OTH REGENSBURG

Module handbook

International Computer Science (B.Sc.)

undergraduate programme

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produced on 18.03.2025

Faculty of Computer Science and Mathematics

Preliminary Remarks

The introduction to this module handbook follows the annex to the study and examination regulations for the bachelor's degree programme **International Computer Studies BSc** at the **OTH Regensburg**, as per version dated **17.04.2023**.

This module handbook outlines the learning objectives of the individual modules based on the competencies to be acquired. These are categorized into **professional competence** (knowledge, skills) and **personal competence** (social competence, independence).

Each competence is assigned a level, indicated by one of the numbers **"1" to "3"** in brackets. The three levels are:

- **Level 1:** Knowledge
- **Level 2:** Skills
- **Level 3:** Understanding and application

In addition to subject-specific skills, the development of personal skills is an integral part of every course and university studies in general. If personal skills are not explicitly stated for a module, students—after successfully completing the module—are able to:

- Analyse their own learning progress and learning needs **(3)** and, if necessary, derive courses of action from this **(3)**.
- Work together with others in a goal-oriented manner **(2)**, understand their interests and social situations **(2)**, deal with them rationally and responsibly, communicate effectively **(2)**, and help shape their working and living environment **(3)**.
- Work scientifically in accordance with the *guidelines of good scientific practice* **(2)**, present subject-specific content **(2)**, and explain it to an audience using correct technical language **(2)**.

Curriculum International Computer Science B.Sc.

	ECTS																											
Semester	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Sum ECTS
1	Mathematics 1							Programming 1								Automata, Formal Languages, and Computation					Business Administration					Language Track 1 A or B *)					30
2	Mathematics 2							Programming 2								Computer Systems					Computer Networks					Language Track 2 A or B *)					30
3	Databases							Global Software Engineering								Operating Systems					Statistics					Language Track 3 A or B *)					30
4	Computer Architecture							Algorithms and Data Structures								Web Technology Project					Software for the Global Market					Language Track 4 A or B *)					30
5	Industrial Placement + Seminar																										AWPM 1		AWPM 2		30
6	Core Module 1 Scientific Seminar					Core Module 2 Advanced Algorithms *)					Core Module 3 Stochastic Algorithms *)					Core Module 4 Big Data Technology *)					FWPM 1					FWPM 2					30
7	Bachelor Thesis													Bachelor Seminar		Core Module 5 Int. Software Development *)					Core Module 6 Information Security *)					FWPM 3					30

***) Language Track 1 - 4:**

Track A: German
Track B: Spanish

***) Core Modules 2 - 6:**

The above-mentioned modules are intended to provide an insight to the course content. Please note, the actual modules offered can be amended at any time.

Module list

Study level 1:

Study level 2:

Study level 3:

Module title	Module code
Automata, Formal Languages and Computation	

Person responsible for the module	Faculty
Prof. Dr. Titus Dose	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
1.	1.	mandatory	5

Mandatory requirements
No prerequisites necessary
Recommended previous knowledge
Attendance of the pre- and bridge courses is recommended

Content
see next page

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Automata, Formal Languages and Computation	4 SWS	5

Submodule	Submodule abbreviation
Automata, Formal Languages and Computation	**AFL**

Responsible person	Faculty
Prof. Dr. Titus Dose	Computer Science and Mathematics
Lecturer	**Availablilty of module**
Prof. Dr. Titus Dose	only in winter semester

Teaching method
Seminar teaching (2 SWS) with exercises (2 SWS).

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
1.	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60h	90h

Method of assessment
written exam 90 minutes

Content
Computability - Computational models and their equivalence (e.g., While programs, register machines, Turing machines) - Church-Turing thesis - Runtime analysis (Landau notation) - Decidability and limits of computations (undecidability of halting problem, Rice's theorem, impossibility of general automatic verification) Formal languages and automata theory - Alphabets, words, languages - Deterministic and non-deterministic finite automata and their equivalence - Automata-based search in texts - Regular expressions - Closure properties of regular expressions - Pumping lemma - Equivalence test and minimization of deterministic finite automata

Learning objectives: Subject competence
After successful completion of the submodule, students are able to, apply (2) and explain (2) the scientific contents dealt with in the lecture. Furthermore, students are aware of the practical implications (2), in particular the possibilities and limits of the

application of computer systems (3) and they are equipped with formal tools to put practical approaches on a solid foundation (2).

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,
communicate professionally and precisely (2) and
work on problems analytically and independently (2).
Furthermore, students are more comfortable with abstract and formal works (1).

Teaching media

Blackboard, slides

Literature

- John E.Hopcroft, Jeffrey D.Ullmann, Rajee Motwani:"Introduction to Automata Theory, Languages and Computation“ von John E. Hopcroft, Pearson Studium, 2002
- John C. Martin: Introduction to Languages and the Theory of Computation, 2011
- Michal Sipser: Introduction to the Theory of Computation, Thomson Course Technology, 2006

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Business Administration	

Person responsible for the module	Faculty
Prof. Dr. Alixandre Ferreira de Santana	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
1.	1.	mandatory	5

Mandatory requirements
no prerequisites necessary
Recommended previous knowledge
no prerequisites recommended

Content
see next page

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Business Administration	4 SWS	5

Submodule	Submodule abbreviation
Business Administration	**BW**

Responsible person	Faculty
Prof. Dr. Alixandre Ferreira de Santana	Computer Science and Mathematics
Lecturer	**Availablilty of module**
Prof. Dr. Alixandre Ferreira de Santana	only in winter semester

Teaching method
Seminar teaching with exercises (total 4 SWS)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
1.	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60h	90h

Method of assessment
written exam: 90 minutes

Content

- Introduction to economic fundamentals and business administration as science.
- Business organisation: business objectives and business typology; choice of location.
- business processes (flow of goods, cash flows and information flow).
- Business functions: Marketing; production; materials management; investment and financing; accounting.

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- explain the business structure (1).
- describe the factors of production and the operational functions of procurement, production, sales, investment, financing and accounting (2).
- understand the possibility of data processing to support the operational functions (3).

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,

- to critically reflect on the course content in discussions and consciously integrate it into their own value system (2).
- apply their expertise to current business topics (3).
- to work goal-oriented in exercise groups on topics related to business administration (ability to work in a team) and to discuss the elaborated results in the auditorium (3).

Teaching materials offered
PDF, Literature
Teaching media
Blackboard, notebook, projector
Literature
• Own script and exercises • Business Essentials, Global Edition. Ronald Ebert, Ronald J. Ebert, Ricky W. Griffin. Edition 12th, 2019. • Management Information Systems: Managing the Digital Firm, Global Edition. Kenneth Laudon, ; Jane Laudon. Publisher: Pearson (edition 17th), 2021. • Management: Tasks, Responsibilities, Practices. Peter Ferdinand Drucker ; Publisher: Harper & Row, 1974.
More information about the course
This module can be substituted by the VHB course "Fundamentals of Business Administration".

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Computer Systems	

Person responsible for the module	Faculty
Beate Mielke (LBA)	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
2.	1.	mandatory	5

Mandatory requirements
no prerequisites necessary
Recommended previous knowledge
Programming 1 (C Programming)

Content
see next page

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Computer Systems	4 SWS	5

Submodule	Submodule abbreviation
Computer Systems	**CS**

Responsible person	Faculty
Beate Mielke (LBA)	Computer Science and Mathematics
Lecturer	**Availablilty of module**
Beate Mielke (LBA)	only in summer semester

Teaching method
Seminar teaching (2 SWS), exercises and practical course (2 SWS)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
2.	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60h	90h

Method of assessment
written exam: 90 minutes

Content

- Overview of how a computer works and important relationships
- Representation of data (char, int, floating-point) and arithmetic
- Instruction Set Architecture
- Assembler programming

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- show (1) and explain (2) the basic structure, functioning and interrelationships of computer systems
- show the representation of data and information (1)
- apply (binary) arithmetic (2)
- describe elementary commands of computer systems using assembly language (2), explain the connection to the architecture in the context of assembly (2), and explain (2) the connection between assembly and high-level languages (C)

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,

- discuss subject content in small groups (2)
- organise the learning process (time management) by oneself (2)
- acquire new content through self-study (2)
- solve individual tasks (2) and deal with constructive criticism (2)
- reproduce technical contexts in correct technical language (3)

Teaching media
Beamer, slides / script, blackboard, notebook
Literature
• own slides / documents • Bryant_Computer Systems, A Programmer's View_Pearson_3rded • Tanenbaum_Structured Computer Organisation • Blum_Professional Assembly Language • Seyfrath_Introduction to 64 Bit Intel Assembler Programming for Linux • Seyfrath_Introduction to 64 bit Windows assembly language programming • Irvine_Assembler language for x86 processors • Kusswurm_Modern x86 assembler programming • Intel_sdm-vol-1_basic architecture • Intel_sdm-vol-2abcd_instruction set architecture • Intel_sdm-vol-3abcd_system programming guide
More information about the course
Recommended previous knowledge: C Programming (Programming 1)

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Language Track A: LTA 1	

Person responsible for the module	Faculty
Dean of Studies	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
1.	1.	mandatory	5

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Language Track A - German as a foreign language 1	6 SWS	5

Submodule	Submodule abbreviation
Language Track A – German as a foreign language 1	**LTA 1**

Responsible person	Faculty
Dean of Studies	Computer Science and Mathematics
Lecturer	Availablilty of module
Sheryl Schneider	only in winter semester

Teaching method
Seminar teaching (4 SWS) with exercises (2 SWS).

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
1.	6 SWS	german/english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
90h	60h

Method of assessment
written exam: 90 minutes

Content
The goal of the course is to acquire a basic knowledge of the German language.

Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • use a solid vocabulary in everyday life and have a sound knowledge of basic German grammar. (3) • use basic syntax and formulate questions. (3) • decline and use definite and indefinite nouns as well as possessive pronouns and comparisons of adjectives. (3) • conjugate strong verbs, form the simple past of „sein“ and the present perfect of weak verbs as wells as conjugate and use modal verbs. (3) • understand and produce simple texts. (3) • conduct simple conversations. (3)

Teaching media
Projector, board, audio-material and interacttive exercises.

Literature
Kurs DaF A1 – Deutsch für Studium und Beruf“ – Klett-Verlag Kurs- und Übungsbuch mit Audios und Videos (ISBN 978-3-12-676838-2) Sprachniveau A1 (Kapitel 1 - 10); stduents have to buy this book themselves. https://www.klett-sprachen.de/kurs-daf-a1/t-1/9783126768382

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Language Track A: LTA2	

Person responsible for the module	Faculty
Dean of Studies	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
2.	1.	mandatory	5

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Language Track A - German as a foreign language 2	6 SWS	5

Submodule	Submodule abbreviation
Language Track A – German as a foreign language 2	**LTA2**

Responsible person	Faculty
Dean of Studies	Computer Science and Mathematics
Lecturer	Availablilty of module
Sheryl Schneider	only in summer semester

Teaching method
Seminar teaching (4 SWS) with exercises (2 SWS).

