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Faculty of Computer Science and Business Information Systems

Technical University of Applied Sciences Würzburg-Schweinfurt

Module Handbook

Bachelor Computer Science (B. Eng.)

Summer semester 2026
Winter semester 2025

Contents

1. semester

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5100350
Algebra

Module profile

Exam number
5100350

Duration
1 semester

Frequency
Every winter semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar-style instruction

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Andreas Keller

Lecturer(s)
Prof. Dr. Andreas Keller

Applicability	BIN
Semester according to SPO	1. semester
Type of module	Compulsory module

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
School maths

Content
General principles:
- Body of real numbers
- Principle of complete induction
- Introduction to the field of complex numbers

Linear algebra:
- Vector spaces (linear independence, basis and dimension)
- Matrices (calculating with matrices, trace and determinant, rank of a matrix)
- Linear systems of equations
- Gaussian algorithm
- Linear mappings
- Eigenvalues and eigenvectors
- Diagonalisation
- Spectral theorem

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Written exam (sP) according to § 23 APO

Examination - length/format
90 minutes

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
1. students remember basic mathematical concepts and procedures relevant to computer science.
2. students understand the principles of algebraic and geometric mathematics and their application in computer science contexts.
3. students apply mathematical techniques to solve problems in computer science and develop solution strategies.
4. students analyse mathematical problems and identify suitable solution approaches taking into account various mathematical theories.
5. students evaluate different solution strategies for their efficiency and appropriateness in computer science.
6. students create mathematical models to abstract and solve complex problems in computer science.

Literature
Bartholomé, Andreas; Rung, Josef; Kern, Hans: Number Theory for Beginners. Vieweg+Teubner, Wiesbaden, 2013.
Beutelspacher, Albrecht; Zschiegner, Marc-Alexander: Discrete mathematics for beginners. Vieweg+Teubner, Wiesbaden, 2014.
Gramlich, Günter: Linear Algebra - An Introduction. Fachbuchverlag Leipzig in the Carl Hanser Verlag, 2021.
Hartmann, Peter: Mathematics for computer scientists. Vieweg +Teubner, Wiesbaden, 2020.
Papula, Lothar: Mathematics for Engineers and Scientists Volumes 1 and 2. Vieweg+Teubner, Wiesbaden, 2018.
Pommersheim, James E.; Marks, Tim K.; Flapan, Erica L.: Number Theory: A Lively Introduction with Proofs, Applications, and Stories. John Wiley & Sons. 2010.
Schubert, Matthias: Mathematics for Computer Scientists. Vieweg +Teubner, Wiesbaden, 2012.
Strang, Gilbert: Linear Algebra. Springer-Verlag, Berlin/Heidelberg/ New York, 2003.

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 9999999
General Compulsory Elective

Module profile

Exam number
9999999

Duration
1 semester

Frequency
Every semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
German/English

Organisation

Responsible lecturer
Prof. Dr. Jochen Seufert

Lecturer(s)
Beate Wassermann

Applicability	BIN, BWI
Semester according to SPO	1. semester
Type of module	AWPM

Required prerequisites for the participation in the module according to the SPO
As a rule, none; exceptions are determined and announced by the Faculty of Natural Sciences and Humanities.

Recommended prerequisites for the participation in the module
none

Content
Selection of two general science electives (AWPF) (2 x 2 SWS) or one AWPF (1 x 4 SWS) from the range of subjects offered by the Faculty of Applied Natural Sciences and Humanities (FANG).

Range of subjects offered by the FANG in the areas of
- languages
- cultural studies
- Natural sciences and technology
- Politics, law and economics
- Education, psychology and social sciences
- Soft skills
- Creativity and art.

Courses whose content is already part of or directly related to parts of other modules of the degree programme are excluded from the FANG catalogue. The corresponding courses are marked with a blocking note in the FANG subject catalogue.
The contents of the individual AWPFs are published on the FANG faculty's own homepage.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Written exam (sP) according to § 23 APO

Examination - length/format
90 minutes

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German/English

Condition for the award of credit points
None

Learning outcomes
The subject-specific learning objectives depend on the AWPF selected.
The students

- also acquire knowledge and competences that are not subject-specific but may be important for the desired career goal, such as special knowledge of foreign languages, natural sciences or social sciences
- analyse a wide variety of issues
- categorise subject-specific knowledge in an interdisciplinary context
- transfer what they have learnt to their current training
- have expanded their key competences and, where applicable, foreign language skills, which supports their personal development, also in intercultural terms
- are aware of their personal, social and ethical responsibilities.

Literature
depending on the selected AWPFs

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5101620,6810030 Databases

Module profile

Exam number
5101620,6810030

Duration
1 semester

Frequency
Every winter semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar-style instruction, Exercise

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Frank-Michael Schleif

Lecturer(s)
Michael Rott

Applicability	BIN, BISD
Semester according to SPO	1. semester
Type of module	Compulsory module

Required prerequisites for the participation in the module according to the SPO
bZv

Recommended prerequisites for the participation in the module
none

Content
The module teaches the basic concepts and techniques of database development. The relational data model and the relational algebra are introduced as theoretical foundations. One focus is on database modelling, in particular the creation of entity-relationship models (ER models) and their conversion into relational schemas, taking normal forms into account. Introduction to the SQL language, including data manipulation, data queries and the definition of schemas and transaction management. Database development and administration is practised in practical exercises and semester-long projects.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Written exam (sP) according to § 23 APO

Examination - length/format
90 minutes

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes

- Students can explain basic concepts of data persistence and the differences between persistent and non-persistent data.
- Students can define the central terms of relational databases, such as relation, primary key, foreign key and normalisation.
- Students understand relational algebra and can apply simple operations to it.
- Students can explain the connection between conceptual, logical and physical data modelling and justify their significance for database development.
- Students are able to create entity-relationship models (ERM) for given use cases and convert these into relational schemas.
- Students can formulate and execute SQL queries for data manipulation (DML) and schema definition (DDL).
- Students can analyse existing database schemas and evaluate them with regard to redundancy, consistency and normal forms.
- Students are able to analyse technical information requirements and derive suitable data structures and queries from them.

Literature

- Michael Kofler (2024). Datenbanksysteme - Das umfassende Lehrbuch (2nd edition). Bonn: Rheinwerk Verlag GmbH
- Kemper, A., & Eickler, A. (2015). Database Systems - An Introduction (10th edition). Munich: De Gruyter Oldenbourg Verlag
- Elmasri, R., & Navathe, S. B. (2015). Fundamentals of database systems (7th edition). Munich: Pearson Studium
- Garcia-Molina, H., Ullman, J. D., & Widom, J. (2013). Database Systems: The Complete Book (2nd ed.). Upper Saddle River, NJ: Pearson
- Saake, G., Sattler, K.-U., & Heuer, A. (2011). Databases - Concepts and Languages (3rd ed.). Munich: Pearson Studium

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Module: 5111010,6810010
Basics of Algorithms and Data Structures

Module profile

Exam number
5111010,6810010

Duration
1 semester

Frequency
Every winter semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar-style instruction, Exercise

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Frank Deinzer

Lecturer(s)
Prof. Dr. Frank Deinzer,
Prof. Dr. Dominik Seuß

Applicability	BIN, BISD
Semester according to SPO	1. semester
Type of module	Compulsory module

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
none

Content
Theoretical topics
- Recursion: end-recursive/non-end-recursive, linear recursion/tree recursion
- Complexity: O-notation, runtime complexity, memory complexity
- Higher order functions
- (Anonymous) lambda functions
- Abstraction mechanisms: procedural abstraction, abstraction with data
- Representation of complex data structures
- Sorting and searching

Practical topics
- Numerical algorithms
- Algorithms on lists
- Algorithms on trees
- Algorithms on fields
- Algorithms on symbolic data
- Algorithms on strings
- Algorithms on sets
- Algorithms on queues

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
Students develop an understanding of the stylistics and aesthetics of programming at the beginning of their training.
Students understand the basic techniques for algorithmic problem solving.
Students generalise the appropriate application of important techniques for mastering complex systems.
Students apply concepts in the areas of recursion and abstraction.
Students apply standard solution techniques to algorithmic problems.

Literature
Abelson, Sussman: Structure and interpretation of computer programs. Springer Verlag, 4th edition, 2014
Wagenknecht: Programming paradigms: An introduction based on Scheme. Vieweg+Teubner, 2013

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5100720
Basics of Computer Engineering

Module profile

Exam number
5100720

Duration
1 semester

Frequency
Every winter semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar-style instruction, Exercise

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Arndt Balzer

Lecturer(s)
Prof. Dr. Arndt Balzer, Christine Zilker

Applicability	BIN
Semester according to SPO	1. semester
Type of module	Compulsory module

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
none

Content

- Technological basics (passive and active components)
- Boolean algebra (axioms and laws) and circuit algebra
- Number representation in digital systems
- Basic switching networks (symbols and representation)
- Minimisation of Boolean functions (Karnaugh-Veitch diagram, method according to Quine and McCluskey)
- Combinatorial circuits: Encoder, decoder, multiplexer, demultiplexer
- Switching network design and analysis
- Runtime effects (hazards)
- Programmable logic devices (PLDs: PROM, PAL, PLA and FPGA)
- Memory elements (types of flip-flops)
- Sequential circuits: Counters, memories, shift registers
- Finite automata (FSM) and realisation by switching mechanisms (Mealy, Moore)
- Switching mechanism synthesis and analysis
- Control unit design
- Circuits for the realisation of arithmetic logic functions
- Introduction to circuit design with VHDL

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Written exam (sP) according to § 23 APO

Examination - length/format
90 minutes

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
Students acquire knowledge of the structure and organisation of digital computing systems in modern computer systems, as well as the milestones in the development of IT systems.
Students are able to

- explain technical realisation forms of circuits,
- implement a formal and programming-language circuit description,
- analyse unknown circuits based on an understanding of the structure and function of all important basic circuits and arithmetic units,
- evaluate circuits with the help of cost functions,
- develop simple circuits of their own.

Literature
Schiffmann, Werner; Schmitz, Rolf: Computer Engineering 1. Springer, 2004.
Hoffmann, Dieter: Fundamentals of Computer Engineering. Hanser, 2023.
Fricke, Karl: Digital technology. Vieweg+Teubner, 2023.
Hennessy, John L.; Patterson, David A.: Computer Organisation and Design. Morgan Kaufmann, 2011.
Becker, Bernd; Drechsler, Rolf; Molitor, Peter: Computer Engineering. Pearson Studium, 2005.
Borucki, Leonhard: Digital Technology. Teubner, 2000.
Woitowitz, Reiner; Urbanski, Klaus: Digitaltechnik. Springer, 2011.
Beuth, Bernd: Digital technology. Vogel, 2019.
Tietze, Ulrich; Schenk, Christoph: Semiconductor circuit technology. Springer, 2013.
Möller, Detlef: Computer Structures - Fundamentals of Computer Engineering. Springer, 2013.

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5100130
Programming I

Module profile

Exam number
5100130

Duration
1 semester

Frequency
Every semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar-style instruction, Exercise

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr.-Ing. Tobias Fertig

Lecturer(s)
Prof. Dr.-Ing. Tobias Fertig, Christine Zilker

Applicability	BIN
Semester according to SPO	1. semester
Type of module	Compulsory module

Required prerequisites for the participation in the module according to the SPO
None

Recommended prerequisites for the participation in the module
none

Content
The Programming I module is about learning procedural programming and the first parts of object-oriented programming in the Java programming language. The ability to programme and thus to independently solve small problems in different areas is one of the basic skills expected of a (business) computer scientist.

The course consists of 13 lessons, which are made up of learning videos, the corresponding exercises, the Power Point slides for the videos and quizzes matching the material.

The learning videos are structured in such a way that students gradually familiarise themselves with the various language constructs and basic programming concepts. The accompanying seminar lessons are used to ask questions and consolidate the material.

The exercises are by far the most important part of the course. Students learn programming by solving problems independently. The tutorials help by giving students food for thought from the lecturer if a student gets stuck with a problem and by discussing and improving the quality of solutions. The exercises usually belong to the previous learning videos and pick up on their content.

There is a quiz for each lesson, which uses simple questions to give students the opportunity to check whether they know or understand the material covered.

Contents:
- Introduction/first programme (Hello world)
- Elementary language constructs (expressions, primitive variables, assignments)
- Essential (control) statements (conditional statements, branching, header- and footer-controlled loops)
- Methods, recursion, arrays, complex data types
- Object-orientation (introduction), classes, objects, (instance) methods, visibility
- Multidimensional arrays, behaviour of reference types, string methods, garbage collector

- Data structures (singly and doubly linked lists, binary trees, traversing trees)
- Packages, implicit inheritance, relations using the example of equals
- DRY principle, tell, don't ask principle
- Optional: bitwise operators

- IDEs used: IntelliJ IDEA, Eclipse, VSCode, ...

This module is the basis for Programming 2 and the programming project.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
bZv - currently suspended

Examination - type
Written exam (sP) according to § 23 APO

Examination - length/format
90 minutes

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
After successfully completing the module, students will be able to

- apply procedural programming as well as introductory principles of object-oriented programming
- independently implement a solution strategy for writing small procedural and object-oriented Java programmes according to a given design idea
- understand simple mathematical and technical problems and implement a solution
- generalise sub-problems by suitable means

Literature
Heinisch, Cornelia; Müller-Hofmann, Frank; Goll, Joachim: Java als erste Programmiersprache; Vom Einsteiger zum Profi; Springer Vieweg, 2023
Christian Ullenboom: Java ist auch eine Insel, 17th, updated and revised edition, Rheinwerk Computing, 2023
Reinhard Schiedermeier: Programming with Java, Pearson Studium - IT, 2010

2. semester

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5100360
Analysis

Module profile

Exam number
5100360

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar-style instruction

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Andreas Keller

Lecturer(s)
Prof. Dr. Andreas Keller

Applicability	BIN
Semester according to SPO	2. semester
Type of module	Compulsory module

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
School maths, algebra

Content
The module deals with fundamental aspects of the analysis of a real variable:

Properties of functions
Sequences and series
Limits of functions and continuity
differential calculus
Integral calculus
Taylor series

Analysis (one- and especially multi-dimensional) serves, among other things, as the basis for many real applications in science and technology, which can be solved on a computer with the help of computer science. It is also indispensable for a thorough understanding of probability theory and statistics as well as numerical mathematics, which in turn forms the basis for many specialist areas of computer science such as artificial intelligence (e.g. neural networks, machine learning), data science, big data, computer vision and image recognition and many more.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Written exam (sP) according to § 23 APO

Examination - length/format
90 minutes

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
Students can explain and determine basic terms (e.g. domain of definition, target domain, range of values) and properties (injectivity/ surjectivity/bijectivity, reversibility, periodicity, monotonicity, etc.) in connection with various standard function types (polynomials, power functions (roots), fractional-rational functions, exponential and logarithmic functions, trigonometric functions). They are familiar with the concept of limits and can calculate basic limits of sequences and functions. They are also familiar with the concept of convergence of series and power series and can analyse them for convergence using standard methods. Optionally, students learn about complexity classes of sequences and functions (bridge to computer science and numerics), which can often be classified using limit considerations.
With the help of the concept of limits, they are also able to analyse functions for continuity and differentiability and know, by way of example, what geometric properties continuous or differentiable functions have and what useful consequences (e.g. intermediate value theorem, zero-position theorem, L'Hospital's theorem, etc.) can be drawn from these properties.
You will be able to differentiate the standard function types with the derivation rules and calculate local and global extreme points/values. As a practical numerical method, they will use Newton's method as an example.
Students will be familiar with the concept of the definite (Riemann) integral and elementary calculation rules for this. They also know the concept of the indefinite integral (antiderivative) as well as the integral function and the connection with differential calculus, in particular the main theorem of differential and integral calculus. They know that integral calculus can be used, for example, to classically determine areas under graphs, but that this is only one facet of integral calculus and that integrating can also be interpreted as a generalised means (e.g. as a propaedeutic for Fourier analysis, which plays a major role in many applications in computer science/technology). Specifically, they are able to calculate elementary indefinite and definite integrals. Optionally, they can also use partial integration or the substitution method to determine more complex integrals or calculate improper integrals.
Students can determine the Taylor polynomial and the Lagrange remainder of a function and are familiar with the most important power series representations of elementary functions. They can also use Taylor polynomials/series, for example, to determine limits and to approximate functions and integrals and give elementary error estimates.

In general, students assess the suitability of mathematical methods for specific problems, check the plausibility of results and interpret them in a specialised context.

By continuously solving problems and working on mathematical texts, students strengthen their ability to think logically, analytically and conceptually and develop strategies for structured problem solving.

Literature

Brill, Manfred: Mathematics for Computer Scientists. Hanser Verlag, Munich/Vienna, 2004.
Hartmann, Peter: Mathematics for Computer Scientists. Vieweg +Teubner, Wiesbaden, 2020.
Oberguggenberger, Michael; Ostermann, Alexander: Analysis for Computer Scientists. Springer-Verlag, Berlin/Heidelberg, 2009.
Papula, Lothar: Mathematics for Engineers and Scientists, Volumes 1 and 2. Vieweg+Teubner, Wiesbaden, 2024.
Schubert, Matthias: Mathematics for Computer Scientists. Vieweg +Teubner, Wiesbaden, 2012.

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Module: 5103220
IT Project Management

Module profile

Exam number
5103220

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar-style instruction

Language of instruction
German/English

Organisation

Responsible lecturer
Prof. Dr.-Ing. Anne Heß

Lecturer(s)
Prof. Dr. Eva Wedlich,
Prof. Dr.-Ing. Anne Heß

Applicability	BIN
Semester according to SPO	2. semester
Type of module	Compulsory module

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
none

Content

- Introduction to project and project management
- Project organisation * Project planning process
- Project costing * Project control and monitoring
- Project completion * Personnel management and project marketing
- IT product management
- Core activities in IT projects (analysis, design, implementation, integration and stabilisation)
- Quality management and quality assurance
- Configuration management (rudimentary)
- Process models (phase models vs. iterative / incremental / agile process models)
- Agile project management / Scrum

In the non-dual study programme, the lecturer determines the topics of the practical examples for seminar lessons and examinations. In the dual study programme, students can work on practical examples from the company in seminar lessons and examinations.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Written exam (sP) according to § 23 APO

Examination - length/format
90 minutes

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German/English

Condition for the award of credit points
None

Learning outcomes

- Students learn project management skills, in particular the necessary knowledge for project managers. Project management methods, processes and tools are covered.
- Students are familiarised with relevant core activities of software development and their objectives
- Students can assign and describe relevant sub-activities, input requirements and result types to the core activities
- Students can describe various process models (waterfall model, V-model, Scrum), including their respective advantages and disadvantages, and can describe and assign activities in the process models
- Students understand characteristic features and differences between phase-orientated process models and iterative/ incremental process models and can select suitable process models for a given project context and justify their selection
- Students know the basic principles, roles, artefacts, ceremonies and practices of agile projects (using Scrum as an example) and can find their way around an agile project as a team member
- Students understand the importance and relevance of software quality
- Students know the key concepts of quality management and quality assurance and can describe the relevant tasks and skills (soft skills) of quality managers
- Students know the main objectives, concepts and activities of configuration management, including the basic functionalities of tools to support configuration management

Literature

- Johannsen, A. and Kramer, A.: Basiswissen für Softwareprojektmanager, dpunkt.verlag, 2017.
- Olfert, K.: Projektmanagement, NWB Verlag, 11th edition 2019.
- Sterrer, C. and Winkler, G.: setting milestones. Project management (methods, processes, tools), Goldegg Verlag, 2010.
- Sterrer, C.: pm k.i.s.s.: Keep it short and simple, Goldegg Verlag, 2011.
- Tiemeyer, E: Handbuch IT-Projektmanagement, Hanser 2018
- Ziegler, Michael : Agile project management with Scrum for beginners, ISBN-13: 979-8751100346 , 2021
- Gundlach, Marco: Agile Project Management - Successfully Navigating with Scrum and Kanban: A Comprehensive Guide for Beginners and Experts, ISBN-13: 979-8392911936, 2023

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5111120,6810070
Internet Communication

Module profile

Exam number
5111120,6810070

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar-style instruction

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Christian Bachmeir

Lecturer(s)
Prof. Dr. Christian Bachmeir

Applicability	BIN, BISD
Semester according to SPO	2. semester
Type of module	Compulsory module

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
none

Content
Rough structure:
1) Introduction to communication networks
2) Theoretical basics of communication technology
3) Practical basics of Internet communication
4) Introduction to IT security
5) Basics of cryptography

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Written exam (sP) according to § 23 APO

Examination - length/format
90 minutes

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
1. students remember the basic concepts of communication systems on the Internet and their technical foundations.
2. students understand the functioning of wireless communication technology and its effects on data transmission.
3. students apply modern cryptographic methods to ensure the security of Internet communication.
4. students analyse the performance, possibilities and limitations of communication systems on the Internet in order to make well-founded decisions when developing distributed systems.
5. students understand and evaluate the necessity of cryptographic procedures in different application scenarios of everyday operations.
6. students create concepts for the implementation of security mechanisms in Internet communication systems based on cryptographic techniques they have learnt.

Literature
Patrick Schnabel, Communication Technology Primer, Kindle eBooks
Kurose, Ross: Computer Networks, The Top-Down Approach, Publisher: Pearson Studium; Edition: 6th, updated edition, 2019
Tanenbaum, Wetherall: Computer Networks, Publisher: Pearson Studium; Edition: 5th, updated edition, 2013
Schmeh: Cryptography: Methods - Protocols - Infrastructures (iX-Edition) Publisher: dpunkt.verlag GmbH; Edition: 5th, updated edition, 2013

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Module: 5100220
Programming II

Module profile

Exam number
5100220

Duration
1 semester

Frequency
Every semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar-style instruction, Exercise

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr.-Ing. Tobias Fertig

Lecturer(s)
Prof. Dr.-Ing. Tobias Fertig, Christine Zilker

Applicability	BIN
Semester according to SPO	2. semester
Type of module	Compulsory module

Required prerequisites for the participation in the module according to the SPO
None

Recommended prerequisites for the participation in the module
Programming I

Content
The Programming II module is about learning object-oriented programming (in the Java programming language). In order to structure larger information systems, it is important to learn how these can be set up, designed and tested.

This course consists of 13 lessons, which are made up of learning videos, the corresponding exercises, the Power Point slides for the videos and quizzes matching the material.

The learning videos are structured in such a way that students are first confronted with tests and then gradually learn object-orientation and its application. The accompanying seminar lessons are used to ask questions and consolidate the material.

The exercises are by far the most important part of the course. Students learn object-orientated programming by solving problems independently. The tutorials help by giving students food for thought from the lecturer if a student gets stuck with a problem and by discussing and improving the quality of solutions. The exercises usually belong to the previous learning videos and pick up on their content.

There is a quiz for each lesson, which uses simple questions to give students the opportunity to check whether they know or understand the material covered.

Contents:
Unit tests (JUnit 5)
Dependency management (Maven)
Inheritance (specialisation, generalisation)
Enumerations
Abstract classes, interfaces, composition
Exceptions
streams
generics
Collections, associative arrays (maps)
Nested classes (static nested, inner, local, anonymous classes)
Lambda expressions
Threads

Design patterns: Builder, Decorator, Visitor
Fluent interfaces
Functional programming with the help of the Stream API

IDE: Eclipse or IntelliJ

The content and skills acquired in this module make the programming project much easier.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
bZv - currently suspended

Examination - type
Written exam (sP) according to § 23 APO

Examination - length/format
90 minutes

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
After successfully completing the module, students will be able to

- apply the concepts of object-oriented programming
- independently implement a solution strategy for writing object-oriented Java programmes
- implement partial solutions to larger programmes/problems
- structure problems into several sub-problems
- Implement tests for software systems
- Understand and use polymorphism in methods and types
- use class libraries to extend programmes
- understand first design patterns

Literature
Schiedermeier, Reinhard: Programming with Java. Pearson, 2nd edition, 2010.
Schiedermeier, Reinhard: Programming with Java II. Pearson, 2013.
Bloch, Joshua: Effective Java. 3rd Edition, Addison-Wesley, 2017.
Ullenboom, Christian: Java ist auch eine Insel. 16th edition, Rheinwerk Computing, 2021.

