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

Module Handbook
Bachelor Information Security (B. Sc.)

Winter semester 2026
Summer semester 2026

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1. semester

Module: 6810040
Algebra

Module profile

Exam number
6810040

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	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
School maths

Content
General Foundations:
- The field of real numbers
- The principle of complete induction
- Introduction to the field of complex numbers

Linear Algebra:
- Vector spaces (linear independence, basis and dimension)
- Matrices (matrix operations, trace and determinant, rank of a matrix)
- Systems of linear equations
- Gauss's algorithm
- Linear transformations

Elementary number theory:
- Remainder representation of integers, GCD
- Extended Euclidean Algorithm
- Modulo arithmetic
- Arithmetic with residue classes
- Linear congruence equations
- Modular exponentiation

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 recall fundamental mathematical concepts and methods 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 to develop solution strategies.
4. Students analyse mathematical problems and identify suitable approaches to solving them, taking various mathematical theories into account.
5. Students evaluate different solution strategies in terms of their efficiency and appropriateness in computing.
6. Students create mathematical models to abstract and solve complex problems in computing.

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, published by Carl Hanser Verlag, 2021.
Hartmann, Peter: Mathematics for Computer Scientists. Vieweg +Teubner, Wiesbaden, 2020.
Papula, Lothar: Mathematics for Engineers and Natural 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.

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
This module covers the fundamental concepts and techniques of database development. The relational data model and relational algebra are presented as the theoretical foundations. A key 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. An introduction to the SQL language is provided, including data manipulation, data querying, schema definition and transaction management. Database development and administration are practised through practical exercises and projects carried out throughout the semester.

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 the fundamental concepts of data persistence and the differences between persistent and non-persistent data.
- Students can define the key 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 relationship 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 in terms of redundancy, consistency and normal forms.
- Students are able to analyse business information requirements and derive suitable data structures and queries from them.

Literature

- Michael Kofler (2024). Database Systems – The Comprehensive Textbook (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 edition). 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: tail recursion/non-tail recursion, linear recursion/tree recursion
- Complexity: O-notation, time complexity, space 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 arrays
- 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
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
At the start of their course, students develop an understanding of the style and aesthetics of programming.
Students understand the fundamental techniques of algorithmic problem-solving.
Students generalise the appropriate application of key 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 Programmes. Springer Verlag, 4th edition, 2014
Wagenknecht: Programming Paradigms: An Introduction Based on Scheme. Vieweg+Teubner, 2013

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Module: 6810050
Foundations of Information Security

Module profile

Exam number
6810050

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.-Ing. Sebastian Biedermann

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

Applicability	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
This module covers topics that form the basis for subsequent modules in the Information Security degree programme, explaining them in the necessary technical depth.
The fundamentals of operating systems, applications, computer networks and programming are taught with a consistent focus on information security issues.
Various types of attackers, their motivations and their business models are discussed using examples drawn from well-known past scenarios.
Furthermore, the various job roles, the associated responsibilities and potential career options in the field of information security are presented.

Examination

Required prerequisites for the participation in the examination according to the SPO appendix
kine

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 fundamental objectives of information security
- are familiar with common strategies used in digital attacks, the motivations behind them and/or the business models involved
- understand how operating systems work, including their security mechanisms and security issues
- understand the basic execution of programmes or processes and the associated security-related interactions
- are familiar with the fundamentals of digital communication, computer networks and the Internet
- are familiar with various career paths and the associated roles within the field of information security
- are able to write simple programmes in a scripting language

Literature
Jason Andress, Foundations of Information Security, 2019
Andrew S. Tanenbaum, Modern Operating Systems, 4th edition, 2016
Andrew S. Tanenbaum, Computer Networks, 5th updated edition, 2019
Justin Seitz & Tim Arnold, Black Hat Python, 2nd edition, 2021

Module: 6820020
Programming in Python

Module profile

Exam number
6820020

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. Tristan Wimmer

Lecturer(s)
Prof. Dr. Tristan Wimmer, Christine Zilker

Applicability	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
This module aims to teach students the basics of programming using the Python programming language. It introduces the fundamental concepts of programming languages and programming paradigms, and lays the foundations for further modules on the Software Engineering degree programme.
The following topics are covered:

- Basic data types, data structures and operators
- Control structures: loops and conditional statements
- Programming with functions
- Introduction to object-oriented programming
- Introduction to the concept of inheritance
- Introduction to exception handling

In addition to these topics, this module highlights suitable ways of organising code, as well as documentation techniques for a clean and readable programming style. Furthermore, students are shown how best to tackle and solve problems.

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
Upon successful completion of the module, students will be able to identify and name the basic data types, data structures and operators, and apply them in the Python programming language.

- Students will be able to explain how control structures, such as loops and conditional statements, control the flow of programmes and how these are implemented in Python.
- Upon successful completion of the module, students will be able to write simple Python programmes that use functions and parameter passing to solve specific tasks, applying the 'divide and conquer' principle.
- Students will be able to apply object-oriented programming to improve the structure and maintainability of a programme through encapsulation.
- Upon successful completion of the module, students will be able to design and implement an object-oriented programme in Python for a specific requirement, utilising the fundamental principles of inheritance.
- Upon successful completion of the module, students will be able to apply exception handling for incorrect input and data type incompatibilities.

Literature
Häberlein, Tobias. Programming with Python: An Introduction to Procedural, Object-Oriented and Functional Programming. 1st ed. 2024. Berlin, Heidelberg: Springer Berlin Heidelberg, 2024. https://doi.org/10.1007/978-3-662-68678-2.

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Module: 6810060
Social Engineering and Security Awareness

Module profile

Exam number
6810060

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,
David Henkelmann

Applicability	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
The module 'Social Engineering and Security Awareness' focuses on the human factor in information security. People play a decisive role in information security within organisations through their behaviour – they are a key security factor. Owing to their influence, they are increasingly targeted by cybercriminals. The module examines the human factor in information security in general and two aspects in particular: the security factor and the victim.

The Human Factor in Information Security:
- The roles of people in information security
- Insider threats
- Reasons for non-compliant behaviour

Information security awareness refers to raising employees' awareness of information security (security factor):
- Security awareness concepts and models
- Psychological understanding of awareness
- Practical examples of awareness measures
- Promoting and measuring security awareness – turning employees into security factors
- Security awareness maturity models

Social engineering is the targeted manipulation of people in order to induce them to carry out unintentional actions (victims):
- Forms and tools of social engineering
- Psychological Tactics Used by Social Engineers
- The Social Engineering Attack Cycle, including Information Gathering
- Phishing and Phishing Simulations

The course utilises group work and interactive elements, and provides opportunities for hands-on experience (in both attacking and defending against the human factor).

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 view people as a solution rather than a problem for information security.
They explain the role of the human factor in information security using examples.
The students are familiar with and can identify the principles of social engineering and can explain them using examples.
They can name different forms of phishing and discuss the advantages and disadvantages of phishing simulations.
They understand what information security awareness means and are familiar with methods to enhance the various aspects of awareness.
Students can develop awareness measures in a targeted and personalised manner.

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 Approaches to Successful Employee Awareness, 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.: People and Information Security, Hanser, 2024.
Weber, K.; Schütz, A.; Fertig, T.: Fundamentals and Applications of Information Security Awareness, SpringerVieweg, 2019.
Take Aware Sec&Life magazine, https://www.take-aware-events.com/news-post/magazinesecandlife

2. semester

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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	BEC, BISD, BDGD
Semester according to SPO	2. 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 Applied Natural Sciences and Humanities.

Recommended prerequisites for the participation in the module
none

Content
A choice of two compulsory elective general science modules (AWPF) (2 x 2 SWS) or one AWPF (1 x 4 SWS) from the range of modules offered by the Faculty of Applied Natural Sciences and Humanities (FANG).

Subjects offered by FANG in the following areas:
- 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, other modules within the degree programme are excluded from the FANG course catalogue. The relevant courses are marked as ‘restricted’ in the FANG course catalogue.
The content of the individual AWPFs is published on the FANG faculty’s own website.

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 AWPFs selected in each case. Students

- also acquire knowledge and skills that are not subject-specific but may be relevant to their intended career path, such as specialised knowledge of foreign languages, the natural sciences or the social sciences
- analyse a wide variety of issues
- place subject-specific knowledge within an interdisciplinary context
- apply what they have learnt to their current training
- have expanded their key competences and, where applicable, their foreign language skills, thereby supporting their personal development, including from an intercultural perspective
- are aware of their responsibilities in personal, social and ethical terms.

Literature
depending on the selected AWPFs

Module: 6810100
Basics of Cryptography

Module profile

Exam number
6810100

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. Andreas Keller

Lecturer(s)
Prof. Dr. Andreas Keller

Applicability	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
'Algebra' module

Content
- Mathematical foundations
- Block ciphers
- DES and AES
- The RSA algorithm
- Cryptographic hash functions
- Discrete logarithms and the ElGamal scheme

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

- identify mathematical concepts from number theory and linear algebra that are relevant to cryptographic methods.
- describe and distinguish between fundamental cryptographic methods such as symmetric and asymmetric encryption.
- explain how selected cryptographic algorithms (e.g. RSA, Diffie-Hellman, AES) work on the basis of mathematical principles.
- analyse the security of cryptographic methods using mathematical criteria (e.g. prime factorisation, discrete logarithm).
- Critically evaluate the applicability of cryptographic methods in terms of key lengths, computational complexity and known attack scenarios.
- Identify and explain the limitations of cryptographic methods, particularly with regard to theoretical and practical attacks.
- Work on cryptographic problems independently and in a structured manner.
- Develop suitable solutions to cryptographic problems through logical thinking and justify them on a sound mathematical basis.
- Reflect on the significance of mathematical structures for the security of encryption methods.

Literature
Beutelspacher, Wolfenstetter: Cryptography in Theory and Practice, Vieweg+Teubner Verlag | Springer Fachmedien Wiesbaden GmbH, Wiesbaden 2010
Delf, Knebl: Introduction to Cryptography, Springer Berlin, Heidelberg, 2016
Ertel: Applied Cryptography, Hanser Verlag, 2018

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Module: 6810120
ISM-Standards and Processes

Module profile

Exam number
6810120

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
English

Organisation

Responsible lecturer
Prof. Dr. Kristin Weber

Lecturer(s)
Prof. Dr. Kristin Weber,
Aaron Kutzner

Applicability	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
Social Engineering and Security Awareness

Content
The module 'Information Security Management (ISM) Standards and Processes' deals with the holistic design of information security management in companies and organisations. Information security does not merely involve implementing technical measures to protect the IT infrastructure. Rather, organisational, technical, physical and personnel security measures must be coordinated with one another and with the organisation's objectives. Effective security concepts are developed, implemented, audited and continuously improved on the basis of established frameworks, taking into account effectiveness, usability and cost-efficiency.

Against this background, the ISM Standards & Processes module covers, amongst other things, the following topics:

- Structure and content of information security management (ISM) standards and frameworks (e.g., ISO 27001, BSI IT-Grundschutz, CISIS12)
- Development of holistic information security concepts
- Organisational security measures, e.g., information security guidelines, information classification schemes
- Metrics and maturity models for information security
- Incident response and business continuity management
- Audits of security concepts and measures

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 are familiar with the content and structure of ISMS standards and frameworks and select the appropriate ones depending on the situation.
Students develop organisational security measures, such as information security guidelines.
Students adapt processes, such as incident response and business continuity management, to meet organisation-specific requirements.
Students understand the relationship between effectiveness, efficiency and usability when selecting and implementing information security measures.
Students are familiar with concepts relating to the evaluation, auditing and continuous improvement of ISMS.

Literature
Green, J.: Information Security Management Principles, 4th ed., BCS, 2024
Harich, T.: IT Security Management – The Comprehensive Practical Handbook, 4th ed., mitp, 2025
Kersten, H.; Schröder, K.: ISO 27001: 2022/2023 – Information Security Management in Line with Current Standards, Springer-Verlag, 2023
Lang, M.; Löhr, H: IT Security – Technologies and Best Practices for Implementation in Organisations, 2nd ed., HANSER, 2025
Sowa, A.: Information Security Management – Control and Optimisation, Springer Vieweg, Wiesbaden, 2017
Weber, K.: People and Information Security, Hanser, 2024
Whitman, M.; Mattord, H.: Management of Information Security, Cengage Learning, 6th ed., 2019

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
Outline:
1) Introduction to communication networks
2) Theoretical principles of communication technology
3) Practical principles of internet communication
4) Introduction to IT security
5) Fundamentals 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 recall fundamental concepts relating to internet communication systems and their technical principles.
2. Students understand how wireless communication technology works and its implications for data transmission.
3. Students apply modern cryptographic methods to ensure the security of internet communications.
4. Students analyse the performance, capabilities and limitations of internet communication systems in order to make informed decisions when developing distributed systems.
5. Students understand and evaluate the necessity of cryptographic methods in various everyday operational scenarios.
6. Students devise concepts for implementing security mechanisms in Internet communication systems based on the cryptographic techniques they have learnt.