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
2.	6 SWS	german/english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
90h	60h

Method of assessment
Written exam 90 minutes

Content
This course provides advanced basic knowledge. It aims at improving the command of grammar and writing skills. Students can understand phrases and common expressions that are related to everyday situations. Communication skills, exchange of information on familiar and routine matters and the expression of one's opinion will be trained. Students consolidate their command of the language in familiar, routine wise situations, especially with topics like studying, internship, mobility.

Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • form subordinate clauses with weil, da, dass, wenn (3) • form the past tenses Perfekt, Präteritum and Futur I (3) • use separable and inseparable verbs, reflexive verbs (3) • use prepositions: local and temporal prepositions, two-case prepositions (3) • form relative clauses (3) • understand everyday conversations and interviews and react to them (3) give instructions and understand them (2) · • communicate their opionion and wishes (3) • form main and subordinate clauses with daher, darum, deswegen, damit, als, wenn (3) • form indirect questions (3) • use demonstrative pronouns (3) • talk about topics related to campus life, bank and job applications (3) • form polite questions (3) make suggestions (3)

Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • apply grammatical structures (3) • form main and subordinate clauses and write various kinds of texts (3) • give reasons and make comparisons (3) • make a summary (3) • engage in dialogues at a restaurant or shop (3) • make an order or a complaint (3) • have a conversation on the telephone (3) • talk about their well-being and their daily routine (3) • give advice (3) • write an apology (3) • analyse a graphic (3) • write an application (3) • make structured notes (3) • conduct a job interview (3) • plan a trip with others (3)
Teaching materials offered
Course and exercise book, additional exercises on handouts or in ELO.
Teaching media
Projector, board, audio-material and interacttive exercises.
Literature
„Kurs DaF A2 – Deutsch für Studium und Beruf“ – Klett-Verlag Kurs- und Übungsbuch mit Audios und Videos (ISBN 978-3-12-676840-5) Sprachniveau A2.1 (Kapitel 11 – 20); students have to buy this book themselves. https://www.klett-sprachen.de/kurs-daf-a2-hybride-ausgabe-allango/t-1/9783126768405

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Language Track B: LTB1	

Person responsible for the module	Faculty
Dean of Studies	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
1.	1.	mandatory	5

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Language Track B - Part 1: Spanish	4 SWS	5

Submodule	Submodule abbreviation
Language Track B – Part 1: Spanish	**LTB1**

Responsible person	Faculty
Dean of Studies	Computer Science and Mathematics
Lecturer	**Availablilty of module**
Birgit Honikel (LB) Leticia Menéndez (LB) Isabel Rosso-Fernandez	only in winter semester
Teaching method	
Seminar teaching (2 SWS) with exercises (2 SWS)	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
1.	4 SWS	german	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60h	90h

Method of assessment
Usually written exam 90 minutes, oral exam 20 minutes;

Content

- To provide a basic knowledge of the Spanish language at CEFR level A1 as well as basic knowledge of the regional studies of Spanish-speaking countries.
- Simple texts and audio examples form the basis for the production of text and spoken language in familiar contexts from everyday life and student life.

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- express themselves with frequently used phrases and in simple language in the core areas of listening, reading, speaking, negotiating and writing (3).
- Use the basic structures of Spanish grammar, especially the different forms of the verb (presente, gerundio, perfecto, futuro) (3).
- Use learning strategies to help develop their knowledge (3).

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,

- express themselves orally and in writing in familiar everyday situations (2).
- be able to introduce oneself and others and to orientate oneself (2).
- give information about origin, education and local area (2).
- Name cities and countries (1).

- Make appointments, give personal and family information, order in restaurants, go shopping, describe routes and one's own home, express personal interests and preferences (2).
- Express plans and opinions, talk about everyday experiences in the present and the near past (2).
- Be able to move fundamentally in the cultural context of the Spanish-speaking world (3).

Literature
Textbook Universo.ele A1 (Lektionen 1-7) und Lektion 8 von Universo.ele A2 (Hueber Verlag)

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Language Track B: LTB2	

Person responsible for the module	Faculty
Dean of Studies	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
2.	1.	mandatory	5

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Language Track B - Part 2: Spanish	4 SWS	5

Submodule	Submodule abbreviation
Language Track B – Part 2: Spanish	**LTB2**

Responsible person	Faculty
Dean of Studies	Computer Science and Mathematics
Lecturer	**Availablilty of module**
Birgit Honikel (LB) Leticia Menéndez (LB) Isabel Rosso-Fernandez	only in summer semester

Teaching method
seminar teaching (2 SWS) with exercises (2 SWS)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
2.	4 SWS	german	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60h	90h

Method of assessment
Usually written examination 90 minutes, oral examination 20 minutes;
Approved Aids for Evidence of Achievement
none

Content
• Consolidation and expansion of the expressive skills of CEFR level A1 • Basic historical and socio-cultural information, e.g. on the recent history of Spain, Latin American literature, internships and studies in Spanish-speaking countries.
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • be able to express themselves in a more complex way in the core areas of listening comprehension, reading comprehension, speaking, negotiating and writing (3). • Already use more complex structures of Spanish grammar: different past tense forms of the verb (perfecto, indefinido, imperfecto), object pronouns, imperative, etc. (3). • To be able to embed the corresponding vocabulary in the grammar structures in a more differentiated way (3).
Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • Understand and write classified ads (2).

- formulate one's own biography and curriculum vitae and apply for an internship or a study semester abroad (2).
- tell about experiences in the past (2).
- understand press, travel and historical information (2).
- express physical and psychological well-being (among friends, at the doctor's) (2).
- Give advice in familiar areas of life (food, health, learning methods) (2).

Literature
Textbook: Universo.ele A2, ab Lektion 9 (Hueber Verlag)

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Mathematics 1	

Person responsible for the module	Faculty
Prof. Dr. Filippo Riccio	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
1.	1.	mandatory	7

Mandatory requirements
none
Recommended previous knowledge
Pre- and bridge courses

Content
see next page

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Mathematics 1 (Linear Algebra)	6 SWS	7

Submodule	Submodule abbreviation
Mathematics 1 (Linear Algebra) (Mathematics 1)	**MA 1**

Responsible person	Faculty
Prof. Dr. Filippo Riccio	Computer Science and Mathematics
Lecturer	**Availablilty of module**
Prof. Dr. Filippo Riccio	only in winter semester

Teaching method
Seminar teaching (4 SWS) with integrated exercises (2 SWS)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
1.	6 SWS	english	7

Study hours required

Hours in attendance/lectures	Hours for self-study
90h	120h

Method of assessment
written exam 90 min

Content
- Fundamentals of logic: set theory, propositional logic and methods of proof. - Algebraic structures: relations, groups, rings, fields - Systems of linear equations: homogeneous, inhomogeneous; Gaussian elimination - Vectors and matrices: linear combinations, linear independence - Vector spaces: subspaces, basis and dimension, norm and scalar product - Linear maps: Image, kernel, composition; orthogonal maps - Quadratic matrices: inverse matrix, determinant, principal axis theorem
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, - understand the concepts of linear algebra (3), - recognise the connections with other fields (e.g. analysis, numerical mathematics, technology and economics) (1), - be able to apply methods of linear algebra (3).
Learning objectives: Personal competence
After successful completion of the submodule, students are able to, - communicate professionally (2), - work on problems analytically and independently (2).

Teaching media
Blackboard, projector, mathematical software

Literature
• Strang, G.: Introduction to linear algebra, 2023, Wellesley-Cambridge Press • Ventre, A. G.: Calculus and linear algebra, 2023, Springer • Andrilli, S.; Hecker, D.: Elementary linear algebra, 2023, Academic Press • Said-Houari, B.: Linear algebra, 2017, Springer International Publishing • Nair, M. T.; Singh, A.: Linear algebra, 2018, Springer Singapore

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Mathematics 2	

Person responsible for the module	Faculty
Prof. Dr. Filippo Riccio	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
2.	1.	mandatory	7

Mandatory requirements
no prerequisites necessary
Recommended previous knowledge
Mathematics 1 and Bridge Courses

Content
see next page

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Mathematics 2 (Analysis)	6 SWS	7

Submodule	Submodule abbreviation
Mathematics 2 (Analysis)	**MA2**

Responsible person	Faculty
Prof. Dr. Filippo Riccio	Computer Science and Mathematics
Lecturer	Availablilty of module
N.N.	only in summer semester

Teaching method
Seminar teaching (4 SWS) with exercises (2 SWS)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
2.	6 SWS		7

Study hours required

Hours in attendance/lectures	Hours for self-study
90h	120h

Method of assessment
Written exam: 90 minutes

Content

- Sequences and series (including convergence terms - convergence criteria for sequences and series - function series).
- Continuity (e.g. continuity concepts - intermediate value theorem)
- Differential calculus (e.g. differentiation rules - mean value theorem of differential calculus - extreme values)
- Integral Calculus (e.g. Riemann's Integral - Mean Value Theorem of Integral Calculus - Main Theorem of Differential and Integral Calculus - Integration Rules)
- Multidimensional analysis (e.g. functions in several variables - limits and continuity - differentiability, total and partial derivative - extreme values)

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- determine the behaviour of a given sequence of numbers (2).
- examine number sequences for the applicability of the various convergence criteria (3) and determine the convergence behaviour (2).
- explain the definition of elementary functions using power series (1).
- describe the concept of the derivative (1) and explain the meaning of the derivative (2).
- calculate the derivatives of given functions (2).
- analyse the behaviour of functions with the help of the central theorems of calculus (e.g. intermediate value theorem or mean value theorem) (3).
- solve application problems for differential calculus (2) and examine the solution for plausibility (3).

- describe the definition of the Riemann integral (1) and explain the meaning of the Riemann integral in different fields of application (2).
- to carry out the elementary integration methods (e.g. partial integration and integration by substitution) (2).
- to recognise the connections between differential calculus and integral calculus (2).
- solve application problems for integral calculus (2) and examine the result for plausibility (3).
- describe the concept of partial differentiability (1).
- explain the geometric meaning of gradients (2) and use them in application tasks (2).
- name methods for calculating local and global extrema (1).
- analyse (3) and solve (3) application tasks for calculating extreme values.

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,

- discuss subject matter in learning groups (2).
- analyse the arguments of others (3).
- evaluate the learning process in learning groups (3).
- name different learning methods (1).
- formulate exactly what they did not understand (2).
- to work out new contents in self-study (2).
- evaluate the personal benefit of different learning methods (3).
- analyse their own learning progress and learning needs (3).
- organise their learning process (time management) independently (2).
- present mathematical relationships in their own words (2).
- recognise their level of knowledge and learning needs (2).

