Module Handbook

Online Bachelor Computer Science

DHBW Mosbach/Stuttgart

This module handbook is for information purposes. Only the German version of the current module handbook for the B.Sc. Computer Science at DHBW Stuttgart is legally valid.

If you have any further questions, please do not hesitate to contact us at: newstudy@mosbach.dhbw.de

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Please find the German version here:
https://www.dhbw.de/fileadmin/user/public/SP/STG/Informatik/Informatik.pdf

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Curriculum (compulsory and elective modules)

Only the German version of the module handbook is legally valid!

module number	module name (in specified module area)	academic year	ECTS (European Credit Transfer System)
	Mathematics I	1st year	8
	Theoretical Computer Science I	1st year	5
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	Databases II	3rd year	5
	Compiler Construction	2nd year	5
	Web Engineering II	2nd year	5
	Web Engineering and Computer Networks	2nd year	5
	Implementation of Web Technologies	2nd year	5
	Architectures	3rd year	5
	Artificial Intelligence and HCI	3rd year	5
	Consulting, Technical Sales and Law	3rd year	5
	Data Science	3rd year	5
	Artificial Intelligence and Machine Learning	3rd year	5

	Human Machine Interaction	3rd year	5
	Big Data Architectures	3rd year	5
	Elective Module Computer Science	2nd year	5
	Elective Module Computer Science II	3rd year	5
	Quality of Software and Distributed Systems	3rd year	5
	Bachelor Thesis	3rd year	12

Mathematics I

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	1st year	2 terms		English

Teaching Methods

teaching forms	teaching methods
lecture, tutorial	lecture, discussion

Forms of Examination

examination forms	exam duration (in minutes)	Grading
written exam	120-150	yes
written exam	120-150	yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
240	96	144	8

Qualification Goals and Competences

professional competence

Students have developed the ability to think and reason mathematically. They have a basic understanding of discrete mathematics, linear algebra and the analysis of a real variable. They are able to apply this knowledge to problems from the field of engineering sciences and computer science.

methodical competence

Mathematics promotes logical thinking, clear structuring, creative exploratory behaviour and perseverance.

personal and social competence

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interdisciplinary competence

Upon completion of the module, students are able to describe scientific and technical processes with the help of discrete mathematics, linear algebra and analysis. They begin to use algorithms of numerical mathematics and to implement them in executable programs.

Learning Units and Contents

teaching and learning units	online	self-study
Linear Algebra	48	72

- Basics of discrete mathematics
- Basic algebraic structures
- Vector spaces and linear mappings
- Determinants, eigenvalues, diagonalizability
- Application examples

Analysis	48	72

- Application examples
- Sequences and series, continuity
- Differential calculus of a variable in the real
- Integral calculus of a variable in the real
- Application examples

Specifics

This module also includes up to 24 hours of guided self-study in the form of practice hours, labs or projects. Here the students work on exercises and/or in-depth assignments.

Prerequisites

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Literature

Theoretical Computer Science I

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	1st year	1 term		English

Teaching Methods

teaching forms	teaching methods
lecture, tutorial	lecture, discussion

Forms of Examination

examination forms	exam duration (in minutes)	Grading
written exam	120-150	yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
150	60	90	8

Qualification Goals and Competences

professional competence

Students can understand the theoretical foundations of propositional and predicate logic. Students understand the formal specification of algorithms and classify them. Students master the logical programming model and apply it.

methodical competence

Students have acquired the competences to divide and master more complex business applications through abstract thinking and to apply case-dependent logical reasoning and inference.

personal and social competence

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interdisciplinary competence

Upon completion of the module, students have acquired the competence to exchange ideas with experts and laypersons on technical questions and tasks in the fields of logic, logical inference as well as verification and abstract thinking at a scientific level.

Learning Units and Contents

teaching and learning units	online	self-study
Basics and Logic	60	90

- Algebraic structures: relations, order, mapping
- Formal logic: propositional logic, predicate logic
- Algorithm theory; complexity, recursion, termination, correctness (with reference to logic)
- Basic knowledge of declarative (logical/functional/....) programming

Specifics

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Prerequisites

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Literature

Theoretical Computer Science II

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	1st year	1 term		English

Teaching Methods

teaching forms	teaching methods
lecture, tutorial	lecture, discussion

Forms of Examination

examination forms	exam duration (in minutes)	Grading
written exam	90	yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
150	48	102	5

Qualification Goals and Competences

professional competence

Students have in-depth knowledge of:

- Algorithm approaches for important problem classes in computer science
- Notion of complexity and complexity calculations for algorithms
- Important abstract data types and their properties

methodical competence

Students will be able to evaluate the need for a complexity analysis for a program and choose an appropriate level for use in a professional environment.

personal and social competence

Students can assess their decision-making and technical competence in the area of selection and design of algorithms and data structures and can communicate on these topics effectively and at a scientific level with experts and laypersons.

interdisciplinary competence

Upon completion of the module, students have acquired the competence to

- select and adapt efficient data structures for practical problems
- divide larger problems into manageable units and solve them through abstract thinking
- design algorithms for defined problems

Learning Units and Contents

teaching and learning units	online	self-study
Algorithms and Complexity	48	102

- Basic concepts of computational complexity
- O-notation

- Algorithms: search algorithms, sorting algorithms
- Hashing: open hashing, closed hashing
- Data structures: sets, lists, stacks, queues, trees, binary search trees, balanced trees
- Graphs: special graph algorithms, semantic networks
- Coding: compression, error-detecting codes, error-correcting codes

Specifics

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Prerequisites

Programming, Mathematical Basics

Literature

Programming

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	1st year	2 terms		English

Teaching Methods

teaching forms	teaching methods
lecture, tutorial	lecture, discussion, group work

Forms of Examination

examination forms	exam duration (in minutes)	Grading
program design		yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
270	96	174	9

Qualification Goals and Competences

professional competence

Students know the basic elements of procedural and object-oriented programming. They know the syntax and semantics of these languages and can independently create a program design, code and test their program for functionality. They know various structuring options and data structures and can apply them exemplary.

methodical competence

Students are able to create simple programs independently and test them for functionality, as well as to use simple design patterns in their program designs. Students can use a development environment to create and structure programs and to check them for errors (incl. debugger).

personal and social competence

Students can explain and justify their program design and its coding in a team. They can analyse and evaluate existing code. They can independently familiarize themselves with development environments and use them for programming and troubleshooting.

interdisciplinary competence

Upon completion of the module, students can independently analyse practical problems and design, program and test programs to solve them.

Learning Units and Contents

teaching and learning units	online	self-study
Programming	96	174

Knowledge of procedural programming:

- Algorithm description
- Data types
- I/O operations and file processing

- Operators
- Control structures
- Functions
- String processing
- Structured data types
- Dynamic data types
- Pointers
- Memory management

Knowledge of object-oriented programming:
- Object-oriented program design
- Idea and characteristics of object-oriented programming
- Class concept
- Operators
- Overloading of operators and methods
- Inheritance and overwriting of operators
- Polymorphism
- Templates or generics
- Class libraries
- Memory management, basic understanding of garbage collection

Specifics

This module also includes up to 24 hours of guided self-study in the form of practice hours, labs or projects. Here the students work on exercises and/or in-depth assignments.

Prerequisites

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Literature

Key Skills

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	1st year	2 terms		English

Teaching Methods

teaching forms	teaching methods
lecture, tutorial	lecture, discussion, group work, project

Forms of Examination

examination forms	exam duration (in minutes)	Grading
combined examination written examination (< 50%)		yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
150	84	66	5

Qualification Goals and Competences

professional competence

Students have acquired basic knowledge of economics and can classify their professional tasks in the business context.

methodical competence

Students have acquired basic economic, intercultural and labour science competences for their profession and studies.

personal and social competence

Students are able to represent their points of view in a (possibly interdisciplinary and intercultural) team and respect other points of view. They can organise themselves and their projects and deal with criticism and conflicts appropriately.

interdisciplinary competence

Upon completion of the module, students' thinking in interdisciplinary contexts has been trained beyond their technical competence, and strategic action competence and entrepreneurial thinking have been imparted.

Learning Units and Contents

teaching and learning units	online	self-study
Business Administration	36	28

- Introduction to theoretical approaches and methods in business administration
- Goals and planning in business administration
- Management styles and concepts
- Legal forms
- Balance sheets

- Profit and loss accounts
- Cost accounting
- Financing and investment
- Holistic business simulation

Foreign Languages 1 24 19
- Written communication: drafting and evaluating reports, statements, speeches, minutes
- Oral communication: Arguing and concluding in a discussion, presenting perfectly

Presentation, Leaning and Working Techniques 24 19
- Verbal vs. non-verbal communication
- Communication goal, message, choice of target audience
- Content structuring
- Structuring the flow of a presentation
- Speaker behaviour (e.g. body language, voice modulation)
- Use of media with practical examples

Marketing 1 24 19
- Introduction to Marketing
- Market Research
- Marketing Planning
- Marketing tools
- Product and assortment policy
- Advertising or communication policy
- Pricing policy
- Distribution policy

Marketing 2 24 19
Deepens various topics of the lecture Marketing 1.

Intercultural Communication 1 24 19
- Major Theories of Intercultural Communication
- Case studies
- Exercises, role plays, small group work, presentations

Intercultural Communication 2 24 19
- Conflict management, negotiation
- Case studies
- Exercises, Role Plays, small group work, presentations

Foreign Languages 2 24 19
- Written communication: drafting and evaluating reports, statements, speeches, minutes
- Oral communication: Arguing and concluding in a discussion, presenting perfectly

Project Management 1 24 19
- What is project management?
- General conditions
- Project and goal definitions
- Mission and goals
- Documents for project planning
- Effort estimation

- Project organisation
- Project phase models
- Planning process and methods
- Personnel planning
- Time scheduling
- Cost planning and economic background
- Introduction to management, control and project completion
- Project management with IT support (e.g. MS Project)
- Exercises for the individual parts

Project Management 2 24 19

- Meetings, teams and conflicts
- Risk planning and risk management
- Quality planning
- Project management and control
- Project completion, project revision and financial considerations
- Other project management methods

Introduction to technical-scientific Work 24 19

Elements of scientific work and its products:

- Content-related, formal and stylistic aspects of scientific work
- Categories of technical and scientific documents and their evaluation
- Use of technical English
- Carrying out source research and its qualitative evaluation
- Elaboration and forms of presentation of scientific papers taking into account the semantic environment
- Task description of a technical or scientific project
- Preparation of an exemplary and complete documentation
- Preparation of an English and German short report
- Methodological note: For the implementation of the practical exercises and the feedback students will be divided into intensive working groups and supervised

Specifics

Either Key Skills as the only unit
or Business Administration as a compulsory unit plus two further units of choice
Further units:

- Foreign Languages 1
- Presentation, Learning and Working Techniques
- Marketing 1
- Marketing 2
- Intercultural Communication 1
- Intercultural Communication 2
- Foreign Languages 2
- Project Management 1
- Project Management 2
- Introduction to technical-scientific Work

Prerequisites

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Computer Engineering I

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	1st year	1 term		English

Teaching Methods

teaching forms	teaching methods
lecture, tutorial	lecture, discussion

Forms of Examination

examination forms	exam duration (in minutes)	Grading
written exam	90	yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
150	48	102	5

Qualification Goals and Competences

professional competence

Students are taught a fundamental basic knowledge of how digital switching elements work and how digital circuits are constructed. This knowledge forms the basis for understanding computer assemblies.

methodical competence

Upon completion of the module, students are able to select and apply the appropriate method for largely standardised use cases in practice.

personal and social competence

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interdisciplinary competence

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Learning Units and Contents

teaching and learning units	online	self-study
Digital Technology	48	102

- Number systems and codes
- Logical links and their representation
- Switching algebra
- Switching networks
- Switching systems
- Circuit technology and interfacing
- Semiconductor memories

Specifics

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Prerequisites

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Literature

Mathematics II

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	2nd year	2 terms		English

Teaching Methods

teaching forms	teaching methods
lecture, tutorial	lecture, discussion

Forms of Examination

examination forms	exam duration (in minutes)	Grading
written exam	90	yes
written exam	90	yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
180	72	108	6

Qualification Goals and Competences

professional competence

Students will have further developed the ability to think and reason mathematically. They have overview knowledge of application areas of mathematics and statistics that are important for computer science and are able to select and apply problem-adequate methods.

methodical competence

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personal and social competence

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interdisciplinary competence

Upon completion of the module, students are able to mathematically model tasks from computer science and solve them in a software-based manner. They are able to describe technical and business processes and problems with methods of multidimensional analysis, the theory of differential equations and probability and statistics. They are proficient in the basic solution methods.

Learning Units and Contents

teaching and learning units	online	self-study
Applied Mathematics	36	54

- Basics of the differential and integral calculus of real functions with several variables as well as differential equations and systems of differential equations
- Numerical methods and further examples of mathematical applications in computer science

Statistics	36	54

- Descriptive Statistics

- Random experiments, probabilities and special distributions
- Inductive Statistics
- Applications in computer science

Specifics

This module also includes up to 24 hours of guided self-study in the form of practice hours, labs or projects. Here the students work on exercises and/or in-depth assignments.