Literature
Patrick Schnabel, A Primer on Communications Technology, 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

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
- Computer classifications (Flynn, Händler, Giloi)
- Computer arithmetic (representation of characters and numbers, IEEE 745, basic arithmetic operations, Booth's algorithm)
- Microprocessor core with control and arithmetic units (pipeline concept, dependencies and their resolution, dynamic scheduling: scoreboard, Tomasulo)
- Machine instructions (ISA, addressing modes, assembler programming)
- x86 assembler (nasm, Linux/Ubuntu)
- RISC/CISC concepts (resource conflicts, microprogramming)
- Memory (structure of DRAM, SRAM, caches, coherence protocols)
- I/O and peripherals (external storage, buses)
- Parallel computing and multithreading
- Performance evaluation (basic concepts, 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 of how different computer architectures work.
In addition, they acquire a basic knowledge of embedded systems.
.
Students are able to

- illustrate the basic components of simple computers,
- explain different implementations of complex circuits,
- describe relevant memory technologies,
- analyse the structure and programming of processors,
- implement simple assembler programmes whilst taking into account the specific characteristics of a computer during programming,
- evaluate the performance of computers,
- design sub-components 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.: Computer Design and Structures, 2006.
Bundschuh, B.; Sokolowsky, P.: Computer Structures and Architectures, 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, 2021 (6th edition). Homeister, Matthias: Understanding Quantum Computing: Fundamentals, Applications and 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: Introductory Course in Computer Science. Springer, 2023.

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

Module: 6820110
Web Exploitation

Module profile

Exam number
6820110

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	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
Students learn about 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., the OWASP Top Ten) in front-ends, back-ends 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 learn how to produce structured reports and present their findings in a manner appropriate to the target audience.

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

- 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).
- identify 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 laboratory setting and analyse their effects.
- Assess discovered vulnerabilities in terms of exploitability and business impact (e.g., using CVSS criteria) and set priorities for remediation.
- Document the results of a web penetration test in a structured report and present key findings in a manner appropriate to the target audience.

Literature
The Web Application 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

3. semester

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. microservices, event-driven)
- Frameworks for implementing backend systems (e.g. Spring)
- Advanced database techniques, scalability, replication, sharding, ORM tools, query caching, the CAP theorem
- Protocols for remote procedure calls, such as GraphQL and Google RPC.
- Fundamentals of the HTTP protocol and its application in the form of Web APIs.
- Comprehensive introduction to the REST architectural principle: resources, URLs, CRUD, hypermedia, caching, security.
- Configuration of web servers (Apache), load balancers and public caches (nginx)
- Testing of backend systems, performance testing using JMeter, monitoring and logging
- Security aspects of network protocols and backend systems

In the traditional degree programme, the lecturer provides or agrees on the topics for the practical examples to be used in 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

- Students understand the fundamental concepts and differences between distributed systems, including their architecture and communication models.
- Students analyse various software architectures for backend systems and evaluate their suitability for different use cases.
- Students apply advanced database techniques such as replication and sharding to enhance data availability and performance.
- Students implement a backend system using a framework such as Spring, following best practices for configuration, deployment and security.
- Students compare different protocols for remote procedure calls, such as GraphQL and Google RPC, assessing their strengths and limitations.
- Students design RESTful APIs by applying the principles of the REST architecture, focusing on resources, URLs, CRUD operations and security strategies.
- 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: 6810180
Governance, Risk, Compliance and Ethics

Module profile

Exam number
6810180

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	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
ISM Standards & Processes

Content
Many individuals and units, both within and outside organisations, are involved in information security management. Governance ensures that transparency, accountability and efficiency are maintained by establishing structures, responsibilities and framework conditions, whilst safeguarding the interests of all stakeholders. This module outlines the stakeholders involved in information security management, how responsibilities are defined, decisions are made and optimal framework conditions are created to ensure maximum information security.

The identification and assessment of IT risks helps organisations to address threats to information security in a targeted and structured manner. The risk-based approach is adopted in many ISMS (Information Security Management System) frameworks. This module covers the fundamentals of IT risk management, including measures for identifying, analysing, assessing and addressing IT risks within a structured risk management process.

The section on ethics explains essential conceptual foundations of moral philosophy. Drawing on established schools of ethics, it examines the normative justification of (information) security as a value and a principle guiding action. The examination of models for integrating ethical considerations into development and system design processes bridges the gap to the practical application of ethical principles. In this context, issues of compliance with current data protection legislation are also of particular relevance. Following an overview of its basic structures, the focus is on the requirements for technical and organisational data protection, as well as on the enforcement of the law and the consequences of legal breaches. Finally, the fundamentals of the reformed information security legislation 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
Upon completion of the module, students will be able to:

- identify and specifically design fundamental 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 both within and outside organisations, and outline their tasks in detail.
- explain the significance and function of IT risk management for information security and illustrate this using practical examples.
- Identify and describe the organisational framework for effective IT risk management.
- Understand, apply and document a simple, structured IT risk management process.
- Recognise ethical challenges when dealing with digital systems relevant to security and develop approaches for integrating ethical principles into work processes.
- Explain the basic structures of data protection law and answer fundamental questions regarding data protection compliance.
- Describe the key elements of information security law and assess their relevance to business practice.
- Communicate effectively with legal or regulatory experts on issues relating to data protection and information security law.
- reflect on the interrelationships between governance, risk and compliance management, and ethics in security-critical IT environments.

Literature
Harich, T.: IT Security Management: The Comprehensive Practical Handbook for IT Security and Technical Data Protection in accordance with ISO 27001. 3rd edition, MITP, 2021.
Johannsen, A.; Kant, D.: IT Governance, Risk and Compliance Management (IT-GRC) – A Competence-Oriented 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 in accordance with the new ISO 27001 – ISMS, Risks, Key Performance Indicators, Controls. 2nd, updated edition, Springer-Verlag, 2020.
Lang, M.; Löhr, H.: IT Security – Technologies and Best Practices for Implementation in Organisations. 2nd, revised edition, Hanser, 2024.
Lewinski/Rüpke/Eckhardt (2022): Data Protection Law. 2nd edition. Munich, C.H. Beck.

Module: 5003230,6810160
IT Project Management

Module profile

Exam number
5003230,6810160

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. Anne Heß

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

Applicability	BISD, BWI
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
- Introduction to projects and project management
- Project organisation
- Project planning process
- Project costing
- Project control and monitoring
- Project closure
- Human resources 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 (basic)
- Process models (phase-based models vs. iterative / incremental / agile process models)
- Agile project management / Scrum

In the non-dual degree programme, the lecturer determines the topics of the practical examples for seminar-based teaching and the examination. In the dual degree programme, students can work on practical examples from the company in seminar-based teaching and in the examination.

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 project management skills, in particular the knowledge required of project managers. To this end, the course covers project management methods, processes and tools.
- Students are familiar with the relevant core activities of software development and their objectives
- Students can identify and describe sub-activities, prerequisites and types of deliverables relevant 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 map activities within these process models
- Students understand the characteristic features and differences between phase-based process models and iterative/incremental process models, and can select suitable process models for a given project context and justify their choice
- Students are familiar with the fundamental 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 are familiar with key concepts of quality management and quality assurance and can describe the relevant tasks and skills (soft skills) of quality assurance officers
- Students are familiar with the key objectives, concepts and activities of configuration management, including the basic functionalities of tools that support configuration management

Literature

- Johannsen, A. and Kramer, A.: Essential Knowledge for Software Project Managers, dpunkt.verlag, 2017.
- Olfert, K.: Project Management, 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.: Handbook of IT Project Management, Hanser, 2018
- Ziegler, Michael: Agile Project Management with Scrum for Beginners, ISBN-13: 979-8751100346, 2021
- Gundlach, Marco: Agile Project Management – Navigating Successfully 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: 6810170
Security Engineering

Module profile

Exam number
6810170

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/English

Organisation

Responsible lecturer
Prof. Dr.-Ing. Sebastian Biedermann

Lecturer(s)
Prof. Dr.-Ing. Sebastian Biedermann,
Prof. Dr. Benjamin Weggenmann

Applicability	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
none

Content
Students acquire the knowledge and skills required to design and analyse secure IT systems using modern cryptographic methods. The focus is on the practical application of fundamental cryptographic concepts, such as symmetric and asymmetric encryption, as well as hashing algorithms, for the development of secure applications. In addition, students examine the functioning and security-related aspects of key protocols such as TLS, PGP, Kerberos, VPN/IPSec and the TOR anonymisation network. Current developments such as post-quantum cryptography (e.g. the Merkle signature scheme), zero-knowledge proofs, and biometric and multi-factor authentication methods are also covered. A further focus is on the principle of 'security by design' and the systematic identification of security-critical vulnerabilities in system architectures. Students learn to analyse security-related requirements and, based on these, to design robust (distributed) systems in accordance with current standards. The module thus imparts both conceptual and technical skills for the development of secure information systems in complex environments.

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

- describe fundamental cryptographic concepts (e.g. symmetric/ asymmetric encryption, hashing) and apply them effectively in security-related application scenarios.
- explain how security-related protocols such as TLS, Kerberos, VPN/ IPSec, PGP or TOR work, and analyse security-critical vulnerabilities.
- assess modern authentication methods, such as multi-factor authentication and biometric methods, and evaluate their security strengths and weaknesses.
- Explain the fundamentals of current cryptographic developments, such as post-quantum cryptography (e.g. Merkle signature schemes), and assess their potential.
- Analyse requirements for secure (distributed) systems and systematically translate them into a secure system design.
- Integrate cryptographic methods into the design of secure systems and protocols, whilst taking current standards and best practices into account.
- Identify potential threats in the design of security-relevant systems and devise suitable technical countermeasures.
- Systematically take into account and evaluate security properties (e.g. confidentiality, integrity, authenticity) in system designs.
- Reflect on the relationship between technical implementation, cryptographic principles and secure system design.

Literature
Security Engineering: A Guide to Building Dependable Distributed Systems, Ross Anderson, 2020
Applied Cryptography: Protocols, Algorithms and Source Code in C, Bruce Schneider, 1996
Bulletproof TLS and PKI, Second Edition: Understanding and Deploying SSL/TLS and PKI to Secure Servers and Web Applications, Ivan Ristic, 2022

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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. Frank Deinzer

Lecturer(s)
Prof. Dr. Arndt Balzer,
Prof. Dr. Frank Deinzer

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
A good command of English

Recommended prerequisites for the participation in the module
none

Content
FWPM is organising a field trip to Bangalore, India, in the second half of February 2027; participants must cover their own flight costs. Further details will be provided in the course.

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

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 key facts about India and its significance in the field of information technology.
Students analyse and evaluate differences between Germany and India.
Students use a visually-oriented, free-flowing presentation style during their presentations.
Students apply basic intercultural communication techniques, using India as an example.
Students demonstrate successful collaboration with students from the partner university as part of a technical project.

Literature
This will be announced during the seminar, depending on the topics covered.

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Module: 5111140 System-oriented Programming

Module profile

Exam number
5111140

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 I and Programming II

Content
- Definition and meaning of system-oriented programming
- Using the command line of an operating system
- Shell programming using Bash as an example
- Data processing on the command line using sed, awk, sort and jq
- Using AI assistance systems (e.g. GitHub Copilot, ChatGPT)
- Editing text documents with vim
- The Git version control system
- Introduction to the C programming language (syntax, data types, pointers, memory management)
- System programming under Linux (system calls, handling files and processes)
- Security aspects of system-related programming and protection mechanisms
- Structure of the Linux operating system
- Processes, process management, scheduling
- Inter-process communication, race conditions, deadlocks, semaphores, Petri nets and deadlock detection, the philosopher's problem, the producer-consumer problem
- Memory management, memory abstraction, partitioning, fragmentation, free memory management, virtual memory, page exchange algorithms
- Input and output, direct memory access, interrupts, hard disks, file systems for hard disks
- Network communication and implementation of network protocols
- Hypervisor technologies, Docker containers, resource management

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 definition and principles of system-oriented programming, including its role in software development.
- The students demonstrate proficiency in using an operating system's command line, applying advanced tools such as sed, awk, sort and jq for data processing tasks.
- The students develop shell scripts in Bash to automate system tasks and streamline operations effectively.
- Students utilise AI assistance systems, such as GitHub Copilot and ChatGPT, to improve coding efficiency and solve programming challenges.
- Students manage text documents using the vim text editor, employing advanced editing and configuration techniques.
- Students implement version control practices with Git to support collaborative software development workflows.
- Students programme in C, focusing on syntax, data types, pointers and memory management, and use debugging and profiling tools such as gdb, strace, ltrace and gprof to analyse code performance.
- Students evaluate the security aspects of system-related programming and apply protection mechanisms to ensure code security.

Literature

- D. J. Barrett, *Efficient Linux at the Command Line: Boost Your Command-Line Skills*, 1st edition. Sebastopol, CA: O'Reilly, 2022.
- A. S. Tanenbaum and H. Bos, *Modern Operating Systems*, 4th ed. Boston: Prentice Hall, 2015.
- K. Hitchcock, *Linux System Administration for the 2020s: The Modern Sysadmin Leaving Behind the Culture of Build and Maintain*. Berkeley, CA: Apress, 2022. doi: 10.1007/978-1-4842-7984-7.
- M. Kalin, *Modern C Up and Running: A Programmer's Guide to Finding Fluency and Bypassing the Quirks*. Berkeley, CA: Apress, 2022. doi: 10.1007/978-1-4842-8676-0.
- K. Hitchcock, *The Enterprise Linux Administrator: Journey to a New Linux Career*. Berkeley, CA: Apress, 2023. doi: 10.1007/978-1-4842-8801-6.
- J. Varma, *Pro Bash: Learn to Script and Program the GNU/Linux Shell*. Berkeley, CA: Apress, 2023. doi: 10.1007/978-1-4842-9588-5.
- S. M. Palakollu, Practical System Programming with C: Pragmatic Example Applications in Linux and Unix-Based Operating Systems. Berkeley, CA: Apress, 2021. doi: 10.1007/978-1-4842-6321-1.

