant to fulfil and visualise their architecture.
- They are familiar with the process of developing a data base, from the idea stage to the actual implementation.
- They apply methods and tools for data base design and are able to design small to medium-sized data bases and implement them.
- They can make queries of relational data bases, set them up and make changes to them.

Contents

- Lecture: Definition of data base systems, architecture of data base systems, relation data base model, conceptual design, logical design, database normalization
- SQL lab: SQL exercises, queries (DQL), update (DML), data base design (DDL)

Classes etc.

Lecturer	Name of the course	hpw
Prof. Dr. Jan Gerken	Database Systems	2
Prof. Dr. Jan Gerken	SQL lab	2

Enterprise Resource Planning

Semester	Offered in	Dura-tion	Type of assess-ment	ECTS	Workload
3	Once a year Winter se-mester	4 hpw	CM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other degree programmes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
None	None	• Examination (Ex) • WE 120 (at the com-puter)	Lecture, mini pro-ject throughout the semester and guest lectures	Prof. Dr. Thomas Schmidt

Intended learning outcomes

- the students understand the role of ERP functionality in a company's information architecture
- they understand the potential and the functionality of ERP systems
- they are familiar with the basic processes of ERP solutions
- they can design a value chain using the functions of ERP systems
- they can design and implement basic organisational ideas of their own with the help of customizing
- they can apply methods for the introduction of ERP systems

Contents

Part 1: ERP processes

- Introduction to Enterprise Resource Planning
- Logistics
- Production planning and control
- Sales and distribution
- Accounting
- Cost accounting

Part 2: Introduction to ERP

- Preparation and organisation phase
- Analysis and conception phase
- Adjustment and change pahse

A list of recommended reading will be provided at the beginning of the semester.

Classes etc.

Lecturer	Name of the course	hpw
Prof. Dr. Thomas Schmidt	Enterprise Resource Planning	4

Software Engineering

Semester	Offered in	Duration	Type of assess-ment	ECTS	Workload
3	Once a year Winter se-mester	4 hpw	CM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other degree programmes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
Programming Ba-sics, Programming User Interfaces	None	• Examination (Ex) • OA: Written report, pro-ject, presentation in class	Workshop	Prof. Dr. Kai Petersen

Intended learning outcomes

- Students conduct an individual small software project using the Scrum method, resulting in an implemented soft-ware
- Students elicit and specify software requirements (e.g. in the form of natural language requirements, use cases, and models) for a given case
- They specify software architectures and analyse their architecture for a given case.
- They define test strategies for a software, design tests and execute them. Thereafter, they analyse the result of the test activity.
- They conduct an individual small software project using the Scrum method, resulting in an implemented soft-ware.

Contents

- Overview of Software Engineering
- Agile approaches (e.g. Scrum, Extreme Programming, DevOps) and hybrid development models
- Comparison of agile approaches with traditional software development (e.g. plan-driven)
- Requirements engineering (elicitation, specification and negotiation of requirements) and types of require-ments
- Software architecture (patterns, specification, and evaluation of architectures)
- Quality assurance (test strategy definition, test design, test execution and test analysis)
- Managerial aspects (risk management, human factors, software metrics)

Recommended level of English language skills: B2 level

Classes etc.

Lecturer	Name of the course	hpw
Prof. Dr. Kai Petersen	Software Engineering	4

Statistical Analysis

Semester	Offered in	Duration	Type of assess-ment	ECTS	Workload
3	Once a year Winter se-mester	4 hpw	CM	5	150 hours: 60 hours in class 90 hours revision outside class

Pre-requisites	Reusability (incl. other de-gree pro-grammes)	Pre-requisites for Cps to be awarded • Form of assessment • Length of the assess-ment	Teaching and study methods	Contact
Statistics	None	• Examination (Ex) • WE 120 (at the com-puter)	Lecture, lab and tutorial	Prof. Dr. Thomas Severin

Intended learning outcomes

The students are familiar with the basic processes in statistics and data mining and apply them to analyse data. They are able to use univariate as well as select multivariate analysis methods and both parametric and non-parametric processes.

They know statistical methods used in other modules (e.g. Business Administration, Marketing, Data Science).

Contents

non-parametric processes (hypothesis testing), regression analysis, time series, analysis of variance, key rules of data mining (e.g. 1 Rule, Naive Bayes), distance and similarity measure, cluster analysis

A list of recommended reading will be provided at the beginning of the semester.

Classes etc.

Lecturer	Name of the course	hpw
Prof. Dr. Thomas Severin	Statistical Analysis	4

Economics

Semester	Offered in	Duration	Type of assess-ment	ECTS	Workload
3	Once a year Winter semester	one semes-ter	CM	5	150 hours: 60 hours in class 90 hours revision outside class

Pre-requisites	Reusability (incl. other degree programmes)	Pre-requisites for Cps to be awarded • Form of assessment • Length of the assess-ment	Teaching and study methods	Contact
None	Module can be used in: Business Administra-tion (bachelor's)	• Examination (Ex) • WE 120	Lecture	Prof. Dr. Susan Kurth

Intended learning outcomes

Students

- are able to explain the main approaches of the theory of consumer choice and the theory of the firm as well as the allocation function of the market.
- can differentiate between market forms influencing the actions of economic units and the market result.
- assess the role of the state in different kinds of market failure.
- question the significance and value of the data of the national accounts, employment figures and the devel-opment of inflation.
- are able to critically assess economic policies based on supply and demand.
- begin to analyse and evaluate the ECB's monetary policy.