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5101820,6810220
Computer Architecture

Module profile

Exam number
5101820,6810220

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar-style instruction, Exercise

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Christian Bachmeir

Lecturer(s)
Prof. Dr. Christian Bachmeir

Applicability	BIN, BISD
Semester according to SPO	2. semester
Type of module	Compulsory module

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
Fundamentals of Computer Engineering

Content
- Historical development
- Calculator classifications (Flynn, Händler, Giloi)
- Computer arithmetic (representation of characters and numbers, IEEE 745, basic arithmetic operations, Booth algorithm)
- Microcomputer core with control and arithmetic unit (pipeline concept, dependencies and their resolution, dynamic scheduling: scoreboard, Tomasulo)
- Machine instructions (ISA, addressing types, assembler programming)
- x86 assembler (nasm, Linux/Ubuntu)
- RISC / CISC concepts (resource conflicts, µprogramming)
- Memory (structure of DRAM, SRAM, caches, coherence protocols)
- I/O and peripherals (external memory, buses)
- Parallel computers and multithreading
- Performance evaluation (basic terms, benchmarks)

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Written exam (sP) according to § 23 APO

Examination - length/format
90 minutes

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
Students gain an understanding of the structure and operation of computer systems,
and the operation of different computer architectures.
They also acquire basic knowledge in the field of embedded systems.
.
Students are able to

- visualise basic components of simple computers,
- explain different forms of realisation of complex circuits,
- describe relevant memory technologies,
- analyse the structure and programming of processors,
- implement simple assembler programmes and take into account specific characteristics of a computer when programming,
- evaluate the performance of computers,
- design subcomponents of a simple computer.

Literature
Hennessy, John L.; Patterson, David A.: Computer Architecture: A Quantitative Approach. Edition: 2025 (7th edition).
Hennessy, John L.; Patterson, David A.: Computer Organisation and Design. - Edition: 2020 (6th edition).
Brinkschulte, Uwe; Ungerer, Theo: Microcontrollers and Microprocessors - 2nd edition: 2010.
Tanenbaum, Andrew S.: Structured Computer Organisation. - Edition: 2012 (6th edition).
Coy, Wolfgang: Structure and operation of computer systems, 2013.
Hermann, Peter: Computer Architecture, 2013.
Bähring, Heinz: Microcomputer systems, 2013.
Märtin, C.: Introduction to computer architectures, 2003.
Malz, H.: Computer Architecture, 2004.
Oberschelp, W.; Vossen, G.: Rechneraufbau und Rechnerstrukturen, 2006.
Bundschuh, B.; Sokolowsky, P.: Rechnerstrukturen und Rechnerarchitekturen, 1988.
Austin, Todd; Tanenbaum, Andrew S.: Computer Architecture: From Digital Logic to Parallel Computing. Pearson, 2014.
Hennessy, John L.; Patterson, David A.: Computer Organisation and Design: The Hardware/Software Interface. Morgan Kaufmann Publishers, year 2021 (6th edition). Homeister, Matthias: Understanding Quantum Computing: Fundamentals-Applications-Perspectives. Springer-Verlag, 2022.
Vossen, Gerhard; Oberschelp, Werner: Computer Architecture. Oldenbourg-Verlag, 2006.
Slomka, Frank; Glaß, Michael: Fundamentals of Computer Architecture. Springer, 2023.
Ernst, Norbert; Schmidt, Inge; Beneken, Johann: Grundkurs Informatik. Springer, 2023.

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5101510
Software Engineering I

Module profile

Exam number
5101510

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar-style instruction

Language of instruction
German/English

Organisation

Responsible lecturer
Prof. Dr. Isabel John

Lecturer(s)
Prof. Dr. Isabel John,
Prof. Dr.-Ing. Anne Heß

Applicability	BIN
Semester according to SPO	2. semester
Type of module	Compulsory module

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
Basic Knowledge of Object Oriented Programming

Content
The module will be taught in english this semester

The discipline of software engineering is part of practical computer science and deals with all activities of software development from Ideas of the user to the tested delivered system

Basic concepts
- Objectives and principles of software engineering
- Presentation of the result types of software development phases with method assignment
- Basics of object-oriented function and data modelling with UML
- Object-oriented analysis based on UML (use case modelling, creation of static models, creation of dynamic models)

In addition to these core activities, the following related topics are considered:

- Modelling
- Costs and benefits
- Software quality, quality assurance and testing (overview)
- Inspections and reviews
- Configuration management (rudimentary)
- Basics of data protection, privacy and ethics

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German/English

Condition for the award of credit points
None

Learning outcomes
1. the students understand the principles of software engineering and their applications in software development.
2. the students apply structured methods to collect, model, and specify requirements during customer discussions.
3. the students analyse requirements using UML diagrams and Use Cases to facilitate effective communication and design.
4. the students evaluate the role of testing in software development processes and classify relevant skills necessary for quality assurance.
5. the students create effective testing strategies by running and evaluating tests throughout all phases of the software life cycle.
6. the students conceptualise design solutions using simple UML diagrams to represent software architecture and functionality.
7. the students address ethical dilemmas, sustainability aspects, and system security requirements in software projects, integrating these considerations into their practice.

Literature
Sommerville, Ian: Software Engineering. 10th edition, Pearson, 2018.
Oestereich, Bernd: Analysis and Design with UML 2.5 / UML 2.5.1. 7th edition, Oldenbourg, Munich, 2020.
Rupp, Chris; SOPHISTs: UML glasklar. 6th edition, Hanser, Munich, 2011.
McLaughlin, Brett D.: Object-oriented analysis and design from head to toe. O'Reilly, 2007.

3. semester

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5101110
Algorithms and Data Structures II

Module profile

Exam number
5101110

Duration
1 semester

Frequency
Every winter semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar-style instruction, Exercise

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr.-Ing. Tobias Fertig

Lecturer(s)
Prof. Dr.-Ing. Tobias Fertig

Applicability	BIN
Semester according to SPO	3. semester
Type of module	Compulsory module

Required prerequisites for the participation in the module according to the SPO
None

Recommended prerequisites for the participation in the module
Fundamentals of Algorithms and Data Structures, Programming I, Programming II, Algebra, Analysis
Applicable programming knowledge from Programming I

Content
The course deals with various complex algorithms and data structures in computer science in theory and practical application.
Java is used to implement the solutions.

The following main topics are covered in theory and practice:
- The concept of algorithms, data structures
- Stacks, queues, lists (with optimisations)
- Graphs & various algorithms on graphs
- Different trees with their respective advantages and disadvantages
- Hashmaps and exploratory strategies
- Monte Carlo and Las Vegas algorithms
- Evolutionary algorithms
- Encryption algorithms and data protection
- Decentralised software and blockchain data structures

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Written exam (sP) according to § 23 APO

Examination - length/format
90 minutes

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
1. students know basic data structures and their performance characteristics.
2. students understand the functionalities and application areas of special graph- and tree-based algorithms.
3. students apply suitable data structures and algorithms for given use cases and can evaluate their performance and applicability.
4. students analyse technical problems in order to select suitable data structures and algorithms and evaluate their performance.
5. students develop their own algorithms to solve practical problems and implement them using Java.
6. students create algorithmic solutions for specific challenges and select the appropriate algorithms for implementation.
7. students evaluate the application scenarios of various algorithms using practical examples and recognise their relevance in real applications.

Literature
Saake, Gunter; Sattler, Kai-Uwe: Algorithms and Data Structures: An Introduction with Java. 5th, revised edition, dpunkt.verlag, Heidelberg, 2013.
Cormen, Thomas H.; Leiserson, Charles E.; Rivest, Ronald L.; Stein, Clifford: Algorithms: An Introduction. 5th edition, Oldenbourg Wissenschaftsverlag, 2022.

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5111160,6810140
Backend Systems

Module profile

Exam number
5111160,6810140

Duration
1 semester

Frequency
Every winter semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 30 hrs

Self-study: 120 hrs

Total: 150 hrs

Teaching format
Seminar-style instruction

Language of instruction
English

Organisation

Responsible lecturer
Prof. Dr. Peter Braun

Lecturer(s)
Prof. Dr. Peter Braun

Applicability	BIN, BISD
Semester according to SPO	3. semester
Type of module	Compulsory module

Required prerequisites for the participation in the module according to the SPO
None

Recommended prerequisites for the participation in the module
Programming 1 and Programming 2

Content

- Introduction to distributed systems, client-server, and peer-to-peer systems.
- Software architectures for backend systems (3-tier, hexagonal, monolithic vs. micro-service, event-driven)
- Frameworks to implement backend systems (e.g. Spring)
- Advanced database techniques, scalability, replication, sharding, ORM-tools, query caching, CAP theorem
- Protocols for remote procedure call, for example, GraphQL and Google RPC.
- Basics of the HTTP protocol and application in the form of Web APIs.
- Comprehensive introduction to the REST architecture principle: resources, URLs, CRUD, hypermedia, caching, security.
- Configuration of Web servers (Apache), load balancer, and public caches (nginx)
- Testing of backend systems, performance testing using JMeter, monitoring and logging
- Security aspects of network protocol and backend systems

In the traditional degree programme, the lecturer provides or agrees with the topics of the practical examples for the examination. In the BIN dual study programme, the lecturer consults with the company on a task, ensuring practical relevance and feedback from the company.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
English

Condition for the award of credit points
None

Learning outcomes

- The students understand the fundamental concepts and differences of distributed systems, including their architecture and communication models.
- The students analyse various software architectures for backend systems and evaluate their suitability for different use cases.
- The students apply advanced database techniques such as replication and sharding to enhance data availability and performance.
- The students implement a backend system using a framework like Spring, following best practices for configuration, deployment, and security.
- The students compare different protocols for remote procedure calls, such as GraphQL and Google RPC, assessing their strengths and limitations.
- The students design RESTful APIs by applying the principles of the REST architecture, focusing on resources, URLs, CRUD operations, and security strategies.
- The students evaluate the security aspects of network protocols and backend systems, proposing improvements based on best practices.

Literature

- Coulouris, J. Dollimore, and T. Kindberg, Distributed Systems: Concepts and Design (4th Edition) (International Computer Science). Boston, MA, USA: Addison-Wesley Longman Publishing Co, Inc, 2005.
- N. Biswas, Practical GraphQL: Learning Full-Stack GraphQL Development with Projects. Berkeley, CA: Apress, 2023.
- J. Webber, S. Parastatidis, and I. Robinson, REST in practice: hypermedia and systems architecture, 1st ed. in Theory in practice. Beijing Cologne: O'Reilly, 2010.
- L. Richardson and M. Amundsen, RESTful Web APIs, First edition, Second release. Beijing Cambridge Farnham Cologne Sebastopol Tokyo: O'Reilly, 2015.
- I. Dominte, Web API Development for the Absolute Beginner: A Step-by-step Approach to Learning the Fundamentals of Web API Development with .NET 7. Berkeley, CA: Apress, 2023.

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5101730
Data Management and Data Science

Module profile

Exam number
5101730

Duration
1 semester

Frequency
Every winter semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar-style instruction, Exercise

Language of instruction
German/English

Organisation

Responsible lecturer
Prof. Dr. Frank-Michael Schleif

Lecturer(s)
Prof. Dr. Frank-Michael Schleif

Applicability	BIN
Semester according to SPO	3. semester
Type of module	Compulsory module

Required prerequisites for the participation in the module according to the SPO
None

Recommended prerequisites for the participation in the module
Databases, programming and software engineering courses

Content
Classical and modern concepts for data management and analysis of (semi-)structured data are covered.

Topics include:

XML / JSON Technologies
- Basics of XML and JSON
- DTD and XML Schema
- XPath, XSLT
- Queries on JSON documents
- Usage Scenarios
- Data Management Concepts

Basics of Data Warehousing
- Multidimensional Data Modelling
- Data Sources: Integration of Relational Database Systems, Web Services, JDBC/ODBC
- Some additional information on Privacy and Information Security in DBMS
- Planning and Implementation of ETL Processes
- Online Analytical Processing (OLAP)
- Introduction to NoSQL Databases and Big Data

Graph Databases
- Introduction to Graphs and Graph Management Systems
- Graph Database Query Language Cypher
- Modelling Concepts in Graph Databases
- Selected Data Analysis Concepts and Algorithms
- Data Analysis with Graph Databases

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Written exam (sP) according to § 23 APO

Examination - length/format
90 minutes

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German/English

Condition for the award of credit points
None

Learning outcomes
1. the students know the fundamental concepts and challenges related to data management and data analysis systems for businesses.
2. the students understand the components and architectures of data warehouse systems and their relevance in organisational contexts.
3. the students apply various data management methods, including non-relational databases (e.g., graph databases), in practical scenarios.
4. the students analyse data management processes and data analysis procedures, identifying key technologies and best practices used in enterprises.
5. the students evaluate solution strategies for application-specific problems in the fields of data management and data science, considering scalability and performance factors.
6. the students create data-driven solutions by designing and implementing database-based systems that address practical business challenges.
7. the students develop a comprehensive understanding of procedural models, multidimensional modelling, and database system integration in the context of data science.

Literature
Skiena, Steven S.: The Data Science Design Manual. Springer, 2017.
Robinson, Ian; Webber, Jim; Eifrem, Emil: Graph Databases. 2nd Edition, O'Reilly Media, 2015.
Friesen, Jeff: Java XML and JSON. Apress, 2019.
Knight, Brian; Becker, Allan; Kimball, Ralph: Professional Microsoft SQL Server 2014 Integration Services (Wrox Programmer to Programmer). Wrox, 2014.
Hastie, Trevor; Tibshirani, Robert; Friedman, Jerome: The Elements of Statistical Learning. 2nd Edition, Springer, 2009.
Kimball, Ralph; Ross, Margy; Thornthwaite, Warren; Mundy, Joy; Becker, Bob: The Data Warehouse Lifecycle Toolkit. 2nd Edition, Wiley, 2008.

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5111180
Professional Skills

Module profile

Exam number
5111180

Duration
1 semester

Frequency
Every winter semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Isabel John

Lecturer(s)
Prof. Dr. Peter Braun,
Prof. Dr. Isabel John,
Prof. Dr. Gabriele Saueressig,
Prof. Dr.-Ing. Tobias Fertig,
Prof. Dr. Frank-Michael Schleif,
Prof. Dr.-Ing. Anne Heß

Applicability	BIN
Semester according to SPO	3. semester
Type of module	Compulsory module

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
none

Content
This module provides students with theoretical and practical knowledge and skills that can be applied in a professional working environment in a wide variety of areas.
Students learn and try out a range of methods, techniques and tools that are categorised into different focus areas. These include

- Learning and working techniques
- Scientific work
- Target group-orientated professional communication and
- Working in (international) teams

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes

- Students apply methods for effective planning and structuring of their work processes
- Students name the basic principles of scientific work in computer science
- Students carry out a literature search and organise the results
- Students describe in detail the basics of designing effective scientific communication in the form of texts, presentations, posters and videos
- Students create scientifically orientated texts, presentations, posters and videos based on scientific standards
- Students learn relevant objectives, skills and best practices for planning, conducting and following up on various survey techniques (such as interviews, surveys)
- Students apply methods for effective communication in teams
- Students apply methods of interviewing to determine requirements

Literature
Will be announced in the lecture

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003031
Software industry, education and economy in India

Module profile

Exam number
5003031

Duration
1 semester

Frequency
Every winter semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
English

Organisation

Responsible lecturer
Prof. Dr. Isabel John

Lecturer(s)
Prof. Dr. Isabel John,
Prof. Dr.-Ing. Erik Schaffernicht

Applicability	BDGD, BEC, BIN, BISD, BWI
Semester according to SPO	3. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
Good knowledge of English

Recommended prerequisites for the participation in the module
none

Content
Introduction to India and our partner university Christ University in Bangalore
Selection of topics for the intercultural presentations (e.g. politics, religion, IT industry) in preparation for the excursion.
Presentation of methods for developing presentations in terms of topic selection, structure and slide design.
Introduction to the topic for the joint projects with Christ University students, which will be worked on in small groups from October.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
English

Condition for the award of credit points
None

Learning outcomes
Students recall basic facts about India and its importance in information technology.
Students analyse and evaluate differences between Germany and India.
Students use an image-orientated, free presentation style in their presentations.
Students apply basic communication techniques in the intercultural field using India as an example.
Students demonstrate successful co-operation with students from the partner university in the context of a technical project.

Literature
Will be announced in the seminar depending on the topics.

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5111170
Stochastics

Module profile

Exam number
5111170

Duration
1 semester

Frequency
Every winter semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar-style instruction

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Patrik Stilgenbauer

Lecturer(s)
Prof. Dr. Patrik Stilgenbauer

Applicability	BIN
Semester according to SPO	3. semester
Type of module	Compulsory module

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
Algebra and analysis: Basic knowledge of linear algebra (in particular linear systems of equations, matrix algebra, vector spaces, scalar product), propositional and set algebra, combinatorics, differential and integral calculus.
Programming I: Programming logic, design of simple algorithms

Content
- Descriptive statistics: basic concepts, frequency distributions, location parameters, scattering parameters, linear correlation and regression analysis.
- Probability theory: result set, events, Kolmogorov's concept of probability, conditional probability and independence, discrete and continuous random variables, expected value and variance, law of large numbers, binomial distribution, hypergeometric distribution, Poisson distribution, exponential distribution, normal distribution, sums of random variables, central limit theorem.
- Inferential statistics: point and interval estimates, significance tests.
- Application and visualisation of stochastic methods using programming examples in Python or R.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Written exam (sP) according to § 23 APO

Examination - length/format
90 minutes

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
After completing the module, students will be able to

- confidently apply basic concepts and terms of probability and statistics,
- calculate and interpret statistical ratios and probabilities and use them to describe data,
- select typical probability distributions and apply them to suitable, practical problems,
- analyse stochastic and statistical problems using logical and structured thinking and work on them in a solution-oriented manner,
- use the methods as a basis for further applications in computer science, data science and machine learning.

Literature
Bamberg, G., Baur, F. and Krapp, M.: Statistics, De Gruyter Oldenbourg, 2022.
Bourier, G.: Descriptive Statistics, Springer Gabler, 2025.
Bourier, G.: Probability theory and inferential statistics, Springer Gabler, 2018.
Dreiseitl, S.: Mathematics for Software Engineering, Springer Vieweg, 2018.
Henze, N.: Stochastics for Beginners, Vieweg + Teubner, 2011.
Kurt, N.: Stochastics for Computer Scientists, Springer Vieweg, 2020.
Teschl, G. and Teschl, S.: Mathematics for Computer Scientists - Volume 2 (Analysis and Stochastics), Springer Vieweg, 2014.

4. semester

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5100430
Applied Numerics

Module profile

Exam number
5100430

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar-style instruction, Exercise

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Patrik Stilgenbauer

Lecturer(s)
Prof. Dr. Patrik Stilgenbauer

Applicability	BIN
Semester according to SPO	4. semester
Type of module	Compulsory module

Required prerequisites for the participation in the module according to the SPO
Mathematics knowledge from previous semesters ready for application

Recommended prerequisites for the participation in the module
Algorithmics, programming I and II (imperative or object-orientated), mathematics (algebra, analysis and stochastics)

Content
The course covers various mathematical and numerical problem-solving methods in theory and application. Either Python or MATLAB is used to implement the solutions.

The following mathematical topics are covered in theory and practice as examples:

- Numerical basics (floating point arithmetic, complexity of algorithms)
- Numerical solution of linear systems of equations (in particular matrix decomposition methods)
- Eigenvalue problems and their application
- Interpolation algorithms
- Numerical differentiation and integration
- Optimisation problems and algorithms (e.g. Newton method, gradient descent)
- Stochastic simulation and Monte Carlo methods

This is accompanied by an introduction to the numerical Python libraries (NumPy, SciPy, Matplotlib, possibly SymPy) or alternatively an introduction to the Matlab tool environment (Matlab as a programming language and development environment, vectors, matrices, data types, operators, maths functions, plots etc.). functions, plots etc.).

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
1. students know basic mathematical concepts and their implementation in Python or Matlab.
2. students understand various mathematical methods that are relevant for solving practical, mathematically modellable problems.
3. students apply specific mathematical methods to solve computer science problems effectively.
4. students analyse mathematical problems and develop logical solution strategies for these problems.
5. students evaluate the suitability of various mathematical methods and their implementation in software development.
6. students create mathematical and algorithmic models to translate development problems into consistent mathematical problems.
7. students are able to use suitable mathematics software tools to support their problem-solving skills.
8. students develop their ability to work independently on specialised scientific literature in order to expand their methodological competence.

Literature
Bayen, A. and Kong, Q. and Siauw, T.: Python Programming and Numerical Methods. Academic Press, 2020.
Huckle, T. and Schneider, S.: Numerical Methods, Springer, 2006.
Johansson, R.: Numerical Python, Apress, 2024.
Knorrenschild, M.: Numerical Mathematics, Carl Hanser Verlag, 2024.
Moler, C. B.: Numerical Computing with MATLAB, SIAM, 2008.
Plato, R.: Basiswissen Numerik, Springer-Spektrum, 2023.
Strang, G.: Linear Algebra and Learning from Data. Cambridge Press, 2020.

Further literature will be announced in the course.

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5100430
Applied Numerics

Module profile

Exam number
5100430

Duration
1 semester

Frequency
Irregular

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 15 hrs

Self-study: 135 hrs

Total: 150 hrs

Teaching format
Seminar-style instruction, Exercise

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Patrik Stilgenbauer

Lecturer(s)
Prof. Dr. Patrik Stilgenbauer

Applicability	BIN
Semester according to SPO	4. semester
Type of module	Compulsory module

Required prerequisites for the participation in the module according to the SPO
Mathematics knowledge from previous semesters ready for application

Recommended prerequisites for the participation in the module
Algorithmics, programming I and II (imperative or object-orientated), mathematics (algebra, analysis and stochastics), knowledge acquired in parallel from programming III.

Content
The course covers various mathematical and numerical problem-solving methods in theory and application. Either Python or MATLAB is used to implement the solutions.

The following mathematical topics are covered in theory and practice as examples:

- Numerical basics (floating point arithmetic, complexity of algorithms)
- Numerical solution of linear systems of equations (in particular matrix decomposition methods)
- Eigenvalue problems and their application
- Interpolation algorithms
- Numerical differentiation and integration
- Optimisation problems and algorithms (e.g. Newton method, gradient descent)
- Stochastic simulation and Monte Carlo methods

This is accompanied by an introduction to the numerical Python libraries (NumPy, SciPy, Matplotlib, possibly SymPy) or alternatively an introduction to the Matlab tool environment (Matlab as a programming language and development environment, vectors, matrices, data types, operators, maths functions, plots etc.). functions, plots etc.).