Prerequisites

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Literature

Theoretical Computer Science III

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	2nd year	1 term		English

Teaching Methods

teaching forms	teaching methods
lecture, tutorial	lecture, discussion

Forms of Examination

examination forms	exam duration (in minutes)	Grading
written exam	90	yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
180	72	108	6

Qualification Goals and Competences

professional competence

Students understand the basics of formal languages and automata theory. They can formally specify regular languages on the one hand by a regular expression, a regex and a type 3 grammar and on the other hand decide by a finite acceptor. They can specify context-free languages on the one hand by a type 2 grammar and on the other hand, they understand the associated stack acceptors both top down as well as bottom up as a basis for translator construction. They know the connection between type 0 languages and Turing machines as the basis of computability theory.

methodical competence

For regular languages, students can construct a minimal finite acceptor from the different forms of description. For context-free languages, they can construct the top down and bottom up stack acceptors (also with finite look-ahead) from the grammar for simple use cases. They understand the theoretical foundations of the translator construction tools scanner and parser for complex use cases.
For practical applications from computability theory such as the halting problem and the equivalence problem, they will be able to recognise whether they are computable or decidable.

personal and social competence

Students have acquired the competence to exchange ideas with experts and laypersons on technical questions and tasks in the field of formal languages, recognising automata as well as methods and tools for their implementation at a scientific level.

interdisciplinary competence

Upon completion of the module, students can analyse the formal language in an application and, in particular, recognise which Chomsky type it belongs to and which formal methods (generators and translator building tools) are suitable for this.

Learning Units and Contents

teaching and learning units	online	self-study
Formal Languages and Automata 1	48	72

- Grammar
- Language classes (Chomsky hierarchy)
- Recognizing automata
  - - Regular languages
  - - Regular Grammars
  - - Finite automata
  - - Non-deterministic / deterministic finite automata
  - - Context-free languages
  - - Context-free grammars
  - - Methods for the analysis of context-free grammars (CYK)
  - - pushdown automata: Top down and bottom up including k-prediction
  - - Application to simple practical examples
  - - Connection between Turing machine, formal languages of Chomsky type 0 and decidability

Formal Languages and Automata 2	24	36

- Delimitation of different language classes (proof by pumping lemma)
- Context-sensitive languages
- Deepening of decidability and computability theory
- Turing power of programming languages (which scope of language is sufficient to implement all computable functions)

Introduction to Compiler Building	24	36

- Phases of the compiler
- Lexical analysis (scanner)
- Syntactic analysis (parser): Top-down procedure, bottom-up procedure
- Syntax-driven translation: Z-attribution, lL-attribution, combination with syntax analysis procedures
- Semantic analysis: type checking

Specifics

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Prerequisites

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Literature

Software Engineering I

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	2nd year	2 terms		English

Teaching Methods

teaching forms	teaching methods
lecture, tutorial, lab work	lecture, discussion, group work

Forms of Examination

examination forms	exam duration (in minutes)	Grading
program design		yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
270	96	174	9

Qualification Goals and Competences

professional competence

Students know the basics of the software development process. They are able to analyse a given problem and design, implement, quality-assure and document computer-aided solutions. They know the methods of the respective project phases and can apply them. They can evaluate proposed solutions for a given problem competitively and make corrective adjustments.

methodical competence

Students are able to discuss problem analyses and proposed solutions, as well as the interrelationships of the individual phases with experts. They can develop simple software projects autonomously or participate effectively in a team for complex projects. They can present and justify their designs and solutions. In the discussion in the team, they can critically deal with different points of view and evaluate them.

personal and social competence

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interdisciplinary competence

Upon completion of the module, students can familiarise themselves with tools independently. They combine the software development process with project management techniques and consider time and cost factors during the project.

Learning Units and Contents

teaching and learning units	online	self-study
Basics of Software Engineering	96	174

- Process models
- Phases of SW engineering and their interrelationships
- Requirements specification and functional specification, use cases
- Analysis and design models (e.g. modelling techniques of UML or SADT)

- Software architecture, interface design
- Code guidelines and code quality: reviewing and test planning, execution and evaluation
- Continuous integration
- Version management
- Operation and maintenance
- Different types of documentation are dealt with on a phase-specific basis
- Implementation of a concrete software development project in project teams of medium size (e.g. a web service / web app, a stand-alone application or a control system)

Specifics

The individual contents of the course are to be deepened by means of a project. In the individual project phases, the use of suitable methods, documentation and quality assurance should be dealt with. Suitable tools are to be used. In the group-oriented laboratory exercises, extracurricular qualifications are practised and (partial) results are presented. This module also includes up to 24 hours of guided self-study in the form of practice hours, labs or projects. Here the students work on exercises and/or in-depth assignments.

Prerequisites

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Literature

Database Systems

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	2nd year	2 terms		English

Teaching Methods

teaching forms	teaching methods
lecture, tutorial	lecture, discussion, group work

Forms of Examination

examination forms	exam duration (in minutes)	Grading
written exam or combined examination		yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
180	72	108	6

Qualification Goals and Competences

professional competence

Students know the basic theories and models of database systems. They can systematically present and explain the basic principles of database systems. They can use these to design a practically usable database and evaluate database designs.

methodical competence

Students can evaluate the strengths and weaknesses of the design methods for databases and assess them with regard to their applicability in a professional environment.

personal and social competence

Students can adequately assess their decision-making and professional competences in the field of database development and involve experts from other fields (esp. the application field) in database design.

interdisciplinary competence

Upon completion of the module, students have acquired the ability to apply theoretical concepts of databases in practical applications in addition to their sound technical knowledge.

Learning Units and Contents

teaching and learning units	online	self-study
Basics of Databases	72	108

- Basic concepts and data modelling (e.g. Entity Relationship Model)
- Relational data model
- Normal forms
- Relational database design
- Multi-user operation and transaction concepts
- Architectures of database systems
- Introduction to SQL (practical project)

Specifics

The module usually consists of a theoretical and a practical part.

Prerequisites

Algorithms and Data Structures, as well as basics of logic

Literature

Computer Engineering II

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	2nd year	2 terms		English

Teaching Methods

teaching forms	teaching methods
lecture, tutorial	lecture, discussion

Forms of Examination

examination forms	exam duration (in minutes)	Grading
written exam	120-150	yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
240	96	144	8

Qualification Goals and Competences

professional competence

Students gain a basic understanding of the tasks, functionality and architecture of modern computer systems. In an exercise section, they are taught system-related programming using an example processor. This hardware-related knowledge is rounded off by the unit "Operating Systems", which illuminates the functioning of computer systems from the perspective of system software. Students are thus able to understand the interaction of hardware and software in a computer in detail.

methodical competence

Students know the scientific methods from the areas of computer architecture and operating systems. They are able to interpret and evaluate the hardware and system software of modern computer systems using these methods. Furthermore, they are able to design and analyse machine-oriented programs.

personal and social competence

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interdisciplinary competence

Upon completion of the module, students are able to assess the performance of a computer system for a practical application. Furthermore, they are able to follow the rapid development in the field of computer hardware and to understand the advantages and disadvantages of introducing a new IT technology. They are also able to understand how the new technology works and they can acquire the necessary new knowledge themselves at any time.

Learning Units and Contents

teaching and learning units	online	self-study
Computer Architectures 1	36	54

- Introduction
- History (mechanical, analogue, digital)
- Architecture according to von Neumann

- Overview of system components
- Rough structure of processor internals
- Arithmetic unit
- Addition: half adder, full adder, word adder, meaning of the carry bit, carry ripple and carry look-ahead adder
- Subtraction: Transformation from addition, meaning of the carry bit
- Multiplication: parallel and serial multipliers
- Division: Concept
- Arithmetic-logic unit (ALU)
- Data path: ALU with arithmetic register and result flags (CCR, status bits)
- Control unit: structure, components and function
- Instruction decoding and microprogramming
- Structure of processor instruction sets
- Classification and application of processor registers (data, address and status registers)
- Performance evaluation and ways to improve performance (e.g. pipelining)
- Bus interface: Data, address and control lines
- Bus components
- Bus cycles: read and write access, handshaking (especially waitstates)
- Bus arbitration and bus multiplexing
- Fundamental architectures
- Concept of system architecture and components: CPU, main memory, I/O: discussion on the connection of external devices (graphics, keyboard, hard disks, DVD, ...)
- Semiconductor memories
- Random access memory: structure, function, address decoding, internal matrix organisation
- RAM: static, dynamic, current developments
- ROM: mask, fuse, EPROM, EEPROM, FEPROM, current developments
- System architecture
- Division of the addressing space
- Design of memory schemes and associated address decoding logic
- Vital system components: power supply, reset logic, system clock, chipset
- Circuits: Interrupt and DMA controllers, timer and clock components.
- Interfaces: Parallel and serial, standards (RS232, USB, ...)

Operating Systems	36	54

- Introduction
- Historical overview
- Operating system concepts
- Processes and threads
- Introduction to the concept of processes
- Process communication
- Exercises on process communication: classical problems
- Scheduling of processes
- Threads
- Memory management
- Simple memory management without swapping and paging
- Swapping
- Virtual memory
- Segmented memory
- File systems
- Files and directories
- Implementation of file systems

- File system security
- Protection mechanisms
- New developments: Log-based file systems
- Input and output: Basic properties of I/O hard disks
- Application of the basics to real operating systems: UNIX/Linux and Windows (NT, 2000, XP, Windows7)

System-oriented Programming 1 24 36

- Programming model for machine programming: instruction set, register set and addressing modes
- Implementation of control structures, evaluation of result flags
- Sub-program call with the aid of the stack
- Conventions
- Concept and implementation of HW and SW interrupts: discussion of HW and SW mechanisms and automatisms, interrupt vector table, special case: boot process
- Discussion of user and supervisor mode of processors
- Practical exercises
- Introduction of an example processor
- Set-up of the exercise computer
- Familiarisation with exercise computer and software and test development for the exercise computer
- Independent development of machine programs with increasing degree of difficulty and structuring

Specifics

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Prerequisites

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Literature

Communication and Networks

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	2nd year	1 term		English

Teaching Methods

teaching forms	teaching methods
lecture, tutorial, lab work	lecture, discussion, group work

Forms of Examination

examination forms	exam duration (in minutes)	Grading
written exam	90	yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
225	84	141	5

Qualification Goals and Competences

professional competence

The module provides basic knowledge of communication networks. Upon completion of the module, the students will have a detailed understanding of the structure, function and interaction of the individual components, as well as the used technologies, services and protocols used in communication and network technology.

methodical competence

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personal and social competence

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interdisciplinary competence

The module brings together several disciplines: Basics from computer technology or computer networks, digital technology, programming as well as the approach for software architectures. The module opens up complex and overarching contexts.

Learning Units and Contents

teaching and learning units	online	self-study
Network Technology	36	39

- Tasks of communication and network technology
- Reference models and their interfaces
- Network elements
- Norms and standards
- Fixed networks LAN/MAN: differentiation, structure, function, current developments
- TCP/IP protocols with IPv4 and IPv6
- Network coupling and security techniques

Laboratory Network Technology 12 63

- Practical exercises on communication networks (e.g. network laboratory).
- Self-study on current network-specific topics
- Optional: development of basic terms from "Signals and Systems", system response with convolution sum or integral, transformations (Fourier, Laplace), linked with exercise and laboratory units

Signals and Systems 1 36 39

- Basic terms and introduction to signals and systems (continuous)
- System response using convolution integral/convolution sum
- Fourier series
- Transformations (Fourier, Laplace)

Specifics

The two units “Laboratory Network Technology” and “Signals and Systems 1” are offered alternatively.

Prerequisites

-

Literature

Software Engineering II

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	3rd year	1 term		English

Teaching Methods

teaching forms	teaching methods
lecture, tutorial	lecture, discussion

Forms of Examination

examination forms	exam duration (in minutes)	Grading
program design		yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
150	48	102	5

Qualification Goals and Competences

professional competence

Students are able to analyse and process complex problems from practice. They gain the relevant information for the solution, can develop a suitable software architecture with relevant techniques and certify it according to current procedures.

methodical competence

Students are able to select and apply an appropriate method for complex practical applications. They are able to assess the possibilities, practicability and limits of the method used and are able to show alternative courses of action and to evaluate them technically and economically.

personal and social competence

Students are aware of their role and responsibility in the company. They can weigh technical, theoretical and economic issues against each other and implement them in a solution-oriented manner.

interdisciplinary competence

Upon completion of the module, students have learned to quickly find their way in new situations and to integrate themselves into new tasks and teams. Students convince as independently thinking and responsibly acting personalities with critical judgement. They are characterised by well-founded knowledge, an understanding of overarching interrelationships and the ability to transfer theoretical knowledge into practice. They solve problems in the professional environment in a methodical and goal-oriented manner and act in a team-oriented manner.