Contents

1. Introduction: What does Economics deal with?, micro and macro economy?, models and theories, nominal and real parameters
2. Theory of consumer choice
3. Theory of the firm
4. Elasticities
5. Market forms
6. The market: Supply and demand and state intervention
7. Markets and welfare
8. The job market
9. Public goods and external effects
10. Macro-economic data

11. The economic cycle
12. The European System of Central Banks: Objectives and monetary policy instruments
13. Monetary and fiscal policy: Keynes vs. neoclassical economics in a closed economy

A list of recommended reading will be provided at the beginning of the semester.

Classes etc.		
Lecturer	**Name of the course**	**hpw**
Prof. Dr. Susan Kurth	Economics	4

Data Science

Semester	Offered in	Duration	Type of assess-ment	ECTS	Workload
4	Once a year Summer semester	4 hpw	CM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other de-gree pro-grammes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
OT, Statistical Analysis	None	• Examination (Ex) • OA: Project	Workshop, maybe online tutorial	Prof. Dr. Jan Gerken

Intended learning outcomes

- The students are familiar with data science methodologies and can visualise a typical approach and the challenges connected to it.
- They learn a programming language used in data science (e.g. Python, R, Julia) and are able to use it.
- They compile data, prepare them for additional analysis and apply basic as well as advanced analysis methods.
- They visualise and interpret the results based on a given problem or task.

Contents

- Definition & data science methodologies
- Data science tools and programming languages (e.g. Python, Jupyter Notebooks)
- Compilation and preparation of data (data APIs, feature engineering)
- Simple analyses
- Advanced analyses (text and data mining, similarity and distance measure, machine learning, e.g. cluster analysis, dimension reduction, graph analysis)
- Information visualisation

Recommended reading:

Grus, J. (2016). Einführung in Data Science: Grundprinzipien der Datenanalyse mit Python. O'Reilly.

Vanderplas, J. T. (2016) Python Data Science Handbook: Essential Tools for Working with Data. O'Reilly

Classes etc.

Lecturer	Name of the course	hpw
Prof. Dr. Jan Gerken	Data Science	4

Data Management & Big Data

Semester	Offered in	Duration	Type of assess-ment	ECTS	Workload
4	Once a year Summer semester	4 hpw	CM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other de-gree pro-grammes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
OP	None	• Examination (Ex) • WE 120 at the com-puter	Lectures on campus Exercises	Prof. Dr. Sönke Cordts Prof. Dr. Ralf Lüb-ben

Intended learning outcomes

Students understand how connected data changes can be kept consistent in multi user mode in transactions in relational data base systems. They can choose different transaction modes depending on the application and they can determine the problems that may occur in multi user mode.
They are familiar with the different index types to speed up access to relational data and can create them based on search queries.
They learn imperative and procedural programming in SQL by creating stored procedures. They know Trigger as a concept for active data base systems and can evaluate possible applications. They can also use other programming languages such as Java and C# to create stored procedures.
They are introduced to the challenges of relational data base systems. They are also introduced to alternative systems such as NoSQL systems and can evaluate their application in projects.
They identify problems when large amounts of data are to be processed and are introduced to concepts and solutions to process and store such amounts of data.

Contents

1. **Transactions**
   What is a transaction and what re its characteristics?
   Recovery
   Transactions in SQL
   Multi user mode (Concurrency Control)
2. **Performance**
   Storage structures
   Index types
   Query Optimizer – Query Evaluation Plan
   Implementation plans and statistics

Operators in implementation plans

3. **Stored procedures in SQL**
   SQL procedures
   SQL functions
   Procedural SQL
   Active vs. passive data base systems
   SQL Trigger
4. **Stored procedures in Java/C#**
5. **NoSQL database systems**
   Problems of relational data bases
   column, document and graph-oriented data bases
6. **Big data technologies**
   Batch vs. stream processing
   Programming models for the processing of large amounts of data
   Distributed data bases for the storage of large amounts of data

Recommended reading

Cordts, S.: Datenbankkonzepte in der Praxis. Nach dem Standard SQL-99; Addison-Wesley; Munich; 2002

Edlich u.a.: NoSQL, 2nd ed. ; Carl Hanser Verlag; Munich; 2011

Elmasri, R.; Navathe, S. B.: Grundlagen von Datenbanksystemen; 3rd ed., Pearson; Munich; 2009

Faeskorn-Woyke, H. u.a.: Datenbanksysteme; Pearson Studium; Munich; 2007

Freiknecht, J.; Papp S.: Big Data in der Praxis: Lösungen mit Hadoop, Spark, HBase und Hive. Daten speichern, aufbereiten, visualisieren. 2nd extended ed., ; Carl Hanser Verlag; Munich; 2018

Gulutzan, P.; Pelzer, T.: SQL-99 Complete, Really; R&D Books; Lawrence, Kansas; 1999

Jarosch, H.: Grundkurs Datenbankentwurf, 3rd ed.; Vieweg & Teubner; Wiesbaden; 2010

Krueger u.a.: Hauptspeicherdatenbanken in Unternehmen; in: Datenbank Spektrum; Springer Verlag; Berlin; 03/2010, pages 143-158

Kleppmann, M.: Datenintensive Anwendungen designen: Konzepte für zuverlässige, skalierbare und wartbare Systeme; O'Reilly; 2018

Kudraß, T (ed.): Taschenbuch Datenbanken; Hanser Fachbuch Verlag; Leipzig; 2015

Kemper, A.; Eickler, A.: Datenbanksysteme, 6th ed.; De Gruyter Oldenbourg Verlag; Munich; 2015

Melton, J.; Simon, A.R.: SQL:1999 - Understanding Relational Language Components; Morgan Kaufmann; San Francisco; 2002

Robinsion, Webber, Eifrem: Graph Databases; O'Reilly; Sebastopol; 2013

Sadalage, Fowler: NoSQL Distilled; Addison-Wesley; 2012

Türker, C.; Saake, G.: Objektrelationale Datenbanken: ein Lehrbuch; dpunkt Verlag; 2006

Türker, C.: SQL:1999 & SQL:2003 - Objektrelationales SQL, SQLJ & SQL/XML; dpunkt Verlag; 2003

Classes etc.