Note: This module is an offer for the repeat examination for the portfolio performance of the course "Applied Numerics" from the previous summer semester. There is no regular course in the winter semester; the content is to be acquired by the students in self-study using the e-learning course from the summer semester. The above-mentioned attendance time is used exclusively to complete the portfolio work. Further information and detailed instructions on portfolio work can be found in the e-learning course for the summer semester.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
1. students know basic mathematical concepts and their implementation in Matlab.
2. students understand various mathematical methods that are relevant for solving practical, mathematically modellable problems.
3. students apply specific mathematical methods to solve computer science problems effectively.
4. students analyse mathematical problems and develop logical solution strategies for these problems.
5. students evaluate the suitability of various mathematical methods and their implementation in software development.
6. students create mathematical and algorithmic models to translate development problems into consistent mathematical problems.
7. students are able to use suitable mathematics software tools such as Matlab and other tools to support their problem-solving skills.
8. students develop their ability to work independently on scientific literature in order to expand their methodological competence.

Literature
Huckle, T. and Schneider, S.: Numerical Methods, Springer, 2006.
Johansson, R.: Numerical Python, Apress, 2024.
Knorrenschild, M.: Numerical Mathematics, Carl Hanser Verlag, 2024.
Moler, C. B.: Numerical Computing with MATLAB, SIAM, 2008.
Plato, R.: Basiswissen Numerik, Springer-Spektrum, 2023.
Strang, G.: Linear Algebra and Learning from Data. Cambridge Press, 2020.

Further literature will be announced in the course

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5111230,6810200
Frontend Systems

Module profile

Exam number
5111230,6810200

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar-style instruction, Exercise

Language of instruction
English

Organisation

Responsible lecturer
Prof. Dr. Peter Braun

Lecturer(s)
Prof. Dr. Peter Braun

Applicability	BIN, BISD
Semester according to SPO	4. semester
Type of module	Compulsory module

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
Backend Systems

Content

- Introduction to Web Technologies: Basic building blocks of web development, including HTML for structuring web content, CSS for styling and layout, and JavaScript for adding interactivity and dynamic behaviour to web pages.
- Advanced JavaScript and Modern ES6+ Features: More details about JavaScript, exploring modern ES6+ features such as let, const, arrow functions, template literals, modules, promises, and async/await, and learn how to apply these in real-world scenarios.
- Fundamentals of React: Core concepts of React, including its component-based architecture, JSX syntax, and the use of state and props to manage data within components, enabling the creation of dynamic and interactive user interfaces.
- Advanced React Techniques: Advanced topics in React, such as the Context API for state management across the application, React hooks for managing state and side effects in functional components, and performance optimisation strategies.
- IT Security in Frontend Development: Principles of IT security as they relate to frontend development, including securing user input, preventing cross-site scripting (XSS) and cross-site request forgery (CSRF), and ensuring secure communication between frontend and backend systems. Introduction to the Open Web Application Security Project Top Ten list.
- Project Development and Deployment: Setting up development environments, following best practices in code organisation and documentation, and deploying and maintaining frontend applications in a production environment.

In the traditional degree programme, the lecturer provides or agrees with the topics of the practical examples for the examination. In the BIN dual study programme, the lecturer consults with the company on a task, ensuring practical relevance and feedback from the company.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
English

Condition for the award of credit points
None

Learning outcomes

- The students understand the foundational principles of HTML, CSS, and JavaScript to build and style basic web pages effectively.
- The students apply modern web frameworks like React and Svelte to develop dynamic and responsive user interfaces.
- The students analyse different state management techniques, such as React hooks and the context API, to manage complexity in web applications.
- The students design cross-platform mobile user interfaces using Flutter, focusing on user experience and performance.
- The students implement best practices in frontend development, including version control, testing, and secure deployment processes.
- The students create a comprehensive frontend project from scratch, integrating all learned concepts into a fully functional application.
- The students evaluate different frameworks and tools for frontend development to make informed decisions based on specific project requirements.

Literature

Marijn Haverbeke: Eloquent JavaScript: A Modern Introduction to Programming. 4th edition, 2024.
Alex Banks, Eve Porcello: Learning React: Modern Patterns for Developing React Apps. O'Reilly, 2020.
Thomas Bailey, Alessandro Biessek: Flutter for Beginners: Cross-platform mobile development from Hello, World! to app release with Flutter 3.10+ and Dart 3.x. Packt, 2023.
Andrew Hoffman: Web Application Security: Exploitation and Countermeasures for Modern Web Applications. O'Reilly, 2024.

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5100620
Basics of Business Administration

Module profile

Exam number
5100620

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar-style instruction

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Eva Wedlich

Lecturer(s)
Prof. Dr. Eva Wedlich

Applicability	BIN
Semester according to SPO	4. semester
Type of module	Compulsory module

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
none

Content
Basic concepts of business administration:
- The company
- The factors of production in business management
- Business objectives
- Key business figures

Constitutive decisions of a business:
Choice of location:
- The location problem
- Location factors
- Germany as a business location

Legal forms:
- Partnerships
- Corporations
- Mixed forms

Business management functions:
Procurement/purchasing
Warehousing
production
Distribution and sales
Cost accounting
Financial accounting

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Written exam (sP) according to § 23 APO

Examination - length/format
90 minutes

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
Students familiarise themselves with the basic concepts of business administration and are able to repeat them.
In the field of business administration, they will be able to understand the constitutive decisions of a company and analyse the business functions.
Students are able to understand and construct economic relationships.
Students are able to understand and correctly interpret economic texts (including those from business journals).

Literature
Balderjahn, I.; Specht, G.: Introduction to Business Administration, 8th edition, Schäffer-Poeschel, Stuttgart, 2020
Vahs, D.; Schäfer-Kunz, J.: Introduction to Business Administration; 16th edition; Schäffer-Poeschel, Stuttgart, 2021
Wöhe, G.: Introduction to general business administration; 28th edition; Vahlen; Munich, 2024

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5101010
Basics of Theoretical Computer Science

Module profile

Exam number
5101010

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar-style instruction, Exercise

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Frank Deinzer

Lecturer(s)
Prof. Dr. Frank Deinzer,
Prof. Dr.-Ing. Pascal Meißner

Applicability	BIN
Semester according to SPO	4. semester
Type of module	Compulsory module

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
Algebra, Analysis, Algorithmics

Content
Automata theory and formal languages
- Automata
- Regular languages
- Context-free languages
- Context-sensitive languages
- General Chomsky Grammar

Computability
- Turing machines, non-deterministic Turing machines
- Programming language models of computation: GOTO programmes, WHILE programmes, LOOP programmes
- Mathematical calculation models: primitive recursion, -recursion
- Halting problem, undecidability, reducibility

Complexity theory
- Complexity classes: P and NP
- NP-completeness

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Written exam (sP) according to § 23 APO

Examination - length/format
90 minutes

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
Students understand the basic concepts in the field of theoretical computer science.
Students understand the concepts of formal languages, automata theory, computability and complexity theory.
Students apply the skills they have acquired in abstract and theoretical thinking. The topics covered are highly abstract and thus promote the ability to think abstractly and theoretically.
Students translate theoretical concepts into practical solutions.

Literature
Uwe Schöning: Theoretische Informatik - kurz gefasst. 5th edition, Spektrum Akademischer Verlag, 2008.
John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman: Introduction to Automata Theory, Formal Languages and Complexity. 2nd edition, Addison-Wesley Longman Publishers, 2011.
Ingo Wegener: Theoretische Informatik - eine algorithmenorientierte Einführung. 3rd edition, Teubner, 2005.

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5100240,6810210
Programming Project

Module profile

Exam number
5100240,6810210

Duration
1 semester

Frequency
Every semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 12 hrs

Self-study: 138 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Peter Braun

Lecturer(s)
Prof. Dr. Peter Braun

Applicability	BISD, BIN
Semester according to SPO	4. semester
Type of module	Compulsory module

Required prerequisites for the participation in the module according to the SPO
BIN: Programming I and Programming II
BISD: Programming I

Recommended prerequisites for the participation in the module
Programming I + II
Databases I
Software Engineering I

Content
The students should realise their own application in groups. An application could, for example, be a game, a three-tier web application or a comparable application. Possible parts of the application could be a graphical user interface (including a web interface), database connection including schema design, network communication, AI, etc. The students also create documentation (general overview, various use cases, the most important activity and sequence diagrams, etc.).

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Practical study achievement

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
After successfully completing the module, students will be able to

- develop a first larger application in a team of 4-6 people
- carry out and implement project planning
- carry out and implement a task distribution
- apply their knowledge of software design
- apply programming concepts they have learnt
- look up required content themselves using suitable literature
- break down a task into sub-problems.

Literature
None

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5102810
Software Engineering II

Module profile

Exam number
5102810

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar-style instruction

Language of instruction
German/English

Organisation

Responsible lecturer
Prof. Dr.-Ing. Anne Heß

Lecturer(s)
Prof. Dr.-Ing. Tobias Fertig,
Prof. Dr.-Ing. Anne Heß

Applicability	BIN
Semester according to SPO	4. semester
Type of module	Compulsory module

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
Software Engineering I
Programming 1 to 3

Content
This module builds on the Software Engineering I module and expands on many of the topics covered there. This includes advanced and quality-orientated activities in software development together with the associated concrete techniques and tools:

- Principles and activities of the human-centred design (HCD) process
- User experience and emotions
- Creativity processes and techniques
- Context of use analysis, requirements specification, interaction design, evaluation
- Deepening and application of QA principles and measures using the example of HCD
- Architecture: architecture principles, design patterns, architecture with UML
- Build systems, continuous integration, continuous deployment
- Design documentation and reviews

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Written exam (sP) according to § 23 APO

Examination - length/format
90 minutes

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German/English

Condition for the award of credit points
None

Learning outcomes

- Students learn relevant basic concepts and terms of HCI (usability, user experience)
- Students gain an overview of various lifecycle models of the human-centred design process
- Students learn why ensuring a positive user experience is important for product success and how this can be constructively ensured in a software development project
- Students learn the principles, methods and techniques of the early phases of the user-centred design process and can apply individual methods / techniques in practice (in particular context of use analysis / user research and requirements elicitation / documentation)
- Students learn principles, methods and techniques for creative brainstorming and designing interactive products
- Students learn principles, heuristics, methods and techniques for evaluating interactive products with regard to usability / user experience
- Students are able to carry out tests of user interfaces
- Students understand the principle of continuous integration
- Students are familiar with the concept of design patterns and can select and, if necessary, implement suitable design patterns for a given problem.
- Students are familiar with common architectural principles and can apply rudimentary design rules

Literature

- Balzert, H.: Lehrbuch der Softwaretechnik: Entwurf, Implementierung, Installation und Betrieb. 3rd edition, Spektrum, 2011.
- Gamma, Erich; Helm, Richard; Johnson, Ralph; Vlissides, John: Entwurfsmuster - Elemente wiederverwendbarer objektorientierter Software. mitp, 2014.
- Oestereich, Bernd: Analyse und Design mit der UML 2.5: Objektorientierte Softwareentwicklung. Oldenbourg, 2012.
- Sommerville, Ian: Software Engineering. Pearson Studium, 2018.

5. semester

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5111250
Supervised Internship

Module profile

Exam number
5111250

Duration
1 semester

Frequency
Every semester

Credit hours (SWS)
1

ECTS-Credits (CP)
30.0

Workload
Guided study time:
Presence time: 15 hrs

Self-study: 885 hrs

Total: 900 hrs

Teaching format
Practice

Language of instruction
German/English

Organisation

Responsible lecturer
Prof. Dr.-Ing. Erik Schaffernicht

Lecturer(s)
Prof. Dr.-Ing. Erik Schaffernicht

Applicability	BIN
Semester according to SPO	5. semester
Type of module	Compulsory module

Required prerequisites for the participation in the module according to the SPO
SPO 2019: >90 ECTS credits, course 510002X
SPO 2023: > 90 ECTS credits, including 55 ECTS credits from the first year of study, as well as the Professional Skills module

Recommended prerequisites for the participation in the module
Databases
Programming I
Programming II
Data Management and Data Science
Business Administration Basics
Programming project
Backend Systems
Frontend Systems
System-oriented programming
Software Engineering II
Project Management
Internet Communication

Content

- As part of a larger IT project, you will be required to work independently in as many project phases as possible (system analysis, system planning, implementation, system introduction and testing). This project should last at least 12 weeks.
- Ideally, the intern will familiarise themselves with various departments and areas of the company prior to the project in order to gain a rough understanding of other departments and the company as a whole.

The contact person/supervisor at THWS is the representative for the supervised practical phase, Prof. Dr.-Ing.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Documentation, Presentation

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German/English

Condition for the award of credit points
None

Learning outcomes
The trainee should

- acquire relevant, practice-orientated knowledge of operational processes
- learn (through guidance) to work independently and autonomously in IT projects.
- combine competences acquired during their studies with practical experience.
- learn to understand problems and requirements (e.g. customer requirements).
- learn to design and implement solutions to problems (e.g. for company processes and/or IT projects).
- experience working in a team.
- get to know and experience embedding in the company, its processes and organisational procedures.
- get to know and experience the IT profession.
- learn to approach the right people when problems arise.
- learn about the unconditional will to successfully and professionally realise projects.
- experience excellence and professionalism.
- experience how employees are captivated.
- recognise and feel the meaning of their work.

Literature
No general literature recommendation possible

6. semester

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003028
ABAP/4 Development Workbench

Module profile

Exam number
5003028

Duration
1 semester

Frequency
Every semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Frank Hennermann

Lecturer(s)
Martin Espenschied

Applicability	BIN, BWI
Semester according to SPO	6. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
none

Content
Basics of programming with ABAP
- Overview of the ABAP programming language
- Creating and testing an ABAP report
- Output statements
- Programme data - types and variables
- Multilingualism - Text elements
- Reading database tables
- Control statements
- Programme data - field strings and internal tables
- Modularisation through function blocks and classes

Dialogue programming
- Dialogue programs from the developer's perspective
- Developing a simple dialogue program
- The graphical elements of a screen
- Transferring definitions from the data dictionary
- The Menu Painter
- Dynamic screen sequence
- Field input checks/messages
- Dynamic screen modifications
- Database changes and locks

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Written exam (sP) according to § 23 APO

Examination - length/format
90 minutes

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
Students are familiar with the architecture and use of the ABAP/4 Development Workbench.
They can create simple programmes and use SAP-specific instructions. They can analyse and rectify errors. They can create function modules and classes and design interfaces

Literature
ABAP Development for SAP S/4HANA by Constantin-Catalin Chiuaru, Sebastian Freilinger- Huber, Timo Stark, Tobias Trapp, Rheinwerk-Verlag, 2nd edition, Bonn 2021.
ABAP - Das umfassende Handbuch by Felix Roth, Rheinwerk-Verlag, 3rd edition, Bonn 2023.
Agile ABAP Development by Winfried Schwarzmann, Rheinwerk-Verlag, Bonn 2018.
BOPF - Developing Business Objects with ABAP by Felix Roth, Stefan Stöhr, Rheinwerk-Verlag, Bonn 2017.

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003180
Advanced Database Techniques

Module profile

Exam number
5003180

Duration
1 semester

Frequency
Every semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Peter Braun

Lecturer(s)
Michael Rott

Applicability	BIN, BWI, BISD
Semester according to SPO	6. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
Databases, Databases I, Backend Systems

Content
As part of this module, students acquire practice-orientated and interdisciplinary skills in the field of modern database management. The content taught is designed to combine technological fundamentals with current requirements from practice and research.

The following aspects are covered in particular:

- In-depth examination of the CAP theorem with consideration of real distributed database systems.
- Systematic selection of suitable database management systems (DBMS) on the basis of concrete application scenarios. This includes both relational (e.g. PostgreSQL, MySQL, SQL Server, Oracle) and non-relational systems (e.g. MongoDB, Redis, Riak).
- Use of a data modelling tool (e.g. erwin Data Modeler) to create conceptual and physical data models.
- Use and evaluation of monitoring and performance tools, in particular with regard to load distribution, system monitoring and analysis of query execution plans.
- Investigating different fragmentation strategies for the efficient storage and management of large amounts of data in distributed database systems.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes

- Students recognise basic concepts, terms and architectures of relational database systems.
- Students understand the structure and functionality of various database management systems (DBMS).
- Students apply relational modelling techniques to create conceptual data models (e.g. ER diagrams).
- Students analyse requirements for database systems in order to select suitable technical solutions.
- Students evaluate simple database designs with regard to freedom from redundancy, normalisation and performance.
- Students create relational database schemas using suitable modelling and implementation tools.

Literature

Kofler, Michael: Datenbanksysteme - Das umfassende Lehrbuch; 2nd edition; Rheinwerk Verlag; Bonn, 2024
Heuer, Andreas; Saake, Gunter: Databases - Concepts and Languages; 6th ed.; MITP-Verlag; Bonn, 2018
Rahm, Saale, Sattler: Distributed and Parallel Data Management; Springer Vieweg; Berlin Heidelberg, 2015

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003859
Agentic AI: Enabling Autonomous and Goal-Driven Intelligence

Module profile

Exam number
5003859

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
English

Organisation

Responsible lecturer
Prof. Dr. Frank-Michael Schleif

Lecturer(s)
Manikanda Kumar

Applicability	BIN, BWI, BEC, BISD
Semester according to SPO	6. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
Python programming, Fundamentals of AI/ML.

Content
This course is designed to introduce next-generation AI systems capable of autonomous decision-making, planning, reasoning, and self-improvement to students. Unlike traditional reactive AI models, Agentic AI systems can initiate actions, perform multi-step tasks, collaborate with other agents, and adapt to dynamic environments. This course equips learners with both theoretical foundations and hands-on experience in building autonomous AI agents.
The learners will explore agent architectures, cognitive models, memory systems, tool-use capabilities, multi-agent collaboration frameworks, and practical agent deployment workflows. Through lab exercises using modern frameworks such as Flowise, LangChain, AutoGen Studio, CrewAI, and AgentOps, students will build goal-driven agents, evaluators, planners, and multi-agent systems. Real-world applications from business automation, sustainability, smart systems, and software engineering will be emphasised throughout.
The course ends with a practical assessment where participants design, implement, and demonstrate a functional autonomous agent. By integrating theory, hands-on experimentation, and evaluation, this course provides a strong foundation for applying Agentic AI in academic, industrial, and research environments aligned with the green digital transformation.

1 Foundations of Agentic AI
Agentic AI - Autonomous AI vs Traditional AI - Agent lifecycle and capabilities - Types of autonomy in AI systems - Rule-based agents vs LLM-driven agents - Real-world examples of agents - maturity levels of autonomous systems - Application domains aligned to sustainability & green digital transition.
Interactive brainstorming: Where can agents be used in business?
2. agent architectures, memory, and planning
Cognitive architecture: perception, reasoning, memory, action - Memory systems in agents: short-term memory, episodic memory, vector-store memory, long-term memory - Planning systems: task decomposition, tree of thought, planner-executor architecture - Tool-calling & API integration - Evaluator-planner loops - Safety layers & guardrails.
3. building autonomous agents and tool-using systems

Agent capabilities: tool-use, retrieval augmentation, action loops - Safety, guardrails, and constraints, Using frameworks: LangChain Agents, AutoGen Studio, CrewAI worker-manager roles - Hands-on use cases: Research automation agents - Business workflow agents.

4. multi-agent systems, collaborations, and workflows

Multi-agent systems: roles & communication, Manager-worker architecture, Planner-agent-reviewer loops, Collaboration strategies: parallel, sequential, cooperative, Real-world MAS applications (smart grids, supply chain, robotics)

5. deployment, monitoring, ethics

Deployment workflows (local, cloud) - Logging, monitoring, and evaluation of agents - Safety, ethical issues & governance of autonomous systems - Responsible AI principles for autonomous systems - Real-world challenges: hallucination, error handling, misuse.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Practical study achievement

The concrete length/format of the examination will be determined in the study plan.

Language of examination
English

Condition for the award of credit points
None

Learning outcomes
1. understand and explain the principles, architecture, and lifecycle of Agentic AI systems and compare them with traditional AI models.
2. design and implement autonomous agents using modern frameworks with capabilities such as planning, memory, tool-use, and reasoning.
3. evaluate and deploy single-agent and multi-agent systems for real-world applications related to sustainability, automation, and intelligent digital ecosystems.

Literature
Text Books:
Martin Ford "Architects of Intelligence: The truth about AI from the people building it" 2018.
Stuart J. Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall Series in Artificial Intelligence, 2009
Reference Books:
Kence Anderson, "Designing Autonomous AI: A Guide for Machine Teaching", O'Reilly Media, Inc., 2022

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 6322190
Augmented Reality

Module profile

Exam number
6322190

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar-style instruction, Exercise

Language of instruction
German

Organisation

Responsible lecturer
Stefan Sauer

Lecturer(s)
Stefan Sauer

Applicability	BEC, BIN, BWI, BISD, BDGD
Semester according to SPO	6. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
none

Content
The event is organised by the Faculty of Polymer Engineering and Surveying (FKV):
(https://geo.thws.de/studium/bachelor-geovisualisierung/studienablauf/modulhandbuch-bgv-ab-ws-202223/)

For scheduling see: https://geo.thws.de/studium/aktuelle-lehrveranstaltungsplaene/

Augmented and mixed reality and their applications
- Realisation of marker-based applications
- Realisation of image-based applications
- Realisation of LBS applications

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
1. students know the basic concepts of augmented reality (AR) and mixed reality (MR) and their areas of application.
2. students understand the differences between marker-based, image-based and location-based applications (LBS) in AR technology.
3. students use appropriate services to plan and realise AR applications.
4. students analyse requirements and possible uses for AR applications in relation to various content-based approaches.
5. students evaluate the effectiveness of different techniques for visualising content relative to spatial objects and markers.
6. students independently create AR applications that are both marker-based and image-based and can successfully publish them.
7. understand concepts for integrating AR applications into existing systems and services.

Literature
Dörner, R.; Broll, W.; Grimm, P.; Jung, B.: Virtual and Augmented Reality (VR/AR): Fundamentals and Methods of Virtual and Augmented Reality. 2nd edition, Springer-Verlag Berlin, Heidelberg, 2019. ISBN 978-3-662-58860-4.
Vetter, M. & Olberding, H.: E-learning material on geovisualisation, [online] smart.vhb.org, 2019/2020.

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003836
BSI BCM Practitioner and BSI Incident Practitioner

Module profile

Exam number
5003836

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Alexander Schinner

Lecturer(s)
Liane Kiesewalter,
Tobias Kasch

Applicability	BIN, BWI, BEC, BISD, BDGD
Semester according to SPO	6. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
none

Content
BCM practitioner
- Introduction to BCM
- BCM process and stage model
- Standards and regulatory principles
- Initiation, planning and set-up
- Structure and empowerment of the BAO
- BIA pre-filter and BIA
- Risk analysis
- Emergency planning (BC strategies, CFPs and WAPs)
- Practising and testing
- Performance review and key figures

Incident practitioner
- Introduction to the cyber security network including framework conditions for digital first responders, incident practitioners and incident experts
- Summary of the content of the basic course
- Behaviour on the phone incl. non-technical measures
- Threats and forms of attack and overview of the current threat situation
- Sequence of standard procedures
- Handling of IT security incidents
- Remote support
- Incident handling for IT systems "away from the usual office environment"
- "After the incident is before the incident" preventive measures

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes

- Teaching the BCMS process in accordance with BSI Standard 200-4 with practical relevance
- Effective detection, analysis and management of security incidents in accordance with BSI standards
- Preparation for the relevant BSI audits as part of the cyber security network (CSN)

Literature
https://www.bsi.bund.de/DE/Themen/Unternehmen-und-Organisationen/Standards-und-Zertifizierung/IT-Grundschutz/Zertifizierte-Informationssicherheit/Schulungen-zum-BCM-Praktiker/Schulungen_zum_BCM_Praktiker_node.html
https://www.bsi.bund.de/DE/Themen/Unternehmen-und-Organisationen/Informationen-und-Empfehlungen/Cyber-Sicherheitsnetzwerk/Qualifizierung/Vorfall_Praktiker/Vorfall_Praktiker.html

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003843
Business Data Visualization with Power BI and AI

Module profile

Exam number
5003843

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
English

Organisation

Responsible lecturer
Prof. Dr. Isabel John

Lecturer(s)
Dr. Soundarabai Beaulah Paulsingh

Applicability	BIN, BWI
Semester according to SPO	6. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
A basic understanding of problem-solving skills including simple excel calculations, creating graphs and charts and a preliminary understanding of database concepts.