Learning Units and Contents

teaching and learning units	online	self-study
Advanced Software Engineering	48	102

- Unified Process with phase and process components
- Use cases
- Design patterns

- Refactoring
- Design heuristics and rules
- Software quality assurance methods
- Requirements engineering
- Usability/SW ergonomics
- SW management (e.g. ITIL)
- Current topics and trends in software engineering

Specifics

-

Prerequisites

-

Literature

IT-Security

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	3rd year	1 term		English

Teaching Methods

teaching forms	teaching methods
lecture, tutorial , lab work	lecture, discussion

Forms of Examination

examination forms	exam duration (in minutes)	Grading
written exam	90	yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
150	48	102	5

Qualification Goals and Competences

professional competence

The students are sensitised to security in essential areas of IT. They are able to detect and take appropriate measures to ensure adequate IT security after a threat analysis within the framework of a security concept. They know the strengths and weaknesses of the possible measures in their professional area of application and can weigh them against each other in concrete action situations. The acquired expertise can be used in discussions on the topic of IT architectures (conception, implementation, porting) as well as in the development of solutions and the specification of IT systems.

methodical competence

-

personal and social competence

Students have acquired the competence to also consider social and ethical aspects when evaluating information technologies. This applies in particular to weighing up the interests of security in IT systems against the right to informational self-determination of the persons affected by data processing.

interdisciplinary competence

The module leads students to a conscious and careful handling of data of any kind. Decisions are always made against the background of IT security. They practice scientific working methods, researching and evaluating current specialist literature.

Learning Units and Contents

teaching and learning units	online	self-study
IT-Security	48	102

- Basic terms and security issues
- Threat analysis and security concepts
- Basic mechanisms (encryption, hash functions, authentication codes, signature algorithms, public key procedures etc.) and their cryptographic basics

- Security models
- Network security and security protocols (e.g. X.509, OAuth)
- Security of web-based applications and services (e.g. XSS, SQL injection, Rest, Soap)
- Data protection
- Embedded security
- Current topics

Specifics

-

Prerequisites

-

Literature

Student Research Project

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	3rd year	2 terms		English

Teaching Methods

teaching forms	teaching methods
individual mentoring	project

Forms of Examination

examination forms	exam duration (in minutes)	Grading
research paper		yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
300	12	288	10

Qualification Goals and Competences

professional competence

Under limited guidance, students can familiarise themselves in depth with a complex but narrowly defined area and acquire the general level of knowledge. They can independently develop solutions and evaluate alternatives. To do so, they use existing specialised knowledge and expand it independently in the topic of the research paper. The students know and understand the necessity of scientific research and work. They are able to manage scientific work efficiently and to document it in a scientifically correct and comprehensible manner.

methodical competence

Students have acquired the competence to collect relevant information using scientific methods and to interpret it taking into account scientific findings.

personal and social competence

Students can persistently and perseveringly carry out larger tasks independently. They can manage themselves and complete tasks on the scheduled date. They can argue cogently and appropriately, present results plausibly and justify even complex issues in a comprehensible manner.

interdisciplinary competence

-

Learning Units and Contents

teaching and learning units	online	self-study
Research Paper	12	288

-

Specifics

Reference is made to the "Guidelines for the Processing and Documentation of the Modules Work Integrated Project I to III, Research Paper and Bachelor's Thesis" (“Leitlinien für die Bearbeitung und Dokumentation der Module Praxisprojekt I bis III, Studienarbeit und Bachelorarbeit”) of the Fachkommission Technik of the Baden-Wuerttemberg Cooperative State University.
The "Major Research Paper" (“Große Studienarbeit”) can be used as a designated module according to the specifications of the study and examination regulations. In addition, the "Major Research Paper" can also be used instead of the modules "Student Research Project I" (“Studienarbeit I”) and "Student Research Paper II" (“Studienarbeit II”) after approval by the head of the degree program.

Prerequisites

-

Literature

Work Integrated Project I

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	1st year	2 terms		English

Teaching Methods

teaching forms	teaching methods
internship, seminar	lecture, discussion, project

Forms of Examination

examination forms	exam duration (in minutes)	Grading
research paper		pass/fail
structure and reflection report		pass/fail

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
600	4	596	20

Qualification Goals and Competences

professional competence

Students grasp industrial problems in their context and in appropriate complexity. They critically analyse which influencing factors must be taken into account to solve the problem and assess the extent to which individual theoretical models can contribute to solving the problem. The students know the central manual and mechanical basic skills of the respective degree program, they can apply these to practical tasks and have learned their significance for the processes in the company. They know the most important technical and organisational processes in subareas of their training company and can explain their function. Students can basically describe technical problems of the respective degree program and explain subject-related correlations.

methodical competence

Students know common procedures in industrial practice and can implement them independently. In doing so, they build on their theoretical knowledge and their professional experience.

personal and social competence

Students are aware of the relevance of personal and social competence for the smooth running of industrial processes and they can name their own strengths and weaknesses. The students succeed in learning from experience, they take responsibility for the assigned tasks with which they also personally identify. Students take responsibility in the team, integrate and contribute to the common achievement of goals through their behaviour.

interdisciplinary competence

Students demonstrate action competence by using their theoretical knowledge to act appropriately, authentically and successfully in practical professional situations.
This also includes independent critical observation, the systematic search for alternative solutions and an initial assessment of the applicability of theories for practice.

Learning Units and Contents

teaching and learning units	online	self-study
Research Project 1	0	560

Reference is made to the respective practice plans of the degree programs of the Faculty of Technology.

Scientific Working 1	4	36

The seminar "Scientific Working I " takes place during the theory phase. The course can either be conducted on the whole in one term or be divided it into two terms. For some basics, the WBT "Scientific Working" (“Wissenschaftliches Arbeiten”) of the DHBW can be used.

- Guidelines for scientific working
- Choosing a topic and finding a topic for the T1000 paper (“Research Paper 1”)
- Typical contents and requirements of a T1000 paper
- Structure and outline of a T1000 paper
- Literature search, procurement and selection
- Use of the library services of the DHBW
- Form of a scientific paper (e.g. citation, bibliography)
- Information on data processing tools (e.g. literature management and generation of indexes in word processing)

Specifics

Reference is made to the "Guidelines for the Processing and Documentation of the Modules Work Integrated Project I to III, Research Paper and Bachelor's Thesis" (“Leitlinien für die Bearbeitung und Dokumentation der Module Praxisprojekt I bis III, Studienarbeit und Bachelorarbeit”) of the Fachkommission Technik of the Baden-Wuerttemberg Cooperative State University.
The paragraph "1.2 Deviations" (”1.2 Abweichungen”) from Appendix 1 (“Anlage 1”) to the Study and Examination Regulations for the Bachelor's degree programs in the Studienbereich Technik at the Baden-Wuerttemberg Cooperative State University does not apply to the examinations of this module.

Prerequisites

-

Literature

Work Integrated Project II

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	2nd year	2 terms		English

Teaching Methods

teaching forms	teaching methods
internship, lecture	lecture, discussion, group work, project

Forms of Examination

examination forms	exam duration (in minutes)	Grading
research paper		yes
structure and reflection report		pass/fail
oral exam	30	yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
600	5	595	20

Qualification Goals and Competences

professional competence

Students grasp industrial problems in an appropriate context and complexity. They critically analyse which factors must be taken into account to solve the problem and can assess the extent to which theoretical models can contribute to solving the problem.

methodical competence

Students know the methods, techniques and skills commonly used in the business environment and are able to assess their strengths and weaknesses when selecting them, so that they can choose the methods appropriately and according to the situation. The students successfully implement the tasks assigned to them through well thought-out concepts, sound planning and good project management. In doing so, they build on their theoretical knowledge as well as their growing professional experience.

personal and social competence

Students are aware of the relevance of personal and social competence for the smooth running of industrial processes as well as for their own career. They are able to name their own strengths and weaknesses. Students succeed in learning from experience, they independently take responsibility for assigned tasks, with which they also personally identify. The students take responsibility in a team, integrate others and contribute to the achievement of common goals through their considered behaviour.

interdisciplinary competence

Students demonstrate growing action competence by using their theoretical expert knowledge and their growing experiential knowledge to act appropriately and successfully in social professional situations. This also includes independent critical observation, the systematic search for alternative ways of thinking and solving problems as well as questioning previous approaches. Students are characterised by personal responsibility and energy; they are also able to act in the context of a globalised working world.

Learning Units and Contents

teaching and learning units	online	self-study
Research Project 2	0	560

Reference is made to the respective practice plans of the degree programs of the Faculty of Technology.

Scientific Working 2	4	36

The seminar "Scientific Working II " takes place during the theory phase. The course can either be conducted on the whole in one term or be divided it into two terms. For some basics, the WBT "Scientific Working" (“Wissenschaftliches Arbeiten”) of the DHBW can be used.

- Guidelines for scientific working
- Choosing a topic and finding a topic for the T2000 paper (“Research Paper 2”)
- Typical contents and requirements of a T2000 paper
- Structure and outline of a T2000 paper
- Preparation for the oral T2000 exam

Oral Exam	1	9

-

Specifics

In accordance with the applicable study and examination regulations for Bachelor's degree programs in the Studienbereich Technik at the Baden-Wuerttemberg Cooperative State University, the oral exam and research project must be passed separately. The module grade is calculated from these two examinations with a weighting of 50:50. Reference is made to the "Guidelines for the Processing and Documentation of the Modules Work Integrated Project I to III, Research Paper and Bachelor's Thesis" (“Leitlinien für die Bearbeitung und Dokumentation der Module Praxisprojekt I bis III, Studienarbeit und Bachelorarbeit”) of the Fachkommission Technik of the Baden-Wuerttemberg Cooperative State University.

Prerequisites

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Literature

Work Integrated Project III

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	3rd year	1 term		English

Teaching Methods

teaching forms	teaching methods
internship, seminar	lecture, discussion, project

Forms of Examination

examination forms	exam duration (in minutes)	Grading
term paper		pass/fail
structure and reflection report		pass/fail

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
240	4	236	8

Qualification Goals and Competences

professional competence

Students grasp industrial problems in a broad context and moderate complexity. They have a good understanding of organisational and content-related contexts as well as of organisational structures, products, procedures, measures, processes, requirements and legal foundations. They critically analyse which influencing factors must be taken into account to solve the problem and can assess to what extent theoretical models can contribute to solving the problem.

methodical competence

Students know the methods, techniques and skills commonly used in the business environment and are able to assess their strengths and weaknesses when selecting them, so that they select the methods appropriately, prudently and according to the situation. The students systematically and successfully implement the tasks assigned to them through well thought-out concepts, sound planning and good project management, even in the face of frequently changing requirements. In doing so, they build on their theoretical knowledge as well as their growing professional experience.

personal and social competence

Students show a high degree of reflexivity also with regard to their own personal and social competences, which is used as a basis for independent personal development. Students succeed in learning from experience, they independently take responsibility for the assigned tasks, with which they also personally identify. Students take responsibility for themselves and others. They are able to deal with conflict and criticism.

interdisciplinary competence

Students demonstrate comprehensive action competence by using their theoretical expert knowledge and their growing experiential knowledge to act appropriately and successfully in practical professional situations. This also includes independent critical observation, the systematic search for alternative ways of thinking and solving problems as well as the questioning of previous approaches. The students are characterised by personal responsibility and energy; they are also able to act in the context of a globalised

working world. They demonstrate a reflective attitude towards the societal, social and ecological implications of their own actions.

Learning Units and Contents

teaching and learning units	online	self-study
Research Project 3	0	220

Reference is made to the respective practice plans of the degree programs of the Faculty of Technology.

Scientific Working 3	4	16

The seminar "Scientific Working III " takes place during the theory phase. The course can either be conducted on the whole in one term or be divided it into two terms. For some basics, the WBT "Scientific Working" (“Wissenschaftliches Arbeiten”) of the DHBW can be used.

- What is science?
- Theory and theory building
- Overview of research methods (interviews, etc.)
- Quality criteria of science
- Making good use of scientific findings (frame of reference, state of research/technology)
- Structure and outline of a Bachelor's thesis
- Project planning within the framework of the Bachelor's thesis
- Cooperation with supervisors and participants

Specifics

Reference is made to the "Guidelines for the Processing and Documentation of the Modules Work Integrated Project I to III, Research Paper and Bachelor's Thesis" (“Leitlinien für die Bearbeitung und Dokumentation der Module Praxisprojekt I bis III, Studienarbeit und Bachelorarbeit”) of the Fachkommission Technik of the Baden-Wuerttemberg Cooperative State University.

Prerequisites

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Literature

Web Engineering

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	1st year	1 term		English

Teaching Methods

teaching forms	teaching methods
lecture, tutorial, lab work	lecture, discussion, lab work

Forms of Examination

examination forms	exam duration (in minutes)	Grading
written exam or combined examination		yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
90	48	42	3

Qualification Goals and Competences

professional competence

Students relate the developed theories and models to their experiences from professional practice and can assess their limits and practical applicability.

methodical competence

Upon completion of the module, students are able to select and apply the appropriate method for largely standardised use cases in practice. They know the strengths and weaknesses of the method in their professional field of application and can weigh these against each other in concrete situations.

personal and social competence

Students can act independently as well as in a team in a goal-oriented and sustainable way.

interdisciplinary competence

-

Learning Units and Contents

teaching and learning units	online	self-study
Web Engineering 1	36	39

- Introduction to HTML and CSS in the current version
- Basics of internet protocols and their associated technologies
- Consideration of a client-side programming language and/or one or more server-side programming language
- Optional: Document mark-up language XML
- Optional: Special document types for displaying 2D or 3D graphics
- Optional: Basics of media design, if not already covered in other modules

Laboratory Web Engineering 1	12	3

- Practical exercises on HTML basics
- Practical exercises on the programming language(s) introduced in the lecture

Specifics

The duration of the examination refers to the written exam.