Lecturer	Name of the course	hpw
Prof. Dr. Sönke Cordts Prof. Dr. Ralf Lübben	Data Management & Big Data	4

Investment and Finance

Semester	Offered in	Duration	Type of assessment	ECTS	Workload
4	Once a year Summer semester	4 hpw	CM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other degree programmes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
OP	Module can be used in: Business Administration (bachelor's)	• Examination (Ex) • WE 120	Lecture	Prof. Dr. Indra Erichsen

Intended learning outcomes

Students know the commonly used investment calculus and conventional financial instruments (equity and debt). They can describe them in a meaningful manner and apply them.

Skills and competencies

- This enables the students to assess the feasibility of an investment.
- They can also assess the use of financial instruments and conduct a qualitative analysis of their application.

Contents

Investment

- Different types of operational investment decisions
- Commonly used static and dynamic investment appraisal methods taking into account the context decisions are taken in

Finance

- Objectives of a company's finance policies and determining the capital requirements
- Systematic approaches to external and internal financing
- Specific forms of finance

A list of recommended reading will be provided at the beginning of the semester.

Classes etc.

Lecturer	Name of the course	hpw
Prof. Dr. Indra Erichsen	Investment and Finance	4

Web Engineering

Semester	Offered in	Duration	Type of assessment	ECTS	Workload
4	Once a year Summer semester	4 hpw	CM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other degree programmes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
OP	None	• Examination (Ex) • OA: Projects, tests	Workshop	Prof. Dr. Kai Petersen

Intended learning outcomes

- The students use web-technologies and protocols (e.g. http)
- They structure content using HTML
- They design web user interfaces using CSS
- They create web applications using up-to-date web frameworks (e.g. Angular)
- They test web applications

Contents

- Web Foundations (Client-Server, Protocols, Web Architectures, e.g. SOA, P2P, etc.)
- HTML
- CSS
- Selected web frameworks (e.g. Angular)

Recommended level of English language skills: B2 level

Classes etc.

Lecturer	Name of the course	hpw
Prof. Dr. Kai Petersen	Web Engineering	4

Research Methods

Semester	Offered in	Duration	Type of assessment	ECTS	Workload
4	Once a year Summer semester	4 hpw	CM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other degree programmes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
None	None	• Examination (Ex) • OA: Written report	Workshop	Prof. Dr. Kai Petersen

Intended learning outcomes

- The students formulate research questions
- They select suitable research methods to answer the questions
- They search for related work using scientific databases for a literature study
- They aggregate and document the findings presented in primary studies
- They design a primary study (experiment, case study, survey) and choose suitable methods for data collection and analysis
- They analyse data (quantitative and qualitative)
- They write the scientific paper

Contents

- Foundations: Empirical research, „Schools of thought“, quantitative vs. qualitative research
- Methods for literature studies (Systematic Review, Systematic Mapping)
- Case studies
- Experiments
- Surveys
- Qualitative data analysis (e.g. Grounded Theory, Content Analysis)
- Quantitative data analysis (e.g. descriptive statistics, parametric and non-parametric hypotheses tests)
- Review of studies
- Documentation of studies (writing a research paper)

Recommended level of English language skills: B2 level

Classes etc.

Lecturer	Name of the course	hpw

Prof. Dr. Kai Petersen	Academic Research and Writing Techniques	4

Business Model Transformation

Semester	Offered in	Duration	Type of assessment	ECTS	Workload
5	Once a year Winter semester	4 hpw	CM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other degree programmes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
OP	None	• Examination (Ex) • OA: Group project & presentation & project report	Lecture with seminar character including project work using case studies and examples as well as discussion in class, presentations and subject-related discussions.	Prof. Dr. Andreas Rusnjak

Intended learning outcomes

The digital transformation can only be successful if we approach it in a structured and holistic manner suing the appropriate models and methods. Adding “engineering” to the more basic term “business modelling” is supposed to stress the necessity of approaching this challenge like an engineer. Business Model Engineering is based on Business Engineering principles, i.e. managing individual change projects in a structured manner and using appropriate methods. It must be clear, however, that Business Model Engineering is not merely a sub-task of Business Engineering but a subject area of its own. Its relevance makes it so. So, in order to successfully complete the transformation of a business model an engineering approach must be applied to the business modelling – particularly in the context of the digital transformation. Other examples are software engineering, requirements engineering, business process engineering etc.

The students are introduced to methods to systematically reconstruct businesses based on their business models using specific analysis methods. They are able to analyse and describe user or customer-based challenges and problems on a meta level. New business model options can be generated and discussed by comparing other systems and business models and combining specific patterns (business model patterns); these new models can then be a starting point for a transformation. This module aims to inspire students to develop innovative, creative solutions for challenges customers and businesses face.

Students form teams to work on case studies and continuously present their key results in accordance with the contents of the module. Students learn to visualise and conceptualise relevant entrepreneurial approaches by developing alternative and additional ideas and solutions.

By working in teams students learn to become part of a group, express their opinion and debate it. They understand the problems and challenges of working in teams and how team dynamics can be used to attain goals. Students learn to understand their own role and their strengths in the context of teamwork by learning and applying strategies to solve conflict situations.