Teaching media

Blackboard, projector, use of mathematical software

Literature

- Fonda, A.: A Modern Introduction to Mathematical Analysis, 2023, Birkhäuser
- Magnus, R.: Fundamental Mathematical Analysis, 2020, Springer
- Ovchinnikov, S.: Real Analysis: Foundation, 2021, Springer
- Abbott, S.: Understanding analysis, 2016, Springer

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Networking	

Person responsible for the module	Faculty
Prof. Dr. Sebastian Fischer	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
2.	1.	mandatory	5

Mandatory requirements
At least 30 credits from the 1st study stage
Recommended previous knowledge
Programming 1

Content
see next page

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Networking	4 SWS	5

Submodule	Submodule abbreviation
Networking	**NW**

Responsible person	Faculty
Prof. Dr. Sebastian Fischer	Computer Science and Mathematics
Lecturer	**Availablilty of module**
Prof. Dr. Sebastian Fischer	only in summer semester

Teaching method
Seminar teaching (2 SWS) with practical training (2 SWS)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
2.	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60h	90h

Method of assessment
Written exam: 90 minutes

Content

- Overview of computer networks (components, operation, protocols, timing of data transmission, network architecture models: ISO - OSI, TCP/IP).
- Application layer (communication between processes, services for network applications, protocol flow and message formats of applications: HTTP, FTP, e-mail, DNS)
- Transport layer (protocol types: TCP, UDP, message formats, flow, congestion control, analysis)
- Network layer (network service model, routing, distance vector algorithm, link state algorithm, hierarchical routing, routing tables, routing protocols: RIP, OSPF, BGP, addressing in TCP/IP networks, IPv4 protocol: message format, fragmentation, flow, analysis, subnetting)
- Data Link (DL) layer (services of the DL layer, techniques for error correction, secured and unsecured transmission protocols: Stop & Wait, Go Back to N, multiple access protocols, ARP protocol, DL for LANs: Ethernet, Fast Ethernet, Gigabit Ethernet, wireless access methods: IEEE 802.11, network components of the DL: bridge, hub, switches)

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- specify network components, their roles and the communication protocols between components (1),
- name the standard ISO-OSI architecture model compared to the TCP/IP model (1), and use different application layer network services (such as DNS, DHCP) (2).
- analyse (3) and identify (1) message content using analysis tools in the lab,

- name the protocols of the transport layer (TCP, UDP) and the most important services of the network layer, such as routing and global addressing (1), and can practically apply them to network components, such as routers and switches (2),
- list the most commonly used methods for message transmission within the data link layer (1)

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,
- present technical content in front of an audience (2),
- ask technical questions (3) and
- reproduce network-related contexts in correct technical language (3).

Teaching media

Blackboard, notebook, projector

Literature

- Lecture slides and tutorials
- Fred Halsall: Computer Networking and the Internet, Addison Wesley, Reading,MA.
- Behrouz Forouzan: Data Communications and Networking, McGrawHill,Boston

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Programming 1	

Person responsible for the module	Faculty
Prof. Dr. Sebastian Fischer	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
1.	1.	mandatory	8

Mandatory requirements
No previous knowledge required
Recommended previous knowledge
No previous knowledge required

Content
see next page

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Programming 1	6 SWS	8

Submodule	Submodule abbreviation
Programming 1	**PG1**

Responsible person	Faculty
Prof. Dr. Sebastian Fischer	Computer Science and Mathematics
Lecturer	**Availablilty of module**
Beate Mielke (LBA)	only in winter semester

Teaching method
Seminar teaching (4 SWS) and tutorial (2 SWS)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
1	6 SWS	english	8

Study hours required

Hours in attendance/lectures	Hours for self-study
90h	150h

Method of assessment
written exam 90 minutes

Content
- Coding, compiling, linking and debugging (with and without IDE) program structure / modules - Statements, expressions - Data types, variables, constants and their visibility - Standard input/output functions - Operators (including arithmetic, relational, logical, bit operators) - Preprocessor - Control structures - Array handling - String handling - Functions (e.g. main with/without arguments) call by value, call by reference - Recursive functions - Variable qualifiers (const, external, static, volatile) - Pointers (including double pointers and functions, pointer arithmetic) - User-defined data types (e.g. enum, struct, union, typedef) - Dynamic memory management (malloc, realloc, free) - Linked lists

Learning objectives: Subject competence
After successful completion of the submodule, students are able to, ... understand the concepts of procedural languages (1) ... understand and apply the syntax of the programming language C (3)

... understand the operation of unknown procedural programs by analyzing the source code and find errors (2)
... analyze simple problems, implement and test algorithms for solving them in the procedural programming language C (3)
... know elementary data structures and apply them independently (2)

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,
... to ask the lecturer technical questions and to reproduce the contents of the lecture in correct technical language (2)
... develop their own solution strategies for exercises (3)
... work persistently on a task (2)
... to work carefully and accurately (2)

Teaching media

Blackboard, notebook, projector

Literature

- Dennis Ritchie, Brian Kernighan, The C Programming Language, 2nd edition, 1990
- Jürgen Wolff / René Kroß: C von A bis Z: Das umfassende Handbuch für C-Programmierer. Zum Lernen und Nachschlagen. Aktuell zum Standard C18 Rheinwerk-computing, 4th edition, 2020 (German e-book, can be automatically translated)

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Programming 2	

Person responsible for the module	Faculty
Prof. Felix Schwägerl	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
2.	1.	mandatory	8

Mandatory requirements
no prerequisites necessary
Recommended previous knowledge
Programming 1

Content
see next page

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Programming 2	6 SWS	8

Submodule	Submodule abbreviation
Programming 2	**PG2**

Responsible person	Faculty
Prof. Felix Schwägerl	Computer Science and Mathematics
Lecturer	**Availablilty of module**
Prof. Felix Schwägerl	only in summer semester

Teaching method
Seminar teaching with exercises (4 SWS) and practical course (2 SWS)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
2.	6 SWS	english	8

Study hours required

Hours in attendance/lectures	Hours for self-study
90h	150h

Method of assessment
Written exam: 90 minutes

Content

- Characterization of procedural, object-oriented, and functional programming languages
- Development and runtime environment (compiler, bytecode, garbage collection)
- Data types (primitives, arrays, enums, classes, reference types, and null)
- Syntactic foundations (comments, declarations, expressions, statements)
- Classes and objects (encapsulation, fields and methods, visibilities, constructors, static members)
- Inheritance (field/method/constructor inheritance, abstract classes, interfaces)
- Polymorphism (late binding, up-/downcasts)
- Generics (generic methods, generic classes, bounded generics, collections)
- Exceptions (causing and handling)
- Functional programming (lambda expressions, method references, streams)
- Structuring larger programs (Packages and modules)
- Concurrency and multithreading
- Graphical user interfaces and file input/output

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- Explain the basic features of object-oriented programming, and how they are offered by a concrete object-oriented programming language (1).
- Transfer the learned principles to other object-oriented programming languages (2).

- Logically grasp problems of medium complexity, design and implement an algorithmic solution in an object-oriented programming language (3).
- Use development tools (compiler, editor, IDE) purposefully (2).
- Make adequate use of libraries and frameworks in order to solve complex problems (2).
- Understand and extend existing software written in an object-oriented programming language (3).
- Master common development tools to edit, compile, debug, and test source code in projects of manageable size (2).

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,

- Name the benefits and limitations of object-oriented programming (1) and assess its suitability for a given project (2).
- Familiarize themselves with new languages, tools, frameworks, and ecosystems of object-oriented programming (2).
- Transfer solution approaches learned in the practical course to similar problems (3).
- Document own programs adequately and know how to use documentation of existing software for building on top of it (2).
- Assess existing source code, find weaknesses, and develop strategies for improvement (2).
- Integrate into a small software development team and implement parts of the software independently while communicating progress and problems adequately and efficiently (3).Recognize deficits in their own learning process, to communicate them, and to make use of the offered assistance (2).

Teaching materials offered

Copies of slides, exercises, code examples

Teaching media

Laptop, beamer, blackboard

Literature

- Kathy Sierra, Bert Bates, Trisha Gee: Head First Java, 3rd edition, O'Reilly, 2022
- B.J. Evans, Jason Clark, David Flanagan – Java in a Nutshell, 8th edition, O'Reilly, 2023
- David Parsons – Foundational Java, 2nd edition, Springer, 2020
- Joshua Bloch – Effective Java, 3rd edition, Pearson, 2018
- James Gosling et al.: The Java Language Specification – Java SE 21 edition, 2023

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Algorithms and Data Structures	

Person responsible for the module	Faculty
Prof. Dr. Titus Dose	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
4.	2.	mandatory	8

Mandatory requirements
At least 30 credits from the 1st study stage
Recommended previous knowledge
Programming 1 and Programming 2

Content
see next page

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Algorithms and Data Structures	6 SWS	8

Submodule	Submodule abbreviation
Algorithms and Data Structures	**AD**

Responsible person	Faculty
Prof. Dr. Titus Dose	Computer Science and Mathematics
Lecturer	Availablilty of module
Prof. Dr. Titus Dose	only in summer semester

Teaching method
Seminar-based teaching (4 SWS) with exercises (2 SWS).

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
4.	6 SWS	english	8

Study hours required

Hours in attendance/lectures	Hours for self-study
90h	150h

Method of assessment
Written exam: 90 minutes

Content
• Complexity analysis (models for runtime and memory analysis, best, average and worst case analysis, asymptotic complexity, solving recursion equations, NP-completeness). • Design methods (divide and conquer, dynamic programming, greedy algorithms, backtracking) • Algorithms for standard problems (elementary, advanced and key-based sorting methods, data structures for managing sets - e.g. binary search trees, balanced trees, queues, hashing, searching in sets and strings, graph algorithms - e.g. depth and breadth-first search, shortest paths, minimal spanning trees)
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, reproduce and implement basic algorithms and data structures for standard problems (1). They can evaluate and compare the efficiency of algorithms and data structures (2). They have understood how efficient algorithms and data structures can be analyzed and designed on the basis of the design principles they have learned (3).
Learning objectives: Personal competence
After successful completion of the submodule, students are able to, independently reproduce (1), process (2) and solve (3) algorithmic problems on fundamental topics in computer science alone and in group work.

They can evaluate and compare their own and other solutions.