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Module: 5111279,6812790
Transfer colloquium

Module profile

Exam number
5111279,6812790

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.-Ing. Erik Schaffernicht

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

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

Required prerequisites for the participation in the module according to the SPO
For dual-track students on the BWI degree programme only

Recommended prerequisites for the participation in the module
none

Content
The Transfer Colloquium is designed to facilitate discussion amongst students on the dual study programme and replaces one of the FWPM sessions. Students on the standard version of the degree programme do not take part in this event. The event takes place spread across the third to seventh semesters, with the exception of the work placement semester. Under the guidance of a lecturer, dual-study students discuss the following topics:

- Introduction and overview: Presentation of the transfer colloquium and its objectives; explanation of the importance of exchanging experiences between the university and the company for dual-study students.
- Reflection on practical experience: In-depth reflection on the knowledge and skills acquired during the degree programme and in practical work, as well as their application in day-to-day business operations.
- Exchange of experiences: Moderated discussions on challenges and solutions relating to balancing university studies with practical work within the company.
- Best-practice examples: Presentation and discussion of successful projects and practices from the company that have been implemented by students during their studies and in practical work.
- Problem-solving strategies: Development and presentation of approaches to solving typical problems that may arise in a dual study programme, including time management and prioritisation.
- Application of theoretical knowledge: Deepening students' understanding of how theoretical knowledge from university modules can be applied in practice within the company.
- IT security in the company: An 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 preparation and presentation of project documentation to present the work carried out within the company in a structured manner.
- Feedback and continuous improvement: Systematic collection and analysis of feedback from companies and the university to ensure the continuous improvement of the dual study programme.

- Professional development and career planning: Discussion of career paths and development opportunities for dual-study students, based on the skills acquired during their studies and in practical work.

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 experiences in order to draw conclusions for their professional development.
- Students develop strategies to resolve problems that arise when balancing their studies with practical work.
- Students apply the theoretical knowledge they have acquired in a practical context within the organisation to optimise the transfer of knowledge between the university and the workplace.
- Students communicate their practical experiences clearly and in a structured manner and present their findings effectively.
- Students assess the importance of IT security in a business context and implement appropriate measures in their day-to-day work.
- Students produce professional project documentation to ensure their work is transparent and traceable.
- Students use feedback constructively to continuously improve their working methods and the collaboration between the university and the company.

Literature
To be announced during the seminar.

Module: 6810150,6102600
Business and IT Law

Module profile

Exam number
6810150,6102600

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	BISD, BEC
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
General Contract Law
Specific Contract Law relating to IT, specific types of contract; fundamentals of copyright law
Overview of relevant areas of industrial property law; law on the internet
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
To provide an understanding of the law, the fundamental legal concepts of our legal system and its basic structures; to give an overview of the role the law plays for computer scientists. Understanding the key principles of general private and public law; understanding and categorising terms relating to IT law; gaining an overview of the key areas of law and contractual matters relevant to IT; Identifying, assessing and mitigating legal risks; developing practical skills in dealing with IT-related legal issues and becoming familiar with basic types of contracts in the IT sector; acquiring a grounding in copyright law, particularly in relation to software and databases; understanding the principles of data protection, particularly in the IT sector.
The importance of data protection law, particularly in an international context, is highlighted. In this regard, emphasis is also placed on conveying how closely computer science, the architecture of IT systems, information security and data protection are interlinked.

Literature
Köhler, The German Civil Code, dtv, 89th edition, 2022
Schneider: IT and Computer Law, 15th edition, Beck dtv, Munich, 2022.
Kallwass, Abels: Private Law, Franz Vahlen Publishers, Munich, 24th edition, 2021
Hoeren: IT Contract Law, 2nd edition, Otto Schmidt Publishers, Cologne 2012.
Marly: Practical Handbook on Software Law, 7th edition, C.H. Beck, Munich 2018.
Härting: Internet Law, 7th edition, Otto Schmidt Publishers, Cologne 2022.
Hoeren: Lecture Notes on Internet Law, University of Münster, as at April 2020
Haug: Fundamentals of Internet Law, W. Kohlhammer, 3rd edition, 2016
Redeker: IT Law, C.H. Beck, 7th edition, 2020
Schneider: Handbook: IT Law, Otto Schmidt, 5th edition, 2017
Kühling, Sack, Hartmann: Data Protection Law, 5th edition, C.F. Müller, 2021

4. semester

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

Module: 6810240
Expertise and Communication

Module profile

Exam number
6810240

Duration
1 semester

Frequency
Every summer 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

Language of instruction
German/English

Organisation

Responsible lecturer
Prof. Dr. Kristin Weber

Lecturer(s)
Prof. Dr. Kristin Weber,
Prof. Dr. Benjamin Weggenmann

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

Required prerequisites for the participation in the module according to the SPO
Module 6810060

Recommended prerequisites for the participation in the module
none

Content
In this seminar, students independently explore current topics from all areas of information security and related fields, such as data protection. The lecturers provide a selection of topics from which students may choose one, or they may propose a different topic. Students independently research their chosen topic comprehensively, applying academic principles, and document their findings in a term paper. The accompanying seminar teaches writing and creativity techniques, as well as the fundamentals of academic research and writing. In addition, students present their topics in a talk to an audience from outside the discipline, in order to test their ability to present technical topics in a way that is appropriate for the target audience.

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
Upon successful completion of this module,

- students will know how to familiarise themselves independently with topics relating to information security and expand their knowledge.
- they will be familiar with further current issues relating to information security and related subject areas, e.g. data protection.
- they will be able to apply the fundamentals of academic work.
- students will be able to present, document and discuss interim findings, and will understand the role that feedback plays in academic discourse.
- they are able to produce a written paper that meets academic standards.
- they can prepare, communicate and present academic and technical topics in a manner appropriate to the target audience.
- they are familiar with writing and creativity techniques and can apply them as the situation requires.

Literature
Aengenheyster, S.; Dörr, K. (eds.): Practical Handbook of IT Communication. SpringerGabler, 2019.
Kirchem, S.; Waack, J.: Developing Personas for Marketing, Sales and Communication – Fundamentals, Concept and Practical Implementation. SpringerGabler, 2021.
Lubienetzki, U.; Schüler-Lubienetzki, H.: What We Say and Show, and How – The Psychology of Human Communication. Springer, 2020.

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
Back-end Systems

Content

- Introduction to Web Technologies: The 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: A more in-depth look at JavaScript, exploring modern ES6+ features such as `let`, `const`, arrow functions, template literals, modules, promises, and `async/await`, and learning 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 Front-end Development: Principles of IT security as they relate to front-end development, including securing user input, preventing cross-site scripting (XSS) and cross-site request forgery (CSRF), and ensuring secure communication between front-end and back-end systems. Introduction to the Open Web Application Security Project's Top Ten list.
- Project Development and Deployment: Setting up development environments, following best practices in code organisation and documentation, and deploying and maintaining front-end applications in a production environment.

In the traditional degree programme, the lecturer provides or agrees on the topics for the practical examples to be used in 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 principles of HTML, CSS and JavaScript, enabling them to build and style basic web pages effectively.
- Students apply modern web frameworks such as React and Svelte to develop dynamic and responsive user interfaces.
- Students analyse different state management techniques, such as React hooks and the Context API, to manage complexity in web applications.
- Students design cross-platform mobile user interfaces using Flutter, focusing on user experience and performance.
- Students implement best practices in front-end development, including version control, testing and secure deployment processes.
- Students create a comprehensive front-end project from scratch, integrating all the concepts they have learnt into a fully functional application.
- Students evaluate different frameworks and tools for front-end 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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Faculty of Computer Science and Business Information Systems
Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 6100930,6810190 Innovation Management and Entrepreneurship

Module profile

Exam number
6100930,6810190

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. Michael Müßig

Lecturer(s)
Prof. Dr. Michael Müßig

Applicability	BEC, 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
none

Content
Introduction: Motivation, innovation, business, business start-ups, start-ups and a look at economic history
Definitions: Management, … and all terms relating to innovation and types of innovation
Processes and interrelationships: Adoption and diffusion, acceptance
Forecasting: Gartner's Hype Cycle and the Three Horizons
Innovation within organisations, Schumpeter and the Innovator's Dilemma, Disruption
Start-up ecosystems
End-to-end: Design Thinking, Personas and Value Proposition, Business Model Canvas, Lean Start-up and Customer Development, MVP and Prototyping
The business plan, the founding team
Growth and change, growth hacking
Setting up, financing, structuring and valuing a business
Open and Crowd Innovation, Jugaad, Frugal Innovation and Sustainability in Start-ups and Innovation

Case Studies (rotating): Tesla, Kodak and digital photography, Fashion and TEC, Scoutbee, Vogel Communications

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

- Describe and explain the terminology relating to innovation management, as well as business start-ups and management
- Assess statements regarding regional and internal corporate ecosystems for innovation, intra-entrepreneurship and entrepreneurship
- To understand the importance of teams and team processes in the field of innovation development and business start-ups, and to apply team-building methods
- To familiarise themselves with the fundamentals of a business plan in terms of its structure and development, and to be able to develop and draw up one independently
- Identify the key tax, legal and economic components of a successful business start-up and analyse their significance
- Using methodological approaches to design thinking, value proposition and business models, students will be able to present and design their own business model ideas

Literature
Compulsory reading:
Hess, Thomas: Strategically Managing Digital Transformation. Springer Fachmedien Wiesbaden GmbH, 2019
Osterwalder, Alexander; Pigneur, Yves et al.: *Business Model Generation*, campus Verlag, 2013 (and later editions)
Ries, Eric: *Lean Startup*, 4th ed., Reline-Verlag, Munich, 2015
Kotsemir, M.; Abroskin, A.; Meissner, D.: Innovation Concepts and Typology – an evolutionary
Discussion. Basic Research Programme, Working Papers, SERIES: SCIENCE, TECHNOLOGY AND INNOVATION WP BRP 05/STI/2013

Supplementary reading:
Christensen, Clayton M.: The Innovator’s Dilemma, Harvard Business Review Press (1997 and current editions, also available in German)
Burkhardt, Christoph: Denkfehler Innovation; SpringerGabler 2017

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 6820220
OS Exploitation

Module profile

Exam number
6820220

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. Benjamin Weggenmann

Lecturer(s)
Prof. Dr. Benjamin Weggenmann

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

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

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Recommended prerequisites for the participation in the module
Fundamentals of IT Security (IT Security Fundamentals)

Content
OS Exploitation provides a practice-oriented introduction to software vulnerabilities and exploitation techniques on modern operating systems. Students learn the relevant fundamentals of operating system architecture (kernel and user space, privilege rings, process and memory management, calling conventions, system calls, access control) as a basis for understanding how typical vulnerabilities such as buffer and heap overflows, integer overflows, format string bugs and race conditions arise in real-world software. Building on this foundation, the module covers user-space and kernel exploitation (including shellcode and privilege escalation), the use of the Metasploit framework (e.g. Meterpreter, privilege escalation), and the analysis of malware families, business models, detection and evasion techniques, with a particular focus on API hooking and endpoint detection and response (EDR/XDR) concepts.

Students apply static and dynamic analysis methods such as disassembly, reverse engineering, debugging, fuzzing, and sandboxing/emulation to identify and assess vulnerabilities in binaries and to select and use suitable exploits. The module discusses compiler-, OS- and hardware-based defence mechanisms (e.g. bounds checking, stack canaries, ASLR, non-executable memory, secure boot) as well as advanced attack techniques such as Return-Oriented Programming to illustrate how such protections can be bypassed. Upon completion, students will understand common classes of vulnerabilities and mitigation techniques in modern operating systems, be able to assess the exploitability and severity of identified weaknesses, interpret and write simple detection rules, and be familiar with basic concepts of threat intelligence sharing.

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 understand common types of software vulnerabilities.
- They can apply static and dynamic analysis techniques to analyse binaries in order to discover and identify vulnerabilities.
- They are able to assess the severity of discovered vulnerabilities based on how easily they can be exploited.
- They are able to select and apply suitable exploits to discovered vulnerabilities.
- Students understand the mitigation techniques implemented in modern operating systems and, where applicable, novel attack strategies that may circumvent them.
- Students understand how malware works and the methods it uses to avoid detection. They can apply simple evasion techniques themselves.
- Students are familiar with threat intelligence sharing and can interpret and write simple detection rules.

Literature
This will be announced during the lecture.

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
Students are to work in groups to develop their own application.
An application could, for example, be a game, a three-tier web application or a similar application. Possible components of the application could include a graphical user interface (including a web interface), a database connection including schema design, network communication, AI, etc.
Furthermore, students will produce documentation (an 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
Upon successful completion of the module, students will be able to

- develop their first major application as part of a team of 4–6 people
- plan and implement a project
- allocate and implement tasks
- apply their knowledge of software design
- apply the programming concepts they have learnt
- look up the necessary information themselves using appropriate literature
- break down a task into sub-problems.