Working on case studies as individual projects allows the students to develop their ability to reflect their own actions and identify their strengths and weaknesses. They know how to best apply their skills and resources and how to further develop them and they work on reducing or even overcoming their weaknesses. The definition of milestones and reporting deadlines prompts the students to organise themselves and work efficiently as well as to document knowledge and results and to present it to specific target groups.

Contents

- Digital competition
- Digital platforms
- Customer experience
- Business analysis methods
- In-depth business modelling
- Business model patterns

A list of recommended reading will be provided at the beginning of the semester.

Classes etc.

Lecturer	Name of the course	hpw
Prof. Dr. Andreas Rusnjak	Business Model Transformation	4

Introduction to Artificial Intelligence

Semester	Offered in	Duration	Type of assessment	ECTS	Workload
5	Once a year Summer semester	4 hpw	CM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other degree programmes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
OP, Data Science	None	• Examination (Ex) • OA: Project	Workshop / seminar	Prof. Dr. Jan Gerken

Intended learning outcomes

- Students are familiar with different approaches to Artificial Intelligence (AI).
- They learn to structure AI projects.
- They are familiar with the basic structure of neuronal networks and their mathematical basis.
- They are able to create a neuronal network, evaluate and optimise it.
- They adjust hyper parameters and can evaluate their impact on the neuronal network's performance.
- They improve the neuronal network's performance experimentally.

Contents

- History of artificial intelligence
- Approaches to artificial intelligence
- Neuronal networks and their design (layers, activation functions, error functions)
- Architecture of neuronal networks (e.g. Convolutional Neural Networks, Recurrent Neural Networks)
- Backpropagation and updating weights
- Approaches to evaluate and improve neuronal networks

A list of recommended reading will be provided at the beginning of the semester.

Classes etc.

Lecturer	Name of the course	hpw
Prof. Dr. Jan Gerken	Introduction to Artificial Intelligence	4

Software Project

Semester	Offered in	Duration	Type of assessment	ECTS	Workload
5	Once a year Winter semester	4 hpw	CM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other degree programmes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
OP	None	• Examination (Ex) • OA: Written report, project, presentation in class	Workshop	Prof. Dr. Kai Petersen

Intended learning outcomes

The students apply the methods learned in the module „Software Engineering“ to develop a complex software product using agile software development methods. They develop the software in a team. The development comprises:

- elicitating and documenting requirements
- specifying the system architecture
- implementing the software
- testing the software
- conducting a post mortem

The students select the processes and methods and motivate their selection. The focus is placed on agile development practices. They compare processes (e.g. different approaches and practices to agile software development from Scrum, Extreme Programming, and DevOps) and critically reflect them.

Contents

- Agile project management
- Agile processes and practices
- Software development lifecycle (requirements, architecture, quality assurance, maintenance and delivery)in an agile context
- Working in an agile cross-functional team

Recommended level of English language skills: B2 level

Classes etc.

Lecturer	Name of the course	hpw

Prof. Dr. Kai Petersen	Software Project	

Marketing

Semester	Offered in	Duration	Type of assessment	ECTS	Workload
5	Once a year Winter semester	4 hpw	CM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other degree programmes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
OP	None	• Examination (Ex) • WE 120	Lecture with subject-related discussions and integrated case studies	Prof. Dr. Nelly Oelze

Intended learning outcomes

Students are familiar with the core elements of a marketing concept and understand the systemic linkages between these individual elements.
They create a daft of their own complete and coherent marketing concept for different products and applications.
They systematically analyse the conditions of internal and external entrepreneurship and how they interact (including the social market environment) and they assess the importance the individual factors and conditions have for the creation of a marketing concept in the context in question.

Contents

1. Guiding principles of a contemporary marketing concept (market and society-orientation)
2. Core elements of a marketing concept
3. Market research: Main types, process steps and decision areas in market research
4. Behavioural basics to buying decisions (market psychology)
5. Areas of analysis and decision-making in strategic marketing
6. Marketing mix (product, price, distribution, communication)
7. Implementing marketing within the business (organisation, HRM, IT and management control systems, corporate culture)

A list of recommended reading will be provided at the beginning of the semester.

Classes etc.

Lecturer	Name of the course	hpw
Prof. Dr. Nelly Oelze	Marketing	4

IT Law

Semester	Offered in	Duration	Type of assessment	ECTS	Workload
5	Once a year Winter semester	4 hpw	CM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other degree programmes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
OP	None	• Examination (Ex) • WE 120	Lecture with case studies	Prof. Dr. Hasso Heybrock

Intended learning outcomes

Entrepreneurial activities always take place within a cultural, economic and legal framework. Students are able to assess the rights and obligations connected to business and trade activities on their own. They understand what measures can be taken to avoid or solve legal questions and problems in a business context. This includes the ability to communicate with internal and external legal consultants. Students are qualified to solve legal conflicts within a company and – insofar as that is permissible – in court.

Contents

Section A: Substantive contents

1 Structure and functioning of the law
2 Enforcement of claims under civil law
3 Declaration of intent and conclusion of contract
4 Principles of interpretation
5 Legal capacity, contractual capacity, responsibility for torts
6 Grounds for invalidity
7 Vitiated consent
8 Agency
9 Law on limitation
10 Terms and conditions
11 Consumer protection (distance selling, doorstep selling, e-commerce)
12 Contents of contractual obligations
13 Provisions on breach of contract

Section B: IT Law

1 Domain law (assignment, disputes, objectives and opponents)
2 Data protection law (informational self-determination, data protection in a business context)

3 Distance selling law (obligation to inform, consumer rights, terms and conditions and contract law, online marketing)
4 Overview of commercial property right and property right law

Recommended reading
- Eugen Klunzinger, Einführung in das Bürgerliche Recht: Grundkurs für Studierende der Rechts- und Wirtschaftswissenschaften
- Hoeren, Thomas, Internetrecht, Skriptum Universität Münster

Classes etc.