Prerequisites

-

Literature

Computer Science Project

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	1st year	1 term		English

Teaching Methods

teaching forms	teaching methods
lecture, tutorial, lab work	project

Forms of Examination

examination forms	exam duration (in minutes)	Grading
combined examination (written exam < 50%)		yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
150	72	78	5

Qualification Goals and Competences

professional competence

Students are able to apply the basics of computer science appropriately to solve problems in simple applications.

methodical competence

Upon completion of the module, students are able to successfully complete an application project using suitable, methodologically sound procedures of project management.

personal and social competence

The reflected, practical implementation of an application project promotes the independence and personal responsibility of the students, as well as self- and time management.

interdisciplinary competence

Through the reflected, practical implementation of an application project in small groups, the students acquire knowledge of interdisciplinary contexts and processes. They have learned to integrate quickly into new tasks, teams and (work) cultures.

Learning Units and Contents

teaching and learning units	online	self-study
Application Project Computer Science	72	78

Management of IT projects

- General conditions
- Project and goal definitions
- Mission and goals
- Project management with IT support (e.g. MS Project)
- Meetings, teams and conflicts
- Project steering and control
- Other project management methods

Teaching by project example

- Carrying out a computer science project
- Practical deepening/exercise on basic lectures (i.e. programming, web engineering, digital technology, algorithms and data structures)
- Interdisciplinary application and deepening of the basics of computer science in an example project
- Use of project management methods (if applicable, deepening of a foundation module project management)

Laboratory Web Engineering 1	12	3

- Practical exercises on HTML basics
- Practical exercises on the programming language(s) introduced in the lecture

Specifics

Project management skills and a deepening of basic knowledge of computer science are taught in an interdisciplinary manner.

Prerequisites

Basic modules in computer science, especially programming. Algorithms and data structures can be taught in parallel if necessary.

Literature

Key Skills II

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	2nd year	1 term		English

Teaching Methods

teaching forms	teaching methods
lecture, tutorial	lecture, discussion, case studies, group work, project

Forms of Examination

examination forms	exam duration (in minutes)	Grading
combined examination		yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
193	108	85	5

Qualification Goals and Competences

professional competence

The students have acquired basic knowledge of economics, especially in the field of marketing, and are able to classify their professional tasks in a business context.

methodical competence

The students have deepened economic, intercultural and labour science competences (cf. module Key Skills).

personal and social competence

Students can represent their points of view in an interdisciplinary and intercultural team and respect other points of view. They can use negotiation and conflict management techniques in a goal-oriented way.

interdisciplinary competence

-

Learning Units and Contents

teaching and learning units	online	self-study
Foreign Languages 1	24	19

- Written communication: drafting and evaluating reports, statements, speeches, minutes
- Oral communication: Arguing and concluding in a discussion, presenting perfectly

Presentation, Leaning and Working Techniques	24	19

- Verbal vs. non-verbal communication
- Communication goal, message, choice of target audience
- Content structuring
- Structuring the flow of a presentation

- Speaker behaviour (e.g. body language, voice modulation)
- Use of media with practical examples

Marketing 1	24	19

- Introduction to Marketing
- Market Research
- Marketing Planning
- Marketing tools
- Product and assortment policy
- Advertising or communication policy
- Pricing policy
- Distribution policy

Marketing 2	24	19

Deepens various topics of the lecture Marketing 1.

Intercultural Communication 1	24	19

- Major Theories of Intercultural Communication
- Case studies
- Exercises, role plays, small group work, presentations

Intercultural Communication 2	24	19

- Conflict management, negotiation
- Case studies
- Exercises, Role Plays, small group work, presentations

Foreign Languages 2	24	19

- Written communication: drafting and evaluating reports, statements, speeches, minutes
- Oral communication: Arguing and concluding in a discussion, presenting perfectly

Project Management 1	24	19

- What is project management?
- General conditions
- Project and goal definitions
- Mission and goals
- Documents for project planning
- Effort estimation
- Project organisation
- Project phase models
- Planning process and methods
- Personnel planning
- Time scheduling
- Cost planning and economic background
- Introduction to management, control and project completion
- Project management with IT support (e.g. MS Project)
- Exercises for the individual parts

Project Management 2	24	19

- Meetings, teams and conflicts
- Risk planning and risk management
- Quality planning

- Project management and control
- Project completion, project revision and financial considerations
- Other project management methods

Introduction to technical-scientific Work 24 19

Elements of scientific work and its products:
- Content-related, formal and stylistic aspects of scientific work
- Categories of technical and scientific documents and their evaluation
- Use of technical English
- Carrying out source research and its qualitative evaluation
- Elaboration and forms of presentation of scientific papers taking into account the semantic environment
- Task description of a technical or scientific project
- Preparation of an exemplary and complete documentation
- Preparation of an English and German short report
- Methodological note: For the implementation of the practical exercises and the feedback students will be divided into intensive working groups and supervised

Key Skills 2 84 66

Deepening of the contents of the module Key Skills I with a special focus on the two core areas:
- Basics of economics
- Basics of marketing
- Marketing instruments
- Advertising or communication policy
- Price and distribution policy

Project management and communication
- Intercultural communication
- Working in intercultural and multilingual teams
- Major Theories of Intercultural Communications
- Conflict Management
- Negotiation

Specifics

The module complements the module Key Skills and deepens contents that were previously only dealt with in a basic way.
Either Key Skills as the only unit
or three further units of choice
Further units:
- Foreign Languages 1
- Presentation, Learning and Working Techniques
- Marketing 1
- Marketing 2
- Intercultural Communication 1
- Intercultural Communication 2
- Foreign Languages 2
- Project Management 1
- Project Management 2
- Introduction to technical-scientific Work

Prerequisites

Module Key Skills, in particular

- Basics of business administration
- Basics of project management

Literature

Databases II

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	3rd year	1 term		English

Teaching Methods

teaching forms	teaching methods
lecture, tutorial, lab work	lecture, discussion, group work, lab work

Forms of Examination

examination forms	exam duration (in minutes)	Grading
written exam	90	yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
150	72	78	5

Qualification Goals and Competences

professional competence

Students can evaluate concepts of current database architectures and database technologies. Students know the meaning and purpose of Data Warehouse (DWH) concepts and can evaluate complex DWH architectures. Students have knowledge about the structure and operation of a DWH and about the principles of a DWH and about the principles of DHW data modelling and storage.

methodical competence

Students will be able to assess the strengths and weaknesses of current database technologies and database architectures as well as data warehouse concepts with regard to their applicability in a professional environment.

personal and social competence

The students can use their decision-making and expert competences in the field of database technologies and database architectures, as well as data warehousing, to adequately assess current concepts and involve experts from other fields (especially in the field of application).

interdisciplinary competence

In addition to the sound technical knowledge, students have acquired the ability to implement theoretical concepts of current database architectures and technologies as well as data warehouse concepts in practical applications.

Learning Units and Contents

teaching and learning units	online	self-study
Database Implementations	36	39

- Storage and access structures
- Transactions, concurrency control and recovery
- Basic algorithms for database operations

- Query optimisation

Data Warehouse	36	39

- Introduction to DWH and business intelligence
- DWH architecture
- Multidimensional data model
- Physical implementation
- Data integration process
- Database technology for DWH

Current Database Architectures and Technologies	36	39

- Current database architectures
- Current database technologies

Laboratory Current Database technologies	36	39

Current database technologies are to be implemented and exercises with these are to be performed independently and under supervision (including the presentation of general concepts such as MapReduce and concrete application examples using different database systems such as Redis, CouchDB, Hadoop, Apache Kafka, etc.).

Specifics

In this module, two of the four units described must be selected.

Prerequisites

Module Database Systems

Literature

Compiler Construction

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	2nd year	1 term		English

Teaching Methods

teaching forms	teaching methods
lecture, lab work	lecture, discussion, lab work

Forms of Examination

examination forms	exam duration (in minutes)	Grading
written exam or program design		yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
150	72	78	5

Qualification Goals and Competences

professional competence

In this module, students learn about, assess and apply the tasks and methods of compilers. Procedures for the efficient transformation of high-level languages into a machine-oriented language and can be implemented.

methodical competence

Upon completion of the module, students are able to select and apply an appropriate method for complex practical applications in the field of compiler construction. They are able to assess the possibilities, practicability and limits of the method used and are able to show alternative courses of action.

personal and social competence

-

interdisciplinary competence

Compiler construction contributes to the understanding of how programs are actually executed on a computer. The students have learned this connection and can therefore assess how programming approaches in the high-level language affect program execution.

Learning Units and Contents

teaching and learning units	online	self-study
Compiler Construction	36	39

- Lexical analysis
- Syntactic analysis
- Syntax-driven translation
- Semantic Analysis
- Runtime organisation
- Intermediate code generation
- Code Optimisation

- Code generation

Laboratory Compiler Construction	36	39

- Generators for structural analysis: LEX, specification of regular languages, YACC, specification of context-free languages, practical applications
- Implementation of semantic analysis
- (Byte) code generation

Specifics

The duration of the examination depends on the study and examination regulations.

Prerequisites

-

Literature

Web Engineering II

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	2nd year	1 term		English

Teaching Methods

teaching forms	teaching methods
lecture, tutorial, lab work	lecture, discussion

Forms of Examination

examination forms	exam duration (in minutes)	Grading
written exam or combined examination		yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
150	48	102	5

Qualification Goals and Competences

professional competence

Students relate the developed theories and models to their experiences from professional practice and can assess their limits and practical applicability.

methodical competence

Upon completion of the module, students are able to select and apply the appropriate method for largely standardised use cases in practice. They know the strengths and weaknesses of the method in their professional field of application and can weigh these against each other in concrete situations.

personal and social competence

Students can act independently as well as in a team in a goal-oriented and sustainable way.

interdisciplinary competence

-

Learning Units and Contents

teaching and learning units	online	self-study
Web Engineering 2	36	39

- Deepening or learning of a server-side programming language and/or deepening or learning client-side programming as a complement to and continuation of Unit Web Engineering 1
- Special contexts of use of client- or server-side programs, including common frameworks/libraries of the programming language used
- Optional: Special execution platforms for web applications
- Optional: Introduction to architectural patterns and concepts of modern web applications.

Laboratory Web Engineering 2	12	63

Practical realisations in real-life scenarios. Project-like tasks in larger student student groups are possible.

Specifics

The duration of the examination depends on the study and examination regulations.

Prerequisites

-

Literature

Web Engineering and Computer Networks

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	2nd year	1 term		English

Teaching Methods

teaching forms	teaching methods
internship, lecture, tutorial	lecture, discussion, lab work

Forms of Examination

examination forms	exam duration (in minutes)	Grading
combined examination		yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
150	72	78	5

Qualification Goals and Competences

professional competence

The module teaches both client-side and server-side solution approaches for complex web applications. The focus is on concepts and techniques of meta languages for creating documents and connecting web applications to databases or communication and IT systems. Students are able to create their own targeted solutions using the concepts, algorithms and architectures mentioned in the module content.

methodical competence

-

personal and social competence

-

interdisciplinary competence

Web applications integrate modern communication technologies. The module conveys complex interrelationships and shows the sensible access to communication and IT systems. The knowledge acquired can be transferred to current issues in different or new environments.

Learning Units and Contents

teaching and learning units	online	self-study
Web Engineering 2	36	39

- Deepening or learning of a server-side programming language and/or deepening or learning client-side programming as a complement to and continuation of Unit Web Engineering 1
- Special contexts of use of client- or server-side programs, including common frameworks/libraries of the programming language used
- Optional: Special execution platforms for web applications
- Optional: Introduction to architectural patterns and concepts of modern web applications

Laboratory Communication Computer Science 36 39

In the Communication Computer Science lab, special topics from parallel lectures are taken up and lectures and are deepened and brought into a functional context by means of practical or experimental exercises. The lab projects contain both a hardware and software component.

Specifics

-

Prerequisites

-

Literature

Implementation of Web Technologies

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	2nd year	1 term		English

Teaching Methods

teaching forms	teaching methods
lecture, tutorial, lab work	lecture, discussion

Forms of Examination

examination forms	exam duration (in minutes)	Grading
program design or combined examination		yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
150	72	78	5

Qualification Goals and Competences

professional competence

Students can design and prototype software development projects in at least one server-side and/or client-side web programming language.

methodical competence

Upon completion of the module, students are able to select and apply the appropriate method for largely standardised use cases in practice. They know the strengths and weaknesses of the method in their professional field of application and can weigh these against each other in concrete situations.

personal and social competence

Students relate the developed theories and models to their experiences from professional practice and can assess their limits and practical applicability.

interdisciplinary competence

-

Learning Units and Contents

teaching and learning units	online	self-study
Web Engineering 2	36	39

- Deepening or learning of a server-side programming language and/or deepening or learning client-side programming as a complement to and continuation of Unit Web Engineering 1
- Special contexts of use of client- or server-side programs, including common frameworks/libraries of the programming language used
- Optional: Special execution platforms for web applications
- Optional: Introduction to architectural patterns and concepts of modern web applications.