Literature
None

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

Module: 6810230
Security Operations

Module profile

Exam number
6810230

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. Benjamin Weggenmann

Lecturer(s)
Dr.-Ing. Rodrigo Daniel do Carmo,
Prof. Dr. Benjamin Weggenmann

Applicability	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
none

Content
Students learn how to secure networks and IT systems using technical security measures. The course focuses on key security components such as firewalls, proxies and intrusion detection systems (IDS). Students gain practical knowledge of how to set up, configure and use these systems in real-world scenarios. The course content is based on typical requirements in a corporate environment as well as established security standards such as those of the National Institute of Standards and Technology (NIST). Particular emphasis is placed on security monitoring: students learn to identify, correlate and analyse security-related information from various sources in a targeted manner. They develop and implement case-specific detection rules for attack detection and examine the tasks and processes of a Security Operations Centre (SOC), including logging, incident detection and response. The module thus provides a practical understanding of the day-to-day operation of IT security systems in modern corporate environments.

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 are familiar with the functions of firewalls, proxies and intrusion detection systems and are able to set them up
- Students can develop and implement case-specific rules for detecting attacks
- Students can identify and collate security-related information for security monitoring
- Students are familiar with the roles of a Security Operations Centre (SOC)

Literature
Defensive Security Handbook: Best Practices for Securing Infrastructure, Lee Brotherston and Amanda Berlin, 2017
Zero Trust Security: An Enterprise Guide, Jason Garbis and Jerry W. Chapman, 2021
Security Operations Centre: Building, Operating and Maintaining Your SOC, Joseph Muniz and Gary McIntyre, 2015

5. semester

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

Module: 6810250
Supervised Internship

Module profile

Exam number
6810250

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
Michael Rott

Lecturer(s)
Michael Rott

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

Required prerequisites for the participation in the module according to the SPO
> 90 ECTS credits. 55 ECTS from the first year

Recommended prerequisites for the participation in the module
none

Content
- As part of a larger IT project, the intern must work independently in as many project phases as possible (system analysis, system planning, implementation, system roll-out and testing). This project should last for at least 12 weeks.
- Ideally, the intern will familiarise themselves with various departments and divisions of the company prior to the project in order to gain a general understanding of other departments and the company as a whole.

The contact person/supervisor at the FHWS is the representative responsible for the supervised practical phase, Prof. Dr Tobias Aubele

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 intern should

- acquire relevant, practical knowledge of business processes
- learn (through guidance) to work independently and on their own initiative on IT projects.
- link the skills acquired during their studies with practical experience.
- learn to understand problems and requirements (e.g. customer requests).
- learn to design and implement solutions (e.g. for business processes and/or IT projects).
- Experience working as part of a team.
- Learn about and experience being integrated into the company, its processes and organisational workflows.
- Learn about and experience the professional field of computer science.
- Learn to approach the right points of contact when problems arise.
- See the unwavering commitment to the successful and professional implementation of projects demonstrated in practice.
- Experience excellence and professionalism.
- See how staff are inspired by this approach.
- Recognise and feel the purpose of their work.

Literature
It is not possible to provide a general recommendation for reading material

6. semester

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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)
Dr. Manikandakumar Muthusamy

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 students to next-generation AI systems capable of autonomous decision-making, planning, reasoning and self-improvement. 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.
Learners will explore agent architectures, cognitive models, memory systems, tool-use capabilities, multi-agent collaboration frameworks, and practical agent deployment workflows. Through laboratory 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 concludes with a practical assessment in which 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 with sustainability and the 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 invocation and API integration – Evaluator-planner loops – Safety layers and 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 and 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
Textbooks:
Martin Ford, *Architects of Intelligence: The Truth About AI from the People Building It*, 2018.
Stuart J. Russell and 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
This event is organised by the Faculty of Plastics Technology and Surveying (FKV):
(https://geo.thws.de/studium/bachelor-geovisualisierung/studienablauf/modulhandbuch-bgv-ab-ws-202223/)

For the schedule, see: https://geo.thws.de/studium/aktuelle-lehrveranstaltungsplaene/

Augmented and Mixed Reality and their applications
- Implementation of marker-based applications
- Implementation of image-based applications
- Implementation 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 are familiar with the fundamental concepts of augmented reality (AR) and mixed reality (MR), as well as their areas of application.
2. Students understand the differences between marker-based, image-based and location-based services (LBS) in AR technology.
3. Students apply relevant services to plan and implement AR applications.
4. Students analyse requirements and potential uses for AR applications in relation to various content-based approaches.
5. Students evaluate the effectiveness of different techniques for visualising content in relation to spatial objects and markers.
6. Students independently create AR applications that are both marker-based and image-based, and are able to publish them successfully.
7. Students 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 Practitioners
- Introduction to BCM
- BCM process and stage-based model
- Standards and regulatory framework
- Initiation, planning and implementation
- Establishing and empowering the BAO
- BIA pre-screening and BIA
- Risk analysis
- Contingency planning (BC strategies, GFPs and WAPs)
- Exercises and testing
- Performance review and key performance indicators

Incident Responders
- Introduction to the cyber security network, including the framework for digital first responders, incident responders and incident experts
- Summary of the content of the basic course
- Conduct on the telephone, including non-technical measures
- Threats and types of attack, and an overview of the current threat landscape
- Standard operating procedures
- Handling IT security incidents
- Remote support
- Incident handling for IT systems ‘outside 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 a practical focus
- Effective detection, analysis and management of security incidents in accordance with BSI standards
- Preparation for the relevant BSI audits within the framework of the Cyber Security Network (CSN)

Literature
https://www.bsi.bund.de/DE/Topics/Companies-and-Organisations/Standards-and-Certification/IT-Basic-Protection/Certified-Information-Security/BCM-Practitioner-Training-Courses/BCM-Practitioner-Training-Courses_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: 5003816
Behavioural Pricing

Module profile

Exam number
5003816

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. Tobias Aubele

Lecturer(s)
Juliane Richter

Applicability	BEC, 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
Students will learn about the influence of prices on consumer behaviour from a psychological perspective. In doing so, they will gain an understanding of the intrapersonal processes involved in the perception, evaluation and retention of price information, and will be able to apply the psychological effects of pricing themselves.

Contents:
Fundamentals of price management
- Introduction to the price management process
- Basic models of business pricing theory
- Approaches to price determination

Introduction to behavioural pricing
- Behavioural pricing as a sub-field of behavioural economics
- Psychological processes and constructs for processing price information
- Behavioural science theories on price perception, evaluation and memory

Behavioural Pricing in Practice
- Designing price information from the supplier’s perspective
- Price psychology effects and practical examples
- Application of behavioural pricing in various sectors

Opportunities and Limitations of (Behavioural) Pricing
- Empirical price research
- Innovative (digital) pricing approaches from a practical and theoretical perspective
- Ethical and legal aspects of (Behavioural) Pricing

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
General learning objectives:
You will be familiar with the methodological and ethical aspects of pricing and will be able to evaluate pricing approaches from both a business management and a behavioural economics perspective

Sub-objectives:
1. Students understand the behavioural pricing approach and are familiar with the theoretical foundations of the psychological impact of price information.
a. Subject-specific competence: Students are familiar with the fundamentals of behavioural pricing management. They understand the psychological impact of price information at different stages of the purchasing process.
b. Problem-solving and evaluation skills: Students understand the behavioural pricing approach as a sub-discipline of behavioural economics and how it differs from classical price theory.
c. Methodological competence: Students practise interpreting behavioural science and psychological models and applying them to pricing management.
d. Communication competence: Students are able to discuss the concepts and models presented in the lecture precisely and using correct technical terminology.
e. Personal competence: Students are able to deepen their knowledge independently by consulting specialist articles.

2. Students are able to apply the effects of price psychology themselves and are familiar with various areas of application.
a. Subject-specific competence: Students understand the influence of different pricing parameters on price perception and consumer behaviour.
b. Problem-solving and evaluation skills: Students are able to evaluate price psychology measures in different contexts and explain them on the basis of the relevant theory. They can independently derive suitable price psychology measures and apply them to specific practical cases.
c. Methodological competence: Students are able to apply the effects discussed in the lecture to practical, price-related issues.
d. Communication competence: Students can contribute to discussions on price psychology measures and present their own approaches. In doing so, they communicate precisely, effectively and using correct technical terminology.
e. Social competence: As part of a practical case study, students work effectively as part of a team.
f. Personal competence: Students work independently and creatively, and use feedback to further their personal development.

3. Students are familiar with the business fundamentals of pricing policy.
a. Subject-specific competence: Students understand the significance and decision-making areas of pricing policy. They are familiar with the classical concepts of price theory and the approaches to price determination.

b. Problem-solving and evaluation skills: Students are able to correctly contextualise the concepts and approaches of pricing management and apply them to case studies.
c. Methodological skills: Students are familiar with empirical methods for price determination, understand the challenges involved and can apply selected survey methods themselves.
d. Personal competence: Students are able to expand on the fundamental concepts covered through independent study of the literature.

4. Students critically examine current trends in pricing management as well as innovative, digital pricing approaches.

Literature

Beck, H. (2014). Behavioural Economics – An Introduction (focusing on Chapters 1, 4–6). Wiesbaden: Springer Gabler.
Diller, H., Müller, S., Ivens, B., & Beinert, M. (2021). Pricing: Principles and Processes of Corporate Pricing Policy. Stuttgart: Kohlhammer.
Holzwarth et al. (2020). Applying behavioural science to health and financial decisions. In: Behavioural Economics Guide 2020.
Kopetzky, M. (2015). Price Psychology: Four Steps to Optimised Pricing. Wiesbaden: Springer Gabler.
Krämer, A. (2020). Dynamic and individualised pricing from the perspectives of businesses and consumers. In R. Kalka & A. Krämer (Eds.), Price Communication. Wiesbaden: Springer Gabler.
Mazumdar, T., Raj, S. P., & Sinha, I. (2005). Reference price research: Review and propositions. Journal of Marketing, 69(4), 84–102.
Meehan, B., Rosenberg, S., & Duke, C. (2018). How to double savings rates: A case study for nudging for good. In: Behavioural Economics Guide 2018.
Pechtl, H. (2014). Pricing policy: Behavioural pricing and pricing systems. Konstanz: UVK Verlagsgesellschaft mbH.
Pechtl, H. (2004). Consumers' price knowledge: a theoretical and conceptual analysis (No. 01/2004). Economic Discussion Papers.
Simon, H. (2015). Confessions of the pricing man. Wiesbaden: Springer Gabler.
Simon, H. & Fassnacht, M. (2016). Price Management: Strategy – Analysis – Decision – Implementation. Wiesbaden: Springer Gabler.

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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 a programme offered by the Virtual University of Bavaria. Further information:
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 a course offered by the Virtual University of Bavaria. Further information:
https://kurse.vhb.org/VHBPORTAL/kursprogramm/kursprogramm.jsp?kDetail=true&COURSEID=20177,83,1508,1

Content
This is a course offered by the Virtual University of Bavaria. Further information:
https://kurse.vhb.org/VHBPORTAL/kursprogramm/kursprogramm.jsp?kDetail=true&COURSEID=20177,83,1508,1

The module is compulsory for students on the ‘Business Technology’ specialisation within the BWI programme
and is used as a substitute for the ‘BI Specialisation I’ module. For students on the BI specialisation,
Prof. Schleif will also be offering 2–3 course components at the SHL during the Summer Semester 2025, specifically on BI topics, supplemented by an enrichment lecture. Please also refer to the timetable for details.

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 a programme offered by the Virtual University of Bavaria.
Further information:
https://kurse.vhb.org/VHBPORTAL/kursprogramm/kursprogramm.jsp?kDetail=true&COURSEID=20177,83,1508,1

Literature
This is a programme offered by the Virtual University of Bavaria.
Further information:
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: 5003856
CANVA – Branding with AI

Module profile

Exam number
5003856

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. Christina Völkl-Wolf

Lecturer(s)
Verena Rempel

Applicability	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
Your own laptop, installation of the Pro version/trial access to the CANVA programme.

Content
1. Corporate Identity – Strategic
Understanding key terms
CI, CD, brand
Best-practice examples from various sectors, analysis of international brands
Positioning, brand values
Mission & vision
Identity models (e.g. Golden Circle)
Target audience profile (e.g. persona)
Brand personality (mood board, archetype)
Tone of voice and writing style

2. Corporate Design – Visual
Developing a design system
From brand essence to visual system (designing with Canva)
Logo
Colour palette
Typography
Visual language
Layout principles (grid, white space, composition)

3. Branding a brand
Creating social media content for the brand
Colour management and colour impact
Fonts and typeface design
Photo editing, graphics
Video, Reels, Stories

Developing a brand ecosystem:
Creating digital and print media such as websites, social media content, audiovisual content, business cards, etc.

Use cases / Application:
Self-employment/freelancing: A consistent corporate identity helps project a professional image and sets you apart.
Portfolio: Having your own branding as a ‘common thread’ creates recognition and demonstrates strategic thinking.

Start-ups & student initiatives: A clear brand identity simplifies communication, fundraising and community-building.
Agency work: CI/CD expertise is a key qualification for strategic design processes carried out on behalf of clients.
Research & science: Scientific projects also benefit from a coherent, comprehensible brand identity.

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 will develop a comprehensive corporate identity and corporate design
concept for a real-world project of their own or a fictional project/ start-up, including visual implementation using Canva and AI applications.
The aim is to design a consistent, professional brand image for subsequent real-world application. Proficiency in using Canva as a design software is a prerequisite.