Lecturer	Name of the course	hpw
Prof. Dr. Hasso Heybrock	IT Law - Section A: Substantive contents	2
Contract lecturer lawyer NN	IT Law - Section B: IT Law	2

Electives (BEM)

Elective modules are always made up of 4 hpw and 5 Credit Points. They are offered in the 4th and 5th semester of the degree programme. Supplementary modules are not designed to offer more in-depth knowledge of the major a student chooses; they aim to expand the students' knowledge in a more horizontal manner.

The range of Electives offered in a semester is not defined in the study and examination regulations. Each semester the Faculty Board agrees on the modules offered for the next semester. Thus, the supplementary modules play an important role in continuously keeping the degree programme up to date.

In the following, the supplementary modules offered at the time this module handbook was created will be listed to give an exemplary overview:

Elective 1 - Overview

Modules as agreed on by the Faculty Board

Semester	Offered in	Duration	Type of assessment	ECTS	Pre-requisite for all BEM
4	Once a year Summer semester	4 hpw	BEM	5	Orientation test (OT)

OPTIONS	(as of 17 Oct 2019)	The module descriptions can be found on the following pages.

Module name	Contact
Advanced Networking	Prof. Dr.-Ing. Ralf Lübben
Agile Product Development	Prof. Dr. Andreas Rusnjak
Workshop Management Information Systems	Prof. Dr. Thomas Schmidt
Mobile App Development	Prof. Dr. Sönke Cordts
Software Quality Assurance	Prof. Dr. Kai Petersen

Advanced Networking

Semester	Offered in	Duration	Type of assessment	ECTS	Workload
4	Once a year Summer semester	4 hpw	BEM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other degree programmes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
OT, Cisco CCNA Course #1	None	• Examination (Ex) • OA: Project	Teaching on campus and online learning	Prof. Dr.-Ing. Ralf Lübben

Intended learning outcomes

- Students know the basics of network technologies and network architectures.
- You are familiar with the most relevant routing protocols.
- You know basic protocols and technologies in Corporate Networks.
- You can create networks based on these protocols and technologies.

Contents

- Wireless networks
- Spanning Tree
- Static and dynamic routing
- Virtual local networks
- Firewalling
- Security concepts
- Network Address Translation

Classes etc.

Lecturer	Name of the course	hpw
Prof. Dr.-Ing. Ralf Lübben	Advanced Networking	4

Agile Product Development

Semester	Offered in	Duration	Type of assessment	ECTS	Workload
4	Once a year Summer semester	4 hpw	BEM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other degree programmes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
OP	None	• Examination (Ex) • OA: Project	Lecture with seminar character including project work using case studies and examples as well as discussion in class, presentations and subject-related discussions. May work in labs such as the FabLab.	Prof. Dr. Andreas Rusnjak

Intended learning outcomes

- The students are introduced to the Google Venture Sprints methodology as part of the innovation process. They are able to analyse and describe user or customer-based challenges and they develop (digital) prototypes following a structured process while under time pressure. By applying relevant methods the students learn to identify problems, express target-oriented requirements and testing hypotheses and to validate, assess and narrow down their ideas for solutions following a decision-making processes. They validate their hypothesis with the help of user studies and one or more (digital) prototypes and they learn to take business decisions focused on the users. This module aims to inspire students to develop innovative, creative solutions for challenges customers of (medium-sized) businesses face. These solutions should be applied for processes, products, services etc.
- Students form teams to work on case studies and continuously present their key results in accordance with the contents of the module. Students learn to visualise and conceptualise relevant entrepreneurial approaches by developing alternative and additional ideas and solutions.
- By working in teams students learn to become part of a group, express their opinion and debate it. They understand the problems and challenges of working in teams and how team dynamics can be used to attain goals. Students learn to understand their own role and their strengths in the context of teamwork by learning and applying strategies to solve conflict situations.
- Working on case studies as individual projects allows the students to develop their ability to reflect their own actions and identify their strengths and weaknesses. They know how to best apply their skills and resources

and how to further develop them and they work on reducing or even overcoming their weaknesses. The definition of milestones and reporting deadlines prompts the students to organise themselves and work efficiently as well as to document knowledge and results and to present it to specific target groups.

Contents

1. Basics of Google Venture Sprints
2. Techniques for analysing and defining problems
3. Techniques for idea generation and evaluation
4. Development of a (digital) prototype
5. Validating the prototype based on the user/customer

Recommended reading

A list of recommended reading will be provided at the beginning of the semester.

Classes etc.

Lecturer	Name of the course	hpw
Prof. Dr. Andreas Rusnjak	Agile Product Development	4

Workshop Management Information Systems

Semester	Offered in	Duration	Type of assess-ment	ECTS	Workload
4	Once a year Summer semester	4 hpw	BEM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other de-gree pro-grammes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
OP	None	• Examination (Ex) • OA: Project report & running software	Workshop	Prof. Dr. Thomas Schmidt

Intended learning outcomes

The students can turn customer requirements into a specific concept and/or prototype Based on these requirements they can conceptualise organisational ideas and implement them on a software-level using business information systems. They are able to organise and manage themselves in a project.

In this workshop students have the opportunity to practice and strengthen key qualifications such as the ability to think analytically, find solutions and work in teams as well as project management.