Development of Information Systems	36	39

- Introduction to the development of web-based information systems

- Introduction to application architectures
- Mobile aspects of business applications
- Web services
- Business patterns (B2B, B2C, B2E, ...)
- CRM / SCM
- Marketplaces
- Portals
- Enterprise Application Integration

In preparation for accompanied system development, the following topics can be explored in greater depth:

- Basics of a programming language (Python, in-depth JavaScript, etc.)
- Data exchange formats (JSON, XML, etc.)
- Platforms and tools - content management systems, agile web development
- App development / mobile systems
- Assignment of a development project and implementation in group work

Specifics

-

Prerequisites

-

Literature

Architectures

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	3rd year	1 term		English

Teaching Methods

teaching forms	teaching methods
lecture, tutorial	lecture, discussion

Forms of Examination

examination forms	exam duration (in minutes)	Grading
written exam	90	yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
150	72	78	5

Qualification Goals and Competences

professional competence

Students know and are able to assess architectural principles of the hardware and software of IT systems. They know the importance of the aspects robustness, security, high availability and maintainability. Students are familiar with the notion of RAS (reliability, availability, serviceability). They can identify requirements for individual application development as well as architectures of state-of-the-art business applications. They can use modular application development and design patterns.

methodical competence

Student know about the integrity for the product and show passion to find the best solution.

personal and social competence

-

interdisciplinary competence

Upon completion of the module, students are able to use principles of software modelling to develop architectures.

Learning Units and Contents

teaching and learning units	online	self-study
Architectures of Computer Systems	36	39

- Mainframe architectures
- Parallel systems (SMP, cluster systems)
- Storage systems for mainframes
- Storage Area Network (SAN) and Network Attached Storage (NAS)
- Operating systems (concepts) for mainframe systems
- Operating of mainframes

- Introduction to application architectures
- Mobile aspects of business applications
- Web services
- Business patterns (B2B, B2C, B2E, ...)
- CRM / SCM
- Marketplaces
- Portals
- Enterprise Application Integration
- PKI Infrastructures

In preparation for accompanied system development, the following topics can be explored in greater depth:

- Basics of a programming language (Python, in-depth JavaScript, etc.)
- Data exchange formats (JSON, XML, etc.)
- Platforms and tools - content management systems, agile web development
- App development / mobile systems
- Assignment of a development project and implementation in group work

Specifics

-

Prerequisites

-

Literature

Artificial Intelligence and HCI

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	3rd year	1 term		English

Teaching Methods

teaching forms	teaching methods
lecture, tutorial, lab work	lecture, discussion, group work

Forms of Examination

examination forms	exam duration (in minutes)	Grading
combined examination		yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
150	72	78	5

Qualification Goals and Competences

professional competence

Students know the different aspects of user interaction and the most important standards. They can analyse interactive systems according to these. To design interactive systems and components, they can integrate suitable approaches into the development approach and apply concepts. They can evaluate interactive systems with regard to their usability. Students know the application areas and typical scenarios of artificial intelligence. They are in a position to recognise in which applications methods of artificial intelligence are advantageous. Students will be able to apply basic methods of artificial intelligence to practical examples.

methodical competence

Students can work with users to analyse their needs in terms of interactive system requirements and usability, and design and evaluate interfaces. They can work in interdisciplinary teams and can discuss technical questions and problems with experts and laypersons. Students can grasp real-world problems and, together with experts, extract the knowledge required to implement an intelligent application.

personal and social competence

Students can reflectively analyse and deal with the effects of aspects of interactive systems on society and social interaction. They can analyse, develop and evaluate interdisciplinary requirements for interactive systems. They can discuss technical questions and problems with experts and laypersons.

interdisciplinary competence

Students can work with users to analyse their needs in terms of interactive system requirements and usability, and design and evaluate interfaces. They can work in interdisciplinary teams.

Learning Units and Contents

teaching and learning units	online	self-study
Basics of Artificial Intelligence	36	39

- Fundamentals and definition of knowledge and modelling

- Use of logic and automatic reasoning
- Use of heuristics (e.g. heuristic search)
- Representation of fuzzy problems (e.g. probabilistic networks, evidence theory / Dempster / Shafer / fuzzy systems)
- Analogy and similarity
- Basics of machine learning
- Application areas of artificial intelligence (e.g. design of digital circuits, big data, autonomous systems, intelligent interaction)
- Practical applications of artificial intelligence methods

Interactive Systems	36	39

- Standards and guidelines
- Forms of interaction
- Software Ergonomics
- Software Usability and User Experience
- Accessibility
- Application contexts of interactive systems (e.g. e-learning, mobile applications, personalisation, gamification, etc.)

Specifics

-

Prerequisites

-

Literature

Consulting, Technical Sales and Law

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	3rd year	1 term		English

Teaching Methods

teaching forms	teaching methods
lecture, tutorial	lecture, discussion

Forms of Examination

examination forms	exam duration (in minutes)	Grading
written exam or combined examination		yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
150	72	78	5

Qualification Goals and Competences

professional competence

Students know the requirements and roles of internal and external consultants. They can evaluate the tasks and success factors of a consultant and the structures and objectives of consulting companies and can apply consulting methods. They know the requirements and structure of sales processes. The module aims at the application and deepening of project management knowledge and methods. Student also know the basics of German law, especially private law and intellectual property law.

methodical competence

-

personal and social competence

-

interdisciplinary competence

Upon completion of the module, students are sensitised to the occurrence of legal issues and their assessment, in particular with regard to the subject area of information technology.

Learning Units and Contents

teaching and learning units	online	self-study
Consulting and Technical Sales	48	52

- External and internal consulting
- Approach in consulting
- Communication in consulting
- Technical sales
- The industrial buying process
- Acquisition planning and account management
- Costs and revenue accounting
- Distribution and sales channels

- Strategic planning and top management selling
- Soft skills: Negotiation e.g. Harvard concept
- Conflict management
- Presentation techniques and moderation
- Leadership
- Self-marketing
- In-depth project management skills

Law	24	26

- Introduction
- Systematics of German law
- Civil law and civil rights
- Legal subjects, legal objects, legal capacity
- Contract law
- General contract theory
- Formation of contract
- Representation
- Inclusion of general terms and conditions in the contract
- Defences
- Consumer Protection
- E-contracting, the contract in cyber law
- Impairments of performance
- Liability for defects in sales law, copyright law, industrial property law
- Copyright law
- Right to one's own image
- Trademark law
- Patents
- Utility Model
- Registered design
- Competition law, data protection law

Specifics

The duration of the examination depends on the study and examination regulations.

Prerequisites

-

Literature

Data Science

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	3rd year	2 terms		English

Teaching Methods

teaching forms	teaching methods
lecture, tutorial, lab work	lecture, discussion, case studies, group work

Forms of Examination

examination forms	exam duration (in minutes)	Grading
written exam or combined examination		yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
150	72	78	5

Qualification Goals and Competences

professional competence

Students have basic knowledge of methods and techniques in the subject area of data science. Students know methods and techniques of automatic data analysis and have in-depth knowledge in one of the areas (data mining, machine learning, internet of things, semantic web).

methodical competence

Students have methodological knowledge of data analysis, in particular the collection and processing of data.

personal and social competence

-

interdisciplinary competence

-

Learning Units and Contents

teaching and learning units	online	self-study
Data Mining	36	39

- Data and data analysis
- Clustering
- Classification
- Association analysis
- Other methods, e.g:
  - Regression
  - Deviation detection
  - Visualisation

As an alternative to the treatment of algorithmic approaches, graphical methods can be dealt with.

Basics of Data Science	36	39

- Basics of Data Science
- Use of tools (e.g. R-programming, Octave etc.)
- Data collection and processing
- Exploratory Data Analysis
- Statistical Inference
- Regression models
- Machine Learning Algorithms
- Data Mining
- Data Visualisation
- Text Mining and Analytics (e.g. Web, Social Media)
- Pattern recognition and cluster analysis

Basics of Machine Learning	36	39

- Introduction to machine learning
- Symbolic learning methods
- Basics of neural networks
- Probabilistic learning models
- Advanced concepts and deep learning
- Design and implementation of selected techniques for an application

Big Data	36	39

Big Data Programming

- Introduction to the subject area of Big Data programming
- Explanation of the horizontal scaling of systems when processing digital mass data
- Introduction to distributed processing of digital mass data
- Introduction to batch and stream processing
- Presentation of current frameworks, libraries, programming languages, etc.
- Implementation of practical examples

Big Date Storage

- Introduction to the topic of Big Data storage
- Explanation of the horizontal scaling of systems for the storage of digital mass data
- Introduction to the storage of digital mass data using different types of storage and access (file systems, databases, etc.)
- Presentation of current frameworks, libraries, programming and query languages, etc.
- Implementation of practical examples

Semantic Web	36	39

- Short introduction to semantic technologies
- The idea of Linked Data
- The Resource Description Framework (RDF): Triples and URLs
- RDF syntax: XML and TTL
- The query language SPARQL
- Semantics in RDF: RDF Schema (RDFS) and the Web Ontology Language (OWL)
- Interaction of the individual components: The Semantic Web Layer Cake
- Application of Linked Data in the context of Industry 4.0

Internet of Things	36	39

- Introduction to IoT
- Application areas

- Technologies (on a current IoT platform)
- Communication protocols
- Sensors and data acquisition
- Platforms

Specifics

-

Prerequisites

Basics of database systems and algorithms and data structures

Literature

Artificial Intelligence and Machine Learning

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	3rd year	2 terms		English

Teaching Methods

teaching forms	teaching methods
lecture, tutorial, lab work	lecture, discussion, group work

Forms of Examination

examination forms	exam duration (in minutes)	Grading
written exam or combined examination		yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
150	72	78	5

Qualification Goals and Competences

professional competence

Students know the application areas and typical scenarios of artificial intelligence. They are in a position to recognise in which applications methods of artificial intelligence are advantageous. The students will be able to apply basic methods of artificial intelligence to practical examples. Depending on their choice of unit, students will have in-depth knowledge of evolutionary computing, machine learning, agent systems or emotional computing.

methodical competence

Students will be able to grasp real-world problems and work with experts to extract the knowledge needed to implement an intelligent application. They have acquired methodological knowledge to develop intelligent software systems (depending on their choice of the unit).

personal and social competence

Students will be able to reflectively analyse and deal with the effects of aspects of interactive intelligent and autonomous systems on society and social interaction. They can discuss technical questions and problems in the field of AI with experts and laypersons.

interdisciplinary competence

-

Learning Units and Contents

teaching and learning units	online	self-study
Basics of Artificial Intelligence	36	39

- Basics and definition of knowledge and modelling
- Use of logic and automatic reasoning
- Use of heuristics (e.g. heuristic search)
- Representation of fuzzy problems (e.g. probabilistic networks, evidence theory / Dempster / Shafer / fuzzy systems)

- Analogy and similarity
- Basics of machine learning
- Application areas of artificial intelligence (e.g. design of digital circuits, big data, autonomous systems, intelligent interaction)
- Practical applications of artificial intelligence methods

Laboratory Artificial Intelligence 36 39

The laboratory accompanies the unit Basics of Artificial Intelligence to deepen the methods taught. Individual related methods can be complemented and deepened using the project example.

Basics of Machine Learning 36 39

- Introduction to machine learning
- Symbolic learning methods
- Basics of neural networks
- Probabilistic learning models
- Advanced concepts and deep learning
- Design and implementation of selected techniques for an application

Agent-based Systems 36 39

- Basics of agents and agent systems
- Structure of agents and agent systems
- Communication in agent systems
- Co-operative problem solving
- Basics of game theory
- Agents in Software Engineering
- Agent frameworks
- Ontologies
- Mobile Agents

Evolutionary Computing 36 39

- History and fields of application of evolutionary algorithms
- Basic principles (mutation, recombination, mating pool selection, fitness function, generation models)
- Application of genetic algorithms to simple practical problems

Emotion in Interactive Systems 36 39

- Introduction and motivation
- Psychological basics of emotion
- Emotion recognition (audio/video/physiological sensors etc.)
- Emotion representation (avatars etc.)
- Basic emotion models
- Use of emotional agents in interactive systems
- Project on emotions in application systems

Specifics

The program management determines the elective unit depending on current circumstances.
The duration of the examination depends on the study and examination regulations.

Prerequisites

-

Literature

Human Machine Interaction

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	3rd year	2 terms		English

Teaching Methods

teaching forms	teaching methods
lecture, tutorial, lab work, seminar	lecture, discussion, group work

Forms of Examination

examination forms	exam duration (in minutes)	Grading
written exam or combined examination		yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
150	72	78	5

Qualification Goals and Competences

professional competence

Students know the areas of application and typical scenarios of interactive systems. They are able to recognise which user interfaces are advantageous in which applications. Students can apply basic methods of developing interactive systems using practical examples. They have in-depth expert knowledge of the design of interactive systems in the context of the digitalisation of processes.

methodical competence

Students will be able to grasp real-world problems and work with experts to extract the knowledge required to implement an intelligent application or to identify the application-related configuration of a learning procedure.

personal and social competence

Students will be able to reflectively analyse and deal with the effects of aspects of interactive intelligent and autonomous systems on society and social interaction. They can discuss technical questions and problems in the field of AI with experts and laypersons.

interdisciplinary competence

-

Learning Units and Contents

teaching and learning units	online	self-study
Interactive Systems	36	39

- Standards and guidelines
- Forms of interaction
- Software Ergonomics
- Software Usability and User Experience
- Accessibility

- Application contexts of interactive systems (e.g. e-learning, mobile applications, personalisation, gamification, etc.)