Teaching media
Blackboard, notebook, projector

Literature

- Lecture slides
- Cormen, T. H., Leisserson, C. E., Rivest, R.L., Stein, C.: Introduction to Algorithms, MIT Press, 2022
- J. Erickson: Algorithms, https://jeffe.cs.illinois.edu/teaching/algorithms/#book, 2019 and other contents not contained in the book, but on the website
- Kleinberg, J., Tardos, E.: Algorithm Design, Pearson Education Limited, 2013
- Sedgewick, R.: Algorithms, Addison Wesley, 2011

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Computer Architecture	

Person responsible for the module	Faculty
Prof. Dr. Sebastian Fischer	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
4.	2.	mandatory	7

Mandatory requirements
At least 30 credits from the 1st study stage
Recommended previous knowledge
Computer Systems

Content
see next page

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Computer Architecture	6 SWS	7

Submodule		Submodule abbreviation
Computer Architecture		**CA**
Responsible person	Faculty	
Prof. Dr. Sebastian Fischer	Computer Science and Mathematics	
Lecturer	Availablilty of module	
Prof. Dr. Sebastian Fischer	only in summer semester	
Teaching method		
Seminar-based teaching (4 SWS) with exercises and practical training (2 SWS).		

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
4.	6 SWS	english	7

Study hours required

Hours in attendance/lectures	Hours for self-study
90h	120h

Method of assessment
Written exam 90 minutes

Content
• Microprocessor Design: Analysis of existing microprocessor architectures (RISC, CISC) with a focus on optimisation technologies like hyperthreading, multiprocessing, etc. • Integration of Advanced Algorithms into Hardware: Exploration of embedding advanced computational methods directly into hardware architecture. • Architecture and Programming of Multi-Processor Systems: Study of design, synchronization, and challenges in multi-processor and multi-core systems, including an overview of novel computing architectures. • Memory Hierarchy and Future Storage Technologies
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • understand the core principles of various microprocessor architectures (3), • analyze the integration of algorithms into hardware (3), • evaluate design and synchronization strategies in multi-processor systems (3), • recognize the role of memory hierarchy and the impact of future storage technologies on system performance (2).
Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • to familiarise themselves independently and with motivation with new topics and to work on them in a structured and step-by-step manner with given documents (2)

- to apply learned solution approaches on the basis of given exercises and example tasks with the help of their own creativity and imagination to other scenarios in their own field of experience (3)
- to recognise own deficits in learning progress, to communicate this and to use the possibilities of the offered assistance (2)

Teaching media
Blackboard, notebook, projector

Literature
• lecture slides • Andrew S. Tanenbaum, Todd Austin, Structured computer organization, 6th edition, Pearson 2023

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Databases	

Person responsible for the module	Faculty
Prof. Dr. Ahmet Kara	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
3./4.	2.	mandatory	7

Mandatory requirements
At least 30 credits from the 1st study stage
Recommended previous knowledge
Good programming skills in C, Java or C++ Theoretical computer science

Content
see next page

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Databases	6 SWS	7

Submodule	Submodule abbreviation
Databases	**DAB**

Responsible person	Faculty
Prof. Dr. Johannes Schildgen	Computer Science and Mathematics
Lecturer	**Availablilty of module**
Prof. Dr. Ahmet Kara Prof. Dr. Johannes Schildgen	only in winter semester

Teaching method
Seminar teaching (4 SWS) with exercises (2 SWS)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
3.	6 SWS	english	7

Study hours required

Hours in attendance/lectures	Hours for self-study
90h	120h

Method of assessment
Written exam: 90 minutes

Content
Conceptual data modelling: entity-relationship model. • Relational model: Relational algebra and normal forms. • SQL: database query language, data definition language (DDL, DML), views, rights management. • Database programming: transactions, accessing databases with suitable programming languages, user-defined functions, triggers. • Concurrency and database recovery: logging and recovery, concurrency, locking mechanisms, deadlocks. • Database optimisation: query optimisation, indexes.

Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • explain the functional principles of databases (1), • design small to medium-sized databases conceptually and logically (2), • set up (2) and use databases with the query language SQL. (2), • evaluate concepts such as views, triggers and user-defined functions (3) and select adequate concepts for specific use cases (3).

Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • model in cooperation with other databases -> plan databases in a team (3)
Teaching media
Blackboard, projector, notebook
Literature
• C.J. Date: Introduction to Database Systems, Addison Wesley, 2003

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
General science compulsory elective module 1	

Person responsible for the module	Faculty
Prof. Dr. Gabriele Blod	

Semester taught according to the curriculum	Level of study	Module type	Credit value
5.	2.	mandatory elective	2

Mandatory requirements
usually none, except for courses that build on each other
Recommended previous knowledge
usually none, except for courses that build on each other

Content
• Imparting orientation knowledge and general education • Teaching and training of key competences (e.g. additional certificate "Soft Skills") • Teaching and training of foreign languages

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	General science compulsory elective module 1	2 SWS	2

Submodule	Submodule abbreviation
General science compulsory elective module 1	**AW1**

Responsible person	Faculty
Prof. Dr. Gabriele Blod	Angewandte Natur- und Kulturwissenschaften
Lecturer	Availablilty of module
N.N.	only in winter semester

Teaching method
Depending on the selected general science elective module (2 SWS)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
5.	2 SWS	german/english	2

Study hours required

Hours in attendance/lectures	Hours for self-study
30h	30h

Method of assessment
Written examination and/or seminar paper and/or oral examination

Content
Depending on the respective course
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, understand and apply the professional competences described in the respective course description.
Learning objectives: Personal competence
After successful completion of the submodule, students are able to, intellectually classify and practically implement the personal competences described in the respective course description.
Teaching media
Depending on the respective course
Literature
Depending on the respective course

More information about the course

The general science elective module 1 can be freely selected from the entire general science elective offer with the following exceptions:

- Modules from the area of EDP
- Modules from the VHB of the subject area Internet Literacy or other IT-related subjects.
- Module "3-D printing" from the area of natural science and technology

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
General science compulsory elective module 2	

Person responsible for the module	Faculty
Prof. Dr. Gabriele Blod	

Semester taught according to the curriculum	Level of study	Module type	Credit value
5.	2.	mandatory elective	2

Mandatory requirements
At least 30 credits from the 1st study stage
Recommended previous knowledge
usually none, except for courses that build on each other

Content
• Imparting orientation knowledge and general education • Teaching and training of key competences (e.g. additional certificate "Soft Skills") • Teaching and training of (foreign) languages

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	General science compulsory elective module 2	2 SWS	2

Submodule	Submodule abbreviation
General science compulsory elective module 2	**AW2**

Responsible person	Faculty
Prof. Dr. Gabriele Blod	Angewandte Natur- und Kulturwissenschaften
Lecturer	Availablilty of module
N.N.	only in winter semester

Teaching method
Depending on the selected general science elective module

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
5.	2 SWS	german/english	2

Study hours required

Hours in attendance/lectures	Hours for self-study
30h	30h

Method of assessment
Written examination and/or seminar paper and/or oral examination

Content
Depending on the respective course
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, understand and apply the professional competences described in the respective course description.
Learning objectives: Personal competence
After successful completion of the submodule, students are able to, intellectually classify and practically implement the personal competences described in the respective course description.
Teaching media
Depending on the respective course

Literature
Depending on the respective course

More information about the course
General science compulsory elective module 2: The following courses are recognised: • Social and methodological competence: blocks 1 - 4 (not block 5) • Social competence • Additional studies in international competence (if at least two courses have been attended, not only the lecture in WiSe) • International rhetorical competence (IRK): Communicating with others (conversation and moderation G1 - G5) • Oral Communication and Speech Training: Oral Communication II

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Global Software Engineering	

Person responsible for the module	Faculty
Prof. Felix Schwägerl	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
3.	2.	mandatory	8

Mandatory requirements
At least 30 credits from the 1st study stage
Recommended previous knowledge
Programming 1 and Programming 2

Content
see next page

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Global Software Engineering	6 SWS	8

Submodule	Submodule abbreviation
Global Software Engineering	**GSE**

Responsible person	Faculty
Prof. Felix Schwägerl	Computer Science and Mathematics
Lecturer	**Availablilty of module**
Prof. Dr. Carsten Kern Prof. Felix Schwägerl	only in winter semester

Teaching method
Seminar teaching with exercises (4 SWS) and practical course (2 SWS)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
3.	6 SWS	english	8

Study hours required

Hours in attendance/lectures	Hours for self-study
90h	150h

Method of assessment
Written exam: 90 minutes

Content

- Basics of software engineering (motivation, economy, ethics, models) Global software development (motivations, socio-technical challenges, methods, tools) Requirements engineering (definitions, gathering techniques, attributes, templates) Object-oriented analysis (use case models, domain models, behavior/interaction models) Software architecture (views, evaluation criteria, architectural styles, documentation) Fine-grained design (refinement, implementation patterns, design principles, design patterns) Testing (regression, refactoring, unit tests, code coverage, test-driven development) Quality assurance (verification/validation, coverage, continuous integration, acceptance tests) Evolution and maintenance (delivery, operation, predictive maintenance) Project management and planning (risk management, team management, cost estimation) Software configuration management (version control, build and release management) Software processes (plan-driven, agile, empirical process improvement) Global project management (people management, planning, estimation)

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- Know and reproduce the ways of thinking and procedures of software engineering (1).
- Explain (1) and classify (2) the specific challenges, methods, and tools occurring in international, intercultural, and interdisciplinary software engineering teams.
- Express awareness about the importance, difficulties and possibilities of software engineering and its disciplines (1).

- Select, tailor, and improve the software development process suitable for a specific project or product (2).
- Use standardized modeling notations on an adequate level of detail and utilize models' ability to break down software engineering tasks by abstracting from requirements, software, and hardware (3).
- Document the results of requirements engineering, object-oriented analysis and fine-grained design using adequate language, terms, and formalisms (2).
- Systematically specify, design, implement, verify, and deliver a software system with limited extent using suitable engineering methodologies and an object-oriented programming language like Java (3).
- Apply appropriate software quality assurance metrics, methods, and tools to existing systems or systems under development (2).
- Select and apply suitable methods and tools for project management, software maintenance, and software configuration management (3).

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,

- Understand how the specifics of global software development impact each discipline of software engineering (1).
- Theoretically know how to collaborate with clients or managers to gather software requirements and help them make informed business decisions based on technical facts (1).
- Ask the crucial questions for being able to select adequate methods and tools for each discipline of software engineering (2).
- Assess analysis, design and implementation artifacts produced by team members according to well-defined criteria and communicate constructive feedback effectively and adequately (2).
- Coordinate the activities of software engineering teams and deal with challenges such as stress, motivation, or conflicts (2).Adopt different roles in software engineering teams with different responsibilities therein (3).

