TECHNISCHE HOCHSCHULE DEGGENDORF

Module Guide
Artificial Intelligence

Faculty Computer Science
Examination regulations 01.10.2024
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AIN-B-34 Compulsory Elective 4 (FWP)
AIN-B-35 Bachelormodul

AIN-B-1 Mathematics 1

Module code	AIN-B-1
Module coordination	Prof. Dr. Cezar Ionescu
Course number and name	AIN-B-1 Mathematics 1
Lecturer	Prof. Dr. Cezar Ionescu
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weight	5/210
Language of Instruction	English

Module Objective

Students understand and communicate the fundamental concepts of mathematics.

Specifically, students will have achieved the following outcomes upon completion of the module:

Subject competency

Students understand fundamental notions and methods of proof.

Methodological competency

Students model practical situations mathematically and select appropriate methods and techniques to answer the corresponding questions.

Personal competency

Students understand complex theoretical concepts and apply them to problems arising in practice.

Social competency

Students communicate clearly, argue and criticize logically and constructively, contribute to reasoned, team-oriented problem solving processes in the group.

Applicability in this and other Programs

This module is a fundamental building block of the AIN programme. It is a pre-requisite of Mathematics 2 and its contents are used in statistics, machine learning, deep learning, and many other modules in the programme.

Entrance Requirements

None

Learning Content

Discrete mathematics

- Logic
- Sets and functions
- Natural numbers and induction
- Recursive datatypes and structural induction

Real Analysis

- Functions of a real variable
- Sequences
- Series
- Continuity
- Differentiability
- Applications of differentiability
- The indefinite integral
- Definite integral and applications

Teaching Methods

- Interactive lectures
- Exercise sessions
- Practical experience with symbolic computation packages (e.g., sympy)

Recommended Literature

- Lincoln K. Durst, The Grammar of Mathematics , Addison-Wesley 1969
- Richard Earl, Towards Higher Mathematics , Cambridge University Press 2017
- McCluskey and McMaster, Undergraduate Analysis, Oxford University Press 2018

AIN-B-2 Programming 1

Module code	AIN-B-2
Module coordination	Prof. Dr. Markus Mayer
Course number and name	AIN-B-2 Programming 1
Lecturer	Prof. Dr. Markus Mayer
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Exercise Performance, written ex. 90 min.
Duration of Examination	90 min.
Weight	5/210
Language of Instruction	English

Module Objective

The students have basic knowledge of programming. The first part of of the lecture is on procedural programming (i.e. the students understand procedural programming and can write programs for simple task descriptions). The second part of the lecture is on object-oriented programming (i.e. the students understand the main concepts of object oriented programming and can write programs for simple task descriptions that are structured in an object-oriented way).

The following learning goals are reached after passing the module:

- Students understand basic concepts of software design.
- Students can perform a translation of simple task descriptions into procedural and object oriented program code

- Students know about coding style that allows for cooperative programming and understanding code of others and can apply the main concepts to their own code.
- Students know about the creative possibilities of programming and can apply this knowledge by developing their own ideas and translate them into code.

Applicability in this and other Programs

Basic introduction into Programming

Entrance Requirements

None

Learning Content

Contents of the lecture:

- Introduction into programming: "Hello world" or "Draw with code"
- Variables, Expressions, Statements
- Control structures (conditionals, loops)
- Data types (integer, floating point numbers, boolean, characters, strings)
- Arrays
- Functions
- Recursion
- Introduction to object orientation: Concepts
- Objects (classes and instances)
- Inheritance
- Static attributes and methods, attribute visibility

The contents to not imply the usage of a specific programming language. An example language were all the content can be shown is a combintation of Processing (a programming sketchbook based on Java, that allows for fast visualizations and simple games) and Java.