Content
This course teaches students how to transform raw business data into actionable insights using Microsoft Power BI through interactive dashboards and AI-driven analytics. Participants gain hands-on experience in data cleaning, transformation, modeling, and visualisation, while applying AI features, including anomaly detection, to uncover trends and patterns. Students will develop practical expertise in the following areas:

- Foundations of Business Visualization: Understanding the role of data visualization in business, Power BI environment overview, data connectivity, and navigation of the Power Query Editor.
- Data Preparation and Modelling: Transforming, cleaning, and structuring data using Power Query, and building analytical data models with effective relationship management.
- Interactive Dashboard Development: Creating business-focused visuals, applying filters, slicers, and drill-throughs, and designing interactive dashboards for insight exploration.
- AI-Enabled Business Insights: Applying Power BI's built-in AI capabilities such as Key Influencers, Decomposition Tree, Q&A, Smart Narratives, and anomaly detection to explain trends, identify key drivers.
- Case Study: Conducting an end-to-end analysis and developing an interactive Power BI dashboard using a real-world business dataset to generate actionable insights.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
English

Condition for the award of credit points
None

Learning outcomes
By the end of this course, students will be able to

- Demonstrate an understanding of business data visualisation principles and the importance of analytics in decision-making.
- Clean, transform, and structure business data using Power Query to ensure reliable and analysis-ready datasets.
- Incorporate Power BI's built-in AI features, including anomaly detection, to explain trends, patterns, and key drivers in business data.
- Design and build interactive Power BI dashboards that effectively communicate insights to business stakeholders.

Literature
Literature will be given in the course

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 100000
Business Intelligence and Reporting

Module profile

Exam number
100000

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 0 hrs

Self-study: 150 hrs

Total: 150 hrs

Teaching format
Lecture

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Frank-Michael Schleif

Lecturer(s)

Applicability	BIN, BWI, BISD, BDGD
Semester according to SPO	6. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
This is an offer of the Virtual University of Bavaria. Further information can be found at https://kurse.vhb.org/VHBPORTAL/kursprogramm/kursprogramm.jsp?kDetail=true&COURSEID=20177,83,1508,1

Recommended prerequisites for the participation in the module
This is an offer of the Virtual University of Bavaria. Further information can be found at https://kurse.vhb.org/VHBPORTAL/kursprogramm/kursprogramm.jsp?kDetail=true&COURSEID=20177,83,1508,1

Content
This is an offer of the Virtual University of Bavaria. Further information can be found at https://kurse.vhb.org/VHBPORTAL/kursprogramm/kursprogramm.jsp?kDetail=true&COURSEID=20177,83,1508,1

The module is mandatory for students of the specialisation: << Business Technology >> in BWI
and is used as a substitute for the module BI specialisation I. For the participants of the BI specialisation
will also be offered 2-3 course parts by Prof. Schleif at SHL in summer semester 2025, especially on BI topics
and supplemented by an enrichment lecture. Please also note the timetable.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Written exam (sP) according to § 23 APO

Examination - length/format
90 minutes

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
This is an offer of the Virtual University of Bavaria. Further information can be found at https://kurse.vhb.org/VHBPORTAL/kursprogramm/kursprogramm.jsp?kDetail=true&COURSEID=20177,83,1508,1

Literature
This is an offer of the Virtual University of Bavaria. Further information can be found at https://kurse.vhb.org/VHBPORTAL/kursprogramm/kursprogramm.jsp?kDetail=true&COURSEID=20177,83,1508,1

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003823
Computer Networks and Cyber Security

Module profile

Exam number
5003823

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
English

Organisation

Responsible lecturer
Prof. Dr.-Ing. Sebastian Biedermann

Lecturer(s)
Siavosh Haghighi Movahed

Applicability	BIN, BWI, BISD
Semester according to SPO	6. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
none

Content
This module is designed to provide students with the knowledge and skills necessary to design, implement, and manage secure computer networks.
In this module, students will gain a solid foundation in establishing and maintaining robust network infrastructures. Simultaneously, the module addresses the critical aspect of securing these networks against potential threats, ranging from cyberattacks to data breaches. Through a combination of theoretical concepts and practical exercises, students will develop the expertise needed to identify vulnerabilities, implement security measures, and formulate strategies to safeguard information assets in the interconnected world of computer networks. In addition to providing a broad range of fundamental computer networking and security knowledge for all IT careers, this module will also provide students with an opportunity to further self-study and gain conceptual knowledge and practical skills required for 200-301 Cisco® Certified Network Associate (CCNA®) exam.

Indicative content:
- Fundamentals of enterprise campus network design
- Network protocols and models
- Fundamentals of IP routing and switching
- IP addressing (IPv4/IPv6)
- Network security concepts and principals
- Configure and verify secure Inter-switch connectivity
- Implementing, optimising, and securing switched networks
- Implementing secure device access and access control systems
- Define key security concepts (threats, vulnerabilities, exploits, and mitigation techniques)
- Firewall Technologies

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Written exam (sP) according to § 23 APO

Examination - length/format
90 minutes

The concrete length/format of the examination will be determined in the study plan.

Language of examination
English

Condition for the award of credit points
None

Learning outcomes
By engaging successfully with this module, students will be able to:
1. Explain the fundamentals of computer network and cyber security.
2. design, implement, configure, and troubleshoot high available secure scalable network infrastructures.
3. implement network security and access control solutions using routers, switches, and firewalls.
4. explain how vulnerabilities, threats, and exploits can be mitigated to enhance network security.

Literature
1. the students know the fundamentals of computer networks and cyber security principles.
2. the students understand the importance of securing network infrastructures against potential threats and vulnerabilities.
3. the students apply best practices in designing, implementing, configuring, and troubleshooting high-availability, secure, and scalable network infrastructures.
4. the students understand how threats and exploits can undermine network security and identify measures to mitigate these risks.
5. the students evaluate network security solutions, including access control measures implemented through routers, switches, and firewalls.
6. the students create comprehensive strategies to secure information assets and maintain robust network infrastructures based on theoretical knowledge and practical exercises.
7. the students develop the practical skills needed to prepare for the 200-301 Cisco® Certified Network Associate (CCNA®) exam, applying their learning to real-world scenarios.

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003861
Computer Networks for Practical Engineers

Module profile

Exam number
5003861

Duration
1 semester

Frequency
Irregular

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
English

Organisation

Responsible lecturer
Prof. Dr. Rolf Schillinger

Lecturer(s)
Bishnu Prasad Gautam

Applicability	BIN, BWI, BEC, BISD, BDGD
Semester according to SPO	6. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
none

Content
This course provides students with practical knowledge and skills in computer networks, focusing on how networks are constructed, configured, and operated by computer network engineers. The course begins at the physical layer with hands-on construction of LAN (Ethernet) cables, and then introduces fundamental concepts such as classful and classless IP addressing, switching, and routing.
Students will learn static routing as a foundation, followed by dynamic routing protocols including RIP, OSPF, and BGP through practical laboratory exercises. The course also introduces essential network security concepts, with particular attention to firewalls and basic network protection mechanisms required in real network environments.
In the final part of the course, students are introduced to next-generation networking paradigms, such as IoT, Software-Defined Networking (SDN), and Quantum Networks, providing insight into future network evolution. In addition to delivering a broad foundation in computer networking for IT and engineering careers, this course also supports self-study towards the 200-301 Cisco Certified Network Associate (CCNA) exam by developing relevant conceptual understanding and practical skills.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Written exam (sP) according to § 23 APO

Examination - length/format
90 minutes

The concrete length/format of the examination will be determined in the study plan.

Language of examination
English

Condition for the award of credit points
None

Learning outcomes

- The students understand the fundamentals of computer networking, including LAN construction, network components, and basic communication principles used in modern information systems.
- The students apply IP addressing, VLAN configuration, and routing concepts to design and configure small- to medium-scale networks using both static and dynamic routing methods.
- The students analyse and compare dynamic routing protocols such as RIP, OSPF, and BGP, and explain their operational principles, use cases, and performance characteristics.
- The students design and implement practical network topologies by integrating routers, switches, and end devices, and verify connectivity through hands-on configuration and testing.
- The students understand emerging and future network systems, including IoT, Software-Defined Networking (SDN), and quantum networks, and evaluate their potential impact on security, scalability, and next-generation communication infrastructures.

Literature
Will be provided at start of module.

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003817
Computer Vision: Artificial Intelligence Applied

Module profile

Exam number
5003817

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
English

Organisation

Responsible lecturer
Prof. Dr.-Ing. Pascal Meißner

Lecturer(s)
Prof. Dr.-Ing. Pascal Meißner

Applicability	BIN, BWI, BISD
Semester according to SPO	6. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
None

Recommended prerequisites for the participation in the module
None

Content
Have you ever wondered how self-service checkouts scan items, self-driving cars recognise pedestrians, computers detect skin cancer, and 3D models of iconic places like the Colosseum are scanned?

This module aims to answer these questions and many more by

- Giving an overview of the problems and approaches in computer vision, for applications as diverse as automation, robotics, medical imaging, and photogrammetry.
- Introducing the fundamentals of neural networks, required for constructing artificial systems with human-level perception capabilities.

The module spans from selecting the appropriate equipment for visual inspection tasks to image classification with convolutional neural networks and image retrieval with bag-of-visual-words models. The topics covered are:

01. introduction - nomenclature, history, state of the art, module logistics
02. image acquisition & digitisation - image sensors & representations, A/D conversion, Fourier transform
03. image enhancement - point operations, contrast adjustment, smoothing filters
04. feature extraction - edge detection, detection and description of local features
05 Segmentation and Morphology - Region growing, Hough transform, morphology operators
06. camera modelling - 3-D transformations, pinhole camera model, camera calibration
07. stereo vision - epipolar geometry, correlation methods, triangulation
08 Classification - Classifier evaluation, generalisation, nearest-neighbor, decision trees
09. ensemble methods - boosting and bagging, random forests, AdaBoost
10. neural networks - multi-layer perceptron, gradient descent, backpropagation

11. convolutional neural networks - Convolution and pooling layers, example architectures
12. bag-of-visual words - K-means clustering, TF-IDF, histogram comparison

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Colloquium

The concrete length/format of the examination will be determined in the study plan.

Language of examination
English

Condition for the award of credit points
None

Learning outcomes
By the end of the module, students should be able to:

- Select appropriate camera systems and convert image representations, as well as discuss causes and avoidance of aliasing
- Implement and apply smoothing and morphology operators, edge detectors, and segmentation techniques
- Differentiate between contrast adjustment methods and compare the various approaches to detect and describe local features
- Determine and compute rigid body transformations. Specify camera models and project image and scene points.
- Determine epipolar geometries and lines. Calculate and discuss different correlation methods
- Assess and implement the various techniques for visualising and cleaning data for training classifiers
- Apply feature engineering and selection to classification tasks
- Differentiate between the quantities in the bias-variance problem and apply it to classifiers
- Assess, implement, and train neural networks and discuss their application to vision tasks

This module will be taught in English and delivered online and on campus. All sessions will be recorded. Colloquia can be done in English or German.

Literature

- Digital Image Processing, Rafael C. Gonzalez and Richard E. Woods, 4th ed. Pearson, 978-0133356724, 2017
- Learning OpenCV 3: Computer Vision in C++ with the OpenCV Library, Adrian Kaehler and Gary Bradski, O'Reilly Media, 978-1491937990, 2017
- Introduction to Machine Learning, Ethem Alpaydin, 4th ed. MIT Press, 978-0262043793, 2020

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003862
Data Analytics

Module profile

Exam number
5003862

Duration
1 semester

Frequency
Irregular

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
English

Organisation

Responsible lecturer
Prof. Dr. Tobias Aubele

Lecturer(s)
Dr. Jaani Väisänen

Applicability	BIN, BWI, BEC, BISD, BDGD
Semester according to SPO	6. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
No coding required. Install Altair AI Studio before the course; a university student licence is available via https://web.altair.com/altair-student-edition.

Content
This course gives business students a practical, no coding introduction to data analytics using Altair AI Studio. You'll learn to build an end to end analytics workflow-from importing and preparing data to selecting variables, building models, evaluating performance, and interpreting results for business decisions.

- Course kickoff, AI Studio workflow basics, and practical data preparation for modelling
- Regression

o Concept: what regression explains
o Hands on workflow: build a regression model in AI Studio
o Validation and model goodness: simple train/validation/test incorporating key fit metrics

- Clustering

o Concept: grouping similar cases
o Hands on workflow: prepare data and create clusters in AI Studio
o Validation and model goodness: choosing a useful number of clusters for the business question

- Tree models

o Concept: classification and interpretable drivers
o Hands on workflow: build and read a decision tree in AI Studio
o Validation and model goodness: cross validation and practical classification metrics

- Association analysis:

o Concept: co-occurrence and recommendations
o Hands on workflow: create association rulesets in AI Studio
o Validation and model goodness: support, confidence, and lift

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
English

Condition for the award of credit points
None

Learning outcomes
Upon successful completion of this course, students will be able to:
1. construct end-to-end analytics workflows (Apply/Create): Independently design and execute complete data mining processes within Altair AI Studio-from data import and cleansing to model generation-without relying on programming code.
2. analyse and select Appropriate Methodologies (Analyze): Diagnose specific business problems to determine the most suitable analytical technique (Regression, Clustering, Decision Trees, or Association Analysis) based on the structure of the data and the desired business outcome.
3. evaluate model performance and robustness (Evaluate): Critically assess the quality of analytical models by interpreting quantitative validation metrics (such as R^2, Lift, Confidence, and Cross-Validation scores) to distinguish between statistical noise and reliable patterns.
4. synthesise data into business strategy (Create): Translate technical model outputs into actionable business insights and formulate data-driven strategic recommendations for management.

Literature
will be specified in the lecture.

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003135
Design Thinking & Innovation

Module profile

Exam number
5003135

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Michael Müßig

Lecturer(s)
Lisa Straub

Applicability	BEC, BIN, BWI, BDGD, BISD
Semester according to SPO	6. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
- Interest in creative but challenging problem-solving approaches
- Entrepreneurial thinking
- Willingness to rigorously put your own ideas to the test

Content
In this course, the basic principles and background of innovation management and especially design thinking are explained and illustrated with clear examples. It is particularly important to convey to the participants that today's innovation processes place people at the centre and attempt to harmonise their customer needs with technical feasibility and economic efficiency. The students are given the first tools to organise and carry out simple design thinking innovation processes independently.
They need to understand which basic elements an innovation or design thinking process is based on and how these can be skilfully run through exercises. This makes it clear in a practical way what differences there are to the classic development process and what advantages a customer-centred approach offers, but also what disadvantages are associated with the DT approach.
The course is divided into two main modules:
1. a brief introduction to innovation management
Participants will gain an insight into common innovation models and processes, as well as the background and basic concepts of innovation research.
2. learning and going through Design Thinking yourself
Design Thinking is based on an iterative, customer-centred and playful problem-solving process that makes it possible to think outside the box in order to realise or strive for the previously unconsidered, seemingly impossible, possibly illogical and unattainable. In the course of this course, participants will go through a design thinking process and develop their own ideas as a project. The course is therefore designed to be interactive, which is why a high degree of proactive participation is expected. In return, participants can expect a course full of creativity, interesting discussions and crazy ideas.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio, Presentation

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
1. students know the basic components of the design thinking process and can name them.
2. students understand the role of design thinking in the context of other innovation models and processes and can categorise them.
3. students apply methods of effective problem definition to identify relevant challenges in the innovation process.
4. students analyse the basics of user studies in the design thinking process and can explain their significance for solution development.
5. students evaluate innovation-relevant assumptions and hypotheses in order to be able to (de)construct them effectively.
6. students organise and conduct brainstorming sessions to generate creative ideas.
7. students create prototyping processes, describe them conceptually and can explain their practical application.

Literature
Wobser, Gunther (2022): Agile innovation management: overcoming dilemmas, mastering ambidexterity and achieving long-term success with innovations. Springer Gabler. 978-3662645147
Hasso Plattner Institute (A): What is Design Thinking. https://hpi-academy.de/en/design- thin- king/what-is-design-thinking.html.
Hasso Plattner Institute (B): The six steps in the Design Thinking innovation process. https://hpi.de/school-of-design-thinking/design-thinking/hintergrund/design-thinking- process.html.
Ideo: Design Thinking. https://designthinking.ideo.com/?page_id=1542.
d.School: An Introduction to Design Thinking. PROCESS GUIDE. Institute of Design at Stanford. https://dschool-old.stanford.edu/sandbox/groups/designresources/wiki/36873/ attach- ments/74b3d/ModeGuideBOOTCAMP2010L.pdf.
Brown, Tim (2009): Change by Design. How Design Thinking Transforms Organisations and Inspires Motivation. 1st edition. Harper Business. 978-006176608-4.
Lewrick, Michael; Link, Patrick; Larry, Leifer (2017): The Design Thinking Playbook. With traditional, current and future success factors. Verlag Franz Vahlen GmbH. 978-3039097050.
Uebernickel, Falk; Brenner, Walter; Pukall, Britta; Naef, Therese; Schindholzer, Bernhard (2015): Design Thinking. The handbook. 1st edition. Frankfurter Allgemeine Buch. 978-3956010651.
Wobser, Gunther: Reinventing yourself: What SMEs can learn from Silicon Valley. BESHU BOOKS. 978-3982195025

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003852
Digital Sovereignty - Operational Concepts and Technologies

Module profile

Exam number
5003852

Duration
1 semester

Frequency
Irregular

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr.-Ing. Tobias Fertig

Lecturer(s)
Prof. Dr. Michael Müßig,
Prof. Dr.-Ing. Tobias Fertig,
Andreas Schütz

Applicability	BIN, BWI, BEC, BISD, BDGD
Semester according to SPO	6. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
None

Recommended prerequisites for the participation in the module
None

Content
The module teaches basic concepts of digital sovereignty with a focus on the operational and technical implementation level.
After an introduction to key terms (e.g. dependencies on platform providers, data sovereignty, vendor lock-in, open source, open standards), specific technical alternatives and tools are considered.

Topics covered include
- Open source software vs. proprietary solutions
- Full stack open source (OS): in e-commerce, IT security, knowledge management, ERPs, ...
- Digital sovereignty at all levels: From hardware to payment flows (PayPal, ApplePay, GooglePay vs. digital euro, GNU Taler, Wero, etc.)
- Cloud alternatives (self-hosting, European cloud providers)
- Open standards and interoperability
- Data protection, encryption and data storage
- Practical examples from administration, education and companies

In the project-oriented part, students work in teams on specific application scenarios (e.g. digital infrastructure of a university, an SME or a municipality).
The aim is to develop realistic technical concepts to improve digital sovereignty.
The results are presented and reflected upon at the end of the semester as part of a transfer conference with a public audience and jury.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Practical study achievement

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes

- Students can name key terms, players and motivations of digital sovereignty.
- Students can explain how technical dependencies arise through software, cloud services and platforms.
- Students can select suitable open source and open alternative solutions for specific application scenarios.
- Students can analyse existing digital infrastructures with regard to dependencies, risks and sovereignty deficits.
- Students can compare technical solutions in terms of costs, maintainability, security and sustainability.
- Students can design and present an operational concept for improving digital sovereignty for a defined scenario.

Literature

- https://link.springer.com/book/10.1007/978-3-031-69994-8
- https://direct.mit.edu/books/monograph/3504/The-StackOn-Software-and-Sovereignty
- https://link.springer.com/article/10.1007/s44206-024-00146-7

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003840
Introduction to Project Management and Software Development based on SAP

Module profile

Exam number
5003840

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Frank Hennermann

Lecturer(s)
Daniel Rösch

Applicability	BIN, BWI
Semester according to SPO	6. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
Business Software, Programming 1

Content
In this FWPM, students learn how modern SAP technologies relating to FIORI 3 and SAP UI5 are connected, structured and used by means of a mobile order release. An application based on FIORI 3 is realised with the help of existing components and the associated OData backend services are connected. From planning to conceptualisation, the data model in the backend to the interface design is also covered. All tasks are worked on in small groups, which should ensure the sustainability of the learning success.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Colloquium

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
The module provides basic knowledge and skills in the area of project management, particularly in the context of consulting and development of SAP FIORI applications.

- Students learn to plan, implement and manage SAP FIORI projects efficiently in order to fulfil the needs of companies in the digital age.
- Students memorise basic concepts, terms and architectures of relational database systems.
- Students understand the structure and functionality of SAP FIORI applications.
- Students apply modelling techniques to create conceptual data models.
- Students analyse the technical and functional requirements of a specific task in order to select suitable technical solutions.
- Students independently create executable SAP FIORI applications using suitable modelling and implementation tools.

Literature
Engelbrecht M.: SAP FIORI - Implementation and Development, SAP PRESS Verlag 2017

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003845
Emotional and Persuasive Design in E-Commerce

Module profile

Exam number
5003845

Duration
1 semester

Frequency
Irregular

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
English

Organisation

Responsible lecturer
Prof. Dr. Tobias Aubele

Lecturer(s)
Petteri Markkanen

Applicability	BIN, BWI, BEC
Semester according to SPO	6. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
none

Content
This module focuses on the design and development of an e-commerce website over the course of one intensive week, with a primary emphasis on emotional and persuasive design. The module combines theoretical foundations with hands-on, iterative practice, enabling students to apply design principles directly to real e-commerce contexts. The work is grounded in user experience design and extends to ethical design in relation to dark patterns, as well as growth hacking as a means of improving and optimising digital commerce solutions.
Throughout the week, students work in teams to design, build, and iteratively refine an e-commerce website. All student teams are provided with access to a shared web hosting environment supplied by the course teacher, which is used throughout the week for building and testing the e-commerce sites. Theoretical concepts are continuously applied through practical implementation, user testing, and reflection. Applying theoretical concepts in practice, combined with iterative testing and refinement of the students' e-commerce websites, provides valuable insights. This process helps students recognise and understand different user groups, learn how to engage them emotionally, and ethically apply emotional and persuasive strategies in an e-commerce context.

- Introduction to basic operations and UX principles.

Students set up the e-commerce website using WordPress and WooCommerce on the provided web hosting environment, define target groups, and create user personas.

- Emotional Design.

Students design and implement emotional design strategies tailored to their selected target groups and personas.

- Persuasive Design and Ethical Design.

Students conduct user testing, apply persuasive design strategies, and develop the next iteration of the website while identifying and avoiding dark patterns.

- Growth Hacking for e-commerce.

Students conduct further user testing, finalize the website, and develop a plan for growth and optimisation.

- Presentation and Reflection.