Teaching materials offered

Copies of slides, exercises, code examples, materials from case studies, templates

Teaching media

Laptop, beamer, blackboard

Literature
• Ian Sommerville: Software Engineering, 10th edition, Pearson, 2016 • Ian Sommerville: Engineering Software Products, Pearson, 2021 • Klaus Pohl, Chris Rupp: Requirements Engineering Fundamentals, RockyNook, 2015 • Grady Booch et al.: Object-Oriented Analysis and Design with Applications, 3rd edition, Addison-Wesley, 2007 • Mark Richards, Neil Ford: Fundamentals of Software Architecture, O'Reilly, 2020 • Erich Gamma et al: Design Patterns, Addison-Wesley, 2009 • Robert C. Martin: Clean Architecture, Prentice Hall, 2018 • Paul Ammann, Jeff Offutt: Introduction to Software Testing, Cambridge University Press, 2016 • Gene Kim et al.: The DevOps Handbook, IT Revolution Press, 2016 • Scott Chacon, Ben Straub: Pro Git, Apress, 2014 • Ken Schwaber, Jeff Sutherland: Scrum Guide, Creative Commons, 2020 • James D. Herbsleb: Global software engineering in the age of GitHub and Zoom. J. Softw. Evol. Process. 35(6), 2023 [and previous work referenced by the author]

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Language Track A: LTA3	LTA3

Person responsible for the module	Faculty
Dean of Studies	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
3.	2.	mandatory	5

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Language Track A - German as a foreign language 3	4 SWS	5

Submodule	Submodule abbreviation
Language Track A – German as a foreign language 3	**LTA3**

Responsible person	Faculty
Dean of Studies	Computer Science and Mathematics
Lecturer	**Availablilty of module**
Sheryl Schneider	only in winter semester

Teaching method
Seminar teaching (2 SWS) with exercises (2 SWS).

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
3.	4 SWS	german/english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60h	90h

Method of assessment
written exam: 90 minutes

Content
In this course, students learn on an advanced level and can communicate about familiar topics from the fields university, work, leisure time.

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- use passive with and without modal verb (3)
- form conditional, concessive, final and generalising relative clauses (3)
- use the conditional (3)
- use participle I and II as adjectives (3)
- use prepositional pronouns (3)
- use vocabulary regarding the topics mobility, freetime, sightseeing, relationships, study and voluntary work (3)
- present the own opinion (2)
- discuss advantages and disadvantages (2)

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,

- write argumentatively (2)
- express purpose and conditions (3)
- understand announcements on the radio (2)
- write in a forum and express their opinions (3)
- share experiences (2)

- hold a presentation (2)

Literature

- „DaF kompakt neu B1“ – Deutsch als Fremdsprache für Erwachsene – Klett-Verlag Kurs- und Übungsbuch mit Audios (ISBN 978-3-12-676315-8) Sprachniveau B1.1 (Kapitel 19 - 24); Studierende müssen sich das Buch selbst kaufen. https://www.klett-sprachen.de/daf-kompakt-neu-b1/t-1/9783126763158

More information about the course

In order for the winter semester 2023/2024 start students to reach the required language level by the end of the 4th semester, there will be an additional 2 hour course per week during both the winter semester 2024/2025 and summer semester 2025.

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Language Track A: LTA4	LTA4

Person responsible for the module	Faculty
Dean of Studies	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
4.	2.	mandatory	5

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Language Track A - German as a foreign language 4	4 SWS	5

Submodule	Submodule abbreviation
Language Track A – German as a foreign language 4	**LTA4**

Responsible person	Faculty
Dean of Studies	Computer Science and Mathematics
Lecturer	Availablilty of module
Sheryl Schneider	only in summer semester

Teaching method
Seminar teaching (2 SWS) with exercises (2 SWS).

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
4.	4 SWS	german/english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60h	90h

Method of assessment
written exam: 90 minutes

Content
• In this course, students learn at an advanced level and master topics related to their personal areas of interest. They can also cope with communication situations encountered when traveling in German-speaking countries or at work. They understand the main points when dealing with familiar topics.

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- use the past perfect tense (3)
- form sentences with twin connectors (3)
- form infinitive and relative clauses (3)
- make prognosis for the future (2)
- talk about different forms of greetings (2)
- understand employment contracts (2)
- to discuss and to convey arguments (2)

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,

- summarise a newspaper article (2)
- write about their dreams for the future (2)
- speak about their future (2)
- talk about experiences (3)
- introduce themselves on their first day at work (3)

- talk about political engagement (3)
- to distinguish varieties of German (2)

Literature

„DaF kompakt neu B1“ – Deutsch als Fremdsprache für Erwachsene – Klett-Verlag
Kurs- und Übungsbuch mit Audios (ISBN 978-3-12-676315-8)
Sprachniveau B1.2 (Kapitel 25 - 30); Studierende müssen sich das Buch selbst kaufen.
https://www.klett-sprachen.de/daf-kompakt-neu-b1/t-1/9783126763158

More information about the course

Previous knowledge: At least level LTA2.
In order for the winter semester 2023/2024 start students to reach the required language level by the end of the 4th semester, there will be an additional 2 hour course per week during both the winter semester 2024/2025 and summer semester 2025.

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Language Track B: LTB3	

Person responsible for the module	Faculty
Dean of Studies	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
3.	2.	mandatory	5

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Language Track B - Part 3: Spanish	4 SWS	5

Submodule	Submodule abbreviation
Language Track B – Part 3: Spanish	**LTB3**

Responsible person	Faculty
Dean of Studies	Computer Science and Mathematics
Lecturer	**Availablilty of module**
Nubia Jaimes Isabel Rosso-Fernandez	only in winter semester

Teaching method
Seminar teaching (2 SWS) with exercises (2 SWS).

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
3.	4 SWS	german	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60h	90h

Method of assessment
usually: written exam (90 min.) and oral exam (usually 20 min. for 1 person)

Content
Start of CEFR level B1: independent use of language - Topics: Study conditions, forecasts, travelogues, social movements inspanic speaking countries

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- express themselves with greater independence in the core areas of listening, reading, speaking, negotiating and writing (2).
- apply further structures of Spanish grammar (3): verbal periphrases, deepened and extended use of the past tense forms of the verb (perfecto, indefinido, imperfecto, pluscuamperfecto), futuro simple and condicional, subjuntivo in the present tense, etc.
- embed the corresponding vocabulary in the grammar structures in a more differentiated way(3): discuss statistics, formulate forecasts, express wishes and opinions, report on the past in a differentiated way.

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,

- name their own study conditions and understand those of others (2).
- Understand or describe statistics, make predictions and describe future plans (2).

- report (positive and negative) experiences of travel, write and talk about them, respond to narratives in a varied way (2).
- express wishes, requests and opinions in conversation and write letters to the editor (2).
- understand original texts on familiar topics (travel, study, social and political movements, economic newsflashes) and comment on them to a limited extent (2).

Literature
Universo.ele B1, Lektionen 1-3 (Hueber Verlag)
More information about the course
Recommended previous knowledge: CEFR level A2

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Language Track B: LTB4	

Person responsible for the module	Faculty
Dean of Studies	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
4.	2.	mandatory	5

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Language Track B - Part 4: Spanish	4 SWS	5

Submodule	Submodule abbreviation
Language Track B – Part 4: Spanish	**LTB4**

Responsible person	Faculty
Dean of Studies	Computer Science and Mathematics
Lecturer	**Availablilty of module**
Nubia Jaimes Isabel Rosso-Fernandez	only in summer semester

Teaching method
Seminar teaching (2 SWS) with exercises (2 SWS).

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
4.	4 SWS	german	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60h	90h

Method of assessment
written exam 90 minutes, oral examin 20 minutes

Content
CEFR level B1, part 2: independent use of language topics: private and public contacts (language tandem, social engagement, celebrating festivals),environment (petitions)

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- express themselves with extended independence in the core areas of listening comprehension, reading comprehension, speaking, negotiating and writing (3).
- apply further structures of Spanish grammar (3): deepened and extended use of the subjuntivo in the present tense (also for the negated imperative); repetition and deepening of the condicional, indirect speech in the present tense etc.
- embed the corresponding vocabulary in the grammar structures in a more differentiated way (3): express wishes, feelings and opinions, formulate advice and requests, express prohibitions, use verbs of change.

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,

- Name interpersonal relationships (2).
- Congratulations (2).
- express wishes and requests as well as opinions in a differentiated way (2).
- talk about changes (2).
- write a petition (2).

- understand, respond to, summarise or communicate original texts on environmental issues, formal and informal invitations, from exchanges (3).

Literature
Textbook: Universo.ele B1, Lektionen 4-6 (Hueber Verlag) Lecturer's script
More information about the course
Recommended previous knowledge: CEFR level A2 and B1.1

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Operating Systems	

Person responsible for the module	Faculty
Prof. Dr. Ahmet Kara	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
3.	2.	mandatory	5

Mandatory requirements
At least 30 credits from the 1st study stage
Recommended previous knowledge
Programming 1 and Programming 2

Content
see next page

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Operating Systems	4 SWS	5

Submodule	Submodule abbreviation
Operating Systems	**OPS**

Responsible person	Faculty
Prof. Dr. Markus Kucera	Computer Science and Mathematics
Lecturer	**Availablilty of module**
Prof. Dr. Ahmet Kara	only in winter semester

Teaching method
Seminar-based teaching (2 SWS) with exercises and practical training (2 SWS). Exercises can also be offered virtually.

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
3.	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60h	90h

Method of assessment
Written exam: 90 minutes

Content
Introduction (history, operating system, layer model, interfaces and virtual machine) Processes (process states, scheduling, synchronisation, communication) Memory management (memory allocation strategies, virtual memory, page management, segmentation, cache) File management (file systems, file attributes, file functions, file organisation)

Learning objectives: Subject competence
After successful completion of the submodule, students are able to, deepen their knowledge also beyond the discipline and reflect on the epistemologically justified correctness of professional and practice-relevant statements in relation to the situation. These are seen in relation to the complex context and critically weighed up against each other. Students collect, evaluate and interpret relevant information and derive scientifically sound judgements. They develop approaches to solutions and realise solutions corresponding to the state of the art in science. They carry out application-oriented projects and contribute to the solution of complex tasks in a team. They independently design further learning processes. The students know the most important mechanisms of an operating system. They understand the basic concepts of a modern operating system and acquire skills in system-related programming. The competences are taught at level 3.

Learning objectives: Personal competence
After successful completion of the submodule, students are able to, formulate subject-specific and factual solutions to problems within their actions and can justify them in discourse with subject representatives with theoretically and methodically sound argumentation. They communicate and cooperate with other subject representatives in order to solve a task responsibly. They also reflect on and take into account different perspectives and interests of other stakeholders. Students develop a professional self-image that is oriented towards goals and standards of professional action in predominantly non-scientific professional fields. They justify their own professional actions with theoretical and methodological knowledge and are able to assess their own abilities, they autonomously reflect on factual design and decision-making freedoms and use these under guidance. Students recognise the framework conditions of professional action appropriate to the situation and justify their decisions responsibly and ethically. They critically reflect on their professional actions in relation to social expectations and consequences. The competences are taught at level 3.
Teaching media
Blackboard, projector, slides
Literature
• Tanenbaum. Moderne Betriebssysteme • Silberschatz et al: Operating System Concepts

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Practical Semester	

Person responsible for the module	Faculty
Praxisbeauftragte-r Informatik	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
5.	2.	mandatory	26

Mandatory requirements
90 credits from the previous 4 semesters or: Complete completion of the foundation modules (acquisition of 60 credit points) and completion of at least one further semester of full-time study.
Recommended previous knowledge
Successful Completion of all the foundation modules (acquisition of 60 credit points) and completion of at least one further semester of full-time study.