Students review key concepts of corporate identity and corporate design.
Students understand the importance of strategic brand management for digital communication media.
Students analyse CI/CD systems in terms of target audiences, differentiation and media usage.
Students evaluate design solutions in the context of user experience, media formats and communication objectives.
Students apply the knowledge they have learnt and create a comprehensive corporate identity concept, including a cross-media design system, for their own or a fictional project.

Literature
https://www.canva.com/de_de/

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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 required to design, implement and manage secure computer networks.
In this module, students will gain a solid foundation in establishing and maintaining robust network infrastructures. At the same time, the module addresses the critical issue 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 required 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 relevant to all IT careers, this module will also offer students the opportunity to pursue further self-study and acquire the conceptual knowledge and practical skills required for the Cisco® Certified Network Associate (CCNA®) 200-301 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 principles
- Configuring and verifying secure inter-switch connectivity
- Implementing, optimising and securing switched networks
- Implementing secure device access and access control systems
- Defining 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
Upon successful completion of this module, students will be able to:
1. Explain the fundamentals of computer networks and cyber security.
2. Design, implement, configure and troubleshoot highly available, secure and 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. Students are familiar with the fundamentals of computer networks and the principles of cyber security.
2. Students understand the importance of securing network infrastructures against potential threats and vulnerabilities.
3. Students apply best practice in designing, implementing, configuring and troubleshooting high-availability, secure and scalable network infrastructures.
4. Students understand how threats and exploits can undermine network security and identify measures to mitigate these risks.
5. Students evaluate network security solutions, including access control measures implemented via routers, switches and firewalls.
6. Students develop comprehensive strategies to secure information assets and maintain robust network infrastructures, drawing on theoretical knowledge and practical exercises.
7. Students develop the practical skills required to prepare for the 200-301 Cisco® Certified Network Associate (CCNA®) exam, applying what they have learnt to real-world scenarios.

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Faculty of Computer Science and Business Information Systems
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)
Prof. 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 built, 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-world network environments.
In the final part of the course, students are introduced to next-generation networking paradigms, such as the Internet of Things (IoT), Software-Defined Networking (SDN) and quantum networks, providing insight into the future evolution of networks. As well as providing a broad foundation in computer networking for careers in IT and engineering, this course also supports self-study for the 200-301 Cisco Certified Network Associate (CCNA) exam by developing the 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

- Students understand the fundamentals of computer networking, including LAN construction, network components and the basic principles of communication used in modern information systems.
- 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.
- Students analyse and compare dynamic routing protocols such as RIP, OSPF and BGP, and explain their operational principles, use cases and performance characteristics.
- Students design and implement practical network topologies by integrating routers, switches and end devices, and verify connectivity through hands-on configuration and testing.
- Students understand emerging and future network systems, including the Internet of Things (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 the start of the 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, how self-driving cars recognise pedestrians, how computers detect skin cancer, and how 3D models of iconic places such as the Colosseum are scanned?

This module aims to answer these questions and many more by

- Providing 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, which are required for constructing artificial systems with human-level perception capabilities.

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

01. Introduction – Terminology, 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, morphological 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-neighbour, 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 the causes of aliasing and how to avoid it
- Implement and apply smoothing and morphological operators, edge detectors and segmentation techniques
- Distinguish between contrast adjustment methods and compare the various approaches to detecting and describing 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
- Distinguish between the quantities in the bias-variance problem and apply this to classifiers
- Assess, implement and train neural networks, and discuss their application to computer vision tasks

This module will be taught in English and delivered online and on campus. All sessions will be recorded. Colloquia may be conducted 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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Faculty of Computer Science and Business Information Systems
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. Please install Altair AI Studio before the course; a student licence is available via https://web.altair.com/altair-student-edition.

Content
This course provides business students with 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 to inform business decisions.

- Course introduction, 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 quality: simple train/validation/test approach 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 performance: choosing a useful number of clusters for the business question

- Tree models

o Concept: classification and interpretable drivers
o Hands-on workflow: build and interpret a decision tree in AI Studio
o Validation and model performance: 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 performance: 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 (Analyse): 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 during 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
- An interest in creative yet challenging problem-solving approaches
- An entrepreneurial mindset
- A willingness to rigorously scrutinise one's own ideas

Content
This course explains the fundamentals and background of innovation management, and design thinking in particular, illustrating these with clear examples. Above all, it is important to convey to participants that today's innovation processes place people at the centre and seek to reconcile customer needs with technical feasibility and economic viability. Students are provided with initial tools to enable them to organise and carry out simple design thinking innovation processes independently.
They must understand the fundamental elements underpinning an innovation or Design Thinking process and how these can be skilfully navigated through practical exercises. This provides a practical illustration of the differences between this approach and the traditional development process, as well as the advantages of a customer-centred approach and the disadvantages associated with the Design Thinking (DT) approach.
The course is divided into two main modules:
1. A brief introduction to innovation management
Participants gain an insight into common innovation models and processes, as well as the background and basic concepts of innovation research.
2. Learning and applying Design Thinking
Design Thinking is based on an iterative, customer-centred and playful problem-solving process, which enables participants to think beyond familiar solutions in order to realise or strive for ideas that have previously been overlooked, seem impossible, or may appear illogical or unattainable. During this course, participants will work through a Design Thinking process and, in doing so, develop their own ideas into a project. The course is therefore designed to be interactive, which is why a high level of proactive participation is expected. In return, participants can look forward to 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 are familiar with the fundamental 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 contextualise them.
3. Students apply methods for effective problem definition to identify relevant challenges in the innovation process.
4. Students analyse the fundamentals of user research within the Design Thinking process and can explain its significance for solution development.
5. Students evaluate assumptions and hypotheses relevant to innovation in order to (de)construct them effectively.
6. Students organise and conduct brainstorming sessions to generate creative ideas.
7. Students develop prototyping processes, describe them conceptually and are able to explain their practical application.

Literature
Wobser, Gunther (2022): Agile Innovation Management: Overcoming Dilemmas, Mastering Ambidexterity and Achieving Long-Term Success through Innovation. Springer Gabler. 978-3662645147
Hasso Plattner Institute (A): What is Design Thinking. https://hpi-academy.de/en/design- thinking/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-prozess.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/attachments/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; Leifer, Larry (2017): The Design Thinking Playbook. Featuring traditional, current and future success factors. 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: 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: 6810300
IT Forensics

Module profile

Exam number
6810300

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. Alexander Schinner

Lecturer(s)
Prof. Dr. Alexander Schinner,
Jan Starke

Applicability	BISD
Semester according to SPO	6. 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
Fundamentals of Forensics
o Introduction to digital forensics and its significance
o Legal framework and ethical considerations
Evidence collection
o Fundamentals and best practices in evidence handling
o Chain of Custody: Traceability and integrity of evidence
o Live Response: First steps and collection of volatile data
Storage Media Forensics
o Analysis of file systems and hidden data
o Recovery of deleted files and partitions
Network Forensics
o Monitoring and analysis of network protocols
o Anomaly detection and traffic analysis
Memory Forensics
o Techniques for collecting and analysing volatile memory data
o Tools and frameworks for working with RAM images
Artifact analysis
o Identification and analysis of digital artifacts
o Timestamp and metadata analysis
Reverse engineering
o Introduction to reverse engineering and analysis methods
o Techniques such as sandboxing, static analysis and deobfuscation
Phishing analysis
o Fundamentals of phishing prevention and detection
o Analysis of email headers and phishing URLs
OSINT (Open Source Intelligence)
o Overview and legal aspects of open-source intelligence
o Tools such as VirusTotal, Shodan and, additionally, Maltego
Threat Hunting
o Introduction to threat hunting
o Use of YARA rules, EDR systems and tools such as Velociraptor and Sigma rules
Threat Intelligence
o Fundamentals of threat analysis and the intelligence lifecycle
o The MITRE ATT&CK framework and the TLP protocol for classification
Reporting and Documentation
o Structure and creation of a professional report

o Communication and presentation of results to different target audiences

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

- describe the structure and operation of the Business Continuity Management System (BCMS) in accordance with BSI Standard 200-4 and apply it in a practical context.
- systematically carry out the individual phases of the BCM phased model (e.g. initiation, BIA, risk analysis, contingency planning, testing).
- identify the regulatory and normative foundations of BCM and explain their relevance for implementation within organisations.
- Carry out a Business Impact Analysis (BIA) and derive appropriate business continuity and recovery plans (BCPs, RPPs) from it.
- Identify and interpret appropriate key performance indicators for assessing the effectiveness of BCM measures.
- Explain the structure and objectives of the BSI Cybersecurity Network (CSN) and distinguish between the roles of digital first responders, incident practitioners and incident experts.
- Recognise, analyse and handle typical IT security incidents in accordance with standardised procedures.
- Take non-technical immediate action during initial contact with those affected and conduct discussions about IT security incidents in a structured and empathetic manner (e.g. over the telephone).
- Collect, prioritise and prepare security-related information for further analysis in the event of incidents – even in non-standardised IT environments.
- Identify preventive measures to avoid future incidents and integrate them into existing security concepts.
- Prepare, both technically and methodologically, for audits and certifications within the framework of the CSN.

Literature
https://www.bsi.bund.de/DE/Topics/Companies-and-Organisations/Standards-and-Certification/IT-Security-Framework/Certified-Information-Security/BCM-Practitioner-Training-Courses/BCM-Practitioner-Training-Courses_node.html
https://www.bsi.bund.de/DE/Themen/Unternehmen-und-Organisationen/Informationenund-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: 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
This module covers the fundamental concepts of digital sovereignty, with a focus on operational and technical implementation.
Following an introduction to key terms (e.g. dependence on platform providers, data sovereignty, vendor lock-in, open source, open standards), specific technical alternatives and tools are examined.

Topics covered include:
- Open-source software vs. proprietary solutions
- Full-stack open source (OS): in e-commerce, IT security, knowledge management, ERPs, etc.
- Digital sovereignty at all levels: from hardware to payment flows (PayPal, Apple Pay, Google Pay vs. the 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 public administration, education and business

In the project-based component, students work in teams on specific application scenarios (e.g. the digital infrastructure of a university, an SME or a local authority).
The aim is to design realistic technical concepts for improving digital sovereignty.
At the end of the semester, the results are presented and discussed at a transfer conference attended by the public and a 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 identify key concepts, stakeholders and motivations relating to 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 in terms of dependencies, risks and sovereignty deficits.
- Students can compare technical solutions in terms of cost, 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: 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 and backdoor attacks. They will learn how to simulate attacks for testing purposes, which detection and protection techniques to employ, and how to apply them.

Machine learning models such as Linear Regression, Support Vector Regression, K-Nearest Neighbours, Logistic Regression, Support Vector Machines (SVM) and 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 utilise several different scenarios for various attacks and machine learning models.

Here is an example of a scenario for a red and blue team exercise focusing on data poisoning and detection:
The company is developing a machine learning model to predict customer churn. The red team aims to reduce the accuracy of the logistic regression model by poisoning the data through label flipping. The blue team's objective is to detect and mitigate the attack.
Red team tasks: Analyse the dataset, develop the poisoning strategy, execute the attack, document the attack. The red team's success is measured by the extent to which they degrade the model's performance.
Blue team tasks: Establish a baseline (train a baseline model and evaluate the model's performance); implement detection mechanisms – using 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 assessed on the clarity and thoroughness of their documentation and presentation of their findings to the whole group

of students, demonstrating 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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Faculty of Computer Science and Business Information Systems
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 audience segmentation
- Social media marketing (including TikTok)
- Digital marketing objectives, 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
Upon completion of the module/course, students will:
1. Remember & Understand:
- explain the role of marketing in e-commerce and in the digital society.
- describe the 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.
- carry out target audience 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 et al. (The lecturer will provide PDFs of the relevant sections of the book)
Digital Marketing Trends 2026 by Brandwatch (The lecturer will provide PDFs of the relevant sections of the book)
Latest Meta and Google Ads best practices (The lecturer will provide PDFs)

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Faculty of Computer Science and Business Information Systems
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 of 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 will discuss — starting from scratch — the design, training and operation of an AI system. Drawing on intuitive concepts and visual insights, we will introduce a technical framework that enables us to describe 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 linking 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 and 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] Identifying 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 various subfields and how they are interconnected.
- They can formulate industry tasks as learning problems (supervised, unsupervised, reinforcement) and select an appropriate AI framework for the type of data in question.
- 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 associated 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.

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 equivalent.

Recommended prerequisites for the participation in the module
none

Content
This module introduces software development for 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 required, but a good understanding of other languages (e.g. Java, Python or JavaScript) is essential.

Introduction to Dart Programming
- Brief overview of Flutter: history, advantages and architecture.
- Introduction to the 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.
- Basics of state management: setState, Provider.
- Implementing forms and handling user input.