Teaching Methods

- Lecture with PowerPoint slides
- Live programming in the lecture
- Exercises to get practical experience that can be done in groups
- Exercises to get practical experience that are intended to work on them allone

- Etherpads to ask questions in iLearn
- Video recording of the lecture (if the lecture room supports that)

Remarks

None

Recommended Literature

- "Learning Processing" by Daniel Shiffman, "The coding train" Youtube lecture, https://www.youtube.com/playlist?list=PLzJbM9-DyOZyMZzVda3HaWviHqfPiYN7e
- "The nature of code" by Daniel Shiffman, available for pay-what-you-want download online, https://natureofcode.com (CC license)
- "Head First Java", Kathy Sierra and Bert Bates, Second Edition, 2005, O'Reilly

AIN-B-3 Foundations of Computer Science

Module code	AIN-B-3
Module coordination	Prof. Dr. Cezar Ionescu
Course number and name	AIN-B-3 Foundations of Computer Science
Lecturer	Prof. Dr. Cezar Ionescu
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Exercise Performance, written ex. 90 min.
Duration of Examination	90 min.
Weight	5/210
Language of Instruction	English

Module Objective

Students will aquire knowledge and understanding of the fundamental concepts and methods of computer science.

Specifically, students will have achieved the following learning outcomes upon completion of the module:

Subject competency

- Students know and understand the fundamental concepts and methods of computer science
- Students explain the fundamental concepts and apply them to practical examples

Methodological competency

- Students describe formally the syntax of programming languages and other kinds of symbolic expression
- Students implement regular expressions with minimal finite automata
- Students synthetize digital circuits from logical specifications

Personal competency

- Students recognize the similarities and differences between mathematical and engineering approaches
- Students explain the meaning of the digital transition and can evaluate its advantages and disadvantages.

Social competency

- Students evaluate competing approaches in exercise sessions, offer and answer constructive criticism.

Applicability in this and other Programs

This module is a pre-requisite for virtually all technical modules in the following semesters, including Computational Logic, Internet Technologies, Databases, Assistance Systems, AI Programming, etc.

Entrance Requirements

None

Learning Content

- Theoretical foundations of computer science
  - logic
  - computability
  - finite automata
  - formal languages
  - complexity
- Foundations of computer engineering
  - digital gates
  - digital circuits
  - computer architecture

Teaching Methods

- Interactive lectures

- Practical exercises using CAD tools, regular expression searches, BNF grammar builders, automata and formal languages simulators, etc.
- Mid-term tests the ability to use software tools for designing circuits and dealing with large data

Recommended Literature

- Susan H. Rodger und Thomas W. Finley: JFLAP: An Interactive Formal Languages and Automata Package , online bei http://jflap.org/
- Erich Hehner: Digital Circuit Design , Vorlesungsskript online bei http://www.cs.toronto.edu/~hehner/DCD/DCD.pdf
- J. Glenn Brookshear und Dennis Brylow: Computer Science--An Overview , 12th Ed, Pearson, 2015

AIN-B-4 Operating Systems and Networks

Module code	AIN-B-4
Module coordination	Prof. Dr. Andreas Wölfl
Course number and name	AIN-B-4 Operating Systems and Networks
Lecturers	Prof. Dr. Christoph Schober Prof. Dr. Andreas Wölfl
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weight	5/210
Language of Instruction	English

Module Objective

Acquisition of knowledge in the fundamentals of operating systems and data transmission in computer networks. Upon completion of the module, students will have achieved the following learning objectives:

Part Operating Systems:

- Students will gain knowledge of concepts and technologies necessary for building operating systems, as well as understanding of the modular structure and functionality of operating systems.

- Students will acquire knowledge and skills in the theoretical foundations, administration, and secure application of operating systems using Linux as an example.
- Students will learn the functioning and usage of the command-line interpreter and gain an overview of the most important shell commands.
- Students will acquire knowledge of methods and algorithms for file, memory, and process management.
- Students will classify and evaluate various operating modes, such as virtual machines or container-based virtualization, in the context of operating systems.

Part Operating Systems:

- Students will learn the basics structures and device arrangement in a computer network, including the physical and logical aspects.
- Students will evaluate network topologies based on graph-theoretical properties.
- Students will acquire knowledge of the structure and functioning of the Internet.
- Students will be able to calculate the key performance metrics like throughput or delay based on given network parameters.
- Students will recognize the significance of layered models and can assign tasks and functions to the layers of the ISO/OSI model.
- Students will gain knowledge about the major network protocols such as Ethernet, TCP, IP, DNS, and understand and explain the concepts of each protocol.
- Students will be able to program simple network applications using sockets.