Students present their completed websites and key findings, followed by reflection on the design and development process.
Mornings are dedicated to theoretical sessions, while afternoons focus primarily on hands-on activities, such as e-commerce site building, user testing, and interviews.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
English

Condition for the award of credit points
None

Learning outcomes
After completing the module, students will be able to:

- apply emotional and persuasive design principles in e-commerce website design
- design and evaluate user experiences for different target groups
- recognise ethical challenges in persuasive design in relation to dark patterns
- iteratively improve an e-commerce website based on user testing and feedback
- reflect on the role of emotional and persuasive strategies in digital commerce

Literature
Norman, D. A. (2004) Emotional Design: Why We Love (or Hate) Everyday Things. New York, NY: Basic Books.
Yocco, V. S. (2016) Design for the Mind: Seven Psychological Principles of Persuasive Design. Brooklyn, NY: Manning Publications.
Ellis, S. and Brown, M. (2017) Hacking Growth: How Today's Fastest-Growing Companies Drive Breakout Success. New York: Currency.

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003846
Ethical AI Hacking

Module profile

Exam number
5003846

Duration
1 semester

Frequency
Irregular

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
English

Organisation

Responsible lecturer
Prof. Dr. Benjamin Weggenmann

Lecturer(s)
Paulius Baltrušaitis

Applicability	BIN, BWI, BEC, BISD, BDGD
Semester according to SPO	6. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
None

Recommended prerequisites for the participation in the module
Python, ML/AI basics

Content
This course provides a comprehensive understanding of Artificial Intelligence (AI) security,
with a focus on ethical hacking principles, attacks on ML models and data, and defence strategies and techniques.

Students will gain theoretical and practical knowledge of key threats such as evasion, model extraction, model inversion, data extraction, data poisoning, backdoor attacks. How to provide attacks for testing purposes and what detection and protection techniques to use and how to use them.

Machine learning models such as Linear Regression, Support Vector Regression, K-Nearest Neighbours, Logistic Regression, Support Vector Machines (SVM), Decision Trees will be used.

Red and blue team scenarios will be used for practical exercises. Each student will play a role on both sides. The course will use several different scenarios for different attacks and machine learning models.

There is an example of a scenario for a red and blue team exercise focused on data poisoning and detection:
The company is developing a machine learning model to predict customer churn. The red team wants to reduce the accuracy of the logistic regression model by poisoning the data with label flipping. The goal of the blue team is to detect and mitigate the attack.
Red team tasks: Analyse the data set, develop the poisoning strategy, execute the attack, document the attack. The success of the red team is measured by the degree to which they degrade the performance of the model.
Blue team tasks: Establish a baseline (train a baseline model and evaluate the model's performance), Implement detection mechanisms - use techniques such as outlier detection (e.g. Isolation Forest), Mitigate the attack, Document the defence. The Blue Team's success is measured by their ability to detect and mitigate the attack and restore the model's performance.
Both teams will be judged on the clarity and thoroughness of their documentation and presentation of their findings to the whole group

of students, showing and commenting on their Python code and explaining their strategies.
Tools for coding: Jupyter Notebook environment for Python (scikit-learn, pandas, numpy, matplotlib, seaborn), e.g. Google Colab.

By the end of the course, students will work in teams to formulate responsible AI security testing methodologies that meet ethical and legal standards. They will discuss and evaluate the ethical implications of AI vulnerabilities and develop a set of ethical guidelines for AI security and ethical hacking.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Written exam (sP) according to § 23 APO

Examination - length/format
90 minutes

The concrete length/format of the examination will be determined in the study plan.

Language of examination
English

Condition for the award of credit points
None

Learning outcomes
1 Understand basic AI security concepts, ethical hacking principles, and key machine learning threats.
2 Identify and classify AI-specific attacks, including evasion, model extraction, and data poisoning.
3 Simulate red team (attacker) and blue team (defender) AI security scenarios.
4. apply ethical hacking techniques to assess and exploit vulnerabilities in AI models.
5. evaluate AI attack detection and protection strategies to improve security.
6. investigate AI security breaches and analyse countermeasures.
7. develop ethical guidelines for responsible AI security testing and vulnerability disclosure.

Literature
To be clarified during lessons

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003863
International Digital Marketing

Module profile

Exam number
5003863

Duration
1 semester

Frequency
Irregular

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
English

Organisation

Responsible lecturer
Prof. Dr. Christina Völkl-Wolf

Lecturer(s)
Sami Lanu

Applicability	BIN, BWI, BDGD, BISD
Semester according to SPO	6. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
None

Content
- Digital Marketing Strategies
- Digital marketing channels (owned, earned, paid)
- Search Engine Optimisation
- Digital marketing target group segmentation
- Social media marketing (including TikTok)
- Digital marketing targets, analytics and metrics

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
English

Condition for the award of credit points
None

Learning outcomes
After the module/course students will:
1. remember & understand:
- explain the role of marketing in e-commerce and in digital society.
- describe fundamental concepts of search engine optimisation (SEO).
- outline key digital marketing metrics and analytical tools.

2. apply
- plan and implement digital marketing campaigns at an international level.
- conduct target group segmentation using Meta and Google Ads tools.
- manage social media marketing activities.
- use digital analytics and tracking tools to monitor campaign performance.

3. analyse
- analyse and select appropriate digital marketing channels (owned, earned, and paid media) for different business objectives.
- evaluate campaign results based on relevant performance indicators.

4. evaluate
- assess the effectiveness and efficiency of digital marketing strategies.
- compare and critically evaluate different digital marketing approaches and channels.

5. create
- develop integrated digital marketing strategies for international markets.
- design data-driven optimisation plans for digital marketing campaigns.

Literature
Marketing 4.0 by Philip Kotler etc. (Lecturer will provide pdf's of the needed part of the book)
Digital Marketing Trends 2026 by Brandwatch(Lecturer will provide pdf's of the needed part of the book)
Latest Meta and Google Ads best practices (Lecturer will provide pdf's)

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003837
Introduction to Artificial Intelligence

Module profile

Exam number
5003837

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
English

Organisation

Responsible lecturer
Prof. Dr. Andreas Lehrmann

Lecturer(s)
Prof. Dr. Andreas Lehrmann

Applicability	BIN, BWI, BEC, BISD, BDGD
Semester according to SPO	6. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
Basic knowledge in programming (Python) and mathematics (linear algebra, analysis).

Content
Over the last few years, artificial intelligence (AI) has profoundly changed the way we process information and make decisions, both in our personal and professional lives. A thorough understanding of the principles underlying AI is therefore a critical skill in many industries.

This course serves as a broad introduction to AI and its subfields. We are going to discuss - from scratch - the design, training, and operation of an AI system. Motivated by intuitive concepts and visual insights, we are going to introduce a technical framework that allows us to express the fundamental building blocks of an intelligently operating system (e.g., an autonomous robot). Such a system needs to:

- Organise task-dependent data and use this data to make predictions.
- Understand its environment by connecting sensory information to physical location.
- Interact with its environment by planning routes and manipulating objects.

The course will be accompanied by small coding projects in Python that demonstrate the application of these concepts in a series of practical scenarios.

In particular, the course covers the following topics:

[The State of AI] Historical developments, emerging trends, and open questions
[Tools & Techniques] AI-assisted productivity & creativity
[The AI Pipeline] From hard-coded rules to learned decisions
[Data] Collection, representation, and analysis of data
[Hello World] Algebraic, analytical, and statistical foundations of AI
[Supervised Learning I] Data-driven models of reality: classification and regression
[Supervised Learning II] Data-driven models of reality: model complexity and regularisation

[Unsupervised Learning] Finding patterns without annotations
[From Perception to Action I] Visual AI: understanding information in images
[From Perception to Action II] Visual AI: localising information in images
[From Perception to Action III] Embodied AI: manipulating environments
[From Perception to Action IV] Embodied AI: navigating environments
[Guest Lecture] Industrial applications of AI in the automotive industry
[AI & U] Working with and contributing to the future of AI

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Written exam (sP) according to § 23 APO

Examination - length/format
90 minutes

The concrete length/format of the examination will be determined in the study plan.

Language of examination
English

Condition for the award of credit points
None

Learning outcomes

- The students understand the structure of the AI landscape, including its different subfields and how they are connected.
- They can express industry tasks as learning problems (supervised, unsupervised, reinforcement) and select an appropriate AI framework for the type of data at hand.
- They are familiar with the individual components of the selected AI framework - (1) data acquisition and representation; (2) model specification and optimisation; and (3) performance evaluation and analysis - and can set up and execute this pipeline.
- The students understand the role of embodied AI and the challenges and solutions that come with it, such as perception, kinematics, and navigation.

Literature
W. Ertel: Introduction to Artificial Intelligence, Springer, 2024.
C. Bishop: Pattern Recognition and Machine Learning, Springer, 2016.

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003069
Mobile Applications

Module profile

Exam number
5003069

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 50 hrs

Self-study: 100 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
English

Organisation

Responsible lecturer
Prof. Dr. Peter Braun

Lecturer(s)
Prof. Dr. Peter Braun

Applicability	BEC, BIN, BWI, BISD
Semester according to SPO	6. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
Good programming skills (e.g. from Programming 1 and 2, Web Programming 1 to 3) or similar.

Recommended prerequisites for the participation in the module
none

Content
This module introduces software development of mobile devices. The Android operating system and/or iOS will be used in the course. The development environment will be Flutter on Android Studio or VS Code. Dart will be used as the programming language. No prior knowledge of Dart programming is expected, but a good understanding of other languages (e.g., Java, Python, or JavaScript) is required.

Introduction to Dart Programming
- Short Overview of Flutter: History, advantages, and architecture.
- Introduction to Dart programming language.
- Setting up the development environment.

Introduction to Flutter - Flutter GUI development
- Understanding widgets and basic UI elements.
- Understanding Stateful and Stateless widgets.
- Layout widgets: Row, Column, Stack, etc.
- Basic interaction elements: Buttons, sliders, and switches.

Navigation and State Management
- Navigation patterns: push/pop navigation, named routes.
- State management basics: setState, Provider.
- Implementing forms and user input handling.

Working with External Data
- Fetching data from the internet (APIs).
- JSON serialisation and deserialisation.
- Firebase

Integrating Device APIs like Location and Camera
- Introduction to Device APIs in Flutter.
- Implementing location services: getting and using GPS data.
- Accessing and using the camera: taking pictures and video recording.
- Permissions handling for location and camera.

Testing Advanced Features and Best Practices

- Animations and transitions.
- Using custom fonts and assets.
- Best practices in Flutter development.
- Testing Flutter Apps

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
English

Condition for the award of credit points
None

Learning outcomes

- The students understand the fundamentals of mobile application development using Flutter for Android and iOS, focusing on professional programming practices.
- The students apply concepts of asynchronous programming and thread management to handle complex tasks in mobile applications efficiently.
- The students analyse architecture concepts for mobile solutions, including the distribution between client and server and communication protocols for mobile devices.
- The students design mobile user interfaces based on reusable software components, ensuring an intuitive and consistent user experience.
- The students implement mobile applications that integrate sensor data evaluation and server communication, following best practices in mobile development.
- The students evaluate different mobile architecture approaches and technologies to choose the most suitable solutions for specific application requirements.
- The students create a fully functional mobile application for Android or iOS, including publishing and deployment.

Literature
Dieter Meiller: Modern App Development with Dart and Flutter 2: A comprehensive introduction to Flutter. De Gruyter Oldenbourg, 2021.

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003864
Next-Generation Ethical Hacking and Cyber Forensics

Module profile

Exam number
5003864

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
English

Organisation

Responsible lecturer
Prof. Dr.-Ing. Sebastian Biedermann

Lecturer(s)
Prof. Dr. Minal Moharir

Applicability	BIN, BWI
Semester according to SPO	6. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
Basic knowledge of Computer Networks, Operating System.
Installation of Kali Linux on oracle virtual box.

Content
1 Introduction to Ethical Hacking and Vulnerability Analysis
Fundamentals of key issues in the information security world, including the basics of ethical hacking,. Ehiical Hacking Life cycle, Different vulnerability assessment and Penetration testing tools, overview of AI in offensive and defensive security
Hands-On:: Shodan, Nmap, Nexpose, Netcraft, privateeye, Google advanced search operators, Harvester, Burpsuite, SIEM tools
2. social engineering and session hijacking
Social engineering concepts and techniques, including how to identify theft attempts, use of generative AI for phishing content and deepfakes
Web server attacks, including a comprehensive attack methodology used to audit vulnerabilities in web server and web applications. web application hacking methodology,.
Hands-On:: Case Study: Phishing attack MiM attack: Kali Linux, BettrCap, SetTool Kit, GoFish, Hacking Web Servers and Hacking Web Applications: SQL Injection attack, CSS attack, Splunk ML Toolkit
3 IoT and Cloud Hacking
IoT and Cloud attacks, hacking methodology, hacking tools, IoT and cloud security techniques and tool
Hands-On:: IoT Scada Hacking using MODBUS. Auto mobile Hacking, role of AI in large-scale log analysis and anomaly detection in cloud/IoT telemetry, Case study using Suricata
4. introduction to Cyber Forensics: Principles of Cyber Forensics, Chain of Custody and Evidence Handling, Introduction to Digital Evidence Types, Importance of Forensic Image Creation, introduction to machine-learning-supported triage of logs, files and network traces
Hands-On:: Create a forensic image using FTK Imager, Validate image integrity with hash functions, Splunk SOAR
5 File System and Disk Forensics: Analyzing File Systems: FAT, NTFS, EXT, Data Recovery Techniques and Deleted File Recovery. Identifying Hidden Files and Metadata
Network Forensics: Basics of Network Traffic Analysis, Identifying Suspicious Network Activity, Packet Analysis and Monitoring Logs
Hands-On:: Create a forensic image using FTK Imager, Validate image integrity with hash functions, Analyze network packets using Wireshark, Capture and analyse suspicious traffic for anomalies

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Practical study achievement

The concrete length/format of the examination will be determined in the study plan.

Language of examination
English

Condition for the award of credit points
None

Learning outcomes
Develop a solid understanding of ethical hacking and cyber forensics concepts, techniques, and tools.
Identify, exploit and analyse vulnerabilities in systems, networks, IoT and cloud environments using both classical and AI assisted tools.
Apply forensic techniques and selected ML-based methods to investigate and document cyber incidents
Execute different attack scenarios within an ethical framework.
Gain hands-on experience with industry-standard and AI-enhanced tools (e.g. Nmap, Wireshark, Metasploit, Autopsy and anomaly-

Literature
CEH with AI v13: Certified Ethical Hacker Study Guide" by Ric Messier
Digital Forensics with Open Source Tools" by Cory Altheide and Harlan Carvey
Securing Agentic AI: A Comprehensive Threat Model and Mitigation Framework for Generative AI Agents, https://arxiv.org/pdf/2504.19956

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003809
Principles of Autonomous Drones

Module profile

Exam number
5003809

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
English

Organisation

Responsible lecturer
Prof. Dr. Frank Deinzer

Lecturer(s)
Marcel Kyas

Applicability	BIN, BWI, BISD, BDGD
Semester according to SPO	6. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
none

Content
You will learn the fundamental methods for endowing aerial autonomous drones with perception, planning, and decision-making capabilities. You will learn algorithmic approaches for robot perception, localisation, and simultaneous localisation and mapping, as well as the control of non-linear systems, learning-based control, and aerial drone motion planning. You will learn methodologies for reasoning under uncertainty.

On day one, you will learn to describe the basic control loop of an autonomous robot. You will explain the basics of drone locomotion and kinematics (how drones move). On day two, you will learn to enumerate the purpose of sensors on a drone. You will explain the structure and applications of Bayesian filters. On day three, you will learn to implement a simple localisation system. On day four, you will learn to explain behavior trees as a formalism to describe drone behaviour. You will learn to define principles of planning algorithms (Dijkstra's Algorithm, A* Search, D* Search). You will apply reinforcement learning to solve drone planning problems.

You will design a simulation in Robot Operating System 2 (ROS2) for demonstrations and hands-on activities.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Colloquium

The concrete length/format of the examination will be determined in the study plan.

Language of examination
English

Condition for the award of credit points
None

Learning outcomes
1. the students know the fundamental principles of motion control applied to aerial autonomous drones.
2. the students understand basic concepts of perception, distinguishing between classic approaches and deep learning methods for robot perception.
3. the students can explain principles of localisation and Simultaneous Localization and Mapping (SLAM), including their importance for autonomous navigation.
4. the students analyze navigation algorithms, focusing on planning and decision-making processes necessary for effective drone operation.
5. the students apply algorithmic approaches for robot perception, localisation, and planning in practical scenarios.
6. the students implement learning-based control techniques for aerial drones to enhance their motion planning capabilities.
7. the students utilize the Robot Operating System (ROS) in demonstrations and hands-on activities, reinforcing the theoretical concepts covered in the course.

Literature
Roland Siegwart, Illah Reza Nourbakhsh, and Davide Scaramuzza. Introduction to Autonomous Mobile Robots, second edition. 2011, The MIT Press
Sebastian Thrun, Wolfram Burgard, and Dieter Fox. Probabilistic Robotics. 2005, The MIT Press

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5102910
Project Work

Module profile

Exam number
5102910

Duration
1 semester

Frequency
Every semester

Credit hours (SWS)
4

ECTS-Credits (CP)
10.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 240 hrs

Total: 300 hrs

Teaching format
Project

Language of instruction
German/English

Organisation

Responsible lecturer
Prof. Dr. Peter Braun

Lecturer(s)
Prof. Dr. Arndt Balzer,
Prof. Dr. Peter Braun,
Prof. Dr. Frank Deinzer,
Prof. Dr. Steffen Heinzl,
Prof. Dr. Isabel John,
Prof. Dr. Frank-Michael Schleif,
Prof. Dr. Christian Bachmeir,
Prof. Dr.-Ing. Sebastian Biedermann

Applicability	BIN
Semester according to SPO	6. semester
Type of module	Compulsory module

Required prerequisites for the participation in the module according to the SPO
100 ECTS points

Recommended prerequisites for the participation in the module
none

Content
The project work is usually teamwork (at least three students). It involves either end-to-end software development according to the rules of software engineering or another task from the IT field (e.g. software comparison, software selection, software introduction). Each project is supervised by a professor from the Faculty of Computer Science and Business Informatics. In the course of the project work, the techniques and methods learned in computer science are practised in a practical professional context (teamwork; project organisation; practical tasks).
The topics of the practical examples for the examination are provided by or agreed with the lecturer in the traditional degree programme. In the BIN dual study programme, a practical task is worked on in consultation with the lecturer. This ensures practical relevance and feedback from the company.
Students are instructed to independently develop software and create documentation consisting of the following parts:

- Software development
- Requirements specification, in which the requirements for the project work are compiled (with milestones/schedule)
- Technical design using appropriate methods
- IT design
- Listing
- User manual
- Appendix (literature used; list of abbreviations, glossary, etc.)
- For other tasks:
- Project description in which the requirements for the project work are summarised (with milestones/schedule)
- Further contents to be specified by the supervising professor, which result from the individual character of the respective assignment
- Appendix (literature used; list of abbreviations, glossary, etc.)

The topics of the practical examples for the examination are provided by or agreed with the lecturer in the traditional degree programme. In the dual study programme variant, a practical assignment is worked on in consultation with the lecturer.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
error

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German/English

Condition for the award of credit points
None

Learning outcomes
Students can methodically process and solve comprehensive tasks.
Students can develop and implement suitable solution strategies in a team.
They know how team processes work and how they can contribute their own personality.
Students can independently set up, implement, support and present a small IT project in a team. They can identify and use appropriate development technologies and test and document their code.

Literature
depending on the respective project work

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003865
Quantum Computing

Module profile

Exam number
5003865

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
English

Organisation

Responsible lecturer
Prof. Dr. Frank-Michael Schleif

Lecturer(s)
Divya Rani

Applicability	BIN, BWI, BEC, BISD, BDGD
Semester according to SPO	6. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
Basic Linear Algebra and Python Programming

Content
This course provides a comprehensive introduction to the principles, mathematical foundations, hardware concepts, and programming tools of quantum computing. Students will explore qubits, superposition, entanglement, quantum gates, algorithms, noise models, error correction, and real-world applications. Hands-on sessions using Qiskit enable learners to construct and simulate quantum circuits and run programs on IBM Quantum devices.

1. foundations of quantum computing
Classical vs Quantum computation, Qubits and quantum states, Superposition and entanglement, Dirac notation (bras & kets),Bloch sphere representation, Quantum measurement and collapse, Physical implementations of qubits: Superconducting, Ion traps, Photonic systems.
2. quantum gates and quantum circuits
Single-qubit gates: Pauli-X, Y, Z, Hadamard (H), Phase, S, T, Multi-qubit gates: CNOT, Swap, Controlled phase, Building quantum circuits, Reversible computing principles, Quantum circuit simulation tools, IBM Qiskit basics, Circuit construction & visualisation, Noise, error sources & decoherence.
3. quantum algorithms
Quantum parallelism, Deutsch-Jozsa algorithm, Grover's search algorithm, Shor's factoring algorithm Quantum Fourier Transform (QFT), Phase estimation, Variational Quantum Algorithms (VQA): VQE, QAOA
4. quantum hardware, noise & error correction
NISQ (Noisy Intermediate-Scale Quantum) era systems, Quantum noise models: Bit flip, Phase flip, Depolarising noise, Quantum error correction basics: Shor code, Steane code, Surface code (overview), Fault-tolerant quantum computation, Quantum supremacy claims (Google, IBM).
5. applications, future trends & quantum programming
Quantum cryptography (BB84, QKD), Post-Quantum Cryptography (PQC), Quantum Machine Learning (QML) basics, Quantum optimization (QAOA use cases), Quantum simulation in chemistry & physics Hands-on Qiskit programming: Creating circuits, executing on simulators, Running on IBM Quantum systems.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Written exam (sP) according to § 23 APO

Examination - length/format
90 minutes

The concrete length/format of the examination will be determined in the study plan.

Language of examination
English

Condition for the award of credit points
None

Learning outcomes
On successful completion of the course the students shall be able to
1. explain the fundamental concepts of qubits, superposition, entanglement, and quantum measurement.
2. construct and simulate quantum circuits using quantum gates and operators.
3. analyse the working of major quantum algorithms and identify their computational advantages.
4. understand hardware constraints, quantum noise, and basic quantum error correction techniques.
5. implement quantum programs using Qiskit and evaluate applications of quantum computing across domains.

Literature
Textbook(s):
1 Nielsen, M., & Chuang, I. Quantum Computation and Quantum Information, Cambridge University Press, 2010.
2. Yanofsky, N., & Mannucci, M. Quantum Computing for Computer Scientists, Cambridge University Press, 2008.
References:
1. IBM Quantum Documentation - https://quantum-computing.ibm.com
2. Qiskit Textbook - https://qiskit.org/learn
3 Preskill, J. Quantum Computing in the NISQ Era.
4. Arun P. Quantum Computing: An Applied Approach, Springe
Online Resources (e-books, notes, ppts, video lectures etc.):
1. Qiskit Tutorials: https://qiskit.org/tutorials
2. Quantum Algorithms Zoo: https://quantumalgorithmzoo.org
3. MIT OCW - Quantum Computation
4. IBM Quantum Lab (free cloud access).

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003067
Requirements Engineering

Module profile

Exam number
5003067

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
English

Organisation

Responsible lecturer
Prof. Dr. Isabel John

Lecturer(s)
Prof. Dr. Isabel John,
Dr. Anne Heß,
Dr.-Ing. Benedikt Kämpgen

Applicability	BEC, BIN, BWI, BISD, BDGD
Semester according to SPO	6. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
Software Engineering /Software Development

Content
This module focuses on the crucial initial phase of the software development lifecycle, where the needs and constraints of the system are gathered, analysed, and documented. Similarly, machine learning (ML) system development projects benefit from RE. So this module covers requirements engineering techniques for traditional systems as well as for ML systems.