Content
see next page

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Industrial Placement		24
2.	Industrial Placement Seminar	2 SWS	2

Notes on the assignment requirement or options

Submodule	Submodule abbreviation
Industrial Placement	**PR**

Responsible person	Faculty
Praxisbeauftragte-r Informatik Prof. Dr. Alixandre Ferreira de Santana	Computer Science and Mathematics
Lecturer	**Availablilty of module**
N.N.	**every semester

Teaching method
Internship (18 weeks full-time in the company) and practical seminar (1 day)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
5.		german/english	24

Study hours required

Hours in attendance/lectures	Hours for self-study

Method of assessment
Proof of 18 weeks of internship in the company, Seminar presentation with success and internship report with success

Content
In the context of IT projects, participation in as many project phases as possible (system analysis, system planning, implementation and system introduction) must be ensured. **The following applies to dual students:** The internship of dual students takes place in the cooperating company in which they are employed during the lecture-free periods. The topics can be agreed with the internship coordinator.

Learning objectives: Subject competence
After successful completion of the submodule, students are able to, to reproduce typical work/tasks from IT in a company (1). They know the working methods and work processes in a company. They have been able to practically apply and in particular deepen the specialist knowledge they acquired during their studies (2-3). They have learned how work results are discussed and presented in the company.

Learning objectives: Personal competence
After successful completion of the submodule, students are able to, reproduce (1), process (2) and solve (3) typical work/tasks from informatics arising in a company, alone and in teams. They can evaluate and compare their own and other solutions. They have a first impression of how they can help shape the future world of work with their own contributions.
Teaching media
Practical seminar: blackboard, notebook, beamer
Literature
More information about the course
Internship and practical seminar Internship:18 weeks, the daily working time corresponds to the usual working time of the training place for full-time employees. see: §3 Section 4 of the APO, approx. 38.5h full-time in the company (total: approx. 693h). Practical seminar (2 SWS): Attendance at seminar, preparation and follow-up work

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Submodule	Submodule abbreviation
Industrial Placement Seminar	**PS**

Responsible person	Faculty
Praxisbeauftragte-r Informatik Prof. Dr. Alixandre Ferreira de Santana	Computer Science and Mathematics
Lecturer	**Availablilty of module**
N.N.	
Teaching method	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
5.	2 SWS	english	2

Study hours required

Hours in attendance/lectures	Hours for self-study

Method of assessment
Seminar presentation with success and internship report with success.

Content
Seminar presentation about the course and contents of the internship in the company and preparation of an internship report.
Teaching media
Industrail Placement Seminar: blackboard, notebook, projector
Literature
More information about the course
Industrail Placement Seminar: presence in the seminar, (preparation and follow-up)

Module title	Module code
Software for the Global Market	

Person responsible for the module	Faculty
Prof. Felix Schwägerl	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
4.	2.	mandatory	

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Software for the Global Market	4 SWS	5

Submodule		Submodule abbreviation
Software for the Global Market		**SGM**
Responsible person	Faculty	
Prof. Felix Schwägerl	Computer Science and Mathematics	
Lecturer	Availablilty of module	
Prof. Felix Schwägerl	only in summer semester	
Teaching method		
Seminar teaching (2 SWS) and exercises (2 SWS)		

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
4.	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60h	90h

Method of assessment
Written exam: 90 minutes

Content
• Global factors of software product management (culture, standards, legal requirements, business strategies) • Basics of intercultural communication (cultural dimensions) • Human-computer interaction (psychology, design process, technologies) • User experience engineering (multilingual/multicultural challenges, measurement criteria) • Software localization, internationalization, and accessibility: requirements and implementation techniques • Configurable systems, variability management, and software product lines
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • Know and reproduce the basic terms and principles of human-computer interaction, user experience engineering, software internationalization, and variability management (1). • Understand and explain the important drivers of variability for global software, e.g., language, culture, standards, legal conditions, and business strategies (1). • Explain requirements and solution approaches of software accessibility (1). • Extend an existing application designed for a local market so that it can be configured for different requirements of the global market (2). • Create graphical user interface prototypes for internationalized software considering different requirements dimensions (3).

Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • Familiarize themselves with new technologies in the field of software internationalization using provided documentation (2). • Transfer the technical skills acquired in this module to equivalent localization/ internationalization libraries of the same or of a different programming language (2). • Study, compile and coherently present a topic related to a dedicated aspect of software for the global market based on a given collection of provided materials (3).
Teaching materials offered
Copies of slides, exercises, code examples, materials from case studies
Teaching media
Laptop, beamer, blackboard
Literature
• Ian Sommerville: Engineering Software Products, Pearson, 2021 • Shannon Arndt: Intercultural Communication, Open Educational Resources Collection, 2020 • Geert Hofstede et al: Cultures and Organizations: Software of the Mind, McGraw Hill, 2010 • Alan Dix et al.: Human-Computer Interaction, 3rd edition, Pearson, 2004 • Jenifer Tidwell: Designing Interfaces, 2nd edition, O'Reilly, 2010 • Jan Yablonski: Laws of UX Design, O'Reilly, 2020 • Ben Shneiderman: Designing the User Interface, Pearson, 2017 • Helen Sharp: Interaction Design, Wiley & Sons, 2023 • Sandra Martin O'Donnell: Programming for the World, Pearson, 2008 • Sven Apel et al.: Feature-Oriented Software Product Lines, Springer, 2013

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Statistics	

Person responsible for the module	Faculty
Prof. Dr. Filippo Riccio	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
3.	2.	mandatory	5

Mandatory requirements
At least 30 credits from the 1st study stage
Recommended previous knowledge
Mathematics 1 and 2 Programming skills

Content
see next page

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Statistics	4 SWS	5

Submodule	Submodule abbreviation
Statistics	**ST**

Responsible person	Faculty
Prof. Dr. Filippo Riccio	Computer Science and Mathematics
Lecturer	Availablilty of module
N.N.	only in winter semester
Teaching method	
Seminar-base teaching (4SWS)	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
3.	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60h	90h

Method of assessment
Written exam: 90 minutes

Content
Descriptive statistics (summarizing data, methods based on the empirical cumulative density function, measures of location, measures of dispersion, exploring relationships with scatterplots). Probability Models (the idea of probability: a measure of uncertainty, probability measures, laws of probability, elementary combinatorics, conditional probabilities, Bayes theorem, independence). Random Variables and Distributions (discrete and continuous random variables, expectation and variance, functions of random variables, joint distributions, covariance and correlation). Convergence and Limit theorems (weak and strong laws of large numbers, the central limit theorem) Statistical Inference (estimation of parameters, confidence intervals, testing hypotheses)
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • to explain definitions, terms and theorems of probability theory in their own words (1), • to work on questions of probability theory independently and in a planned manner (2), • apply basic procedures of descriptive statistics (2), • be able to assess the methodology of statistical estimation and testing procedures and apply them to practical problems (3),

- to approach stochastic applications in computer science independently and confidently (3),
- understand and classify additional statistical literature (2),
- carry out simple and more demanding statistical analyses for their own work (seminar, theses, research projects) (3).

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,

- work in a team in a goal-oriented manner (teamwork skills) (1),
- present the results in a factual and target-oriented manner (presentation competence) (2),
- defend their point of view professionally (argumentation competence) (3),
- present their findings to target groups (adaptability) (1),
- defend their own results and opinions in front of different target groups (confidence in their own judgement) (2)
- evaluate challenging questions and work on them in a goal-oriented way (3)

Teaching media

Blackboard, notebook, projector

Literature

- Dekking, F.M; Kraaikamp, C.; Lopuhaä, H.P; Meester, L.E: A Modern Introduction to Probability and Statistics, 2007, Springer-Verlag London Ltd
- Forsyth, D.: Probability and Statistics for Computer Science, 2018, Springer International Publishing
- Kenett, R. S.; Zacks, S.; Gedeck, P.: Modern Statistics, 2022, Springer International Publishing

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Web Technology Project	

Person responsible for the module	Faculty
Prof. Felix Schwägerl	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
4.	2.	mandatory	

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Web Technology Project	4 SWS	5

Submodule	Submodule abbreviation
Web Technology Project	**WTP**

Responsible person	Faculty
Prof. Felix Schwägerl	Computer Science and Mathematics
Lecturer	**Availablilty of module**
Prof. Felix Schwägerl	only in summer semester

Teaching method
Seminar teaching (2 SWS) and project (2 SWS)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
4.	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60h	90h

Method of assessment
Submission of developed project artifacts

Content

- Standards and protocols of the world-wide web (HTTP, HTML, CSS, JSON, REST)
- Foundations, design, and implementation of REST APIs
- Browser-side scripting languages
- Responsive web design
- Server-side rendering of web pages using template engines
- Single-page web applications
- Full-stack web development
- Design, implementation, and test-deployment of an individual interactive web application, consisting of a client-side and server-side component

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- Know and reproduce the basic technologies, standards, and principles of web development (1).
- Acknowledge that web development is a dynamic field rapidly evolving around a few basic technologies, standards, and protocols (1).
- Design, implement, document, and use REST APIs (2).
- Develop small interactive web applications using up-to-date technology for frontend, backend, database and deployment (2).
- Evaluate the specification of a web technology project, design and implement the solution using the learned principles and technologies (3)

Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • Familiarize themselves with new technologies in the field of web technology using provided documentation (2). • Recognize deficits in their own learning process, to communicate them, and to make use of the offered assistance (2). • Review existing web applications and communicate feedback effectively (2). • Integrate themselves into web development teams and adopt different roles (e.g., front-end, or back-end developer) therein (3).
Teaching materials offered
Copies of slides, code examples, project templates, technical documentation
Teaching media
Laptop, beamer, blackboard
Literature
• Juha Hinkula: Full Stack Development with Spring Boot 3 and React, Packt, 2022 • Mike Amundsen: Design and Build Great Web APIs, The Pragmatic Programmers, 2020 • Ben Frain: Responsive web design with HTML5 and CSS, 3rd edition, Packt, 2020 • Adam Freeman: Essential Type Script 4, 2nd edition, Apress, 2021 • Adam L. Davis: Spring Quick Reference Guide, Apress, 2020 • On-line documentation of selected frameworks and tools (e.g., React, Bootstrap, Spring Boot, OpenAPI, Docker)

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Bachelor Thesis	

Person responsible for the module	Faculty
Vorsitzender der Prüfungskommission	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
7.	3.	mandatory	15

Mandatory requirements
Successful passing of all exams of the 1st stage of studies, At least 110 credit points from the 1st + 2nd stage of studies, Successful completion of the practical semester.
Recommended previous knowledge
All modules of the 1st and 2nd stage of studies

Content
see next page

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Bachelor seminar	2 SWS	3
2.	Bachelor Thesis		12

Submodule	Submodule abbreviation
Bachelor seminar	**BS**

Responsible person	Faculty
Prof. Dr. Frank Herrmann	Computer Science and Mathematics
Lecturer	**Availablilty of module**
alle Professoren/innen der Fakultät IM	only in winter semester
Teaching method	
Seminar	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
7.	2 SWS	english	3

Study hours required

Hours in attendance/lectures	Hours for self-study
30h	60h

Method of assessment
Successfully complete a presentation, admission requirement: registration of own bachelor thesis Participation in 9 further seminar presentations:Participation possible with entry into the 3rd stage of studies, registration of one's own Bachelor thesis is not required.