Integration Seminar Digitalisation 36 39

Current topics of digitalisation are developed in group work and in the form of a seminar. Besides the technology itself, the focus is on people and their interaction with this technology. The seminar has an interdisciplinary orientation and combines information technology methods with current fields of application (IoT, Smart Home, etc.) and also takes ethical questions into account. In addition, specialist lectures on the respective topic area are integrated.

Intelligent Interaction Lab 36 39

Development of exemplary intelligent interactive systems, usually in group work. Theoretical basics (using practical examples) (if applicable, complement to Software Engineering and Interactive Systems)

- Interaction design basics
- Creativity and design thinking
- User experience and usability testing
- Interaction and visualisation techniques
- Social and emotional interaction
- Adaptive systems
- Integration of sensor technology for modern interaction (gesture control etc.)
- The role of human-machine interaction (HMI) in digital transformation

Gamification 36 39

- Analysis of existing games and gamification concepts
- Synthesis of one's own gamification concept on a chosen use case: Integrating game dynamics into a site, service, community, content or campaign, in order to drive participation
- Psychological basics of gamification
- Examples of applications
- Research in gamification (literature)

Specifics

The duration of the examination depends on the study and examination regulations.
The module consists of the compulsory unit Interactive Systems plus one further unit of choice.
Further units:

- Integration Seminar Digitalisation
- Intelligent Interaction Lab
- Gamification

Prerequisites

-

Literature

Big Data Architectures

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	3rd year	1 term		English

Teaching Methods

teaching forms	teaching methods
lecture, tutorial, lab work	lecture, discussion, group work

Forms of Examination

examination forms	exam duration (in minutes)	Grading
written exam or combined examination (written exam + program design)	90	yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
186	72	114	5

Qualification Goals and Competences

professional competence

Students know the basics of Big Data IT architectures and in particular distributed IT systems, their architectures (middleware), central services as well as algorithms for synchronisation and data management. Students should know and be able to evaluate traditional and modern architectures of computer systems for mass data processing. The focus is on the individual components and their interaction in a heterogeneous and distributed system.

methodical competence

Upon completion of the module, students will be able to analyse core aspects of a specification in order to select or develop a suitable IT architecture, especially for Big Data applications. They can use the acquired expertise in discussions on the topic of IT architectures (conception, implementation, porting) and can be applied in the development of solutions and specification of IT systems.

personal and social competence

-

interdisciplinary competence

-

Learning Units and Contents

teaching and learning units	online	self-study
Distributed Systems	36	39

- Introduction to distributed systems
- Requirements and models
- Hardware and software concepts
- Multiprocessor, multicomputer
- Operating system support, process management

- Distributed file systems, distributed memory
- Communication in distributed systems
- Synchronisation, time and concurrency, transactions
- Consistency and replication
- Middleware architectures
- Standard (internet) applications
- Distributed programming e.g. with RPC/RMI

IT Architectures	36	39

- Basics and introduction to computer architectures
- Mainframe architectures
- Parallel Systems (SMP, Cluster Systems)
- Cloud architectures / grid computing
- Storage systems (Storage Area Network (SAN) and Network Attached Storage (NAS), etc.)
- Operating system concepts
- Operation of computer systems
- Use of IT architectures for Big Data

Specifics

The duration of the examination applies to the written exam.

Prerequisites

-

Literature

Elective Module Computer Science

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	2nd year	1 term		English

Teaching Methods

teaching forms	teaching methods
lecture, tutorial, lab work	lecture, discussion, case studies, group work

Forms of Examination

examination forms	exam duration (in minutes)	Grading
written exam or combined examination		yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
150	72	78	5

Qualification Goals and Competences

professional competence

Students have the expert knowledge described in the units to choose from (see below). They can describe these, present them systematically and can apply them accordingly to analyse problems.

methodical competence

Students know the range of methods and techniques for dealing with complex, scientific problems in their field of study and its marginal areas. They are able to select the appropriate methods and apply them, linking them to known methods in order to develop new solutions. They can explain the advantages and disadvantages of the selected method.

personal and social competence

Students can act independently as well as in a team in a goal-oriented and sustainable way.

interdisciplinary competence

Students can solve problems by using appropriate methods. They can also apply their knowledge in unfamiliar situations. Students are able to present the results of their work.

Learning Units and Contents

teaching and learning units	online	self-study
Compiler Construction	36	39

- Lexical analysis
- Syntactic analysis
- Syntax-driven translation
- Semantic Analysis
- Runtime organisation
- Intermediate code generation
- Code Optimisation

- Code generation

Web Engineering 2	36	39

- Deepening or learning of a server-side programming language and/or deepening or learning client-side programming as a complement to and continuation of Unit Web Engineering 1
- Special contexts of use of client- or server-side programs, including common frameworks/libraries of the programming language used
- Optional: Special execution platforms for web applications
- Optional: Introduction to architectural patterns and concepts of modern web applications

Driver Information Systems	36	39

- Methods of information systems and development of driver information systems
- Differentiation from security systems
- Assistance functions and entertainment systems
- Functional scope and operation of a driver information system
- Structure of a driver information system
- Integration of the system into the vehicle
- Networking in the vehicle and interaction with other systems
- Sensors: gyroscope, odometer
- Galileo basics
- Dead Reckoning
- Map matching
- Route Search (Algorithms)
- TMC, RDS, DAB and successors
- HMI (Human Machine Interface)

Computer Science and Ethics	36	39

- Introduction to Ethics, Digital Ethics
- Law and ethics
- Responsibility and accountability of the programmer
- Ethics by Design, Values by Design, Privacy by Design
- Case discussions and current case law

Introduction to Java	36	39

- General information about Java
- Data types and control structures
- Classes, objects and methods
- Interfaces
- Exceptions
- Input/Output
- Collections
- Visibility
- Inheritance and polymorphism
- Program structures such as packages, jars
- Modelling with UML
- Swing or Java FX

Programming with Rust	36	39

- Rust in a nutshell: history, classification as a programming language
- Working environment and ecosystem
- Build tool chain cargo, editor/IDE

- Basic program constructs
- Types of strings in Rust
- Error handling
- Ownership mechanism
- Life-time / ownership / references / borrowing
- Complex data structures, enums, pattern matching
- Management for large projects
- Packages, modules, creates
- Collections and error types
- Automated tests
- Functional concepts
- Smart pointers
- Concurrency
- Projects from Rust's areas of application such as distributed systems, data science and Web applications

Wireless LANs	36	39

- Historical development
- Basics (modulation, FHSS, DSSS, OFDM, OFDMA)
- From IEEE802.11 to IEEE802.11ax (physical layer, MAC layer, extensions)
- Security
- Antennas
- Antenna line
- Network planning

App Development with Flutter and Dart	36	39

- Introduction to Flutter (brief history of Flutter, who developed Flutter, facts & figures)
- Basics in Flutter (similarity to other languages, examples of the language, advantages)
- Installation of Flutter and emulator
- Page management
- Various other small points (important libraries, etc.)
- Project implementation with Flutter and Dart

Organisational Basics of Information Security	36	39

- Information security: definition and meaning
- Roles and responsibilities in companies
- Security processes and security objectives
- Authorisation concepts
- Data Protection
- Sensitive data and data leaks
- Ethical behaviour and responsible disclosure
- Standards and norms (e.g. ISO/IEC 27001)
- Organisational handling of spam and phishing e-mails, passwords
- Case studies from everyday life in the company and in private life

Consulting, Sales and Law	36	39

A) Consulting & Sales

- Consulting
- Negotiation
- Self-management/marketing
- Moderation

- Basics of technical sales
- The industrial buying process
- Acquisition planning and account management
- Distribution and sales channels

B) Legal Issues for IT
- Systematics of German law
- Civil law and civil rights
- Legal subjects, legal objects, legal capacity
- Contract law
- General contract theory
- Formation of contract
- Representation
- Inclusion of general terms and conditions in the contract
- Defences
- Consumer protection
- E-contracting, the contract in cyber law
- Impairments of performance
- Liability for defects in sales law, copyright law, industrial property law
- Copyright, right to one's own image, trademark law
- Patents, utility models, registered designs
- Competition law, data protection law

C# / .NET 1 36 39
- Overview of the .NET Framework
- Basic language components, including statements, expressions, type system and generics, Attributes
- Basics of .NET: CLR, .NET bytecode, reflection
- Advanced language components, including iterators, important interfaces and classes
- Introduction to user interface programming with Windows Forms and WPF
- Special topics such as concurrent programming, GUI frameworks, access to native code

C++ 36 39
- Historical classification of the C++ language
- Essential language features, advantages and disadvantages C++
- Differences to Java
- File organisation in C++, module concept, header and implementation file, pre-processor
- Main program, program entry point, compiling and binding
- Input and output stream, namespace
- Formatted output, strings from the C language, ANSI/ISO class 'string'
- Pointers, object instances, void* pointers and NULL pointers
- Constructor/Destructor
- Initialisations in C++
- Copying objects, shallow copy, deep copy, copy constructor
- Overloading the assignment operator
- Symbolic constants
- Initialising class attributes, constant attributes
- Read-only methods, 'const' after method signature
- Enumeration types and constants
- Default parameters
- Overloading operators
- Inheritance, constructors in inheritance

- Friend class, visibility rules
- Multiple inheritance, access control in inheritance
- Virtual methods, polymorphism
- Abstract classes
- 'const' before parameters of a function/method
- 'const' before the return value of a function/method

Linux 1 36 39

- Basics/Introduction: history, what is Linux, differences
- Windows/Linux, licences, distributions, support, documentation concepts
- Installation and first practical experiences: Knoppix, Suse or another major distribution, KDE and other interfaces
- Shell/console: shell and its commands, pipes
- Users, file permissions, processes, Linux boot process, runlevels
- File system: file types, standard file system (FHS), log files
- Network: introduction/network configuration, uses of Linux in the network, server types (inetd/ standalone)
- typical servers and important implementation (ssh, mail, http, op3, imap, NIS, ldap, X11), network troubleshooting, practical exercises for apache/nfs/samb, network security
- Miscellaneous: vmware and other OS emulators, real-time Linux, Linux on embedded devices

Discrete Mathematics 1 36 39

- Basic concepts and structures: integers and division, the Euclidean Algorithm, polynomials, the Ring Z of integers, systems of equations, modular arithmetic, systems of congruences, the Chinese Remainder Theorem, finite groups and vector spaces, finite rings and fields
- Selected topics of number theory: The fundamental theorem of arithmetic, Fermat's Little Theorem, Euler's Theorem, Fermat numbers, square-free numbers
- Applications: computer arithmetic with large integers, matrices, cryptography, affine ciphers, the Hill n-Cipher, Diffie-Hellman private key generation, RSA encryption and decryption

Agent-based Systems 36 39

- Basics of agents and agent systems
- Structure of agents and agent systems
- Communication in agent systems
- Co-operative problem solving
- Basics of game theory
- Agents in Software Engineering
- Agent frameworks
- Ontologies
- Mobile Agents

Signals and Systems 2 36 39

- Introduction to Signals and Systems (Discrete)
- Discrete Fourier Transformation
- Z-transformation
- Non-recursive and recursive systems
- Digital filters
- Wavelet transformation

Cloud Computing 36 39

- Why cloud computing? Introduction

- Basics of cloud computing
- Architectures and providers
- Special features of the cloud
- Software technologies for the cloud
- Strategies for migration to the cloud
- Implementation of the cloud (Warehouse Scale Datacenter, WSC)
- Trends

Cross Platform Web Development	36	39

- Basics JavaScript
- Basics Node.js
- HTTP server with Express JS
- MongoDB and Mongoose
- Angular JS
- Ionic Framework
- Apache Cordova
- Websockets and possibly desired topics.

The contents are always applied practically. An exemplary application is developed together during the lecture.