Applicability in this and other Programs

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Entrance Requirements

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Learning Content

1 Introduction to Operating Systems
2 The Linux Operating System
3 Memory Management
4 IPC & Scheduling
5 Container-based Virtualization
6 Introduction to Networks

7 Network Structures
8 Data Transfer and Performance
9 Reference Models
10 Network Protocols
11 Network Programming

Teaching Methods

- Lectures
- Lab Practice

Remarks

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Recommended Literature

Andrew Tanenbaum, Nick Faemster, David Wetherall, *Computer Networks* , 6th ed., Pearson, 2021

Kurose, J., Ross, K., *Computernetze* , 6. ed, Pearson, 2014

Andrew Tanenbaum, Herbert Bos, Modern Operating Systems, Prentice Hall, 4th ed., 2014

Abraham Silberschatz, Peter Gavin, Greg Gagne, Operating System Concepts, John Wiley & Sons, 10th ed, 2018

Christine Bresnahan, Richard Blum, Mastering Linux System Administration, 1st. ed, Sybex, 2021

AIN-B-5 Introduction to Artificial Intelligence

Module code	AIN-B-5
Module coordination	Prof. Dr. Javier Valdes
Course number and name	AIN-B-5 Introduction to Artificial Intelligence
Lecturers	Prof. Dr. Christina Bauer Prof. Dr. Javier Valdes
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 0 hours self-study: 90 hours virtual learning: 60 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weight	5/210
Language of Instruction	English

Module Objective

Students acquire the basic knowledge required for the understanding and development of AI systems, including basic knowledge of knowledge representation, language processing, image recognition, agents, statistics and machine learning. Furthermore, students acquire an overview of the computer science-based thinking and working methods of artificial intelligence intelligence, primarily on the basis of practical applications. Students acquire formal competence so that initial problems can be formally can be described formally. They apply their AI knowledge in the development of small AI solution concepts successfully.

Students are able to roughly assess suitable AI tools for solving the tasks. to roughly assess the tasks including ethical aspects. Through group work, students learn the ability to cooperate.

Professional competence
Students have basic knowledge of AI modeling and machine learning.

Social competence
The students have an insight into the solution of problems through group work and teamwork.

Methodological competence
The students have basic knowledge of AI methods for processing practical tasks, such as language processing, software agents, knowledge representation, user modeling and machine learning learning as a basis for understanding application solutions.

Personal competence
Students are able to deepen their own time management and self-study skills as they spend approx. 25 % of their time on virtual teaching.

Applicability in this and other Programs

This module is the basis for the other AI subjects. The module can be taken as a "Knowledge-based systems" module in the Bachlelor of WI or as an FWP subject in other degree programs.

Entrance Requirements

None

Learning Content

Part I

1. AI: Definition, history and general overview
1.1 AI application examples
1.2 Definition of AI
1.3 Phases of historical AI development, in particular German AI history
1.4 Rough overview of AI areas/technologies
2 AI in the knowledge management process
2.1 Knowledge qualities - Knowledge is subjective - Knowledge is capital
2.2 Knowledge management process
2.3 Knowledge acquisition and knowledge search
3. Overview of knowledge representations: Semantic network/ontology, inference with logic, boundary and constraints
4. Introduction to language processing systems - chatbots for knowledge communication

4.1 History and applications of chatbots
4.2 Basics of the realization of chatbots
5 Overview of software agents
5.1 Definition and characteristics of a software agent
5.2 Rational agent
5.3 Architecture of a software agent
5.4 Applications
6 User modeling
6.1 User model
6.2 Adaptivity in learning applications
6.3 Recommendation systems and user modeling
7. Decision Trees
8. Philosophy of Artificial Intelligence
8.1 Ethics in Artificial Intelligence
8.2 Bias in Artificial Intelligence

Part II

1 Introduction to machine learning
1.1 Data mining projects in companies
1.2 What is machine learning?
1.3 R data analysis software
2 Reporting
3 Data Structures
4 Exploratory Data Analysis
6 Principles of Data Visualization
7 Supervised Learning (I): parameter-based methods
7.1 Introduction
7.2 Regression
7.2.1 Simple linear regression
7.2.2 Multiple linear regression
8 Supervised Learning (II): Non-parametric methods
8.1 Introduction
8.2 Training and test data set
8.3 Decision trees
9 Unsupervised Learning
9.1 Hierarchical clustering
9.2 K-means clustering

Teaching Methods

Blended learning, i.e. students prepare the attendance to lectures with digital materials.