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

Integrating Device APIs such as Location and Camera
- Introduction to device APIs in Flutter.
- Implementing location services: retrieving and using GPS data.
- Accessing and using the camera: taking photographs and recording video.
- Handling permissions 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

- Students gain an understanding of the fundamentals of mobile application development using Flutter for Android and iOS, with a focus on professional programming practices.
- Students apply concepts of asynchronous programming and thread management to handle complex tasks in mobile applications efficiently.
- Students analyse architectural concepts for mobile solutions, including the division of responsibilities between client and server and communication protocols for mobile devices.
- Students design mobile user interfaces based on reusable software components, ensuring an intuitive and consistent user experience.
- Students implement mobile applications that integrate sensor data analysis and server communication, following best practice in mobile development.
- Students evaluate different mobile architecture approaches and technologies to select the most suitable solutions for specific application requirements.
- Students create a fully functional mobile application for Android or iOS, including publication 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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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 equipping autonomous aerial drones with perception, planning and decision-making capabilities. You will learn algorithmic approaches to robot perception, localisation and simultaneous localisation and mapping, as well as the control of non-linear systems, learning-based control and motion planning for aerial drones. 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 list the purposes 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 behaviour trees as a formalism for describing drone behaviour. You will learn to define the 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. Students are familiar with the fundamental principles of motion control as applied to autonomous aerial drones.
2. Students understand the basic concepts of perception, distinguishing between traditional approaches and deep learning methods for robot perception.
3. Students can explain the principles of localisation and Simultaneous Localisation and Mapping (SLAM), including their importance for autonomous navigation.
4. Students analyse navigation algorithms, focusing on the planning and decision-making processes necessary for effective drone operation.
5. Students apply algorithmic approaches to robot perception, localisation and planning in practical scenarios.
6. Students implement learning-based control techniques for aerial drones to enhance their motion planning capabilities.
7. Students utilise 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: 6810310
Project Work

Module profile

Exam number
6810310

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.-Ing. Sebastian Biedermann

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	BISD
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 credits

Recommended prerequisites for the participation in the module
none

Content
Project work is usually carried out in teams (at least three students). It involves either a comprehensive software development project in accordance with the principles of software engineering, or another task from the field of IT (e.g. software comparison, software selection, software implementation). Each project is supervised by a professor from the Faculty of Computer Science and Business Informatics.
As part of the project work, students practise the techniques and methods of computer science they have learnt in a professional context (teamwork; project organisation; practical tasks).
In the standard degree programme, the topics for the practical examples used in the assessment are provided by the lecturer or agreed with them. In the BIN dual study programme, a task from a real-world business context is undertaken in consultation with the lecturer. This ensures a practical focus and provides feedback from the company.
Students are guided to independently produce a software development project and accompanying documentation comprising the following parts:

- For a software development project
- Specification document setting out the requirements for the project (including milestones and a timetable)
- Technical design using appropriate methods
- IT design
- Programme listing
- User manual
- Appendix (bibliography; list of abbreviations, glossary, etc.)
- For other types of assignment:
- Project description setting out the requirements for the project work (including milestones and a timetable)
- Further content to be specified by the supervising professor, arising from the individual nature of the respective assignment
- Appendix (bibliography; list of abbreviations, glossary, etc.)

In the traditional degree programme, the topics for the practical examples to be included in the examination are provided by the lecturer or agreed with them. In the dual study programme, a task from a real-world business context is undertaken 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 are able to approach and solve complex problems using appropriate methodologies.
Students are able to develop and implement suitable solution strategies as part of a team.
They understand how team processes work and how they can contribute their own personality to these processes.
Students can independently set up, carry out, oversee and present a small IT project as part of a team. They can identify and use appropriate development technologies, and test and document their code.

Literature
depending on the specific project work

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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)
Dr. Divyarani Mandya Shivakumar

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 programmes on IBM Quantum devices.

1. Foundations of Quantum Computing
Classical versus quantum computation, qubits and quantum states, superposition and entanglement, Dirac notation (bras and 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 and visualisation; Noise, error sources and 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, basics of quantum error correction: Shor code, Steane code, surface code (overview), fault-tolerant quantum computation, claims of quantum supremacy (Google, IBM).
5. Applications, Future Trends & Quantum Programming
Quantum cryptography (BB84, QKD), Post-Quantum Cryptography (PQC), basics of Quantum Machine Learning (QML), Quantum optimisation (QAOA use cases), Quantum simulation in chemistry & physics Hands-on Qiskit programming: Creating circuits, running them on simulators, and running them 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
Upon successful completion of the course, students will 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 how major quantum algorithms work and identify their computational advantages.
4. Understand hardware constraints, quantum noise and basic quantum error correction techniques.
5. Implement quantum programmes using Qiskit and evaluate applications of quantum computing across various fields.

Literature
Textbooks:
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, Springer
Online resources (e-books, notes, PowerPoint presentations, 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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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, during which the system's requirements and constraints are gathered, analysed and documented. Similarly, machine learning (ML) system development projects benefit from RE. This module therefore covers requirements engineering techniques for both traditional systems and ML systems.

Basics of Requirements Engineering
Task-Oriented and Goal-Oriented RE
Elicitation Techniques
Analysis Techniques
Specification and 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 and 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
Students recall fundamental RE models, methods and their relevance to the software development process.
Students understand the importance of requirements engineering, including stakeholder analysis, in a variety of project contexts, including international and AI-driven projects.
Students apply requirements elicitation techniques and modelling methods, such as UML, use cases, user stories and non-functional requirements, to real-world scenarios.
Students analyse requirements through negotiation, prioritisation and validation against quality criteria to ensure completeness and clarity.
Students evaluate different RE approaches and adapt techniques suited to specific domains such as machine learning and generative AI systems.
Students create comprehensive requirements specifications and models that address the needs of complex, modern software systems, including AI applications.
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
Content: In this specialisation module, students work independently on topics relating to smart systems. They develop and present solutions (involving both hardware and software).
Topics from previous years (selection): AI-based checkout, Braille reader, inverse pendulum, Kalman filtering, pathfinding with Turtlebot, quadcopter, radar + lidar, ROS (Robot Operating System), SDR (Software-Defined Radio), SLAM (mapping, localisation, navigation), supervised learning, reinforcement learning, rock-paper-scissors on Pepper, Wi-Fi indoor localisation, …
The seminar operates under a regularly updated overarching theme, within which individual topics are assigned. The topics are determined at the start of the seminar and are based on current developments. Areas of interest always include actuators and sensors, low-performance systems right through to smartphones, their programming and the evaluation of prototype implementations.

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 engaging with a selected topic, students will develop their ability to tackle challenging subjects.

- Students will acquire fundamental mathematical and technical knowledge
- They will derive from this the specialist knowledge required for their specific topic or field of application
- They apply this knowledge using the methods they have learnt and gain greater confidence in their application

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

- Students acquire the skill to document and present results clearly.
- Students apply methods of scientific work, including (literature) research.
- Students generalise their ability to independently expand their existing knowledge and to quickly familiarise themselves with topics covered by other students

Literature

- To be announced in each case.

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 6820270
Secure Blockchain Technologies

Module profile

Exam number
6820270

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.-Ing. Tobias Fertig

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

Applicability	BISD
Semester according to SPO	6. 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
In this module, students gain in-depth insights into the technical fundamentals and security-related aspects of modern blockchain systems. To begin with, they learn about the basic functioning of blockchains, including data structure, cryptographic security and decentralised consensus. Building on this, the module offers a practical, in-depth exploration of Ethereum-based blockchains, covering the underlying cryptographic concepts, in particular Elliptic Curve Cryptography (ECC). A central component of the module is working with smart contracts. Students are introduced to the architecture of the Ethereum Virtual Machine (EVM) and learn to write, test, deploy and assess their own smart contracts in terms of security. The focus is not only on technical implementation but also on the security of smart contracts. To deepen their understanding, students examine typical security vulnerabilities and attack scenarios. In practical exercises, they analyse common exploits and learn reverse engineering methods to examine existing smart contracts and identify security-critical vulnerabilities. The aim of the module is to provide a comprehensive understanding of the responsible use of blockchain technologies and the secure development of decentralised 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
Upon completion of the module, students will be able to:

- describe the fundamental principles and functioning of blockchain technologies.
- explain the structure and functioning of Ethereum-based blockchains and the Ethereum Virtual Machine (EVM).
- understand the basic concepts of Elliptic Curve Cryptography (ECC) in the context of blockchain systems.
- compare different consensus mechanisms (e.g. Proof of Work, Proof of Stake) and assess their suitability for specific use cases.
- Identify typical application scenarios for blockchain technologies and analyse their potential benefits.
- Independently implement, test and deploy smart contracts in a blockchain environment.
- Recognise security-critical aspects in the development of smart contracts and implement appropriate protective measures.
- Practically understand known vulnerabilities and exploits in smart contracts and analyse how they work.
- Apply basic reverse engineering techniques to examine and evaluate existing smart contracts.
- Reflect on the risks and challenges involved in the development and deployment of blockchain-based systems.

Literature
https://www.rheinwerk-verlag.de/blockchain-the-comprehensive-guide-to-blockchain-development-ethereum-solidity-and-smart-contracts/
https://book.getfoundry.sh/
https://www.harpercollins.com.au/9780008562809/proof-of-stake-the-making-of-ethereum-and-the-philosophy-of-blockchains/
https://www.campus.de/buecher-campus-verlag/wirtschaft-gesellschaft/wirtschaft/mehr_als_geld-17528.html

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Module: 5003098
Social Media in the business world

Module profile

Exam number
5003098

Duration
1 semester

Frequency
Every summer semester

Credit hours (SWS)
4

ECTS-Credits (CP)
5.0

Workload
Guided study time:
Presence time: 40 hrs

Self-study: 110 hrs

Total: 150 hrs

Teaching format
Seminar

Language of instruction
German

Organisation

Responsible lecturer
Prof. Dr. Christina Völkl-Wolf

Lecturer(s)
Tobias Tellers,
Philipp Oberkalkofen

Applicability	BEC, 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
- Basic knowledge of social media and using internet applications
- An interest in corporate communications

Content
The module focuses on the professional development and implementation of social media strategies. Students learn to define strategic objectives and analyse target audiences in a nuanced way. They gain a comprehensive overview of relevant social media channels and their targeted use, in particular blogs, Facebook, X (formerly Twitter), YouTube, Instagram and professional networks such as XING and LinkedIn. Another key focus is on the effective combination and interlinking of these platforms, as well as their integration into overarching marketing strategies.

In addition, methods for monitoring, measuring success and social media management are taught. Particular attention is paid to community management as a key factor for successful communication on social networks. This includes the development of a community strategy, the fundamentals of online dialogue, dealing with challenges such as trolls or online backlash, and the basic principles of crisis communication. Students also learn how community engagement can be specifically encouraged and positively influenced by psychological factors. This subject area is complemented by the development of a content strategy, the use of social customer service and appropriate methods for evaluating the success of community initiatives.

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
Upon successful completion of the module, students will be able to:
Students identify key concepts, building blocks and technical fundamentals of social media strategies in a business context.
Students classify competing social media platforms, target audiences and communication formats, and explain their respective applications.
Students apply principles of community management in practical situations to engage, moderate and maintain online communities.
Students distinguish between typical dialogue situations and challenges in social media dialogue and structure corresponding interaction and response patterns.
Students assess the success of social media initiatives using basic monitoring and analysis tools and derive well-founded recommendations for action from these findings.
Students develop a comprehensive social media strategy, including objective setting, channel selection, content planning and integration with overarching marketing objectives.

Literature
Appel, G., Grewal, L., Hadi, R., & Stephen, A. T. (2020). The future of social media in marketing. Journal of the Academy of Marketing Science, 48(1), 79–95.
Rana, N. P., Slade, E. L., Dwivedi, Y. K., & Tajvidi, M. (Eds.). (2020). Digital and Social Media Marketing: Emerging Applications and Theoretical Development. Springer.
Wolff, C. (2024). Social media strategies for B2B companies. Springer Gabler.
Tajvidi, M., Wang, Y., Hajli, N., & Love, P. E. D. (2021). Brand value co-creation in social commerce: The role of interactivity, social support, and relationship quality. International Journal of Information Management, 57.
Kapoor, K. K., Tamilmani, K., Rana, N. P., Patil, P., Dwivedi, Y. K., & Nerur, S. (2018). Advances in social media research: Past, present and future. Information Systems Frontiers, 20, 531–558.
Opresnik, M. O., & Hollensen, S. (2023). Social Media Marketing: A Practitioner's Guide. Springer.

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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 Back-end Programming or Programming in Python or Fundamentals of Programming; Object-Oriented Programming in Java
Participants will be provided with a virtual machine, the functionality of which should be tested before the course begins.

Content
This module covers various types of testing and their application in software development. It covers the SOLID principles and the 4-layer concept for test architectures. It also addresses automated testing of user interfaces and APIs, as well as the use of mocking. Another key focus is Behaviour-Driven Development with Cucumber. Exploratory testing and the integration of automated tests into a DevOps life cycle are also covered. The module comprises practical content, for which a virtual machine is provided. This requires VirtualBox to be installed.

- Fundamentals of testing (test coverage, test paths, black-box, white-box, grey-box, functional and non-functional tests, test pyramid)
- Test automation (objectives, success factors, differences between various types, the JUnit test framework, annotations, assertions, exception testing, parameterisation, test types, record and 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, key design patterns for testing)
- Testing graphical user interfaces (introduction to Selenium, drivers, PageObject pattern, 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 servers (Jenkins basics & DevOps basics, gPipelines, the 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 a piece of software.
- Students analyse test objectives and define appropriate 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 and Joe Timoney, 2021, Cambridge University Press

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 microcontroller programming (ESP32, Espressif's 32-bit microcontroller family)
- Memory model, interrupt concept, …
- Hardware architecture 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, ultrasonic sensors and actuators: displays, servos, loudspeakers, etc.
- Programming of wireless interfaces (RF) such as Bluetooth and Wi-Fi for controlling applications such as servos, etc., using smartphones
- Implementation of small AI models (image recognition using a USB camera)
- Introduction to a modern, 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 will be able to

- explain the specific programming of controllers and their interfaces,
- to evaluate interfaces that have evolved over time,
- to use a software development environment that makes efficient use of innovative and application-optimised peripheral functions,
- to develop low-level software in the C programming language for various use cases.