Basics of Requirements Engineering
Task Oriented, Goal Oriented RE
Elicitation Techniques
Analysis techniques
Specification / Modelling techniques
Validation techniques
RE in User Experience Engineering
RE Skills
Case Studies and Applications of Requirements Engineering
Requirements Engineering for machine learning systems
Requirements Engineering in the age of ChatGPT / generative artificial intelligence

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
English

Condition for the award of credit points
None

Learning outcomes
The students remember fundamental RE models, methods, and their relevance in the software development process.
The students understand the importance of requirements engineering, including stakeholder analysis, in diverse project contexts, including international and AI-driven projects.
The students apply requirements elicitation techniques and modelling methods, such as UML, use cases, user stories, and non-functional requirements, to real-world scenarios.
The students analyze requirements through negotiation, prioritisation, and validation against quality criteria to ensure completeness and clarity.
The students evaluate different RE approaches and adapt techniques suited for specific domains like machine learning and generative AI systems.
The students create comprehensive requirements specifications and models that address the needs of complex, modern software systems, including AI applications.
The students are able to adapt requirements engineering techniques for generative artificial intelligence based systems

Literature
Cockburn, Writing Effective Use Cases, Addison Wesley, 2016
Hull, Requirements engineering, Springer Verlag, 2019
Berenbach, Software & Systems Requirements Engineering: In Practice, McGraw Hill, 2017
Chris Rupp & the SOPHISTs , Requirements Engineering (in German), Hanser, 2022
Huyen, Chip. Designing machine learning systems. " O'Reilly Media, Inc.", 2022.

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003857
Seminar Smart Systems

Module profile

Exam number
5003857

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Arndt Balzer

Lecturer(s)
Prof. Dr. Arndt Balzer

Applicability	BIN, BWI, BEC, BISD, BDGD
Semester according to SPO	6. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
Courses in the field of computer engineering

Content
Contents: In the specialisation module, students work independently on topics from the field of smart systems. Solutions (hardware and software) are developed and presented.
Topics from previous years (selection): AI based checkout, Braille Reader, Inverse Pendulum, Kalman Filtering, Pathfinding with Turtlebot, Quadrocopter, Radar + Lidar, ROS (Robot Operating System), SDR (Software Defined Radio), SLAM (Mapping, Localisation, Navigation), Supervised Learning, Reinforcement Learning, Rock-Paper-Scissors on Pepper, WIFI Indoor Localisation, ...
The seminar is organised under a regularly updated umbrella topic, for which individual topics are assigned. The topics are determined at the beginning of the seminar and are based on current developments. Actuators and sensors, low performance systems through to smartphones, their programming and evaluation of prototype implementations are always of interest.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Multimedia presentation, Colloquium

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
Learning objectives: By dealing with a selected topic, the ability to deal with challenging topics is deepened.

- The students acquire mathematical and technical basics
- Derive the specialised knowledge required for their specific topic or area of application
- Implement this knowledge using the methods they have learnt and acquire additional confidence in their application

The findings are documented and the results are presented at the end of the seminar

- Students acquire the skills to document and present results in a comprehensible manner.
- Students apply methods of scientific work including (literature) research.
- Students generalise their ability to independently expand existing knowledge and quickly familiarise themselves with the topics of others (fellow students)

Literature

- Will be announced in each case.

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003854
Smart Agriculture

Module profile

Exam number
5003854

Duration
1 semester

Frequency
Irregular

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
English

Organisation

Responsible lecturer
Prof. Dr. Peter Braun

Lecturer(s)
Prof. Dr. Peter Braun,
Prof. Dr. Isabel John

Applicability	BIN, BWI, BEC
Semester according to SPO	6. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
None

Recommended prerequisites for the participation in the module
None

Content
The module deals with typical problems of smart agriculture using a concrete example: systematic data acquisition in the field with drones, structured processing and analysis of image data and the derivation of comprehensible key figures and maps as a basis for an initial inspection. Building on this, methods for image-based detection and quantification of anomalies are developed and integrated into simple data management with visualisation. A further focus is on the validation of image-based findings using independent measured values and on the statistical testing and interpretation of relationships using correlations. The implementation is carried out prototypically in the form of software artefacts and presentations of results.

The module is carried out in cooperation with the partner university Suwa University of Technology in Japan and is supported by teaching contributions from professors at the partner university. An important part of the module is an excursion to Suwa University, during which the prototype results are further developed, validated and jointly presented together with Japanese students. Intercultural content includes manners, communication styles in emails and video conferences, joint laboratory work, projects and presentations as well as behaviour and everyday rules on site in Japan.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
English

Condition for the award of credit points
None

Learning outcomes

- Students describe central data sources and outputs (drone images/ logs, AI results, measured values) and organise them into a consistent data flow.
- Students implement a traceable data pipeline in Python including simple quality controls and reproducible exports (e.g. GeoTIFF/PNG, reports).
- A group of students calculate ExG/VARI/NDVI and critically interpret index maps under field conditions (light changes, shadows, missing bands).
- A group of students explain basic AI tasks (classification, detection, segmentation) and assess limitations due to domain shift and uncertainty in the field.
- A group of students correlate physiological measurements (Fv/Fm, chlorophyll index) with image/KI metrics (Pearson/Spearman) and derive an evidence-based assessment.
- Students explain basic forms of behaviour and politeness in the Japanese university environment and derive an appropriate appearance in meetings and on site.
- Students formulate professional emails and prepare video conferences with Japanese contacts in a structured manner.
- Students lead their project using appropriate project management methods and pay attention to intercultural project management aspects during the excursion and interaction with Japanese students

Literature
Will be announced later in the seminar.

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003810
Software Testing

Module profile

Exam number
5003810

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
English

Organisation

Responsible lecturer
Prof. Dr. Peter Braun

Lecturer(s)
Pascal Moll

Applicability	BEC, BIN, BWI, BISD
Semester according to SPO	6. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
None

Recommended prerequisites for the participation in the module
Programming I or backend programming or programming in Python or basic programming; object-orientated programming in Java
Participants will receive a virtual machine, the functionality of which should be tested before the course begins.

Content
This module deals with different types of tests and their application in software development. The SOLID principles and the 4-layer concept for test architectures are taught. It also covers the automated testing of interfaces and APIs as well as the use of mocking. Another focus is on behaviour-driven development with Cucumber. Exploratory testing and the integration of automated tests into a DevOps life cycle are also discussed. The module includes practical content for which a virtual machine is provided. The prerequisite for this is the installation of VirtualBox.

- Fundamentals of testing (test coverage, test paths, black box, white box, grey box, functional and non-functional tests, test pyramid)
- Test automation (goals, success factors, differences between different types, test framework JUnit, annotations, assertions, exception testing, parameterisation, test types, record replay, scripted testing, keyword-driven testing)
- Test architecture (SOLID principles, 4-layer concept, test modelling layer, test definition, test execution, test adaptation, interfaces, design and development, important design patterns for testing)
- Testing of graphical user interfaces (introduction to Selenium, drivers, PageObject patterns, identifiers, waits, cookies)
- Mocking (Wiremock)
- Behaviour Driven Development (Feature Files & Step Files, Cucumber & Gherkin, Parameters, Data Tables, Scenario Outlines and Background, Runner Classes)
- Exploratory testing (methods and techniques)
- Build Server (Jenkins basics & DevOps basics, gPipelines, DevOps process from a testing perspective)

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
English

Condition for the award of credit points
None

Learning outcomes

- Students define test objectives for software.
- Students analyse test objectives and define suitable test types.
- Students translate test types into automated tests.
- Students decide on the use of design patterns in testing and apply design patterns.
- Students explain Behaviour Driven Development.
- Students set up and configure a build server for testing.

Literature
Essentials of Software Testing by Ralf Bierig, Stephen Brown, Edgar Galván, Joe Timoney, 2021, Cambridge University Press

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003858
Smart Systems

Module profile

Exam number
5003858

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Arndt Balzer

Lecturer(s)
Prof. Dr. Arndt Balzer

Applicability	BIN, BWI, BISD, BDGD
Semester according to SPO	6. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
Programming I + II, Fundamentals of Computer Engineering, Computer Architecture, Operating Systems, Algorithms & Data Structures

Content
- Introduction to C for programmers
- Specifics of programming microcontrollers (ESP32, 32-bit microcontroller family from Espressif)
- Memory model, interrupt concept, ...
- Hardware structure and programming of common interfaces for communication and control of peripherals such as U(S)ART, SPI (Four Wire), I²C (Two Wire), OneWire, CAN
- Programming of peripheral devices such as digital sensors: IMU (10-axis), digital thermometers, ultrasound and actuators: displays, servos, loudspeakers, ...
- Programming of wireless interfaces (RF) such as Bluetooth and WiFi to control applications such as servos, etc. using smartphones
- Implementation of small AI models (image recognition using USB cam)
- Introduction to a current, application-based development environment ESP-IDF (Espressif IoT Development Framework)

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Colloquium, Practical study achievement

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
Students are able to

- explain the specific programming of controllers and their interfaces,
- assess historically grown interfaces,
- use a software development environment that makes efficient use of innovative and application-optimised peripheral functions,
- develop hardware-related software in the C programming language for various applications.

Literature

- Kernighan, Ritchie: The C programming language, 2nd Edition (ANSI)
- Udo Brandes: Microcontroller ESP32 - The comprehensive manual
- Dausmann, et. al.: C as the first programming language, Vieweg, 2011, ebook
- Wolf: C from A to Z, Galileo Computing, openbook

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Module: 5111279
Transfer colloquium

Module profile

Exam number
5111279

Duration
1 semester

Frequency
Every semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
German/English

Organisation

Responsible lecturer
Prof. Dr. Peter Braun

Lecturer(s)
Prof. Dr. Peter Braun

Applicability	BIN
Semester according to SPO	6. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
Only for dual students on the BWI degree programme

Recommended prerequisites for the participation in the module
None

Content
The transfer colloquium serves the exchange of students in the dual study programme and replaces one of the FWPM. Students on the normal version of the degree programme do not take part in this event. The event takes place over the third to seventh semester, with the exception of the practical semester. Under the guidance of a lecturer, the dual study programme students discuss the following topics:

- Introduction and overview: Presentation of the transfer colloquium and its objectives, explanation of the importance of the exchange of experience between the university and company for dual students.
- Reflection on practical experience: In-depth reflection on the knowledge and skills acquired during the programme and in practice, as well as their application in everyday working life.
- Exchange of experience: Moderated discussions on challenges and solutions in the coordination between university studies and practical work in the company.
- Best practice examples: Presentation and discussion of successful projects and practices from the company that have been implemented by students in their studies and in practice.
- Problem-solving strategies: Development and presentation of solutions to typical problems that can arise in dual studies, including time management and prioritisation.
- Application of theoretical knowledge: Deepening the understanding of how theoretical knowledge from the university modules can be practically applied in the company.
- IT security in the company: Introduction to the importance and implementation of IT security measures in practice, based on theoretical principles and practical applications.
- Project documentation and presentation: training in the creation and presentation of project documentation in order to present the work carried out in the company in a structured manner.
- Feedback and continuous improvement: Systematic collection and analysis of feedback from companies and the university to continuously improve the dual study programme.
- Professional development and career planning: Discussion of career paths and development opportunities for dual study programme

students, based on the skills acquired during their studies and in practice.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German/English

Condition for the award of credit points
None

Learning outcomes

- Students systematically reflect on their practical experience in order to draw conclusions for their professional development.
- Students develop strategies for solving problems that arise in the coordination between study and practice.
- Students apply the theoretical knowledge they have acquired in practice in the company in order to optimise the transfer of knowledge between university and practice.
- Students communicate their practical experience in a clear and structured manner and present their results effectively.
- Students evaluate the importance of IT security in the corporate context and implement appropriate measures in their daily work.
- Students create professional project documentation to make their work transparent and comprehensible.
- Students use feedback constructively to continuously improve their working methods and the cooperation between the university and the company.

Literature
Will be announced in the seminar.

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 100002
Usability for Engineers and Computer Scientists

Module profile

Exam number
100002

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 0 hrs

Self-study: 150 hrs

Total: 150 hrs

Teaching format
Lecture

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Isabel John

Lecturer(s)

Applicability	BIN, BWI, BISD, BDGD
Semester according to SPO	6. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
This is an offer of the Virtual University of Bavaria. Further information can be found at https://kurse.vhb.org/VHBPORTAL/kursprogramm/kursprogramm.jsp?kDetail=true&COURSEID=19832,83,816,1

Recommended prerequisites for the participation in the module
none

Content
This is an offer of the Virtual University of Bavaria. Further information can be found at https://kurse.vhb.org/VHBPORTAL/kursprogramm/kursprogramm.jsp?kDetail=true&COURSEID=19832,83,816,1
In our highly technical and networked world, the usability of products, services and interactive systems is becoming an increasingly important feature for users on the one hand and a competitive advantage for manufacturers on the other. With a comparable range of functions, many products are being offered at increasingly favourable prices in global competition. The user has a choice and will opt for the advantages of a product that has been tested and optimised for usability and user experience. By using usability engineering methods, manufacturers can meet these requirements and develop unique selling points for their products. Usability and user experience objectives should therefore be taken into account as early as possible in the development process and implemented using suitable methods, among other things to avoid costly misdevelopments and increase the benefits for customers. Prospective engineers and computer scientists must be able to recognise this problem and know in which phases of product development suitable methods are used.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Written exam (sP) according to § 23 APO

Examination - length/format
90 minutes

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
This is an offer of the Virtual University of Bavaria. Further information can be found at https://kurse.vhb.org/VHBPORTAL/kursprogramm/kursprogramm.jsp?kDetail=true&COURSEID=19832,83,816,1
Naming the content of the analysis phase in usability engineering.

- Independent application of analysis methods and techniques of usability engineering
- Application-specific identification of relevant parts of the DIN/ISO 9241 series of standards
- Describe and apply terms (usability) and principles (dialogue design)
- Describe and apply a process for designing usable interactive systems
- Describe the essential aspects of cognitive psychology and industrial psychology
- Identify and name criteria for evaluating colour design in order to identify and name associated usability problems.
- Describe fundamental aspects of contrasts and their use in design.
- Recognise in which development phases design laws must be observed and how these simple laws help to identify usability problems
- Apply design laws in a targeted manner in the context of usability evaluations
- Describe the typical procedure in interface and interaction design.
- Name different types of prototypes and describe their function in usability engineering
- Describe and apply usability metrics from the areas of \"Usability Performance Metrics\" and \"Usability Issue based Metrics\".

Literature
see course

fiw.thws
Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 6322200
Virtual Reality

Module profile

Exam number
6322200

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar-style instruction, Exercise

Language of instruction
German

Organisation

Responsible lecturer
Stefan Sauer

Lecturer(s)
Stefan Sauer

Applicability	BEC, BIN, BWI, BISD, BDGD
Semester according to SPO	6. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
none

Content
The event is organised by the Faculty of Polymer Engineering and Surveying (FKV):
(https://geo.thws.de/studium/bachelor-geovisualisierung/studienablauf/modulhandbuch-bgv-ab-ws-202223/)

For scheduling: https://geo.thws.de/studium/aktuelle-lehrveranstaltungsplaene/

- Creation of 3D models for transfer to game engines
- Dealing with game engines
- Rendering pipeline
- Integration of VR functionalities in game engines
- Creation of fully functional 3D models in game engines
- Realisation of virtual tours

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Written exam (sP) according to § 23 APO

Examination - length/format
90 minutes

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
After participating in the module, students can independently plan, realise and set up VR applications or publish them using appropriate services.

Game engines are used to create VR environments. Students therefore learn the basics of importing and operating geodata in game engines, as well as the settings for rendering and preparing the data for VR applications, including programming controllers and the interface to VR glasses.

Literature
Akenine-Möller, T.; Haines, E.; Hoffman, N.; Pesce, A.; Iwanicki, M.; Hillaire, S.: Real-Time Rendering, 2018, 4th edition, Milton: Chapman and Hall/CRC, London, ISBN: 9781138627000 Edler, D.; Husar, A.; Keil, J.; Vetter, M. & Dickmann, F.: Virtual Reality (VR) and Open Source Software: A Workflow for Constructing an Interactive Cartographic VR Environment to Explore Urban Landscapes, 2018. In: Kartographische Nachrichten, Journal of Cartography and Geographic Information, 68(1), p. 5-13, ISSN: 2524-4965
Edler, D.; Kühne, O.; Jenal, C.; Vetter, M.; Dickmann, F.: Potentials of spatial visualisation in virtual reality (VR) for social constructivist landscape research, 2018. In: Kartographische Nachrichten, Journal of Cartography and Geographic Information, 68(5), p. 245-254, ISSN: 2524-4965
Vetter, M.: Technical Potentials for the Visualisation in Virtual Reality, 2020. in D. Edler, C. Jenal, & O. Kühne (Eds.), Modern Approaches to the Visualisation of Landscapes, 2020, Wiesbaden: Springer VS, ISBN: 978-3-658-30956-5

fiw.thws
Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003855
Web Exploitation

Module profile

Exam number
5003855

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar-style instruction

Language of instruction
German/English

Organisation

Responsible lecturer
Prof. Dr.-Ing. Sebastian Biedermann

Lecturer(s)
Prof. Dr.-Ing. Sebastian Biedermann

Applicability	BIN, BWI, BEC
Semester according to SPO	6. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
None

Content
Students learn the professional role and methodological workflow of web penetration testers, including legal and ethical frameworks. Techniques for identifying and exploiting common web vulnerabilities (e.g., OWASP Top Ten) in frontends, backends and APIs are taught. Web post-exploitation scenarios (e.g., web shells, session hijacking, API abuse) and related containment considerations are practised in isolated labs. Finally, students train structured reporting and target-audience appropriate presentation of findings.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Written exam (sP) according to § 23 APO

Examination - length/format
90 minutes

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German/English

Condition for the award of credit points
None

Learning outcomes
After completing the module, students can:

- describe the professional role of web penetration testers and their responsibilities within IT security.
- outline the typical workflow of a web penetration test (reconnaissance → enumeration → exploitation → post-exploitation → reporting).
- name legal constraints, scope boundaries and ethical considerations and incorporate them into test planning.
- identify common web vulnerabilities (e.g., injection, XSS, CSRF, authentication issues) in test applications and produce reproducible proofs of concept.
- perform web post-exploitation techniques (e.g., session takeover, web shells, API abuse) in a lab context and analyse their effects.
- assess discovered vulnerabilities in terms of exploitability and business impact (e.g., using CVSS criteria) and set remediation priorities.
- document the results of a web penetration test in a structured report and present key findings in a target-appropriate manner.

Literature
The Web Application's Hackers Handbook (Dafydd Stuttart et al.), 2023
Penetration Testing - a Hands-On Introduction to Hacking (Georgia Weidman), 2014
Hacking, The Next Generation (Nitesh Dhanjani et al.), 2021

7. semester

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003850
AI and Security

Module profile

Exam number
5003850

Duration
1 semester

Frequency
Irregular

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
English

Organisation

Responsible lecturer
Prof. Dr. Benjamin Weggenmann

Lecturer(s)
Prof. Dr. Benjamin Weggenmann

Applicability	BIN, BWI, BEC
Semester according to SPO	7. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
Linear Algebra

Content
In this module, students learn about the basic concepts and methods of artificial intelligence (AI) and specifically apply them to information security issues.
First, various classification strategies -- such as Naive Bayes or neural networks -- are introduced, and their possible applications in a security context are explained. In practical exercises, students develop and train their own models, e.g. for the automated detection of phishing emails or attacks in network traffic.
Another component of the module is the critical examination of the use of AI by attackers.
Here, application scenarios are discussed in which AI is used to improve digital attacks, for example to optimize social engineering strategies or to generate deceptively authentic content.
Finally, students deal with issues concerning the security and privacy of AI systems themselves.
Among other things, forms of attack such as data poisoning, adversarial examples, and backdoors are discussed, which can be used specifically to manipulate AI models.
The aim of the module is to develop a sound understanding of the responsible and security-conscious use of AI in cybersecurity.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
English

Condition for the award of credit points
None

Learning outcomes

- Students know the basics of artificial intelligence and at least two classification strategies (e.g., Naive Bayes Classifier, neural networks).
- Students can analyse a given application scenario and accordingly select and use suitable models (e.g., using Python).
- Students can train their own models with suitable data (incl. pre-processing) and evaluate the results.
- Students recall various scenarios in the field of information security in which AI models are already being used successfully and understand how.
- Students understand the fundamental security-related problems of AI models. They can apply corresponding attacks and basic defences.

Literature

Introduction to Artificial Intelligence (3rd edition), Wolfgang Ertel, 2025
Machine Learning and Security: Protecting Systems with Data and Algorithms, Clarence Chio and David Freeman, O'Reilly 2018
Machine Learning for Hackers, Drew Conway, 2012
Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, Aurélien Géron, 2022

fiw.thws
Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003123
Agile Enterprise - Agile Methods in Practice

Module profile

Exam number
5003123

Duration
1 semester

Frequency
Irregular

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Isabel John

Lecturer(s)
Christoph Schüll,
Christian Dewein

Applicability	BEC, BIN, BWI
Semester according to SPO	7. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
Basic knowledge of IT project management, IT process models

Content
- Agile values & principles
- Scrum, Kanban and XP
- Agile estimating, planning and reporting
- Setting up agile IT projects
- Continuous integration, delivery and deployment
- DevOps basics
- Scaling Agile
- Communication & leadership

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes

- Students can identify the prerequisites of current agile concepts based on different company models, explain their practical effects and assess key success factors in their application.
- Students can confidently name terms and methods of agile concepts, explain their meaning, apply them to specific situations and differentiate between different approaches.
- Students can explain agile values and principles, analyse their relevance in typical project situations and critically evaluate typical conflicts and contextual factors.
- Students can plan and apply Scrum and related agile methods in a project context, orchestrate their process components and formulate and evaluate the effects on results.
- Students can implement DevOps practices in development, plan and execute continuous integration, delivery and deployment in the project and critically assess efficiency, quality and risk.