Recommended Literature

Han, Kamber and Pei. Data Mining: Concepts and Techniques. Third Edition
Russell and Norvig, Artificial Intelligence a Modern Approach. Third Edition.
Ullman. Mining of massive datasets. Third edition
Venables & Ripley (2002). Modern Applied Statistics with S, Springer.
Wickham (2014). Advanced R, Chapman & Hall/CRC Press.

AIN-B-6 Key Competencies 1

Module code	AIN-B-6
Module coordination	Kathrin Auer
Course number and name	AIN-B-6 Business Administration AIN-B-6 Media Skills and Self-Organization AIN-B-6 Key Competencies 1 (Business Administration, Media Skills and Self-Organization)
Lecturers	Prof. Dr. A Admin Kathrin Auer Prof. Dr. Helena Liebelt N.N. Wilko Westphal Prof. Dr. Roland Zink
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	8
ECTS	5
Workload	Time of attendance: 150 hours self-study: 150 hours Total: 300 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weight	5/210
Language of Instruction	English

Module Objective

The transition from school to university is a challenge for many students right at the beginning of their studies.

Moving away from predetermined timetables and curricula, towards independence, autonomy and responsibility. The module Key Competencies 1 is intended to respond to these challenges, particularly with a view to digitalization and the economic reference (internship in the 5th semester).

The learning outcomes of the module consequently consist of the two subjects "Business Administration" (Subject A) and "Media Competence and self-organization" (subject B).

Subject A

In the subject Business Administration, the students deal in particular with

general business administration, cost and performance accounting and

human resources management. Furthermore, contents are principles of procurement, logistics, marketing and business model creation and financial management. Although the students are taking a technical or computer science-oriented course of study, the knowledge acquired in the field of

business knowledge should make it easier for them to start their careers. Through the

broadening of the students' knowledge base it is intended thatsuboptimal decisions in companies can be avoided.

Professional competence

o The students get to know the operational functional areas in overview and selected concepts of corporate management/strategy development.

o The students know and understand the principles and methods of systematic decision making.

o The students know the purposes of cost and performance accounting (CCA) and the structure of cost and performance accounting.

o They are familiar with important instruments of cost and activity accounting, cost center and cost

center and cost unit accounting as well as short-term profit and loss accounting.

o They will be able to carry out cost center and order-related target/actual comparisons and evaluate them

o They will be able to apply direct costing in the form of contribution margin accounting.

o They will be able to carry out decision calculations on the basis of cost and performance accounting.

Subject B

The digital transformation of society is increasingly penetrating our professional and

everyday life and is characterized by a rapidly increasing abundance of information.

In order to deal with this amount of information and to be able to communicate, students need a high level of media competence. The contents of this subject are based on the media competence grid of the Standing Conference of the Ministers of Education and Cultural Affairs (2016) with its six pillars:

1. Searching, processing and storing
2. Communicating and cooperating
3. Producing and presenting
4. Protecting and acting safely
5. Problem solving and acting
6. Analyzing and reflecting

The competencies acquired in school are to be specifically expanded for the challenge of studying. The focus is no longer on searching for and presenting information, but rather its selection, evaluation and interpretation, analysis and synthesis. The subject introduces students both to the use of digital media in the context of studies, data protection and copyrights, and in independent organization of studies.

Subject competence

o The students are familiar with various digital media for organizing learning and are able to use them.

o The students will be able to select both analog and digital teaching and learning content for their studies.

o Students will be able to use digital media competently and in a targeted manner.

o The students are able to organize their studies in terms of time and content and to process the high amount of information in a targeted manner.