Literature

- Kernighan, Ritchie: The C Programming Language, 2nd Edition (ANSI)
- Udo Brandes: The ESP32 Microcontroller – The Comprehensive Handbook
- Dausmann, et al.: C as a First Programming Language, Vieweg, 2011, ebook
- Wolf: C from A to Z, Galileo Computing, openbook

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Module: 6810290
Threat Intelligence

Module profile

Exam number
6810290

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
English

Organisation

Responsible lecturer
Prof. Dr. Christian Bachmeir

Lecturer(s)
Prof. Dr. Christian Bachmeir

Applicability	BISD
Semester according to SPO	6. 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
Students gain a thorough understanding of the background to digital attacks and the systematic analysis of threat intelligence. They are introduced to various cybercrime scenarios and examine the underlying strategies, motivations and business models of attackers. Particular emphasis is placed on the detection and analysis of malware. Students examine the functioning of popular malware families and the development of corresponding detection methods, particularly using Indicators of Compromise (IoCs). Both static and dynamic analysis techniques are taught in a practical manner. In addition, students gain an overview of publicly available sources of information on the threat landscape, such as those from CERTs, threat feeds or open-source platforms. They learn how to research and evaluate these sources and integrate them into technical applications. Tools and standards such as YARA signatures, dashboards and threat intelligence platforms are also utilised. The aim of the module is to develop a practical understanding of how to handle threat intelligence and to recognise its added value for information security.

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 are familiar with the strategies, motivations and business models behind digital attacks
- Students understand the common methods used to detect malware
- Students can analyse unknown files for suspicious behaviour (static vs. dynamic analysis)
- Students can utilise and integrate freely available sources of information

Literature

Incident Response with Threat Intelligence: Practical insights into developing an incident response capability through intelligence-based threat hunting, Roberto Martínez, 2022
Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software, Michael Sikorski and Andrew Honig, 2012
Practical Cyber Threat Intelligence: Gather, Process, and Analyse Threat Actors' Motives, Targets, and Attacks Using Cyber Intelligence Practices, Erdal Ozkaya, 2023

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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 a programme offered by the Virtual University of Bavaria.
Further information:
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 a programme offered by the Virtual University of Bavaria.
Further information:
https://kurse.vhb.org/VHBPORTAL/kursprogramm/kursprogramm.jsp?kDetail=true&COURSEID=19832,83,816,1
In our highly technologised and interconnected world, the usability of products, services and interactive systems is becoming an increasingly important factor for users on the one hand, and a competitive advantage for manufacturers on the other. With comparable functionality, many products are being offered at ever lower prices in the global marketplace. Users have a choice and will opt for the benefits of a product that has been tested and optimised for usability and user experience. By employing 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 appropriate methods, not least to avoid costly development failures and to increase the benefits for customers. Prospective engineers and computer scientists must be able to recognise these issues and know in which phases of product development suitable methods are applied.

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 a course offered by the Virtual University of Bavaria. Further information:
https://kurse.vhb.org/VHBPORTAL/kursprogramm/kursprogramm.jsp?kDetail=true&COURSEID=19832,83,816,1
Identifying the content of the analysis phase in usability engineering.

- Independently applying analysis methods and techniques of usability engineering
- Identifying, on a specific application basis, relevant sections of the DIN/ISO 9241 series of standards
- Describing and applying terminology (usability) and principles (dialogue design)
- Describing and applying a process for designing usable interactive systems
- Describing the key aspects of cognitive psychology and occupational psychology
- Identifying and naming criteria for evaluating colour schemes in order to identify and name associated usability problems.
- Describing fundamental aspects of contrast and its use in design.
- Recognising the development phases in which Gestalt principles must be taken into account, and how these simple principles help to identify usability problems
- Applying Gestalt principles in a targeted manner within the context of usability evaluations
- Describing the typical approach in interface and interaction design.
- Identify 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

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

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

- Creating 3D models for integration into game engines
- Working with game engines
- Rendering pipeline
- Integration of VR functionality into game engines
- Creation of fully functional 3D models in game engines
- Development 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
Upon completion of this module, students will be able to independently plan, develop 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 working with geodata in game engines, as well as the settings for rendering and processing the data for VR applications, including the programming of controllers and the interface to VR headsets.

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), pp. 5–13, ISSN: 2524-4965
Edler, D.; Kühne, O.; Jenal, C.; Vetter, M.; Dickmann, F.: The Potential of Spatial Visualisation in Virtual Reality (VR) for Social Constructivist Landscape Research, 2018. In: Kartographische Nachrichten, Journal of Cartography and Geographic Information, 68(5), pp. 245–254, ISSN: 2524-4965
Vetter, M.: Technical Potentials for 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

7. semester

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 6810340
AI and Security

Module profile

Exam number
6810340

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. Benjamin Weggenmann

Lecturer(s)
Prof. Dr. Benjamin Weggenmann

Applicability	BISD
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
In this module, students are introduced to the fundamental concepts and methods of artificial intelligence (AI) and apply these specifically to issues relating to information security. First, various classification strategies – such as Naive Bayes or neural networks – are introduced, and their potential applications in a security context are explained. In practical exercises, students develop and train their own models, for example for the automated detection of phishing emails or attacks in network traffic. Another component of the module is a critical examination of the use of AI by attackers. This covers application scenarios in which AI is used to enhance digital attacks, for example to optimise social engineering strategies or to generate content that is deceptively realistic. Finally, students examine the security vulnerabilities inherent in AI systems themselves. Among other things, the module discusses forms of attack such as data poisoning, adversarial examples and backdoors, which can be specifically employed to manipulate AI models. The aim of the module is to develop a sound understanding of how to use AI responsibly and with security in mind within the field of 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
German

Condition for the award of credit points
none

Learning outcomes

- Students are familiar with the fundamentals of artificial intelligence and at least two classification strategies (e.g. Naive Bayes classifier, neural networks)
- Students can select and implement suitable models depending on the application scenario (e.g. Python)
- Students can train models using suitable data (including pre-processing) and interpret the results
- Students are familiar with various scenarios in the field of information security in which AI models are already being used successfully
- Students are familiar with the fundamental security-related issues associated with AI models and attacks on AI models

Literature
Introduction to Artificial Intelligence, Wolfgang Ertel, 2025
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, 2019

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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	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
Databases, Databases I, Back-end Systems

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

In particular, the following aspects are covered:

- An in-depth examination of the CAP theorem, taking real-world distributed database systems into account.
- The systematic selection of suitable database management systems (DBMS) based on specific application scenarios. These include 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, particularly with regard to load balancing, system monitoring and the analysis of query execution plans.
- Investigation of various fragmentation strategies for the efficient storage and management of large volumes 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 recall the fundamental concepts, terminology and architectures of relational database systems.
- Students understand the structure and operation 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 in terms of redundancy, normalisation and performance.
- Students create relational database schemas using appropriate modelling and implementation tools.

Literature

Kofler, Michael: Database Systems – The Comprehensive Textbook; 2nd ed.; 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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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, BISD
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, and the basics of operating systems

Content
Introduction/recap on communication models for distributed systems
- Remote procedure calls
- Blackboards and event-based models

Fundamentals of 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 common problems in distributed systems
- Coordination
- Leader election
- Searching
- Fault tolerance / fault handling
- Consistent data replication

The course will be taught in English.
The course is programming language-agnostic; students may 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
Upon completion of the course, students will be able to

- understand the capabilities and limitations of distributed systems,
- explain different failure models,
- use remote procedure call frameworks to programme in distributed systems,
- design and implement solutions to common problems in distributed systems,
- select algorithms to manage conflicts and failures in distributed systems,
- discuss the main 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
Further specific reading recommendations will be provided during the course

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 6810350
Bachelor Thesis / Bachelor Seminar

Module profile

Exam number
6810350

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.-Ing. Sebastian Biedermann

Lecturer(s)
Prof. Dr. Kristin Weber,
Prof. Dr.-Ing. Tobias Fertig,
Prof. Dr. Alexander Schinner,
Prof. Dr.-Ing. Sebastian Biedermann,
Prof. Dr. Christian Bachmeir

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

Required prerequisites for the participation in the module according to the SPO
150 ECTS credits, courses in soft and professional skills, practical module, project work

Recommended prerequisites for the participation in the module
none

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

The Bachelor's thesis includes, amongst other things, the student's own studies and research into the state of the art within the relevant subject area. In particular, the thesis must abstract from constraints that are not technically justified by their very nature, but rather result from the specific circumstances of the company or organisation. Where software-based solutions are required as part of the task, this generally means that prototypes are to be implemented as part of the Bachelor's thesis; however, this does not include ensuring product properties (including accompanying manuals, etc.).

The Bachelor's seminar includes, amongst other things, independent study and research into the state of the art within the relevant subject area. In particular, the work must abstract away from constraints that are not, by their very nature, technically justified, but rather result from the specific circumstances of the company or organisation. Where software-based 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 specifications (including accompanying manuals, 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
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
Through the Bachelor's dissertation or seminar, the student demonstrates that they are capable of independently tackling a challenging problem in computer science (which may be interdisciplinary), that they have a firm grasp of the methodological and academic foundations of the subject, and that they can present the results appropriately.

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

Literature
Depending on the topic set; the Bachelor's thesis must be written to an academic standard, i.e. the relevant literature must be thoroughly reviewed, utilised and cited in accordance with the topic.

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, 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
- Basic programming knowledge (Java/Python)
- Previous experience with databases and Linux is 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, types of analytics and Hadoop architecture, followed by hands-on programming skills using 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 covers the following content:
- Understanding Big Data concepts, including the 4 Vs and types of analytics
- Overview of the Hadoop ecosystem and architectural 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 to gain practical experience
- Data analysis using Pig Latin and scripting operators
- Building data warehousing solutions using Hive and HiveQL
- Learning about Kafka architecture, key 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

The course combines on-site teaching in Würzburg (one week in October) with online teaching for the remainder of the 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
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: Use Hadoop HDFS and carry out distributed storage and processing.
- LO3: Implement MapReduce programmes using Java, including advanced features such as distributed caching and joins.
- LO4: Use Pig Latin and HiveQL for high-level querying of large datasets.
- LO5: Demonstrate an understanding of real-time streaming using Apache Kafka.
- LO6: Develop integrated solutions using multiple components of the Hadoop ecosystem.

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)

Module: 5003082
Computer Graphics

Module profile

Exam number
5003082

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, BISD
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, knowledge of C++

Content
Theoretical topics
- Mathematical foundations of computer graphics
- Fundamentals of physically-based lighting
- Ray tracing

Algorithmic topics
- Overview of fundamental computer graphics algorithms
- Lighting
- Texturing
- Shadows
- Volume rendering

Practical topics
- Computer graphics with OpenGL
- Implementation of ray tracing
- Shader programming

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 broaden and deepen their knowledge in the field of 'computer graphics' and acquire the skills to analyse and structure complex problems.
Students understand problems in the field of 'computer graphics', analyse them and develop solutions.
As part of their assignments, students apply their knowledge in a practical context.
Students develop high-performance computer graphics applications.
Students understand the mathematical principles underlying computer graphics.

Literature
Foley, van Dam, Feiner: Fundamentals of Computer Graphics. Introduction, Concepts, Methods. Addison Wesley, 1999
Zeppenfeld, K.: Textbook of Graphics Programming: Fundamentals, Programming, Applications. Spektrum Akademischer Verlag, 2003
Peter Shirley: Fundamentals of Computer Graphics. AK Peters LTD, 3rd edition, 2009
Hearn, Baker, Carithers: Computer Graphics with OpenGL. Prentice Hall, 4th edition, 2010
Matt Pharr, Greg Humphreys: Physically Based Rendering, Second Edition: From Theory to Implementation, Morgan Kaufmann, 2010

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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, BISD
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 sections, 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 mechanisms of barriers, and the allocation of responsibilities
- Relevant standards, norms and legislation supporting accessibility in national and international contexts
- Strategies for implementing accessible design and development processes
- Identifying, reducing and preventing barriers in digital media: the web, documents (e.g. MS Word, MS PowerPoint, PDF, e-books), and audiovisual media (e.g. video, audio)
- Conceptualisation, design, implementation and testing of accessible web applications
- Setting up and using 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 conceptual and design approaches associated with accessibility, and understand their similarities and differences.

- They are familiar with the most common types of disability and can characterise the prevailing models of understanding in society and academia.
- They understand demographic trends and are familiar with the key statistics on disability worldwide, in Europe and in Germany.
- They can identify various types of barriers that arise when interacting with digital products. They are familiar with assistive technologies and adaptation strategies for overcoming these barriers.
- You are familiar with the standards, norms and laws relevant to accessibility at various levels (global, European, D-A-CH) and understand how they relate to one another.
- You have internalised the benefits of accessible design at a personal, societal and business level and are familiar with strategies for implementing and embedding accessibility within organisations and development processes.
- You understand the barriers that can arise in various digital media (the web, documents, multimedia systems, e-books, apps, software, terminals, etc.) and are familiar with the principles, techniques and tools for identifying, reducing and preventing barriers.
- You will have in-depth knowledge of the conception, design and implementation of accessible web applications; you will be able to evaluate such applications for accessibility and will be familiar with relevant testing tools and methods.
- You have the skills to check, assess and correct digital documents for accessibility, as well as to create accessible documents independently.
- You are familiar with the use of common screen readers on different platforms and are able to set up a suitable testing environment for assessing web and other applications.