Contents

This workshop offers students the chance to apply their knowledge on business information systems in a project with an actual business. The workshops differ depending on the requirements of the participating businesses. This class is based on the contents of the modules “Enterprise Resource Planning (ERP)” and “Business Intelligence (BI)”.

Recommended reading

A list of recommended reading will be provided at the beginning of the semester.

Classes etc.

Lecturer	Name of the course	hpw
Prof. Dr. Thomas Schmidt	Management Information Systems	4

Mobile App Development

Semester	Offered in	Duration	Type of assess-ment	ECTS	Workload
4	Once a year Summer semester	4 hpw	BEM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other de-gree pro-grammes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
OP	None	• Examination (Ex) • OA: Project	Lectures on cam-pus/online Exercises Quizzes Inverted Class-room	Prof. Dr. Sönke Cordts

Intended learning outcomes

Students can develop your own mobile apps for Android, iOS and windows. They are familiar with the most relevant mobile programming concepts and can identify and implement them (markup language to describe user interface, retaining a specific state, navigation, sensors). They know current patterns such as Model-View-Controller (MVC) and Model-View-ViewModel (MVVM) to separate user interface, logic and data and they are able to consider them in their design.

Contents

1. **Introduction**
   Mobile apps and cross-platform development
   Xamarin.Forms
2. **Practical introduction – First app**
   Project files and project types
   Shared Project and .NET-Standard-Library
   XAML
3. **XAML**
   XML name spaces
   Codebehind
   Markup expansions
   Resources
4. **Basic classes**
   Element, control and class
   View, VisualElement and BindableObject
5. **Layout controls**
   StackLayout
   ScrollView

AbsoluteLayout
Grid
RelativeLayout
ContentView

6. **Simple controls**
   Button controls
   Switch
   Image
   Text controls
7. **Multi-element controls**
   Picker
   ListView
   TableView
8. **Other controls**
   ToolbarItems
   Popup
   ActivityIndicator and ProgressBar
   DatePicker and TimePicker
   Video and audio
9. **Permissions**
10. **Retaining a state**
    Lifecycle of an app
    Complex session data
11. **Navigation**
    Navigating between pages
    Passing on parameters
    Navigation history
    CarouselPage
    MasterDetailPage
12. **Data Binding**
    BindingContext
    Searching for errors
    Converters
    Automatic messages for changes
    Binding mode
    Method binding
    MVVM

Recommended reading

Cordts, S.; Nasutta, M.: Mobile Apps mit Xamarin.Forms; mana-Buch Verlag; Heide; 2018
Hermes, D.; Mazloumi, N.: Buildung Xamarin.Forms Mobile Apps Using XAML; Apress; New York; 2019
Karlsson, J.; Hindrikes, D.: Xamarin.Forms Projects; Packt Publishing; Birmingham; 2018
Petzold, C.: Creating Mobile Apps with Xamarin.Forms Preview Edition 2; Microsoft Press; 2015
Snider, S.: Mastering Xamarin.Forms, Second Edition; Packt Publishing; Birmingham; 2018
Versluis, G.; Thewissen; S.: Xamarin.Forms Solution; Apress; New York; 2019
Versluis, G.: Xamarin.Forms Essentials; Apress; New York; 2017

Online classes

Microsoft Learn: https://docs.microsoft.com/de-de/learn/browse/?roles=developer&products=xamarin

Classes etc.		
Lecturer	**Name of the course**	**hpw**
Prof. Dr. Sönke Cordts	Mobile App Development	4

Software Quality Assurance

Semester	Offered in	Duration	Type of assess-ment	ECTS	Workload
4	Once a year Summer se-mester	4 hpw	BEM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other degree programmes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
OP	None	• Examination (Ex) • OA: Project, written report	Workshop	Prof. Dr. Kai Pe-tersen

Intended learning outcomes

- The students describe and classify techniques and methods used in software quality assurance.
- They choose suitable techniques and methods to solve practical quality assurance problems.
- They create a test plan.
- They apply static methods (e.g. static code analysis, inspections) on real software (open source).
- They apply dynamic methods (e.g. exploratory testing, boundary value testing) on real software.

Contents

- Overview and definitions
- Static quality assurance (automated and manual)
- Test coverage and methods (e.g. white-box, black-box, data-driven testing, combinatorial testing)
- Test processes (exploratory vs. scripted, Test-Driven Development, Behaviour-Driven Development)
- Evaluation of test suites (e.g. Mutation testing)
- Special topics (e.g. model-based testing, operational profile testing, statistical testing, GUI Test)

Recommended level of English language skills: B2 level

Classes etc.

Lecturer	Name of the course	hpw
Prof. Dr. Kai Petersen	Software Assurance	4

Software Quality Assurance

Semester	Offered in	Duration	Type of assess-ment	ECTS	Workload
4	Once a year Summer se-mester	4 hpw	BEM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other degree programmes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
OP	None	• Examination (Ex) • OA: Project, written report	Workshop	Prof. Dr. Kai Pe-tersen

Intended learning outcomes

- The students describe and classify techniques and methods used in software quality assurance.
- They choose suitable techniques and methods to solve practical quality assurance problems.
- They create test plans.
- They apply static methods (e.g. static code analysis, inspections) on real software.
- They apply dynamic methods (e.g. exploratory testing, boundary value testing) on real software.

Contents

- Overview and definitions
- Static quality assurance (automated and manual)
- Test coverage and methods (e.g. white-box, black-box, data-driven testing, combinatorial testing)
- Test processes (exploratory vs. scripted, Test-Driven Development, Behaviour-Driven Development)
- Evaluation of test suites (e.g. Mutation testing)
- Special topics (e.g. model-based testing, operational profile testing, statistical testing, GUI-Test)

Classes etc.