Content
subject-specific theme The following applies to dual students: Dual students generally complete a Bachelor's thesis in collaboration with their partner company. The supervisor from the company is always invited to the seminar presentation as part of the examination performance for dual students. The seminar presentation (public) can also take place in the partner company if the company so wishes.
Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • present subject-specific results of own work in oral and written form (2) • discuss questions and solutions in a team (3)
Teaching media
Blackboard, notebook, beamer and other media if necessary
Literature

More information about the course
Recommended prerequisites: All modules of the 1st and 2nd study section

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Submodule	Submodule abbreviation
Bachelor Thesis	**BA**

Responsible person	Faculty
Vorsitzender der Prüfungskommission	Computer Science and Mathematics
Lecturer	Availablilty of module
alle Professoren/innen der Fakultät IM	only in winter semester

Teaching method
Working independently on a problem, preparing a written paper, preparing a presentation

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
7.		english	12

Study hours required

Hours in attendance/lectures	Hours for self-study
	360h

Method of assessment
Written elaboration

Content
Subject-specific theme Dual students usually write a Bachelor's thesis in collaboration with their partner company. The supervisor at the company and the supervisor of the Bachelor's thesis at OTH Regensburg agree on the topic and its definition.
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, apply the competences acquired during their studies to a complex subject-related problem in an interdisciplinary manner (2) and systematically expand them (3). They can efficiently research, evaluate and correctly cite scientific sources (2). They can derive a technical task from the developed state of the art and process it using scientifically validated methods (3).
Learning objectives: Personal competence
After successful completion of the submodule, students are able to, independently subdivide the processing of a complex task into work packages, plan their processing, continuously track the work status and complete it on time (2). They can present technical content in a linguistically appropriate, concise and precise manner and clearly distinguish their own results from the state of the art (2). They are able to compare alternative solutions and weigh them up in a well-founded manner (3).

Teaching media
Paper, CD/DVD, PDF file, etc.
Literature
More information about the course
Recommended prerequisites: All modules of the 1st and 2nd study section

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Core Module 1	

Person responsible for the module	Faculty
Dekan Fakultät IM	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
6.	3.	mandatory	

Mandatory requirements
Successful completion of all examinations of the 1st study section, At least 110 credit points from the 1st + 2nd study section
Recommended previous knowledge
depending on the respective course

Content
depending on the respective course. The courses offered are governed by the curriculum

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Scientific Seminar	4 SWS	5

Submodule	Submodule abbreviation
Scientific Seminar	**WIS**

Responsible person	Faculty
Prof. Dr. Sebastian Fischer	Computer Science and Mathematics
Lecturer	**Availablilty of module**
N.N.	only in summer semester
Teaching method	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
6.	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60h	90h

Method of assessment
Project report

Content
This module introduces students to science communication. The following contents are taught and applied by means of a student research project from a chosen field: - Introduction to the scientific method - Structure of a scientific paper - Writing style of scientific texts - Formal design of a scientific paper - Working with scientific literature - Scientific preparation of technical knowledge
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • state the main criteria of scientific writing (1). • identify scientific literature (3). • use tools for literature research (3). • apply rules of correct citation (3). • develop an outline for a scientific research paper (3). • write a scientific text in a formally correct way (3). • to work independently on a scientific topic (3). • critically evaluate scientific literature (3).

Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • to work on problems adequately and in a target-group-oriented manner (2). • to independently develop a written result in a methodically sound manner within an agreed period of time (3). • work on complex technical topics (3).
Teaching media
The media and content of the presentation and the exercises offered are discussed and prepared in the team under the guidance of the lecturer.
Literature
Current literature from the chosen subject area

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Core Module 2	

Person responsible for the module	Faculty
Dekan Fakultät IM	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
6.	3.	mandatory	5

Mandatory requirements
Successful completion of all examinations of the 1st study section, At least 110 credit points from the 1st + 2nd study section
Recommended previous knowledge
depending on the respective course

Content
depending on the respective course. The courses offered are governed by the curriculum

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	International Software Development	4 SWS	5

Submodule	Submodule abbreviation
International Software Development	**ISD**

Responsible person	Faculty
Prof. Felix Schwägerl	Computer Science and Mathematics
Lecturer	**Availablilty of module**
Prof. Felix Schwägerl	only in winter semester

Teaching method
Project (4 SWS)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
7.	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60h	90h

Method of assessment
Individual project presentation: 20 minutes

Content

- Analysis, design, implementation, and test-deployment of a software project in an international team (in cooperation with partner universities of OTH Regensburg, if applicable)
- Confrontation with socio-technical challenges such as cultural differences, time-zone discrepancy, remote collaboration
- Practice of agile software development in different roles
- Usage of novel support technologies facilitating software development and management (e.g., artificial intelligence, augmented reality)

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- Explain the specifics of the software engineering technologies employed in the project, both for development and for team management (1).
- Repeat and reapply the software engineering activities conducted in the project using the same or similar technologies in real-world international software projects (2).
- Evaluate the requirements to a given software project, design and implement parts of the solution using adequate technologies and present the solution (3).
- Resolve and apply the specific challenges, methods, and tools occurring in international, intercultural, and geographically dispersed software engineering teams (3).

Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • Reproduce (1) and describe by own experience (2) the socio-technical challenges occurring in international software development teams. • Work productively as part of an international software development team, adopting different roles across the software engineering lifecycle (2). • Participate in and contribute to the improvement of the existing planning, design, and quality assurance processes (3).
Teaching materials offered
Requirements specification, project templates, technical documentatio
Teaching media
Laptop, beamer, blackboard
Literature
• Shannon Arndt: Intercultural Communication, Open Educational Resources Collection, 2020 • Ian Sommerville: Engineering Software Products, Pearson, 2021 • James D. Herbsleb: Global software engineering in the age of GitHub and Zoom. J. Softw. Evol. Process. 35(6), 2023 [and previous work referenced by the author] • On-line documentation of selected frameworks and tools

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Core Module 3	

Person responsible for the module	Faculty
Dekan Fakultät IM	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
6.	3.	mandatory	5

Mandatory requirements
Successful passing of all examinations of the 1st study section, At least 110 credit points from the 1st and 2nd study stage
Recommended previous knowledge
Depending on the respective course

Content
depending on the respective course The courses offered are governed by the curriculum

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Information Security	4 SWS	5

Submodule	Submodule abbreviation
Information Security	**IS**

Responsible person	Faculty
Prof. Dr. Sebastian Fischer	Computer Science and Mathematics
Lecturer	Availablilty of module
N.N.	only in summer semester

Teaching method
Seminar-based teaching with exercises

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
6.	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60h	90h

Method of assessment
Written exam

Content
• Introduction and topic classification • Protection goals • Classic vulnerabilities • Protective mechanisms • Organisational models • Technical aspects and solutions • Trends and developments • Practical exercises
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • understand theoretical basics and technical measures of information security and apply them to specific situations (3) • analyse security aspects and vulnerabilities (3) • weigh up security levels in a risk-oriented manner (3) • design and implement security solutions (3)
Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • analyse technical concepts in depth (3) • solve selected technical problems in group work (3) • communicate in teams and present their own results (3)

- acquire in-depth technical knowledge through private study (3)

Teaching media
Blackboard, notebook, projector, group work in computer lab

Literature
• lecture slides • Pieprzyk, J. et al: Fundamentals of computer security, 2010, Springer

More information about the course
Recommended prerequisites: Communication Systems and Computer Systems

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Core Module 4	

Person responsible for the module	Faculty
Dekan Fakultät IM	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
6.	3.	mandatory	5

Mandatory requirements
Successful passing of all examinations of the 1st study section, At least 110 credit points from the 1st and 2nd study stage
Recommended previous knowledge
Depending on the respective course

Content
depending on the respective course The courses offered are governed by the curriculum

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Big Data Technology	4 SWS	5

Submodule	Submodule abbreviation
Big Data Technology	**DW**

Responsible person	Faculty
Prof. Dr. Ahmet Kara	Computer Science and Mathematics
Lecturer	**Availablilty of module**
N.N.	only in summer semester

Teaching method
Seminar-based teaching (2 SWS) with exercises (2 SWS)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
6.	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60h	90h

Method of assessment
Written examination and/or seminar paper and/or oral examination

Content
This course teaches the fundamentals of data warehousing. This includes: • Fundamentals of Data Warehouses • Data-Warehousing Architecture • Multi-dimensional Data Modelling, Star/Snowflake-Schema • ETL Process, Data Cleaning, Data Integration • Data Analytics • Advanced SQL: Grouping Sets, Window Functions, Skyline Queries The theoretical basics taught are directly practised with modern databases.
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, - describe the internal structure of a data warehouse, the associated OLAP process and the necessary loading processes from production operations (1), - create smaller data warehouse systems, initiate ETL processes and perform OLAP queries (2), - operate larger data warehouse systems, solve performance problems, control complex ETL processes and design elaborate OLAP queries and interpret their results correctly (3).
Learning objectives: Personal competence
After successful completion of the submodule, students are able to,

- Understand and operate complex data warehouse systems, conduct extensive analyses of their own independently, and present the insights from data to others (3)

Teaching materials offered
Lecture notes PowerPoint presentation All programmes used in the course
Teaching media
Blackboard, projector with notebook
Literature

- Köppen/Sattler/Saake: Data Warehouse Technologies, 2014
- Bauer/Günzel: Data Warehouse Systems, dpunkt, 2013
- Mehrwald: Datawarehousing with SAP BW 7.3, dpunkt, 2013
- Kimball/Ross: Kimball's Data Warehouse Toolkit, Wiley&Sons, 2009
- Kemper/Baars/Mehanna: Business Intelligence, Springer, 2010
- Jockisch: Data Warehouse and SAP Business Information Warehouse, Script OTH Regensburg
- Kurz: Data Warehousing, mitp, 1999

More information about the course
Recommended prerequisites: Extensive knowledge of databases

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Core Module 5	

Person responsible for the module	Faculty
Dekan Fakultät IM	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
7.	3.	mandatory	5

Mandatory requirements
Successful passing of all examinations of the 1st study section, At least 110 credit points from the 1st and 2nd study stage
Recommended previous knowledge
Depending on the respective course

Content
depending on the respective course. The courses offered are governed by the curriculum

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Advanced Algorithms	4 SWS	5

Submodule	Submodule abbreviation
Advanced Algorithms	**ADA**

Responsible person	Faculty
Prof. Dr. Titus Dose	Computer Science and Mathematics
Lecturer	**Availablilty of module**
Prof. Dr. Titus Dose	only in winter semester

Teaching method
Further details can be found in the specialisation module catalogue for Bachelor's degree programmes at the Faculty of Computer Science and Mathematics.