Literature

Extract from recommended literature on the topics:

- Mike Cohn: Agile Estimating and Planning.2005, Prentice Hall
- Ken Schwaber: Agile Project Management with Scrum.2004, Microsoft Professional
- Mike Cohn: User Stories applied.2010, MITP
- Boris Gloger: Scrum. 2016, Hanser
- Fritz B. Simons: Introduction to systems theory and constructivism.
- Paul Watzlawick, Janet H Beavin: Human Communication: Forms, Disorders, Paradoxes.
- Friedemann Schulz von Thun: Talking to each other 1: Disruptions and clarifications: General psychology of communication.
- T. Groth, G.P.Krejci. S.Günther: New Organising

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003847
Algorithms for Distributed Systems

Module profile

Exam number
5003847

Duration
1 semester

Frequency
Irregular

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
English

Organisation

Responsible lecturer
Prof. Dr.-Ing. Erik Schaffernicht

Lecturer(s)
Prof. Dr.-Ing. Erik Schaffernicht

Applicability	BIN, BWI, BEC
Semester according to SPO	7. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
Courses on computer networks and communication (e.g. internet communication, backend systems), algorithms and data structures, operating system basics

Content

Introduction/recap regarding of communication models for distributed systems
- Remote procedure calls
- Blackboards and Event-based models

Fundamentals for distributed algorithms
- differences between algorithms in distributed systems, parallel algorithms and single machine algorithms
- consensus problems
- failure models
- physical clocks and logical clocks

Algorithms for
- coordination
- leader election
- searching
- failure tolerance / failure handling
- consistent data replication

The course will be given in English.
The course is programming language agnostic, students can choose their preferred languages to implement seminar assignments.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
none

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
English

Condition for the award of credit points
none

Learning outcomes
After completing the course students are able to

- understand the capabilities and limitations of distributed systems,
- explain different failure models,
- utilise remote procedure call frameworks to program in distributed systems,
- design and implement solutions to common problems in distributed systems,
- choose algorithms to handle conflicts and failures in distributed systems,
- discuss the major challenges in distributed systems both in general and for specific tasks,
- compare different algorithmic solutions to common problems in distributed systems and discuss potential trade-offs

Literature
M. van Steen and A.S. Tanenbaum, Distributed Systems, 4th ed., 2023
Additional specific reading recommendations will be provided during the course

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003828
Automotive and Industrial Cybersecurity

Module profile

Exam number
5003828

Duration
1 semester

Frequency
Every winter semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
German/English

Organisation

Responsible lecturer
Prof. Dr.-Ing. Sebastian Biedermann

Lecturer(s)
Dr.-Ing. Rodrigo Daniel do Carmo

Applicability	BEC, BIN, BWI
Semester according to SPO	7. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
none

Content
Part I: Automotive Cybersecurity

Introduction to Automotive Cybersecurity
- Architecture of Modern Vehicles
- Cybersecurity Challenges of Modern Vehicles and E/E Architectures

Legislation and Standardisation for Cybersecurity in the Automotive Industry
- Introduction to Automotive Cybersecurity Regulations and Standards: UN ECE WP.29 and the UN Regulations No. 155 and 156, Vehicle Type Approval, Overview of Global and European Approach
- Introduction to the International Standard ISO/SAE 21434
- Related and Upcoming Standards

Automotive Threat Analysis and Risk Assessment (TARA) According to ISO/SAE 21434
- Introduction to Risk Management and TARA
- Scope of a TARA, Attacker Model, Item Definition
- Asset Identification (Typical Assets for Automotive Embedded Systems)
- Cybersecurity Properties (CIA Triad and Other Properties)
- Definition of Damage Scenarios
- Identifying Threats: Overview of Threat Modelling, STRIDE, Brainstorming, MITRE ATT&CK, OWASP
- Definition of Attack Paths: Identification and Description of Attack Paths, Attack Trees, Vulnerabilities
- Attack Feasibility Evaluation
- Risk Evaluation
- Risk Treatment Decision: Cybersecurity Goals
- Cybersecurity Claims, Typical Controls for Automotive Embedded Systems

Part II: Industrial Cybersecurity

Introduction to Industrial Networks and Control Systems
- Industrial Security, Basic Process Control Systems, Differences Between IT and OT Systems

- Components and Architecture of Industrial Control Systems: Field Devices, Programmable Logic Controllers, Distributed Control Systems, Supervisory Control and Data Acquisition (SCADA) Systems, Network Transmission Media, Field Device Architecture, Industrial Network Protocols, Enterprise Network Protocols, Industrial Safety and Protection Systems, Safety Instrument Systems (SIS), OT/IT Network Integration, Purdue Reference Model

Industrial Cybersecurity and Secure OT Architectures

- Introduction to Cybersecurity Challenges in the Modern Industry (Industry 4.0): Examples of Attacks, MITRE ATT&CK Database, SHODAN
- Overview of Relevant EU Cybersecurity Regulations: NIS2, Cyber Resilience Act (CRA), Regulation on Machinery, Radio Equipment Directive (RED)
- Secure OT Architecture: Boundary protection, Firewalls, Industrial Demilitarised Zone, Proxies, Network Zoning, Data Diode, Zero Trust Architecture (ZTA)

The International Standard IEC 62443

- Overview of the International Standard ISA/IEC 62443
- Basic Terminology
- Security of Industrial Networks: Security Programme, The Automation Solution Security Lifecycle, Security Levels and Maturity Levels, Security Objectives and Foundational Requirements, Defense-in-Depth Principle, Threat-Risk Assessment, Security Zones and Conduits
- Security of Products: Risk-based Approach and Relation to Cyber Resilience Act, Security Levels and Functional Requirements, Secure Development Lifecycle

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Practical study achievement

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German/English

Condition for the award of credit points
None

Learning outcomes

- Students understand the architecture and cybersecurity challenges of modern vehicles, including the basics of E/E architectures.
- Students know the essentials of risk management and threat modelling, including terminology, standards, and methods for conducting threat analysis and risk assessment (TARA) in both automotive and industrial contexts.
- Students know fundamental cybersecurity protection concepts for industrial control systems (ICS), understand the differences between OT and IT, understand terminology and concepts of the IEC 62443 standard, and are aware of relevant guidelines and new European regulations.
- Students are capable of performing comprehensive threat analysis and risk assessment (TARA) for automotive systems and industrial/operational technology (OT) environments, identifying vulnerabilities, and evaluating risks.
- Students are able to manage and develop the work products of automotive development projects in accordance with the international standard ISO/SAE 21434.
- Students can design and implement secure network architectures for industrial systems, applying principles such as zoning, Zero Trust, and Defence-in-Depth.
- Develop analytical, structured, and logical thinking skills to systematically evaluate and address cybersecurity challenges in both automotive and industrial contexts.
- Enhance abstraction skills to understand and apply complex cybersecurity concepts, standards, and risk management techniques.

Literature

- N. Ferguson, B. Schneier, T. Kohno, "Cryptography Engineering - Design Principles and Practical Applications", Wiley, 2010
- C. Paar, J. Pelzl, "Understanding Cryptography - A Textbook for Students and Practitioners", Springer, 2010
- M. Rosulek, "The Joy of Cryptography", 2021. URL: https://joyofcryptography.com
- L. Van Houtven, "Crypto 101", 2013. URL: https://www.crypto101.io
- C. Smith, "The Car Hacker's Handbook: A Guide for the Penetration Tester", 1st edn. No Starch Press, San Francisco, 2016
- M. Wurm, "Automotive Cybersecurity: Security Building Blocks for Automotive Embedded Systems", Springer Berlin Heidelberg, Berlin, Heidelberg, 2022
- A. Shostack, "Threat Modelling: Designing for Security", 1st edn. Wiley Publishing, 2014
- ISO/SAE 21434:2021, "Road vehicles - Cybersecurity engineering", International Standard
- R. do Carmo, A. Schlensog, "Automotive Threat Analysis and Risk Assessment in Practice", Springer, 2024
- IEC 62443 International Series of Standards (Parts 1-1 to 4-2)
- The MITRE Corporation, MITRE ATT&CK®. URL https://attack.mitre.org/
- OWASP Foundation, "OWASP Top Ten". URL https://owasp.org/www-project-top-ten/

- C. Brooks, P. Craig, "Practical Industrial Cybersecurity - ICS, Industry 4.0, and IIoT", Wiley, 2022
- P. Kobes, "Guideline Industrial Security: IEC 62443 is easy", VDE Verlag, 2023
- NIST SP 800-82r3, "Guide to Operational Technology (OT) Security", 2023
- P. Ackermann, "Industrial Cybersecurity - Second Edition: Efficiently monitor the cybersecurity posture of your ICS environment", Packt Publishing, 2021

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5103500
Bachelor Thesis / Bachelor Seminar

Module profile

Exam number
5103500

Duration
1 semester

Frequency
Every semester

Credit hours (SWS)
1

ECTS-Credits (CP)
15.0

Workload
Guided study time:
Presence time: 40 hrs

Self-study: 410 hrs

Total: 450 hrs

Teaching format
Seminar

Language of instruction
German/English

Organisation

Responsible lecturer
Prof. Dr. Peter Braun

Lecturer(s)
Prof. Dr. Arndt Balzer,
Prof. Dr. Peter Braun,
Prof. Dr. Frank Deinzer,
Prof. Dr. Steffen Heinzl,
Prof. Dr. Isabel John,
Prof. Dr. Frank-Michael Schleif,
Prof. Dr. Christian Bachmeir,
Prof. Dr.-Ing. Sebastian Biedermann,
Prof. Dr.-Ing. Pascal Meißner

Applicability	BIN
Semester according to SPO	7. semester
Type of module	Compulsory module

Required prerequisites for the participation in the module according to the SPO
120 ECTS credits from the first two years of study, practical module, professional skills, project work

Recommended prerequisites for the participation in the module
none

Content
The Bachelor's thesis module consists of the Bachelor's thesis (12 CP) and the Bachelor's seminar (3 CP).

The Bachelor's thesis includes own studies and research on the state of the art in the respective subject area. In particular, the thesis must abstract from boundary conditions that are not technically based in nature, but result from the specific circumstances of the company/ operation. If software solutions are required as part of the assignment, this generally means that prototypes are implemented as part of the Bachelor's thesis, but does not include ensuring product features (incl. accompanying manuals, etc.).

The topics of the practical examples for the examination are provided by or agreed with the lecturer in the traditional degree programme. In the dual study programme, a task from the practical company is worked on in consultation with the lecturer.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Thesis, Presentation

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German/English

Condition for the award of credit points
None

Learning outcomes
With the Bachelor's thesis / Bachelor's seminar, the student demonstrates that he/she is capable of independently solving a challenging task in the field of computer science (possibly interdisciplinary), that he/she has mastered the methodological and scientific principles of the subject and can adequately present the result.

Students from the dual study programme are assigned a topic related to the respective partner company. The task is set by the supervising professor at THWS.

Literature
depending on the topic; the Bachelor's thesis should be written scientifically, i.e. literature must be intensively analysed, used and cited according to the topic.

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003848
Big Data Analytics

Module profile

Exam number
5003848

Duration
1 semester

Frequency
Irregular

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
English

Organisation

Responsible lecturer
Prof. Dr. Isabel John

Lecturer(s)
Prof. Dr. Rajesh Ramachandran

Applicability	BIN, BWI, BEC
Semester according to SPO	7. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
- Basic programming knowledge (Java/Python)
- Prior exposure to databases and Linux recommended

Content
This comprehensive course provides an in-depth introduction to Big Data technologies, focusing on Hadoop and its ecosystem. Participants will learn core concepts such as the Big Data 4 Vs, analytics types, and Hadoop architecture, followed by hands-on programming skills with MapReduce, Hadoop Streaming, Pig, Hive, and Kafka. The modules combine theoretical knowledge with practical projects, including real-world case studies and an integrated data pipeline, preparing learners to handle large-scale data processing and analytics.
The course has the following content:
- Understanding Big Data concepts, including the 4 Vs and analytics types
- Overview of the Hadoop ecosystem and architecture components
- Programming with MapReduce using Java, including advanced techniques
- Developing Hadoop Streaming applications with Python/Shell scripts
- Exploring real-world case studies and mini projects for practical experience
- Data analysis with Pig Latin and scripting operators
- Building data warehousing solutions using Hive and HiveQL
- Learning Kafka architecture, topics, and data pipeline integration
- Hands-on exercises with HDFS, YARN, Pig, Hive, and Kafka
- Final project focusing on designing an end-to-end data processing pipeline

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
English

Condition for the award of credit points
None

Learning outcomes
Upon successful completion of this module, students will be able to:

- LO1: Explain the fundamental characteristics of Big Data systems and analytics.
- LO2: Operate Hadoop HDFS and perform distributed storage and processing.
- LO3: Implement MapReduce programs using Java, including advanced features like distributed cache and joins.
- LO4: Use Pig Latin and HiveQL for high-level querying over large datasets.
- LO5: Demonstrate understanding of real-time streaming using Apache Kafka.
- LO6: Develop integrated solutions using multiple Hadoop ecosystem components.

Literature
Tom White, Hadoop: The Definitive Guide (2012), O'Reilly
Garry Turkington, Hadoop Beginner's Guide (2013), Packt Publishing
Pethuru Raj et al, High-Performance Big Data Analytics (2015), Springer
Official Apache Docs: Hadoop, Pig, Hive, Kafka (2018)

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003188
Blockchain and Smart Contracts

Module profile

Exam number
5003188

Duration
1 semester

Frequency
Irregular

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
English

Organisation

Responsible lecturer
Prof. Dr.-Ing. Tobias Fertig

Lecturer(s)
Prof. Dr.-Ing. Tobias Fertig,
Andreas Schütz

Applicability	BEC, BIN, BWI
Semester according to SPO	7. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
none

Content
In this module, students gain deep insights into blockchain technology and smart contracts. After learning the basics, students are divided into teams to develop prototypes for suitable use cases. At the end of the module, students are able to evaluate use cases and implement them in practice.

The following content is taught to students:
- Evaluating use cases
- How blockchains work
- How the various consensus models work
- Introduction to contract-oriented programming
- Introduction to Solidity and suitable development environments
- Introduction to programming smart contracts
- Testing and debugging smart contracts
- Common design patterns for smart contracts
- Deployment and management of smart contracts
- Basics of decentralised applications (DApps)
- Frameworks for programming DApps
- Development of DApps
- Deployment of DApps
- Testing of DApps

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
English

Condition for the award of credit points
None

Learning outcomes
1. students recall the basic concepts of blockchain technology and its functionalities.
2. students understand the principles and functioning of smart contracts and their significance within the blockchain ecosystem.
3. students apply the Solidity programming language to develop and implement smart contracts.
4. students develop decentralised applications (DApps) for the Ethereum blockchain and integrate smart contracts.
5. students analyse security vulnerabilities in smart contracts and can formulate and implement strategies to avoid these risks.

Literature
https://www.rheinwerk-verlag.de/blockchain-the-comprehensive-guide-to-blockchain-development-ethereum-solidity-and-smart-contracts/

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003804
Cloud Native Enterprise Java

Module profile

Exam number
5003804

Duration
1 semester

Frequency
Every winter semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Rolf Schillinger

Lecturer(s)
Matthias Reining

Applicability	BEC, BIN, BWI
Semester according to SPO	7. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
Programming skills in Java

Content
The course teaches the basics of Jakarta EE (https://jakarta.ee/), also known under its predecessor name Java EE (EE: Enterprise Edition). The focus of the course is on the creation of modern cloud native enterprise applications, divided into the following topics:

- General requirements for business applications
- Web services (JAX-RS - Restful Web Services)
- Enterprise software patterns (CDI - Context and Dependency Injection)
- Data persistence (JPA - Java Persistence API)
- Use of microservice architecture patterns (via Microprofile https://microprofile.io/)
- Different runtimes (on-prem and cloud)

Most of the topics will be demonstrated and discussed directly using source code and live coding examples.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Written exam (sP) according to § 23 APO

Examination - length/format
90 minutes

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
After successfully completing the module, students will be able to

- Differentiate between terms such as Java, Java EE and Jakarta EE and categorise buzz words from the Java Enterprise world.
- efficiently implement applications in different runtime environments based on the Jakarta EE APIs
- design and implement microservice architectures using Jakarta EE / Quarkus.
- use Docker in the Jakarta EE / Quarkus environment
- Analyse Docker cloud deployments.

Literature
https://eclipse-ee4j.github.io/jakartaee-tutorial/
https://jakarta.ee/
https://microprofile.io/
https://www.adam-bien.com/roller/abien/

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003814
Digital Accessibility

Module profile

Exam number
5003814

Duration
1 semester

Frequency
Irregular

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Tobias Aubele

Lecturer(s)
Joschi Kuphal

Applicability	BEC, BIN, BWI, BDGD
Semester according to SPO	7. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
Experience in the design and/or development of web applications (HTML, CSS, JavaScript)

Content
The event is divided into theoretical and practical parts, each with a specific focus on digital accessibility:

- Fundamentals of digital accessibility, design and development models
- Types of disabilities, assistive technologies and adaptation strategies
- Types and modes of action of barriers and allocation of responsibilities
- Relevant standards, norms and laws to support accessibility in the national and international environment
- Strategies for implementing accessible design & development processes
- Recognising, reducing and avoiding barriers in digital media: web, documents (e.g. MS Word, MS PowerPoint, PDF, e-book), audio-visual media (e.g. video, audio)
- Conception, design, implementation and testing of accessible web applications
- Setting up and working with screen readers and other assistive technologies

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
Students are familiar with various approaches to thinking and design that are associated with accessibility and are aware of their similarities and differences.

- They know the most common types of disabilities and are able to characterise the dominant models in society and science.
- They understand the demographic development and know the most important key figures on disabilities worldwide, in Europe and in Germany.
- You will be able to identify different types of barriers that occur when interacting with digital products. They will be familiar with assistive technologies and adaptation strategies for overcoming these barriers.
- They are familiar with the standards, norms and laws relevant to accessibility at various levels (world, Europe, D-A-CH) and know their interrelationships.
- They have internalised the advantages of accessible design on a personal, social and business level and know strategies for implementing and anchoring accessibility in organisations and development processes.
- They understand the barriers that can occur in various digital media (web, documents, multimedia systems, e-books, apps, software, terminals, etc.) and know principles, techniques and tools for recognising, reducing and avoiding barriers.
- They have in-depth knowledge of the conception, design and implementation of accessible web applications, can evaluate them for accessibility and are familiar with relevant testing tools and methods.
- They have the skills to check, evaluate and correct digital documents for accessibility and to create accessible documents independently.
- They know how to use common screen readers on different platforms and are able to set up a suitable test environment for testing web and other applications.

Literature

- Matuzović, Manuel (2024) - Web Accessibility Cookbook: Creating Inclusive Experiences, O'Reilly
- Kalbag, Laura (2017) - Accessibility for Everyone, A Book Apart
- Silver, Adam (2018) - Form Design Patterns, Smashing
- Pickering, Heydon (2018) - Inclusive Components: The Book, Smashing
- Alexander, Kerstin (2019) - Image & Type: Communicating Accessibly with Typography and Image, Frank & Timme
- Miller, Susi (2021) - Designing Accessible Learning Content, Kogan Page

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003830
Introduction to SAP Business Technology Platform

Module profile

Exam number
5003830

Duration
1 semester

Frequency
Every winter semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Karl Liebstückel

Lecturer(s)
Christian Fink

Applicability	BEC, BIN, BWI
Semester according to SPO	7. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
SAP user knowledge

Content

- What is SAP Business Technology Platform (SAP BTP)?
- History of SAP BTP
- SAP's strategy in the area of SAP BTP
- How is the BTP structured?
- What services does SAP BTP contain?
- Technical aspects of SAP BTP
- Overview of the areas of application of SAP BTP such as side-by-side extension, clean core, integration, analytics and AI, low-code / no-code
- Reference architectures with without S/4HANA

SAP BTP Custominzing

- Basic customising
- Roles and authorisations
- Development of sample applications

o A first app in SAP BTP
o Configuring the work zone
o Clean Core with S/4HANA
o Setting up an integration scenario
o First integration of Generative AI

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
1) Students will be familiar with the basic concepts and definitions of the SAP Business Technology Platform (SAP BTP) and its historical development.
2. understand the strategic importance of SAP BTP and its role in the context of a company's digitalisation strategy.
3. explain the structure and architecture of SAP BTP as well as the services it contains and their functions
4. apply basic customising techniques to adapt SAP BTP to specific application scenarios.
5. students analyse different areas of application of SAP BTP, such as side-by-side extensions, integration and analytics as well as low-code / no-code approaches.
6. students evaluate reference architectures of SAP BTP, including their integration with S/4HANA and the development of integration scenarios.

Literature
SAP Business Technology Platform - Administration, Martin Koch, Siegfried Ziegler, Rheinwerk-Verlag, Bonn 2024, ISBN 978-3-367-10020-0.
SAP Integration Suite, Jan Arensmeyer, Enrico Hegenbart, Rheinwerk-Verlag, Bonn 2024, ISBN 978-3-8362-9933-6
Enterprise Content Management with SAP, Christian Fink, Rheinwerk-Verlag, Bonn 2019, ISBN 978-3-8362-6524-9

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003851
Ethical Hacking (Blended Intensive Program)

Module profile

Exam number
5003851

Duration
1 semester

Frequency
Irregular

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
English

Organisation

Responsible lecturer
Prof. Dr.-Ing. Tobias Fertig

Lecturer(s)
Prof. Dr.-Ing. Tobias Fertig,
Franziska Königer

Applicability	BIN, BWI, BEC
Semester according to SPO	7. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
n/a

Recommended prerequisites for the participation in the module
Before the course unit, the learner/student is expected to be able to have basic computer networking, Linux, programming skills and ML/AI basics.

Content
This intensive Ethical Hacking learning programme focuses on ethical hacking techniques and practices. The programme in 2025 is oriented towards network and AI security, and typically covers topics such as attacks on AI systems, penetration testing, vulnerability assessment, IDS, Packet Analysis, various testing and hacking tools, and defensive strategies. Participants can expect hands-on training and real-world simulations to enhance their skills in ethical hacking. Team-based learning approaches will be used. The competition will take place at the end. By the end of the programme, participants should be equipped with the knowledge and tools needed to conduct ethical hacking assessments, identify security weaknesses, and recommend solutions to strengthen cybersecurity defences.

This course will be offered as a Blended Intensive Programme with several online sessions and a study trip to Kaunas, Lithuania.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
n/a

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
English

Condition for the award of credit points
n/a

Learning outcomes

- The students explain foundational ethical and legal principles of ethical hacking and organise effective teamwork norms.
- The students justify technical findings in clear oral and written presentations for diverse audiences.
- The students construct a controlled simulation environment (cyber range) to practice and test skills safely.
- The students analyse full packet captures with Wireshark to extract protocols, flows, and indicators.
- The students classify common cybersecurity attacks and select appropriate tools for safe reproduction and analysis.
- The students design basic penetration tests and interpret IDS outputs to assess detection and response.
- The students evaluate vulnerabilities in AI systems and propose defence strategies against adversarial attacks.
- The students plan a continuous-learning roadmap, selecting tools and resources that build knowledge and self-confidence.

Literature
Will be announced during class.

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003827
Governance, Risk, Compliance and Ethics (FWPM)

Module profile

Exam number
5003827

Duration
1 semester

Frequency
Every winter semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar-style instruction

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Kristin Weber

Lecturer(s)
Prof. Dr. Kristin Weber,
Prof. Dr. Markus Oermann

Applicability	BIN, BWI, BEC
Semester according to SPO	7. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
ISM Standards & Processes

Content
Many people and units inside and outside organisations are involved in the management of information security. Governance regulates how transparency, accountability and efficiency are ensured by defining structures, responsibilities and framework conditions, while at the same time safeguarding the interests of all stakeholders. This module shows which stakeholders are involved in information security management, how responsibilities are defined, decisions are made and optimal framework conditions for maximum information security are created.

The identification and assessment of IT risks helps organisations to deal with threats to information security in a targeted and structured manner. The risk-oriented approach is pursued in many ISMS frameworks (information security management system). The module teaches the basics of IT risk management, such as measures for identifying, analysing, assessing and handling IT risks in a structured risk management process.

In the section on ethics, essential conceptual foundations of moral philosophy are explained. On the basis of established schools of ethics, the normative justification of (information) security as a value and guiding principle is examined. The consideration of models for the integration of ethical considerations in development and system design processes builds a bridge to the application of ethical principles in practice. Questions of compliance with the applicable data protection law are also of particular relevance here. After an overview of its basic structures, the focus is on the requirements for technical and organisational data protection as well as the enforcement and consequences of legal violations. Finally, the basics of the reformed information security law are explained.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Written exam (sP) according to § 23 APO

Examination - length/format
90 minutes

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
After completing the module, students will be able to

- name and specifically design basic governance mechanisms (e.g. responsibilities, guidelines, decision-making processes, committees) in the context of information security.
- describe relevant roles and stakeholders in information security management within and outside of organisations and differentiate between their tasks.
- explain the importance and function of IT risk management for information security and illustrate this using practical examples.
- identify and describe the organisational framework conditions for effective IT risk management.
- understand, apply and document a simple, structured IT risk management process.
- recognise ethical challenges in dealing with digital systems with security relevance and develop solutions for integrating ethical principles into work processes.
- explain the basic structures of data protection law and answer fundamental questions about data protection compliance.
- describe the main contents of information security law and assess their relevance for operational practice.
- communicate in a targeted manner with legal or regulatory experts on issues relating to data protection and information security law.
- reflect on the relationships between governance, risk and compliance management and ethics in security-critical IT environments.