Literature

- Alexander, Kerstin (2019) — Image & Type: Communicating Accessibly through Typography and Images, Frank & Timme
- Aubele, Tobias; Gierke, Detlef (2025) — Accessible Websites, Rheinwerk Verlag
- Kalbag, Laura (2017) — Accessibility for Everyone, A Book Apart
- Matuzović, Manuel (2024) — Web Accessibility Cookbook: Creating Inclusive Experiences, O'Reilly
- Miller, Susi (2021) — Designing Accessible Learning Content, Kogan Page
- Pickering, Heydon (2018) — Inclusive Components: The Book, Smashing
- Silver, Adam (2018) — Form Design Patterns, Smashing

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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, BISD
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 starting this course unit, learners/students are expected to have a basic understanding of computer networking, Linux, programming and the fundamentals of ML/AI.

Content
This intensive ethical hacking training programme focuses on ethical hacking techniques and practices. The 2025 programme is geared 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 ethical hacking skills. Team-based learning approaches will be utilised. A competition will take place at the end. By the end of the programme, participants should be equipped with the knowledge and tools required to carry out ethical hacking assessments, identify security weaknesses, and recommend solutions to strengthen cybersecurity defences.

This course will be delivered as a Blended Intensive Programme comprising 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 the fundamental ethical and legal principles of ethical hacking and establish effective teamwork standards.
- The students present their technical findings clearly, both orally and in writing, to a variety of audiences.
- Students build a controlled simulation environment (cyber range) to practise and test their skills safely.
- Students analyse full packet captures using Wireshark to extract protocols, data flows and indicators.
- Students classify common cyber security attacks and select appropriate tools for safe reproduction and analysis.
- Students design basic penetration tests and interpret IDS outputs to assess detection and response.
- Students evaluate vulnerabilities in AI systems and propose defence strategies against adversarial attacks.
- Students plan a continuous-learning roadmap, selecting tools and resources that build knowledge and self-confidence.

Literature
This will be announced during the lesson.

Module: 5003868
Internet of Things

Module profile

Exam number
5003868

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, BISD
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
- Architectures and 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 laboratory:
- 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
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 will be familiar with the key principles, components and processes of IoT systems. Participants will gain an insight into architectures, hardware platforms, communication technology, protocols, programming (device and cloud) and security concepts.
Students explain how individual components and processes function within IoT systems. They can describe and explain how architectures, protocols and security concepts interrelate.
Students can apply the fundamentals they have learnt to practical problems and make practical use of suitable IoT components. As part of the course, they develop an IoT prototype to gain hands-on experience of what they have learnt.
Students are able to make specific statements about systems, identify differences and distinguish between different systems.
Students can make informed decisions regarding the use of various IoT systems. They are able to evaluate the advantages and disadvantages of specific architectures, protocols or platforms.
By developing the IoT prototype, students design their own system that integrates various 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: 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, 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
An interest in games
Experience with Unreal
Creating small VR applications
Basic experience with Blender or 3ds Max

Content
In Project-Based Geovisualisation VI, a deep-sea scenario is being developed using the Unreal game engine, with the aim of exploring the scenario from inside a submersible in the MAVEL multi-projection VR laboratory.
The focus is on independent project work using Unreal, 3ds Max and Blender in the areas of modelling, animation, shaders, scripting, particle systems, rendering and project management.

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 taking part in this module, students will be able to examine and apply selected topics from the field of geovisualisation using practical examples and exercises, thereby broadening and deepening their knowledge. Participants will be able to assess, evaluate and compare the results of their practical work, and present them in a manner tailored to specific topics and target audiences.

Literature
varies depending on the project

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003872
Topics of Socioinformatics

Module profile

Exam number
5003872

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/English

Organisation

Responsible lecturer
Prof. Dr. Markus Oermann

Lecturer(s)
Prof. Dr. Markus Oermann

Applicability	BISD, BWI, BIN
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
Successful completion of the module 'Introduction to Socioinformatics'

Content
The module 'Topics in Socioinformatics' is designed to provide in-depth practice in the skills required for the analysis of socio-technical digital systems, using current examples and discourses. To this end, the content of this module is adapted each year to reflect the latest social and academic discourses on the topic of digitalisation. At the start of the semester, participants determine the selection of discourses to be examined in consultation with the lecturer. To this end, participants map out the landscape of available sources on current topics in socio-informatics and the digital society, and then evaluate these to identify which topics are currently shaping the discourse. Building on this, the participants make a selection in consultation with the lecturer. Working independently in small groups, the participants develop the background knowledge for a discourse of their choice, identifying the key concepts, the issues under discussion and specific examples of application. The results of this group work are presented and discussed in the seminar. They also serve as the basis for the assessment (portfolio).

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
- gain an overview of the discourse surrounding current topics in socio-informatics and the digital society.
- expand their personal repertoire of sources for reliable information on these topics.
- gain in-depth knowledge, based on the topics they have studied, of the issues, key concepts and societal challenges associated with the digital transformation, whilst at the same time developing their skills in analysing socio-informatics systems.
- evaluate at least one socio-technical system using a small-group-based methodological approach, thereby deepening key skills for the remainder of their studies, such as for project work in the 6th semester.

Literature
Zweig, Katharina A./Krafft, Tobias D./Klingel, Anita/Park, Enno (2021): Socio-informatics: A New Perspective on Computer Science and Society, (1st ed.). Carl Hanser, Munich.
Nassehi, Armin (2019): Patterns: A Theory of Digital Society (2nd ed.). C.H. Beck, Munich.

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Module: 5003876
General Management

Module profile

Exam number
5003876

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.-Ing. Anne Heß

Lecturer(s)
Patrick Kalisch

Applicability	BIN, BWI, BEC, BDGD, BISD
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 Business Management module focuses on the following key topics:

1. Understanding the fundamentals of business management
- The concept and functions of business management
- Distinguishing between management, leadership and organisation
- The role of business management within the overall business system
- Corporate objective systems: economic, social and environmental objectives
- Corporate management as a process of decision-making, control and coordination

2. Understanding and applying corporate objectives and objective systems
- Types of objectives: substantive objectives, formal objectives and secondary/sub-objectives
- Goal hierarchies and goal conflicts
- Goal-setting within the organisation
- Operationalisation and measurability of goals
- Key performance indicator-based goal management

3. Understanding and applying strategic corporate management
- The concept of strategy and strategic thinking
- Analysis of the external environment and the organisation
- Competitive strategies
- Growth, differentiation and cost strategies
- Strategy development, implementation and monitoring

4. Understanding and applying business management analysis tools
- SWOT analysis
- PESTEL analysis
- Industry analysis and competitive analysis
- Portfolio approaches
- Use of key performance indicators and management tools to support decision-making

5. Understanding organisational design and organisational structure

- Basic principles of organisation
- Functional, procedural and process organisation
- Forms of organisation: functional, divisional, matrix, project and process organisation
- Advantages and disadvantages of different organisational structures
- The influence of organisational structure on leadership and communication

6. Understanding leadership styles, leadership behaviour and motivation
- The concept of leadership and leadership tasks
- Traditional and modern leadership styles
- Leadership behaviour in different business contexts
- Motivation theories, e.g. Maslow, Herzberg, Vroom
- Leading staff, delegation and feedback

7. Understanding and applying decision-making and problem-solving in management
- Decision-making processes and decision-making logic
- Rational versus intuitive decision-making
- Methods of problem analysis and creativity techniques
- Risks, uncertainty and decision quality

8. Understanding change management and organisational development
- Causes and triggers of change processes
- Phases of change processes
- Resistance to change
- Methods of organisational development

9. Understanding sustainable business management and corporate governance
- Sustainability as a management principle
- ESG criteria and social responsibility
- Corporate Social Responsibility (CSR)
- Good governance, compliance and ethical leadership
- Engaging with stakeholders and long-term value creation

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. Fundamentals of Business Management
Students are able to explain the fundamental tasks, concepts and objectives of business management and understand their significance for the management of organisations.

2. Business Objectives and Objective Systems
Students can analyse different types of objectives and conflicts of interest, as well as develop and evaluate systems of objectives for organisations.

3. Strategic Business Management
Students can describe and contextualise strategic approaches, competitive strategies and the process of strategy development and implementation.

4. Analytical Tools in Business Management
Students can apply common analytical tools such as SWOT or PESTEL and utilise their findings to inform strategic decisions.

5. Organisational Design and Structure
Students can compare and evaluate organisational forms and structures and apply them to practical business situations.

6. Leadership Styles, Leadership Behaviour and Motivation
Students can explain leadership styles and motivation theories, and derive measures for effective staff management.

7. Controlling and Business Management
Students can explain the functions of controlling and apply basic tools for the planning, monitoring and management of businesses.

8. Change Management and Organisational Development
Students can identify change processes, resistance and success factors in change management and devise appropriate measures.

9. Sustainable Business Management and Corporate Governance
Students can assess sustainable, ethical and governance-related aspects of business management and apply them to operational decisions.

Literature
To be announced during the course.

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Technical University of Applied Sciences Würzburg-Schweinfurt

Module: 5003873
From Software Craftsmanship to AI-powered software

Module profile

Exam number
5003873

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. Peter Braun

Lecturer(s)
Prof. Dr. Peter Braun,
Prof. Dr. Isabel John,
Prof. Dr.-Ing. Tobias Fertig,
Christine Zilker

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
Modules on Programming and Software Engineering

Content
The module examines professional software development as a progression from traditional craftsmanship principles towards AI-supported development processes. In each thematic block, the historical foundations are first explored, such as software craftsmanship, clean code, *The Pragmatic Programmer*, complexity management, module design, and deep and flat modules. This is followed by a discussion of the relevance of these concepts in a future where AI assistants generate, refactor and test code, and prepare design decisions. Students learn to critically evaluate tried-and-tested principles and apply them to modern tools such as prompt engineering, agentic coding and AI-assisted development. Guest contributions from industry highlight current and future use cases.

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

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

- Describe key concepts and principles of software craftsmanship, clean code, pragmatic software development and AI-assisted development.
- Explain the historical evolution of professional software development, from traditional craftsmanship practices to AI-assisted development processes.
- Apply software design principles such as complexity management, modularisation, and deep and flat modules to specific code and architecture examples.
- Analyse recommendations from *Clean Code*, *The Pragmatic Programmer* and *Software Craftsmanship* in terms of their viability, limitations and context-dependence.
- Evaluate AI-assisted development practices such as prompt engineering, code generation, refactoring support, test generation and agentic coding in terms of their benefit-risk profiles.
- Apply classic development principles to the use of AI assistants to enable better prompts, reviews, tests and design decisions.
- Develop their own approaches to professional AI-assisted software development that take into account quality standards, traceability, accountability and the critical review of generated artefacts.

Literature

- Ousterhout, John. A Philosophy of Software Design. 2nd ed., Yaknyam Press, 2021.
- Hunt, Andrew, and David Thomas. The Pragmatic Programmer: Your Journey to Mastery. 20th Anniversary Edition, Addison-Wesley, 2019.
- Mancuso, Sandro. *The Software Craftsman: Professionalism, Pragmatism, Pride*. Prentice Hall, 2014.
- Martin, Robert C. *Clean Code: A Handbook of Agile Software Craftsmanship*. Prentice Hall, 2008.
- Kuhlen, Rainer. The Consequences of Information Assistants: What Does Information Autonomy Mean, and How Can Trust in Electronic Services Be Ensured in Open Information Markets? Suhrkamp, 1999.
- Taulli, Tom. *AI-Assisted Programming: Better Planning, Coding, Testing, and Deployment*. O'Reilly Media, 2024.
- Kofler, Michael, Bernd Öggl, and Sebastian Springer. *AI-Assisted Coding: The Practical Guide for Software Development*. Rheinwerk Computing, 2025.
- Pereira, Sergio. Generative AI for Software Development. O'Reilly Media, 2025.
- Huyen, Chip. AI Engineering: Building Applications with Foundation Models. O'Reilly Media, 2025.

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Module: 1000010
Web Programming

Module profile

Exam number
1000010

Duration
1 semester

Frequency
Every 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. Rolf Schillinger

Lecturer(s)

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

Required prerequisites for the participation in the module according to the SPO
This is a programme offered by the Virtual University of Bavaria. Further information:
https://kurse.vhb.org/VHBPORTAL/kursprogramm/kursprogramm.jsp?kDetail=true&COURSEID=20775,84,1218,2

Recommended prerequisites for the participation in the module
This is a course offered by the Virtual University of Bavaria. Further information:
https://kurse.vhb.org/VHBPORTAL/kursprogramm/kursprogramm.jsp?kDetail=true&COURSEID=20775,84,1218,2

Content
This is a course offered by the Virtual University of Bavaria. Further information:
https://kurse.vhb.org/VHBPORTAL/kursprogramm/kursprogramm.jsp?kDetail=true&COURSEID=20775,84,1218,2

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 a programme offered by the Virtual University of Bavaria.
Further information:
https://kurse.vhb.org/VHBPORTAL/kursprogramm/kursprogramm.jsp?kDetail=true&COURSEID=20775,84,1218,2

Literature
This is a programme offered by the Virtual University of Bavaria.
Further information:
https://kurse.vhb.org/VHBPORTAL/kursprogramm/kursprogramm.jsp?kDetail=true&COURSEID=20775,84,1218,2