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
7.	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60h	90h

Method of assessment
Further details can be found in the specialisation module catalogue for Bachelor's degree programmes at the Faculty of Computer Science and Mathematics.

Content
• Flow networks (Ford-Fulkerson and Edmonds-Karp algorithm) and matchings (Hopcroft-Karp algorithm) • Linear programming and the simplex algorithm • Approaches for NP-hard problems (approximation algorithms, exact algorithms, FPTs) • Fast discrete Fourier transformation • Multiplication algorithms (Karatsuba, Toom-Cook, Schönhage-Strassen) • Matrix multiplication (e.g., the Strassen algorithm)] Contents

Learning objectives: Subject competence
After successful completion of the submodule, students are able to, After successful completion of the submodule, students are able to, • explain the concept of splay trees and their basic operations (2), name the advantages and disadvantages of splay trees over other types of binary search trees (1), and prove (amortized) runtimes of the basic operations (3) • reproduce the max-flow-min-cut theorem (2), apply the algorithms of Ford-Fulkerson, Edmonds-Kard, and Hopcroft-Karp to examplary graphs (2), and trasfer the techniques used to slightly different problems (3) • describe the concept of (integer) linear programs (1), use linear programs to express other problems (2) and explain the basic ideas of the Simplex algorithm (3)

- name typical approaches for handling NP-hard problems, their strengths and limitations (1), explain each of the concepts on the basis of an example (2), and create algorithms for variations of problems discussed in the lecture (3)
- explain the discrete Fourier Transformation (2), name applications of the fast Fourier transformation (1), and reason the correctness and runtime of the Cooley-Tukey algorithm (3)
- explain the Karatsuba, Toom-Cook, and Schönhage-Strassen algorithm for integer multiplication (2) and prove their correctness and rumtime (3)
- solve recurrence relations even better (2)
- explain the Strassen algorithm for matrix multiplication (2) and argue for its correctness and runtime (3)
- describe parallel approaches for the matrix multiplication (2)

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,
After successful completion of the submodule, students are able to

- reason with mathematical formalism and precision (3)
- work persistently on tasks (2)
- discuss contents in a team (2)
- present results to others in a way that is both easy to follow and correct (2)
- enjoy good algorithms (3)

Teaching media

Blackboard, notebook, projector

Literature

• Lecture slides
• T. H. Cormen, C.E. Leisserson, R.L. Rivest, C. Stein: Introduction to Algorithms, MIT Press, 2022
• J. Erickson: Algorithms, https://jeffe.cs.illinois.edu/teaching/algorithms/#book, 2019 and other contents not contained in the book, but on the website
• G. Ausiello, P. Crescenzi, G. Gambosi, V. Kann, A. Marchetti-Spaccamela, M. Protasi: Complexity and Approximation: Combinatorial optimization problems and their approximability properties, 1999] Literature

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Core Module 6	

Person responsible for the module	Faculty
Dekan Fakultät IM	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
7.	3.	mandatory	5

Mandatory requirements
Successful passing of all examinations of the 1st study section, At least 110 credit points from the 1st and 2nd study stage
Recommended previous knowledge
Mathematics 1 / 2, Statistics, Programming 1 / 2 und Algorithms and Data Structures.

Content
depending on the respective course. The courses offered are governed by the curriculum

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Stochastic Algorithms	4 SWS	5

Submodule	Submodule abbreviation
Stochastic Algorithms	**STA**

Responsible person	Faculty
Prof. Dr. Filippo Riccio	Computer Science and Mathematics
Lecturer	**Availablilty of module**
Prof. Dr. Filippo Riccio	only in winter semester

Teaching method
Further details can be found in the specialisation module catalogue for Bachelor's degree programmes at the Faculty of Computer Science and Mathematics.

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
7.	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60h	90h

Method of assessment
Oral exam and project report / presentation

Content
Stochastic algorithms for optimization • Simulated annealing • Genetic algorithms • Particle swarm optimization • Stochastic gradient descent Stochastic algorithms for simulation • Montecarlo methods • Markov chain Monte Carlo methods: Hastings-Metropolis algorithm, Gibbs sampler

Learning objectives: Subject competence
After successful completion of the submodule, students are able to, After successful completion of the submodule, students are able to • approach and solve challenging optimization problems (2), • combine concepts from probability, statistics, and computer science (1), • critically evaluate which method is most appropriate for a given problem (1), • analyze data and make decisions based on statistical evidence (3), • model complex systems accurately by incorporating randomness (1), • evaluate system performance under different conditions and optimizing outcomes (3), • define the problem, model it appropriately, and interpret the results critically (2)

Learning objectives: Personal competence
After successful completion of the submodule, students are able to, After successful completion of the submodule, students are able to • reflect on assumptions, make informed adjustments, and understand the broader impact of their work (1), • handle diverse challenges, rethink strategies, and quickly learn new methods as situations change (2), • approach challenges with confidence and a solutions-oriented mindset (3)
Teaching media
Blackboard, notebook, projector
Literature
• J. C. Spall. Introduction to stochastic search and optimization. Wiley-Interscience, 2003 • G. Lan. First-order and stochastic optimization methods for machine learning. Springer, 2020. • C. P. Robert, G. Casella. Monte Carlo Statistical Methods. Springer, 2004. • C. P. Robert, G. Casella. Introducing Monte Carlo Methods with R. Springer, 2010.

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Mandatory Subject-Specific Elective Module 1	

Person responsible for the module	Faculty
N.N.	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
6.	3.	mandatory elective	5

Mandatory requirements
At least 30 credits from the 1st study stage

Recommended previous knowledge
Modules of the 1st and partly of the 2nd study stage depending on the chosen course

Content
Depending on the respective course Scope of teaching 4 SWS

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value

Notes on the assignment requirement or options
The courses offered for the subject-specific compulsory elective modules (FWPM) are regulated by the semester-specific study plan. The module descriptions for the semester-specific subject-related compulsory elective modules offered by the faculty can be found in the "Overview of module descriptions for subject-related compulsory elective modules - current semester offer" on the homepage of the faculty for each degree programme under the heading "Modules and subject descriptions". The module offers for the respective semester are marked with the corresponding degree programme and study section assignment. The assignment criteria of the courses to the degree programmes and study sections must be strictly adhered to: Notes on study section assignment: Z + module abbreviation: Second stageg of studies D + module abbreviation: Third stage of studies K + module abbreviation: Second and third stage of studies The following applies to dual students: For dual students, the faculty guarantees that at least one course is offered each semester in the area of Mandatory Subject-Specific Elective Modules with reference to application-oriented projects from the company. Dual students can introduce individual topics from their company practice into this course. In the central course allocation procedure in the area of Mandatory Subject-Specific Elective Modules, dual study students are guaranteed a place in this project module.

Module title	Module code
Mandatory Subject-Specific Elective Module 2	

Person responsible for the module	Faculty
Dekan Fakultät IM	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
6.	3.	mandatory elective	5

Mandatory requirements
Successful completion of all examinations of the 1st study stage, at least 110 credit points from the 1st + 2nd study stage.
Recommended previous knowledge
Modules of the 1st and 2nd stage of studies depending on the chosen course

Content
depending on the respective course

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value

Notes on the assignment requirement or options
The courses offered for the subject-specific compulsory elective modules (FWPM) are regulated by the semester-specific study plan. The module descriptions for the semester-specific subject-related compulsory elective modules offered by the faculty can be found in the "Overview of module descriptions for subject-related compulsory elective modules - current semester offer" on the homepage of the faculty for each degree programme under the heading "Modules and subject descriptions". The module offers for the respective semester are marked with the corresponding degree programme and study section assignment. The assignment criteria of the courses to the degree programmes and study sections must be strictly adhered to: Notes on study section assignment: Z + module abbreviation: Second stageg of studies D + module abbreviation: Third stage of studies K + module abbreviation: Second and third stage of studies The following applies to dual students: For dual students, the faculty guarantees that at least one course is offered each semester in the area of Mandatory Subject-Specific Elective Modules with reference to application-oriented projects from the company. Dual students can introduce individual topics from their company practice into this course. In the central course allocation procedure in the area of Mandatory Subject-Specific Elective Modules, dual study students are guaranteed a place in this project module.

Module title	Module code
Mandatory Subject-Specific Elective Module 3	

Person responsible for the module	Faculty
Dekan Fakultät IM	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
7.	3.	mandatory elective	5

Mandatory requirements
Successful completion of all examinations of the 1st study section, At least 110 credit points from the 1st + 2nd study section
Recommended previous knowledge
Modules of the 1st and 2nd stage of studies depending on the chosen course

Content
depending on the respective course

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value

Notes on the assignment requirement or options
The courses offered for the subject-specific compulsory elective modules (FWPM) are regulated by the semester-specific study plan. The module descriptions for the semester-specific subject-related compulsory elective modules offered by the faculty can be found in the "Overview of module descriptions for subject-related compulsory elective modules - current semester offer" on the homepage of the faculty for each degree programme under the heading "Modules and subject descriptions". The module offers for the respective semester are marked with the corresponding degree programme and study section assignment. The assignment criteria of the courses to the degree programmes and study sections must be strictly adhered to: Notes on study section assignment: Z + module abbreviation: Second stageg of studies D + module abbreviation: Third stage of studies K + module abbreviation: Second and third stage of studies The following applies to dual students: For dual students, the faculty guarantees that at least one course is offered each semester in the area of Mandatory Subject-Specific Elective Modules with reference to application-oriented projects from the company. Dual students can introduce individual topics from their company practice into this course. In the central course allocation procedure in the area of Mandatory Subject-Specific Elective Modules, dual study students are guaranteed a place in this project module.