Programming techniques for Embedded Systems	36	39

- Definition of embedded systems
- Introduction; repetition in C++ concepts for efficient programming in C++
- Memory management and allocation techniques
- Implementation of state machines
- Writing maintainable code
- Dealing with static variables

Internet of Things	36	39

- Introduction to IoT
- Application areas
- Technologies (on a current IoT platform)
- Communication protocols
- Sensors and data acquisition
- Platforms

Programming in Python	36	39

- Introduction "historically" to Python
- Syntax and basic programming
- Python in web programming
- Plotting data with the add-on package Matplotlib in Python
- Data analysis with Python
- Python and Django
- Application example

Basics of Android Programming	36	39

- History and development of the Android operating system
- Java basics
- Android basics and differences
- Programming and configuration of Android apps
- Linking hardware and software

- Workshop with various programming exercises (reading sensors, creating simple applications)

Programming with PHP	36	39

- Introduction
- Basics and syntax
- Database connection
- Information Transfer
- Security
- Application examples

Quantum Computers	36	39

- History of quantum computers
- Technologies, e.g. quantum mechanics, necessary for understanding quantum computing
- Current state of the technology
- Ideas for future use

Network Technologies of Access and Wide Area Networks	36	39

- Development of access and wide area networks
- Basics and techniques of wired and wireless access networks
- Basics and techniques of wide area networks

Augmented Reality	36	39

- Basics of augmented reality (AR)
- Differentiation from virtual reality (VR)
- Introduction to the AR glasses used
- Working with the development environment and graphics engine
- Project creation
- Explanation of the holographic emulation mode
- Positioning 3D objects in 3D space
- Dynamic instantiation of objects at runtime
- Dynamic creation of 3D space data
- Movement and interaction with 3D objects

App Development with Swift	36	39

- Overview of mobile operating systems
- Introduction to the Xcode development environment
- iOS development with Swift
- Interface development with Interface Builder
- Swift on other platforms

Microservices	36	39

- Introduction
- Microservices: Concepts, advantages, design principles,
- Advantages and disadvantages of the microservice approach
- Microservices vs. SOA
- The overall architecture of microservice systems
- The architecture of individual services
- Design and development of a more complex application consisting of several microservice
- Optional: introduction to the programming language Node.js, practical exercises, why it is perfectly suited for microservices

- Optional: Docker – concepts, practical work with Docker, deployment of the application with Docker

User Experience and User Interface Design 36 39

- Introduction to user experience
- Identification and assessment of user requirements
- Collaborative concept development
- Creation of prototypical designs
- Knowledge of methods for measuring usability
- Implementation and evaluation of usability tests

Specifics

The module contains two elective units from a given selection catalogue, one of which can be specified by the program director.
Elective units:
Compiler Construction
Web Engineering 2
Driver Information Systems
Introduction to Java
Programming with Rust
Consulting, Sales and Law
C# / .NET 1
C++
Linux 1
Discrete Mathematics 1
Signals and Systems 2
Cloud Computing
Cross Platform Web Development
Programming Techniques for Embedded Systems
Internet of Things
Programming in Python
Programming with PHP
Quantum Computers
Network Technologies of Access and Wide Area Networks
Augmented Reality
App Development with Swift
Microservices
Basics of Android Programming
User Experience and User Interface Design
Wireless LANs
App Development with Flutter and Dart
Organisational Basics of Information Security

The duration of the examination depends on the study and examination regulations.

Prerequisites

-

Literature

Elective Module Computer Science II

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	3rd year	1 term		English

Teaching Methods

teaching forms	teaching methods
lecture, tutorial, lab work	lecture, discussion, case studies, group work

Forms of Examination

examination forms	exam duration (in minutes)	Grading
written exam or combined examination		yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
372	144	228	5

Qualification Goals and Competences

professional competence

Students have the expert knowledge described in the units to choose from (see below). They can describe these, present them systematically and can apply them accordingly to analyse problems.

methodical competence

Students know the range of methods and techniques for dealing with complex, scientific problems in their field of study and its marginal areas. They are able to select the appropriate methods and apply them, linking them to known methods in order to develop new solutions. They can explain the advantages and disadvantages of the selected method.

personal and social competence

Students can act independently as well as in a team in a goal-oriented and sustainable way.

interdisciplinary competence

Students can solve problems by using appropriate methods. They can also apply their knowledge in unfamiliar situations. Students are able to present the results of their work.

Learning Units and Contents

teaching and learning units	online	self-study
Digital Image Processing	36	39

- Introduction to the methods of image processing
- Image acquisition (digitalisation, scanning, rasterisation)
- Storing image data (data compression methods)
- Image editing (histogram smoothing, contrast enhancement)
- Operations in the spatial domain (local operators, convolution filters)
- Operations in the frequency domain
- Segmentation (thresholding, edge detectors)

- Image analysis (morphological methods, feature extraction, edge and area determination)
- Classification (neural networks)

Software Quality	36	39

- Quality concepts
- Quality assurance (QA) according to TQM, quality management under dynamic market development, definitions, standards
- Quality audit
- Quality improvement with measurable factors
- QA methods, product life cycle with the QTK circle, Lean Production

Basics of Data Science	36	39

- Basics of Data Science
- Use of tools (e.g. R-programming, Octave etc.)
- Data collection and processing
- Exploratory Data Analysis
- Statistical Inference
- Regression models
- Machine Learning Algorithms
- Data Mining
- Data Visualisation
- Text Mining and Analytics (e.g. Web, Social Media)
- Pattern recognition and cluster analysis

Introduction to Data Analysis with R	36	39

- The working environment, R, editor/IDE, ...
- The basic data structures of R: vector, matrix, data frames,...
- R as a language
- Data import (data sources)
- Transforming data (data munging/data wrangling)
- Visualisation of data: "The Grammar of Graphics" (ggplot2)
- S3 classes, outlook on S4 classes
- Modern approaches to data analysis: the "Tidyverse”
- Creating R notebooks
- Creating R packages

Introduction to Blockchain	36	39

- Distributed ledger techniques and blockchain
- Basics (history, introduction to asymmetric cryptography, data structures)
- Differences between implementations
- Introduction to technologies (Hyperledger Fabric, Ethereum, Bitcoin)
- Development (architectures of decentralised applications, smart contracts)

High Performance Optical Networks	36	39

- Basics of light conduction fibres
- Dispersion effects
- Non-linear effects (Kerr effect, Raman scattering, Brillouin scattering)
- Alternative fibre concepts (hollow-core fibre, multicore fibre)
- Techniques for transceivers > 10Gbit-s-1
- Theoretical limits in transmission (Shannon limit)
- Introduction to all-optical switching

- Insights into submarine cable systems

Introduction to Computer Tomography	36	39

- Tomographic measurement
- Fields of application
- Reconstruction algorithms
- Computer technology for tomography

Formal Models and Concepts of Communication Technology	36	75

- Modelling and analysis of communication networks
- Modelling of arrival processes
- Service and queuing concepts
- Traffic flow control in high load phases
- Performance evaluation and QOS concepts

Cyber Security Basics	36	39

- Introduction along the dimensions: protect, attack, analyse, repair, design
- Case studies from everyday life in the company and in private life
- Legal and technical aspects of cyber attacks
- Basic protection and standards
- IT security management
- Authentication and access protection
- Classification of security software

Sales and Business Mangement	36	39

- Technical sales
- The industrial buying process
- The Buying Centre Concept
- Acquisition planning and account management
- Sales channels and forms of cooperation in the investment and project business
- Cost and revenue accounting in the project and investment business
- Product Management and Marketing Program Planning
- Corporate strategy
- Content and structure of an annual report
- Business ethics and corporate governance

Consulting, Sales and Law	36	39

A) Consulting & Sales

- Consulting
- Negotiation
- Self-management/marketing
- Moderation
- Basics of technical sales
- The industrial buying process
- Acquisition planning and account management
- Distribution and sales channels

B) Legal Issues for IT

- Systematics of German law
- Civil law and civil rights
- Legal subjects, legal objects, legal capacity

- Contract law
- General contract theory
- Formation of contract
- Representation
- Inclusion of general terms and conditions in the contract
- Defences
- Consumer protection
- E-contracting, the contract in cyber law
- Impairments of performance
- Liability for defects in sales law, copyright law, industrial property law
- Copyright, right to one's own image, trademark law
- Patents, utility models, registered designs
- Competition law, data protection law

Assembler Programming 36 39

- 8051 processor family
- Development environment, e.g. µVision from Keil in the demo version
- Ungraded exercises: e.g. serial interface, analogue digital converter
- Graded program design: completion time approx. 3 weeks
- Other current topics by arrangement

Linux 1 36 39

- Basics/Introduction: history, what is Linux, differences
- Windows/Linux, licences, distributions, support, documentation concepts
- Installation and first practical experiences: Knoppix, Suse or another major distribution, KDE and other interfaces
- Shell/console: shell and its commands, pipes
- Users, file permissions, processes, Linux boot process, runlevels
- File system: file types, standard file system (FHS), log files
- Network: introduction/network configuration, uses of Linux in the network, server types (inetd/ standalone)
- typical servers and important implementation (ssh, mail, http, op3, imap, NIS, ldap, X11), network troubleshooting, practical exercises for apache/nfs/samb, network security
- Miscellaneous: vmware and other OS emulators, real-time Linux, Linux on embedded devices

Discrete Mathematics 1 36 39

- Basic concepts and structures: integers and division, the Euclidean Algorithm, polynomials, the Ring Z of integers, systems of equations, modular arithmetic, systems of congruences, the Chinese Remainder Theorem, finite groups and vector spaces, finite rings and fields
- Selected topics of number theory: The fundamental theorem of arithmetic, Fermat's Little Theorem, Euler's Theorem, Fermat numbers, square-free numbers
- Applications: computer arithmetic with large integers, matrices, cryptography, affine ciphers, the Hill n-Cipher, Diffie-Hellman private key generation, RSA encryption and decryption

Bioinformatics 1 36 39

- Introduction to computational life sciences
- Molecules and sequences
- Sequence and shape of important biomolecules
- Protein structure and function
- Gene and protein databases
- Sequence similarity search for genes and proteins

- Kinetics, regulation and systems
- The cellular life cycle proteins
- Kinetics of chemical reactions
- Gene regulation and micro arrays
- Simulation of reaction and regulation networks
- Simulation of complex biological systems

Bioinformatics 2 36 39

- Random Numbers :offers approximately the same material on random numbers as Knuth's "The Art of Computer Programming", complemented by newer generators and especially by the use of random numbers in simulation systems

or

- Swarm Programming: introduces two swarm programming environments (swarm and NetLogo) and starting from the biological systems motiving this approach (ants) develops the application of swarm programming for solving search, transport and optimisation tasks. Scope and content roughly correspond to the "classic" of this young discipline: Bonabeau.

Advanced Management 36 39

- Knowledge Management: KM basics, overview of KM instruments and tools, knowledge repositories, Communities of Practice, After Action Reviews, planning and implementation, future trends
- Supply Change Management: SCM terminology, SCM case studies, approaches and history, current developments and key words, simulation and exercise (Beer Game), representation SC (Matrix Model), Representation SC Nodes (cost factors), cost management approaches, identification of cost drivers, strategic business decisions and control models in SC

Spoken Language Processing 36 39

- Introduction: human speech understanding and production
- Speech recognition
- Speech coding
- Speech synthesis
- Procedures for improving speech quality
- Designing of speech dialogue systems
- Speech transmission in packet-based networks

AI Game Development 36 39

- Introduction, history and environment (game genres, hardware, graphics etc.)
- AI methods in computer games (tracking and pathfinding, flocking, control systems, fuzzy and finite state machines etc.)
- Scripting and scripting languages
- Game engines and development environments
- Gamification and serious games
- Practical project

Agent-based Systems 36 39

- Basics of agents and agent systems
- Structure of agents and agent systems
- Communication in agent systems
- Co-operative problem solving
- Basics of game theory
- Agents in Software Engineering
- Agent frameworks
- Ontologies

- Mobile Agents

Big Data	36	39

Big Data Programming
- Introduction to the subject area of Big Data programming
- Explanation of the horizontal scaling of systems when processing digital mass data
- Introduction to distributed processing of digital mass data
- Introduction to batch and stream processing
- Presentation of current frameworks, libraries, programming languages, etc.
- Implementation of practical examples

Big Date Storage
- Introduction to the topic of Big Data storage
- Explanation of the horizontal scaling of systems for the storage of digital mass data
- Introduction to the storage of digital mass data using different types of storage and access (file systems, databases, etc.)
- Presentation of current frameworks, libraries, programming and query languages, etc.
- Implementation of practical examples

Microcontroller Programming with Arduino	36	39

- Basics of microcontroller programming
- Arduino boards with its timers, interrupts and interfaces (digital, analogue)
- practical exercises

Cross Platform Web Development	36	39

- Basics JavaScript
- Basics Node.js
- HTTP server with Express JS
- MongoDB and Mongoose
- Angular JS
- Ionic Framework
- Apache Cordova
- Websockets and possibly desired topics.

The contents are always applied practically. An exemplary application is developed together during the lecture.