Lecturer	Name of the course	hpw
Prof. Dr. Kai Petersen	Software Quality Assurance	4

Elective 2 - Overview

Modules as agreed on by the Faculty Board

Semester	Offered in	Duration	Type of assessment	ECTS	Pre-requisite for all BEM
5	Once a year Winter semester	4 hpw	BEM	5	Orientation test (OT)
OPTIONS		(as of 17 Oct 2019)			The module descriptions can be found on the following pages.
Module name					**Contact**
Design Thinking & Lean Start Up					Prof. Dr. Andreas Rusnjak
Internet of Things					Prof. Dr. Sönke Cordts
Methods of Futures studies					Prof. Dr. Till Albert
Software Security					Prof. Dr. Kai Petersen

Design Thinking & Lean Start Up

Semester	Offered in	Duration	Type of assessment	ECTS	Workload
5	Once a year Winter semester	4 hpw	BEM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other degree programmes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
OP	None	• Examination (Ex) • OA: Group project & presentation & project report	Lecture with seminar character including project work using case studies and examples as well as discussion in class, presentations and subject-related discussions.	Prof. Dr. Andreas Rusnjak

Intended learning outcomes

The students are introduced to the Design Thinking as part of the innovation process. They are able to analyse user or customer-based challenges and they find and design possible user or customer-centred solutions. By using the lean start up method the students learn to validate and evaluate their solutions and to improve them in an iterative process. They apply methods and tools for design thinking and for the basic and generic description of customer and business models. This module aims to inspire students to develop innovative, creative solutions for challenges customers of (medium-sized) businesses face. These solutions should be applied for processes, products, services etc.

Students form teams to work on case studies and continuously present their key results in accordance with the contents of the module. Students learn to visualise and conceptualise relevant entrepreneurial approaches by developing alternative and additional ideas and solutions.

By working in teams students learn to become part of a group, express their opinion and debate it. They understand the problems and challenges of working in teams and how team dynamics can be used to attain goals. Students learn to understand their own role and their strengths in the context of teamwork by learning and applying strategies to solve conflict situations.

Working on case studies as individual projects allows the students to develop their ability to reflect their own actions and identify their strengths and weaknesses. They know how to best apply their skills and resources and how to further develop them and they work on reducing or even overcoming their weaknesses. The definition of milestones and reporting deadlines prompts the students to organise themselves and work efficiently as well as to document knowledge and results and to present it to specific target groups.

Contents
1. Mega trends, trends and technologies and their impact on businesses, society etc. 2. Techniques and tools to analyse the business environment 3. Methods to analyse problems and questions ion the client's environment 4. Trend and technology assessment, idea generation, combining ideas 5. Development of customer-centred product/service concepts 6. Description of simple, generic business models 7. Early on validation with the customer and business model iteration A list of recommended reading will be provided at the beginning of the semester.

Classes etc.		
Lecturer	**Name of the course**	**hpw**
Prof. Dr. Andreas Rusnjak	Design Thinking & Lean Start Up	4

Internet of Things

Semester	Offered in	Duration	Type of assess-ment	ECTS	Workload
5	Once a year Winter semester	4 hpw	BEM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other de-gree pro-grammes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
OP	None	• Examination (Ex) • OA: Project	Lectures on campus/online Exercises Quizzes Inverted Class-room	Prof. Dr. Sönke Cordts

Intended learning outcomes

Students are able to design simple electronic connections using a single-board computer and put them together on their own. They can describe and explain the structure of a single-board computer and the functions of the different bus systems using Raspberry Pi as an example. They can develop their own simple apps on the single-board computer. They know the basic terms of sensors and actors and can control them using the single-board computer.

Contents

1. **Introduction**
2. **Installation and administration**
3. **First app**
4. **Power and voltage**
5. **Digital sensors**
6. **Bus systems**
7. **Analogue sensors**
8. **Data storage**
9. **Connectivity**

Recommended reading

Bartmann, E.: Die elektronische Welt mit Raspberry Pi entdecken; O'Reilly Verlag; Cologne; 2013

Bell, C.: Windows 10 for the Internet of Things; Springer Science+Business Media; New York; 2016

Cordts, S.; Nasutta, M.: Apps für Windows 10 in C#, 3rd ed.; mana-Buch Verlag; 2017; Heide

Engelhardt, E.F.: Sensoren am Raspberry Pi, 2nd ed.; Franzis Verlag; 2016
Hüwe, S.: Raspberry Pi für Windows 10 IoT Core; Hanser Verlag; 2016
Immler, C.: Raspberry Pi für Kids; Franzis Verlag; 2016
JOY-iT: SensorKit X40; JOY-iT Europe GmbH; o.A.; o.J (Online files)
Karvinen, K.; Karvinen, T.: Make: Getting started with sensors; Maker Media Inc.; San Francisco; 2014
Karvinen, K. u.a.: Sensoren – Messen und experimentieren mit Arduino und Raspberry Pi; dpunkt.verlag; Heidelberg; 2015 (zhb: book reserve)
Kofler, M. u.a.: Raspberry Pi – Das umfassende Handbuch, 3rd ed.; Rheinwerk Verlag; 2016 (zhb: book reserve)
Molloy, D.: Exploring Raspberry Pi – Interfacing to the real world with embedded Linux; Wiley Inc.; Indianapolis; 2016
Monk, S.: Der Maker-Guide für die Zombie-Apokalypse; dpunkt.verlag; 2016
Monk, S.: Raspberry Pi Cookbook; o'Reilly Media Inc.; Sebastopol; 2014 (zhb: book reserve)
not stated: c't Raspberry Pi; Heise Medien Verlag; Hannover; 2016
Platt, C.: Make: Elektronik; o'Reilly Verlag; Cologne; 2010