Literature
Harich, T.: IT-Sicherheitsmanagement: das umfassende Praxis-Handbuch für IT-Security und technische Datenschutz nach ISO 27001. 3rd edition, MITP, 2021.
Johannsen, A.; Kant, D.: IT Governance, Risk and Compliance Management (IT-GRC) - A competence-orientated approach for SMEs. In: HMD - Praxis der Wirtschaftsinformatik, 57, 2020, pp. 1058-1074. https://doi.org/10.1365/s40702-020-00625-8
Kersten, H. et al: IT security management according to the new ISO 27001 - ISMS, risks, indicators, controls. 2nd, updated edition, SpringerVieweg, 2020.
Lang, M.; Löhr, H.: IT-Sicherheit - Technologien und Best Practices für die Umsetzung in Unternehmen. 2nd, revised edition, Hanser, 2024.
Lewinski/Rüpke/Eckhardt (2022): Data protection law. 2nd edition. Munich, C.H. Beck.

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003198
Green IT (Blended Intensive Program)

Module profile

Exam number
5003198

Duration
1 semester

Frequency
Irregular

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar-style instruction

Language of instruction
English

Organisation

Responsible lecturer
Prof. Dr. Peter Braun

Lecturer(s)
Prof. Dr. Peter Braun,
Prof. Dr. Frank-Michael Schleif

Applicability	BIN, BWI, BEC, BISD, BDGD
Semester according to SPO	7. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
None

Recommended prerequisites for the participation in the module
None

Content
This module explores how sustainability principles can be integrated into the design, development, deployment, and management of IT systems. It offers a multidisciplinary perspective on the environmental, economic, and societal implications of information technology. Through lectures, case studies, and collaborative international projects, students gain both theoretical foundations and practical experience in Green IT strategies. Partnering with universities in the Czech Republic, Germany, and Iceland, the module includes cross-border collaboration and comparative analysis of regional IT sustainability approaches. This module contains a compulsory study trip to Prague, the Czech Republic.

- Introduction to Green IT: Definition, significance, and global relevance; real-world applications in industry and academia
- Environmental Impact of IT: Carbon footprint, e-waste, lifecycle analysis, and Green Computing standards
- Sustainable Software Engineering: Design principles and code optimisation for energy efficiency
- Green Algorithms and Data Structures: Techniques to reduce energy consumption and benchmark software for efficiency
- AI and Machine Learning for Green IT: Optimisation of energy use, environmental monitoring, and ethical implications
- Green IT Strategies in Mobile and Distributed Systems: Sustainable design and management of mobile technologies and data centres
- Life Cycle Assessment (LCA): Application of LCA in IT hardware and software development
- Education and Training for Green IT: Curriculum development, capacity building, and case studies
- Regulatory and Compliance Aspects: Overview of international standards, compliance practices, and green certifications

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
English

Condition for the award of credit points
None

Learning outcomes
Upon successful completion of this module, students will be able to:

- Remember key concepts and terminology related to Green IT, including sustainability goals, environmental impacts, and regulatory frameworks
- Understand the ecological footprint of hardware and software systems and explain how IT contributes to global sustainability challenges
- Apply principles of sustainable software engineering, energy-efficient algorithms, and lifecycle assessments to practical use cases
- Analyse and compare national and regional Green IT strategies and regulatory approaches across Germany, Iceland, and the Czech Republic
- Evaluate the sustainability impact of IT systems and development practices using recognised metrics and standards
- Create innovative, practical solutions to real-world Green IT challenges by working on interdisciplinary, cross-national projects

Literature
It will be announced in class

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 6322290
Project-related geovisualization VI (deep sea VR)

Module profile

Exam number
6322290

Duration
1 semester

Frequency
Every winter semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Project

Language of instruction
German

Organisation

Responsible lecturer
Stefan Sauer

Lecturer(s)
Stefan Sauer

Applicability	BIN, BWI, BEC
Semester according to SPO	7. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
Interest in games
Experience with Unreal
Creation of small VR applications
Basic experience with Blender or 3ds max

Content
As part of the module, specific, application-related topics are developed and previously acquired specialist knowledge is applied to specific projects. The design of these modules allows a flexible, contemporary selection of topics as well as interdisciplinary work through the inclusion of other subject areas, e.g:

- Facility Management
- Property and insurance management
- transport logistics
- Telecommunications
- product design

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
none

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Presentation

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
none

Learning outcomes
By participating in the module, students are able to investigate and apply selected topics from the field of geovisualisation using practical examples/exercises, thereby expanding and deepening their knowledge. Participants are able to assess, evaluate and compare the results of the practical work and present them in a topic- and target group-specific manner.

Literature
Varies depending on the project

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003170
Project Management and Strategic Management

Module profile

Exam number
5003170

Duration
1 semester

Frequency
Every winter semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Eva Wedlich

Lecturer(s)
Prof. Dr. Eva Wedlich,
Manuela Ziegler

Applicability	BEC, BIN, BWI
Semester according to SPO	7. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
"IT Project Management" or "Project Management" and "Fundamentals of Economics" or "Fundamentals of Business Administration"

Content
This course consists of a two-day business game "Project Management" (SysTeams by RIVA) and a two-day business game "Strategic Management" (Global Strategy).
Structure:
I. Introduction to FWPM (organisational aspects),

II. part 1: "Project Management" block course

Content: Project management simulation game from SysTeamsProject by Riva.
The simulation game simulates a project management process from initial contact with the client to successful project completion. In small teams, the participants define, plan and control the project and also implement it themselves. Numerous project management tools are available for competent planning, e.g:

- Target plan
- work breakdown structure
- Milestone plan
- Gantt chart
- Project reports
- Risk analyses

The project is divided into several phases in which various project management tasks and work packages have to be completed, taking into account the available resources.

III Introduction "Strategic Management"

IV. Part 2: "Strategic Management" block course

Content: Global Strategy is an intensive general management simulation. Over the course of several rounds, participants develop a successful strategy for their company. The importance of strategic management for the company's success and business interrelationships are recognised and understood.

Contents and procedure:

- Profit and loss account, balance sheet
- Corporate and liquidity planning
- Costing
- Contribution margin accounting
- Cost management
- Break-even analysis
- Financing
- marketing
- investment appraisal
- Balanced Scorecard
- SWOT analysis
- Value-orientated corporate management
- Investment appraisal
- Balanced Scorecard
- SWOT analysis
- Value-orientated corporate management

V. Review

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Written exam (sP) according to § 23 APO

Examination - length/format
90 minutes

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes

- Students understand the principles and methods required for the effective planning and implementation of projects and for the management of a company.

organisation.

- Students apply the knowledge they have learnt in realistic, simulated projects to gain practical experience.
- Students analyse the results of each phase of the project and each financial year to identify strengths and weaknesses.
- Students evaluate the effectiveness of the implemented strategies in project management and business management based on the simulation results.

simulation results.

- Students develop new strategies for future simulation periods based on the findings from the previous phases.
- Students reflect on their experiences in the simulation in order to set personal and team-related learning goals for future challenges.

Literature
Workbook and explanatory literature will be provided during the course.

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003826
Social Engineering and Security Awareness

Module profile

Exam number
5003826

Duration
1 semester

Frequency
Every winter semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar-style instruction

Language of instruction
English

Organisation

Responsible lecturer
Prof. Dr. Kristin Weber

Lecturer(s)
Prof. Dr. Kristin Weber,
Andreas Schütz

Applicability	BIN, BWI, BEC
Semester according to SPO	7. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
none

Content
The module Social Engineering and Security Awareness focuses on the human factor of information security. People make a decisive contribution to information security in companies with their behaviour - they are an important security factor. Due to this influence, they are increasingly targeted by cyber criminals. The module primarily looks at these two aspects - security factor and victim - of the human factor in information security.

Information security awareness describes the sensitisation of employees for information security (security factor). The module contains the following contents on awareness:
- Concept and models, psychological understanding of awareness
- Practical examples of awareness measures
- Promoting and measuring awareness

Social engineering is the targeted manipulation of people in order to seduce them into unintentional actions (victims). The following contents, among others, are dealt with in social engineering:
- Basics and forms
- Psychological tricks
- Phishing and phishing simulations

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Written exam (sP) according to § 23 APO

Examination - length/format
90 minutes

The concrete length/format of the examination will be determined in the study plan.

Language of examination
English

Condition for the award of credit points
None

Learning outcomes
Students see people as a solution and not as a problem for information security.
They explain the role of the human factor in information security using examples.
The students know and identify the principles of social engineering and can explain them using examples.
They name different forms of phishing and can discuss the advantages and disadvantages of phishing simulations.
They understand what information security awareness means and know methods to enhance the different aspects of awareness.
Students can create awareness measures in a targeted and individualised way.

Literature
Beißel, S.: Security Awareness, De Gruyter, 2019.
Cialdini, R.: Influence - The Psychology of Persuasion, Collins Business, 2007.
Hadnagy, C. (with Schulman, S.): Human Hacking - Win Friends, Influence People, and Leave Them Better Off for Having Met You, Harper Business, 2021.
Helisch, M.; Pokoyski, D. (eds.): Security Awareness - New Ways to Successfully Sensitise Employees, Vieweg+Teubner, 2010.
Schroeder, J.: Advanced Persistent Training, Apress, 2017.
Verplanken, B. (Ed.): The Psychology of Habit - Theory, Mechanisms, Change, and Context, Springer, 2018.
Weber, K.: Humans and Information Security, Hanser, 2024.
Weber, K.; Schütz, A.; Fertig, T.: Fundamentals and Application of Information Security Awareness, SpringerVieweg, 2019.
Take Aware Sec&Life Magazine, https://www.take-aware-events.com/news-post/magazinesecandlife

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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003109
Data Protection - Technical Aspects

Module profile

Exam number
5003109

Duration
1 semester

Frequency
Every winter semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Kristin Weber

Lecturer(s)
Prof. Dr. Alexander Schinner, Christian Wolff

Applicability	BIN, BWI
Semester according to SPO	7. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
none

Content
Based on an overview of the current legal situation regarding the protection of personal data and the definition of informational self-determination and privacy, basic types of protection concepts and the applicable technologies and protective measures are discussed in detail.
The following core topics are covered:

- Basic protection goals and guarantee goals in the area of information security and data protection
- Technical-organisational measures for implementing the objectives/ requirements
- Measures for access and access control
- Data protection-relevant functions for mobile devices
- Security and data protection in cloud computing and big data analytics
- Special privacy-preserving technologies ("privacy-preserving technologies")

The second part deals with technical aspects of protecting data and systems. The aim of the event is to look at attacks on data from different perspectives. These include the perspective of the person who wants to store data securely, the person who wants to recognise or investigate attacks, but also the perspective of the attacker himself.
The event will cover the following core topics:

- Cyber Kill Chain and MITRA Att&ck Framework
- Cryptography
- steganography
- Attacks on cryptography
- Quantum key exchange
- Authentication
- Passwords
- Zero Knowledge Proof
- attacks
- Blockchain
- Blockchain basics
- Attacks
- NFTs
- Ordinals
- Forensics

- Basic principles
- Preservation of evidence
- Carving

Practical demonstrations on the topics of incident response and cryptography complement the event.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
The aim of the course is to convey the basic requirements of data protection in Germany and the resulting measures in the area of information security and the protection of personal data. The focus is on technical aspects.
After successfully completing the module, students will be able to

- Understand and differentiate between terms such as "information security", "data protection", "informational self-determination", "privacy", "anonymity"
- Analyse legal and normative requirements with regard to the protection and guarantee objectives they contain and apply them to a given context
- Derive technical and organisational measures from the requirements with regard to their suitability for implementing protection and guarantee objectives and evaluate them with regard to their protective effect
- Know and understand the functioning of basic technologies and procedures in the field of information security and data protection (e.g. procedures from the areas of anonymisation, encryption, authentication, communication security, incident detection & response, security testing), including the associated potential vulnerabilities and attack possibilities
- Develop a protection concept for a given scenario or a given application context (e.g. protecting the data of a website or an end device) in which these measures are used

Literature
Literature:
Eckert, Claudia: IT Security: Concepts - Procedures - Protocols, Oldenbourg Wissenschaftsverlag, 10th edition, 2018
Schwenk, Jörg: Security and Cryptography on the Internet: From secure email to IP encryption, Vieweg+Teubner Verlag, 4th ed., 2014
Schneier, Bruce: Secrets & Lies. IT security in a networked world, dpunkt.verlag/Wiley, 2001
Blog: http://www.schneier.com

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5107201
Digital Media and Multimedia Techniques

Module profile

Exam number
5107201

Duration
1 semester

Frequency
Every winter semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Frank Deinzer

Lecturer(s)
Prof. Dr. Frank Deinzer

Applicability	BIN, BWI
Semester according to SPO	7. semester
Type of module	Concentration module

Required prerequisites for the participation in the module according to the SPO
Course Practical module; 120 ECTS credits

Recommended prerequisites for the participation in the module
none

Content
Basics of media, computer science and maths:
- Media elements
- Coding
- Transformation of data

Media techniques
- Compression methods for images
- Compression methods for videos
- Audio compression techniques

Multimedia applications
- Consumer electronics and Internet

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
Students understand the basic algorithms for coding and transformation
Students analyse the various compression properties.
Students understand the principles of moving image compression and can explain motion estimation methods.
Students evaluate individual compression methods with regard to specific application requirements.
Students implement an image compression process in the practical part.

Literature
Will be announced in the seminar

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5105213
Internet of Things

Module profile

Exam number
5105213

Duration
1 semester

Frequency
Every winter semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Christian Bachmeir

Lecturer(s)
Prof. Dr. Christian Bachmeir

Applicability	BIN
Semester according to SPO	7. semester
Type of module	Concentration module

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
none

Content
- Architectures & concepts of IoT systems
- Hardware platforms and sensors
- Communication technology for IoT
- IoT software platforms, cloud integration
- Security and privacy for IoT
- Practical development of an IoT prototype in the lab:
- Design, build and evaluation
- Demonstration of the prototype and oral presentation at the end of the course
- Documentation

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Colloquium

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
Students will be familiar with the basic principles, components and processes of IoT systems. Students gain an insight into architectures, hardware platforms, communication technology, protocols, programming (device & cloud) and security concepts.
Students will be able to explain how individual components and processes work in IoT systems. They can describe and explain how architectures, protocols and security concepts interact.
Students will be able to apply the fundamentals they have learnt to problems and use suitable IoT components in practice. As part of the course, they develop an IoT prototype to experience what they have learnt hands-on.
Students are able to make individual statements about systems, work out differences and differentiate between systems.
Students can make well-founded decisions about the use of different IoT systems. They are able to evaluate the advantages and disadvantages of certain architectures, protocols or platforms.
By developing the IoT prototype, students design their own system that integrates different components and processes. |

Literature
- CLOUD] C. Fehling,F. Leymann, R. Retter, W. Schupeck, P. Arbitter, Cloud Computing Patterns: Fundamentals to Design, Build, and Manage Cloud Applications, 2014, Springer, ISBN: 978-3709115671

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5007212
Mobile and Ubiquitous Design

Module profile

Exam number
5007212

Duration
1 semester

Frequency
Every winter semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Karsten Huffstadt

Lecturer(s)
Prof. Dr. Karsten Huffstadt

Applicability	BEC, BIN, BWI
Semester according to SPO	7. semester
Type of module	Concentration module

Required prerequisites for the participation in the module according to the SPO
Course Practical module; 120 ECTS credits

Recommended prerequisites for the participation in the module
none

Content
In the Mobile and Ubiquitous Design module, students develop comprehensive skills in context-sensitive interaction design. The focus is on designing digital products and services that adapt flexibly to mobile usage situations and ubiquitous environments. The user-centred design process encompasses all relevant phases - from analysing the context of use, conception and prototype implementation through to systematic evaluation.

Particular emphasis is placed on the visual, functional and interactive quality of the solution: At the end of the module, students create a fully clickable high-fidelity prototype that realistically simulates central interactions, interface logic and design elements. This is developed using the Figma design tool and embedded in a structured, professionally designed design brochure that documents the usage scenario, the derivation of the design decisions and reflections on the development process. This results in design-based, practical solutions that are both convincing in terms of content and communicable.

Specific contents are
- Design principles of mobile and ubiquitous systems
- Context-sensitive interaction design (location, time, movement, environment)
- Methods of human-centred and participatory design
- UX/UI design for mobile contexts (touch, language, responsive design)
- Wireframing, low-fidelity and high-fidelity prototyping with Figma
- Design and construction of interactive click prototypes
- Usability testing, user testing and feedback integration
- Documentation and visualisation of design processes (structure, style, argumentation)
- Design ethics, accessibility and data protection in ubiquitous systems
- Project work: conception, prototyping and design brochure

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Practical study achievement

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
After successfully completing the module, students will be able to

- name central terms, interaction patterns and technologies of mobile and ubiquitous systems (to remember)
- explain the special features of mobile usage contexts and their influence on design decisions (to understand)
- use user-centred methods (e.g. personas, scenarios, customer journeys, wireframes) specifically in the design process (to apply)
- capture real-life usage scenarios and technical requirements and systematically translate them into design concepts (to analyse)
- evaluate designed interaction solutions in terms of user-friendliness, context sensitivity, accessibility and feasibility (to evaluate)
- develop context-sensitive application concepts, realise them with Figma as a high-fidelity prototype and document them professionally in a design brochure (to create)

Literature
Rogers, Y., Sharp, H., & Preece, J. (2023). Interaction Design: Beyond Human-Computer Interaction. Wiley
Schmidt, A., & Kranz, M. (2017). Mobile interaction. Oldenbourg
Norman, D. A. (2013). The Design of Everyday Things. Basic Books
Buxton, B. (2007). Sketching User Experiences. Morgan Kaufmann
Kuutti, K., & Bannon, L. (2014). The turn to practice in HCI: towards a research agenda. In CHI '14
Figma Design Tool: https://www.figma.com

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003834
Web-Intelligence

Module profile

Exam number
5003834

Duration
1 semester

Frequency
Every winter semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Mario Fischer

Lecturer(s)
Dr.-Ing. Benedikt Kämpgen

Applicability	BEC, BIN, BWI
Semester according to SPO	7. semester
Type of module	FWPM

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
none

Content

- Methods and technologies for the systematic, preferably automatic collection and evaluation of business-relevant information from the Internet, in particular from the World Wide Web
- Web Intelligence as a type of "data reconnaissance/procurement via the web",
- for better decisions and
- for the development of more useful web applications.
- Practical insights into the following topics:
- Data analytics (e.g. pivot, OLAP, data warehousing, BigQuery),
- Web applications (e.g. Low-Code, AppSheet, MediaWiki),
- Data Lake (e.g. Big Data, NoSQL, Cloud, SaaS, MapReduce),
- Graph data (e.g. knowledge graph, semantic web, reasoning),
- Text data (e.g. natural language processing, large language model, ChatGPT),
- Internet of Things (e.g. sensor, actuator, micro:bit),
- Artificial intelligence (e.g. machine learning, responsible AI).

Each session consists of approximately 50% lecture and 50% tutorial.
The content of the course is taught in lectures and presentations.
Students should be encouraged to study the literature and analyse the content of the topics.
In addition to the lecturer, up to two external speakers will give practical presentations.
In the exercises, students will work together in groups to answer specific questions and work on practical examples. You will need your own laptop or one laptop per group to complete the exercises.
The course slides, sample solutions for the exercises and additional material will be made available on the THWS e-learning platform (https://elearning.fhws.de).
The portfolio examination form is chosen for the award of credit points. This involves 6-8 portfolio tasks, which the students are allowed to solve on predetermined dates in 1-3-page documents.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Other exam (soP) according to §§ 26, 27 APO

Examination - length/format
Portfolio

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
After successfully completing the module, students will be able to:

- Identify appropriate data sources and data on the web and apply analysis tools to compare data.
- Identify systems on the web and apply low-code systems for their own systems.
- Illustrate the problem of big data and apply possible solutions.
- Identify, compare and demonstrate the use of text data and graph data.
- Illustrate the Internet of Things.
- Apply artificial intelligence to data on the web. Discuss further use cases for Artificial Intelligence on the web.

Literature
Jiming Liu, Ning Zhong, Yiyu Yao, and Zbigniew W. Ras. The Wisdom Web: New Challenges for Web Intelligence (WI). Journal of Intelligent Information Systems. 2003.
Tom Heath, and Christian Bizer. Linked Data: Evolving the Web into a Global Data Space. Vol. 1. Morgan & Claypool. 2011.
Sergey Melnik, Andrey Gubarev, Jing Jing Long, Geoffrey Romer, Shiva Shivakumar, Matt Tolton, Theo Vassilakis, Hossein Ahmadi, Dan Delorey, Slava Min, Mosha Pasumansky, and Jeff Shute. Dremel: A Decade of Interactive SQL Analysis at Web Scale. PVLDB. 2020.

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5102120,6102600
Business and IT Law

Module profile

Exam number
5102120,6102600

Duration
1 semester

Frequency
Every winter semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 60 hrs

Self-study: 90 hrs

Total: 150 hrs

Teaching format
Seminar-style instruction

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Oliver Ehret

Lecturer(s)
Prof. Dr. Oliver Ehret

Applicability	BEC, BIN
Semester according to SPO	7. semester
Type of module	Compulsory module

Required prerequisites for the participation in the module according to the SPO
none

Recommended prerequisites for the participation in the module
none

Content
General contract law
Special contract law with regard to IT, special types of contracts Basic principles of copyright law
Overview of relevant areas of intellectual property law Internet law
Data protection law

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
None

Examination - type
Written exam (sP) according to § 23 APO

Examination - length/format
90 minutes

The concrete length/format of the examination will be determined in the study plan.

Language of examination
German

Condition for the award of credit points
None

Learning outcomes
1. students know the basic terms and concepts of our legal system and its basic structures.
2. students understand the role of law for computer scientists and the relevance of legal knowledge in the IT sector.
3. students acquire the essential basics of general private and public law and their application in practice.
4. students explain IT legal terms and are able to categorise them in the context of relevant areas of law and contractual areas.
5. students recognise legal risks in the IT sector, are able to assess them and develop strategies to limit them.
6. students develop practical skills in dealing with IT-relevant legal problems, including knowledge of basic types of contracts in the IT sector.
7. students understand the principles of data protection, especially in the IT sector and their significance in an international context.
8. students reflect on the interlinking of computer science, architecture of IT systems, information security and data protection in order to gain a holistic understanding of these topics.

Literature
o Köhler, German Civil Code, dtv, 89th edition 2022
o Schneider: IT and Computer Law, 15th edition, Beck dtv, Munich 2022.
o Kallwass, Abels: Private Law, Verlag Franz Vahlen Munich, 24th edition, 2021
o Hoeren: IT Contract Law, 2nd edition, Verlag Otto Schmidt, Cologne 2012.
o Marly: Praxishandbuch Softwarerecht, 7th edition, C.H.Beck, Munich 2018.
o Härting: Internetrecht, 7th edition, Verlag Otto Schmidt, Cologne 2022.
o Hoeren: Skript Internetrecht Uni Münster, as of April 2020
o Haug: Basic knowledge of internet law, Verlag W. Kohlhammer, 3rd edition, 2016
o Redeker: IT law, C.H.Beck, 7th edition, 2020
o Schneider: Handbook, IT law, Otto Schmidt, 5th edition, 2017
o Kühling, Sack, Hartmann: Data protection law, 5th edition C.F.Müller, 2021