Minimizing EMF Risk	36	39

Approach to the physics of electromagnetic fields (EMF)
- Basics of electromagnetic fields
- Alternating electric fields (low frequency, LF)
- Alternating magnetic fields (LF)
- Electromagnetic waves (high frequency, HF)
- Direct electric and magnetic field
- Representation of field quantities in decibels
- Field measurement techniques from a building biology perspective
- Discussion of the different measurement methods for the above listed field types
- Introduction to LF and HF measuring instruments and the spectrum analyser

Measurement Technology Lab I: Carrying out measurements of low-frequency electric and magnetic fields as well as high-frequency electromagnetic fields
- Usage and practice of the handling of the LF and HF measuring instruments

- Carrying out measurements at specially prepared measuring stations
- Measurement protocols as part of the certificate of achievement

Measures for field reduction in buildings (especially sleeping places)
- Low-frequency alternating electric fields (switching off, disconnecting, shielding)
- Low-frequency alternating magnetic fields (mains systems, shielding, harmonics)
- High-frequency electromagnetic waves (large-area shielding, HF interference in the electrical system)
- Office and sleeping places, electronics, lighting

Measurement Technology Lab II: Carrying out a sleeping area measurement, analysing the analysis of the actual state as well as derivation and implementation of measures for the field reduction
- LF and HF measurement of a prepared sleeping place
- Determination of all field sources
- Deriving measures to minimise the fields
- Preparation of a measurement protocol as the second part of the certificate of achievement

Discussion of the effects of electromagnetic fields on humans and the environment from a scientific and medical point of view
- History of the development of limit values for the protection of humans and the environment
- Presentation and discussion of international scientific studies

Internet of Things 36 39
- Introduction to IoT
- Application areas
- Technologies (on a current IoT platform)
- Communication protocols
- Sensors and data acquisition
- Platforms

Cloud Computing 2 36 39
- IT as a service and its characteristics with a clear separation of the IT service provider and the IT service consumer
- What IT services are there? (XaaS)
- How cloud computing differs from other IT services
- Influence on internet start-ups
- The most important Open Source developments
- Compute, network and storage virtualisation (using the example of Open Stack)
- Containers and container orchestration (using the example of Kubernetes)
- Platform models (like Cloud Foundry)
- Severless deployment (OpenWhisk)
- Differentiation of traditional IT with cloud computing and the added value of combining both worlds in a hybrid model
- New scalable applications (stateful, stateless, 12 Factor App) with a Service interface (REST, microservices)
- Data management in the cloud such as Object Store (Swift), SQL (MySQL) and NoSQL (CouchDB) Databases
- Are there service level objectives?
- European data protection law (GDPR)
- General security architecture (overview)
- Encryption like TLS (Data in transit) or AES (Data in Rest) and key management
- Practice : Cloud as access to new services (Cognitive Systems)

Combinatorial Optimisation 36 39

- P/NP Problem
- Shortest paths
- Networks and cost minimum flows
- Traveling Salesman Problem / Vehicle Routing Problem
- Matchings
- Interrelationship of networks
- Graph colouring
- Linear and integer optimisation

Microservices with Docker and Node.js: A practical Introduction 36 39

- Node.js: Introduction to the programming language, practical exercises, why it is perfectly suited for Microservices
- Microservices: Concepts, advantages, design principles, relation to SOA
- Design and development of a complex application consisting of several microservices
- Docker: concepts, practical work with Docker, deployment of the application with Docker
- Summary, further discussion: DevOps, management, monitoring, security

Introduction to DevOps, Continuous Delivery Tools and Mindset 36 39

- what is DevOps and what is the use of it (DevOps culture and differences to traditional enterprises)
- Provisioning with Vagrant, Packer as well as AWS/Azure/GCP API
- Docker basics, container orchestration with Kubernetes
- Build with maven, gradle, Jenkins etc.
- Config management / deployment with ansible, chef, salt and puppet
- Deployment strategies, graphical deployment tools: Spinnaker, GoCD
- Testing with SonarCube, PhantomJS, Windmill, Selenium, Cucumber
- Monitoring with Nagios and ELK-Stack, Graphite, AWS CloudWatch
- ChatOps with Hubot, Lita and Err
- Prerequisites for the successful introduction of DevOps

Data Mining and Basics of Machine Learning 36 39

Machine Learning:

- Introduction to machine learning
- Symbolic learning methods
- Basics of neural networks
- Probabilistic learning models
- Advanced concepts and Deep Learning
- Design and implementation of selected techniques for an application

Data Mining:

- Data and data analysis
- Clustering
- Classification
- Association analysis
- Other methods, e.g.:
  - Regression
  - Deviation detection
- Visualisation

As an alternative to the treatment of algorithmic approaches, graphical methods can be dealt with.

Programming in Python 36 39

- Introduction "historically" to Python
- Syntax and basic programming
- Python in web programming
- Plotting data with the add-on package Matplotlib in Python
- Data analysis with Python
- Python and Django
- Application example

App Development with Swift 36 39

- Overview of mobile operating systems
- Introduction to the Xcode development environment
- iOS development with Swift
- Interface development with Interface Builder
- Swift on other platforms

Microservices 36 39

- Introduction
- Microservices: Concepts, advantages, design principles,
- Advantages and disadvantages of the microservice approach
- Microservices vs. SOA
- The overall architecture of microservice systems
- The architecture of individual services
- Design and development of a more complex application consisting of several microservice
- Optional: introduction to the programming language Node.js, practical exercises, why it is perfectly suited for microservices
- Optional: Docker – concepts, practical work with Docker, deployment of the application with Docker

User Experience and User Interface Design 36 39

- Introduction to user experience
- Identification and assessment of user requirements
- Collaborative concept development
- Creation of prototypical designs
- Knowledge of methods for measuring usability
- Implementation and evaluation of usability tests

Specifics

The module contains two elective units from a given selection catalogue, one of which can be specified by the program director.
Elective units:
Digital Image Processing
Software Quality
Basics of Data Science
Introduction in Data Analysis with R
Introduction in Blockchain
High Performance Optical Networks
Introduction to Computer Tomography
Formal Models and Concepts of Communication Technology
Cyber Security Basics
Sales and Business Management
Consulting, Sales and Law
Assembler Programming
Linux 1

Discrete Mathematics
Bioinformatics 1
Bioinformatics 2
Advanced Management
Spoken Language Processing
AI Game Development
Agent-based Systems
Big Data
Microcontroller Programming with Arduino
Cross Platform Web Development
Minimizing EMF Risk
Internet of Things
Cloud Computing 2
Combinatorial Optimisation
Microservices with Docker and Node.js: A practical Introduction
Introduction to DevOps, Continuous Delivery Tools and Mindset
Data Mining and Basics of Machine Learning
Programming in Python
App Development with Swift
Microservices
User Experience and User Interface Design

The duration of the examination depends on the study and examination regulations.

Prerequisites

-

Literature

Quality of Software and Distributed Systems

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	3rd year	1 term		English

Teaching Methods

teaching forms	teaching methods
lecture, tutorial	lecture, discussion, group work

Forms of Examination

examination forms	exam duration (in minutes)	Grading
combined examination		yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
150	72	78	5

Qualification Goals and Competences

professional competence

Students are able to analyse and process complex problems from practice in such a way that they can create corresponding program systems. They obtain the relevant information for the solution, independently carry out the software design and give critical on the quality of their results.

methodical competence

Upon completion of the module, students are able to select an appropriate method for quality assessment and assurance for complex software systems. They are able to assess the possibilities, practicability and limitations of the method used and are able to identify alternative courses of action.

personal and social competence

-

interdisciplinary competence

-

Learning Units and Contents

teaching and learning units	online	self-study
Software Quality	36	39

- Quality concepts
- Quality assurance (QA) according to TQM, quality management under dynamic market development, definitions, standards
- Quality audit
- Quality improvement with measurable factors
- QA methods, product life cycle with the QTK circle, Lean Production

Distributed Systems	36	39

- Introduction to distributed systems
- Requirements and models
- Hardware and software concepts
- Multiprocessor, multicomputer
- Operating system support, process management
- Distributed file systems, distributed memory
- Communication in distributed systems
- Synchronisation, time and concurrency, transactions
- Consistency and replication
- Middleware architectures
- Standard (internet) applications
- Distributed programming e.g. with RPC/RMI

Specifics

-

Prerequisites

Software Engineering 1

Literature

Bachelor Thesis

Formal Details of the Module

module no.	location in course of study	duration	responsibility	language
	3rd year	1 term		English

Teaching Methods

teaching forms	teaching methods
individual mentoring	project

Forms of Examination

examination forms	exam duration (in minutes)	Grading
bachelor thesis		yes

Workload and ECTS Credit Points

total workload (in hours)	of which online	of which self-study	ECTS
360	6	354	12

Qualification Goals and Competences

professional competence

-

methodical competence

-

personal and social competence

-

interdisciplinary competence

Students grasp industrial problems in a broad context and in realistic complexity. They have a good understanding of organisational and content-related contexts as well as of organisational structures, products, procedures, measures, processes, requirements and legal foundations. They critically analyse which influencing factors must be taken into account to solve the problem and can assess to what extent theoretical models can contribute to solving the problem. The students can independently, with little guidance, delve into theoretical basics of a subject area and acquire the general state of knowledge. Based on theory and practice, they can independently develop solutions and evaluate alternatives. They are able to efficiently manage a scientific work as part of a practical project and to document it in a scientifically correct and comprehensible manner.

Students are characterised by personal responsibility and drive; they are also capable of acting in the context of a globalised working world. They demonstrate a reflective attitude towards the societal, social and ecological implications of their own actions.

Learning Units and Contents

teaching and learning units	online	self-study
Bachelor Thesis	6	354

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Specifics

Reference is made to the "Guidelines for the Processing and Documentation of the Modules Work Integrated Project I to III, Research Paper and Bachelor's Thesis" (“Leitlinien für die Bearbeitung und Dokumentation der Module Praxisprojekt I bis III, Studienarbeit und Bachelorarbeit”) of the Fachkommission Technik of the Baden-Wuerttemberg Cooperative State University.

Prerequisites

-

Literature

Appendix

Examinations and Grades

Grading Scheme

Grade value	Grade level	Grade description
1.0 – 1.5	very good	= an excellent performance
1.6 – 2.5	good	= a performance significantly above average
2.6 – 3.5	satisfactory	= a performance that meets average requirements
3.6 – 4.0	sufficient	= a performance which, despite its shortcomings, still meets the requirements
4.1 – 5.0	not sufficient	= a performance that, due to considerable shortcomings, does not meet the requirements

Examination Forms

- structure and reflection report:
  The examination performance "structure and reflection report" (SRR) contains a documentation of the time and content of the practical phase and a reflection on the student's progress in learning and acquisition of knowledge during the practical phase as well as a reflection on the linking of the contents of the theoretical and practical phases from the student's point of view. The SRR must be submitted at the end of each practical project as an ungraded examination.
- term paper:
  In a term paper, a given problem or exercise is to be independently worked out using the lecture notes and/or other scientific sources and document it in a written paper of the specified scope.
- written exam:
  In the written exams, students are to prove that they can solve tasks and work on topics with the permitted aids in the specified time. The written exams consist of knowledge, method and comprehension questions and give the students the opportunity for critical reflection. The duration of an individual written exam is given in the respective module description. The length of the written exam depends on the number of ECTS credit points of the corresponding module:
  - 5 or 6 ECTS credit points 90 - 120 minutes
  - 7 or 8 ECTS credit points 120 - 150 minutes
  - 9 or 10 ECTS credit points 150 - 180 minutes
- combined examination:
  A combined examination consists of at least two examination parts of the following examination forms: Oral examination, program design, term paper, presentation, lab work, elaboration and written examination. A selected form of examination may not be used more than once. Each part of the examination must comprise at least 20 % of the total examination performance and be weighted accordingly. Points shall be awarded for each part of the examination. The points of an individual examination part are only to be announced when the points of all examination parts have been determined and the module grade can be calculated. The module grade results from the points awarded for the individual examination parts. The regulations of § 17 are not applicable to the examination parts.
- lab work (including elaboration):
  A lab work comprises the performance of a lab experiment including a detailed written elaboration of the performance and results.

- oral exam:
  The oral exam is approximately 30 minutes long for each person to be examined. The oral examination should, among other things, test the student's understanding of the project work and its connections with other subject areas. In addition to the subject-specific qualifications, it shall also include interdisciplinary qualifications (e.g. methodological competences).
- program design:
  A program design includes the solving of a task with the selection of suitable methods, the formulation of the algorithms in a programming language, testing and checking the results for correctness and the program documentation.
- research paper:
  The research paper documents the concrete solution of an engineering task (or two smaller tasks) in the practical phase. The paper shows in-depth, comprehensive and independent work and links the practical tasks with current technical literature from theory and practice. The research project must be completed during the practical phase.
- presentation:
  A presentation is an oral presentation of independently developed content of between 10 and 30 minutes.
- research project:
  The research project should be a concrete solution to an engineering task and show in-depth, comprehensive and independent work, taking into account theoretical findings.
- bachelor thesis:
  The length of the bachelor thesis is generally 60 to 80 pages. Deviations require the approval of the supervisors; unapproved deviations result in an appropriate reduction in the grade. The bachelor thesis may be of experimental, theoretical or constructive nature or any combination of these three possibilities.

Notes on Graded Examinations

- written exam: The written exam is a written test that is graded. Examinations are usually written in the 12th week of lectures. The elective and additional subject examinations in the 4th, 5th and 6th semesters are mainly the last lecture date of the respective subject and thus not in the examination week, so that, if possible, 2 examinations do not take place on the same day. The exam dates are set by the DHBW.

- presentations/projects: Presentations and project work can also be carried out as graded examinations. Individual grades must be determined in this case.

- Post-exam: If, due to illness, the scheduled examination date cannot be kept the exam must be rewritten. This takes place after consultation with the responsible program director. The date is generally scheduled immediately after the student has recovered. A late appointment can only be granted if the certificate of incapacity for examinations is available. Please also note the information on the degree program portal.

- repetition exam: If the result of an examination is 4.1 or below and therefore "not sufficient", a repetition exam will be scheduled. This will take place at the earliest 4 weeks after the grade has been announced. All repetition exams have to be passed.

- oral examination: If, after exhaustion of the repetition exams per academic year, at least an adequate performance has not been achieved in only one examination, a second repetition exam can be take place, as a rule, within two to six weeks after the announcement of the examination result; this is conducted as an oral examination and only decides on the grade "sufficient" (4.0) or "insufficient" (5.0). The duration of the oral examination is between 20 and 35 minutes. Failure to pass leads to ex-matriculation.