Classes etc.		
Lecturer	**Name of the course**	**hpw**
Prof. Dr. Sönke Cordts	Internet of Things	4

Methods of Futures Studies

Semester	Offered in	Duration	Type of assessment	ECTS	Workload
5	Once a year Winter semester	4 hpw	BEM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other degree programmes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
OP	None	• Examination (Ex) • OA: Presentation in class	Seminar in workshop format	Prof. Dr. Till Albert

Intended learning outcomes

- They know the basic terms of Futures Studies in a business context.
- They are able to assess in how far different methods are suitable to solve given problems.
- They can apply these methods and produce a holistic perspective on a business' future.

Contents

- Trend extrapolation
- Scouting, scanning, context analysis, desk research, PESTEL
- Prognostic crowdsourcing/future markets
- Delphi method
- various creativity techniques
- Cross-impact analysis
- Scenario technique
- Technology road mapping
- Technology assessment
- Wildcards

A list of recommended reading will be provided at the beginning of the semester.

Classes etc.

Lecturer	Name of the course	hpw

Prof. Dr. Till Albert	Methods of Futures studies	4

Software Security

Semester	Offered in	Duration	Type of assessment	ECTS	Workload
5	Once a year Winter semester	4 hpw	BEM	5	150 hours: 60 hours in class and 90 hours revision outside class

Pre-requisites	Reusability (incl. other degree programmes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods	Contact
OT, Software Engineering	None	• Examination (Ex) • OA: Written report	Workshop	Prof. Dr. Kai Petersen

Intended learning outcomes

- The students use attacks to exploit software vulnerabilities on a test server
- They conduct a risk analysis
- They identify and evaluate countermeasures

Contents

- Standards and processes (e.g. ITIL, Cigatel Touchpoints, Microsoft Security Development Lifecycle)
- Attacks (e.g. SQL-Injections, Cross-site Scripting, DoS)
- Security Touchpoints
  - Requirements (Misuse cases, Attack Trees)
  - Risk analysis (e.g. Peltier, Countermeasure Graphs)
  - Countermeasures in the architecture to avoid attacks
  - Countermeasures in the implementation to avoid attacks
  - Static code analysis for security
  - Penetration testing

A list of recommended reading will be provided at the beginning of the semester.

Classes etc.

Lecturer	Name of the course	hpw

Prof. Dr. Kai Petersen	Software Security	4

Modules to be completed at the end of the studies (ESM):

Internship

Semester	Offered in	Duration	Type of assessment	ECTS	Workload
6	No restriction Summer semester / winter semester	12 weeks	ESM	18	540 hours: 480 hours at the training institution und 60 hours of additional activities (formalities, creating and holding a presentation)

Pre-requisites	Reusability (incl. other degree programmes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods
120 ECTS	None	• Coursework (CW) • OA: Signed and completed internship agreement • After the completion of the internship: Students must hand in internship report and letter of reference or similar document	Time period of practical work in a company

Intended learning outcomes

- Students are expected to gain insights into the technical, business and social aspects of businesses and administrative bodies. They acquire professional qualifications as is best done in an actual work-life environment.
- In particular, they gain a realistic perspective on actual tasks of the profession of their choice. They are enabled to assess the feasibility of theoretical concepts. Furthermore, this direct contact with the professional world makes the choice of their future field of employment easier for the prospective graduates. They will also find it easier to transition to professional employment.
- Finally, the internship should be regarded as one possible starting point to improve cooperation between employers and the university. A continuous exchange of information and personal contacts can be valuable impulses for both sides.

Contents

The internship shall be completed in those professional fields that are related to the bachelor's degree programme Business Informatics. The student shall be introduced to planning, implementation and review activities reoccurring regularly as well as the application of business information systems.

Bachelor's thesis (thesis and colloquium)

Semester	Offered in	Duration	Type of assess-ment	ECTS	Workload
6	No re-striction Summer se-mester / winter se-mester	8 weeks	ESM	12	360 hours

Pre-requisites	Reusability (incl. other de-gree pro-grammes)	Pre-requisites for Cps to be awarded • Type of assessment • Form of assessment	Teaching and study methods
1. Thesis: Successful completion of ex-aminations from the 5th semester and coursework from semester 1 to 5 2. Colloquium: Thesis graded with at least "ausreichend" [sufficient], intern-ship confirmed	None	• Examination (Ex) • Thesis (8 weeks) and fi-nal colloquium (30 mins)	Written copy (CD), abstract for publication in digital form.

Intended learning outcomes

The objective of the thesis is for the students to produce a paper about 40 pages long in which they show that they are able to take on a question from their major applying academic methods.

Contents

The bachelor's thesis is made up of a written final thesis and a graded colloquium. As part of the thesis students are expected to fully comprehend a topic and put their thoughts and findings down on paper. The final thesis typically is written in cooperation with a company.

Usually the topic and the completion of the final thesis are connected to the internship both in terms of content and in terms of time. The time invested to complete the thesis is estimated at about 360 hours of work; this workload equals that of a typical 38.5 hours work week for a period of seven to eight weeks. If the topic of the

thesis requires an adjusting of the organisation of the work required and the workload per week (e.g. when significant amounts of time are necessary to acquire data in empirical research), this should be possible. The thesis' supervisor can grant an extension of the completion time to a maximum of 12 weeks or three months this way.