Subject A and B

Methodological competence

o The students are enabled to work in a transparency-, structure- and decision-oriented way.

o The students are made aware of the fact that the cost-performance calculation is to be conceived purpose-oriented.

o The students are enabled to work independently.

o Students acquire competencies in the use of digital media.

o Students will learn strategies for acquiring knowledge using blended learning methods.

Personal competence

o Through exercises, students learn to work independently and in a problem-, solution- and

and action-oriented world.

Social competence

o Students practice partner- and team work in the exercises.

o Students learn to work independently.

Applicability in this and other Programs

The module lays the foundations for the course of study in general and is linked in particular with the following advanced module:

AIN-B, KI-B and CY-B: Key Competencies 3.

AIN-B, KI-B and CY-B: Key Competencies 4

AIN-B, KI-B and CY-B: Internship module

AIN-B, KI-B and CY-B: Bachelor module

Course of studies: BA Artificial Intelligence (BA Künstliche Intelligenz and BA Cyber Security, both in in German language)

Entrance Requirements

No prerequisites.

Learning Content

Subject A

o The company at a glance

o Corporate management and corporate policy

o Vision, goals, strategies

o Constitutive corporate decisions

o Factors of production

o Operational functions

o Overview of the approaches of the decision theory

o Purposes of cost-performance accounting and cost allocation principles

o Systems of cost performance accounting

o Specific cost accounting contents in the areas of Artificial Intelligence and Cyber Security

o Cost-performance accounting on full cost basis

o Cost element accounting

o Cost center accounting

o Cost unit accounting

o Cost-performance accounting on partial cost basis (contribution margin accounting)
o The short-term profit and loss account
o Decision-oriented cost-performance accounting incl. the principle of relevant costs
- Principles of procurement
- Principles of logistics
- Principles of marketing
- Business model generation
- Principles of trade and service management
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Subject B

o Information, data and knowledge
o Self-organization and study design
o Digital media in the student learning context
o Digital media in science and communication
o Data protection and netiquette
o Copyright and rights of use
o Media use and pillars of media competence

Teaching Methods

o Seminar-based teaching with group and partner work
o Project work
o Blended learning

Recommended Literature

Subject A

o Sangster, A. (2021): Frank Wood's Business accounting : an introduction to financial accounting, 15th edition, Pearson, Harlow (UK)
o McLaney, E. J. (2020): Accounting and finance: an introduction, 10th edition, Pearson, Harlow (UK)
o Elliott, B. (2019): Financial accounting and reporting, 19th edition, Pearson, Harlow (UK)
o Atrill, P. (2018): Management Accounting for decision makers, Pearson, Harlow (UK)
o Albrecht, W. Steve. (2012), Studyguide for Financial accounting, Content Technologies Inc., Milton Keynes

Subject B

o Heard, Stephen B. (2016): The Scientist?s Guide to Writing: How to Write More Easily and Effectively throughout Your Scientific Career, Princeton University Press, Princeton

Oldenbourg.
o Gapski, H., Oberle, M. & Staufer, W. (2017): Media literacy. Challenge
For politics, political education and media education. Bonn.
o Bühler, P. & Schlaich, P. (2016): Media literacy. Understanding digital media ?
create ? use.
o Mack, Chris A. (2018): How to write a good scientific paper, SPIE Press, Bellingham (WA)
o (Additionally internet documents and guides are used!).

AIN-B-7 Mathematics 2

Module code	AIN-B-7
Module coordination	Prof. Dr. Cezar Ionescu
Course number and name	AIN-B-7 Mathematics 2
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weight	5/210
Language of Instruction	English

Module Objective

Students understand and communicate the fundamental concepts of mathematics.

Specifically, students will have achieved the following outcomes upon completion of the module:

Subject competency

Students understand fundamental notions and methods of proof.

Methodological competency

Students model practical situations mathematically and select appropriate methods and techniques to answer the corresponding questions.

Personal competency

Students understand complex theoretical concepts and apply them to problems arising in practice.

Social competency

Students communicate clearly, argue and criticize logically and constructively, contribute to reasoned, team-oriented problem solving processes in the group.

Applicability in this and other Programs

This module is a fundamental building block of the AIN programme. Its contents are used in statistics, machine learning, deep learning, and many other modules in the programme.

Entrance Requirements

Mathematics 1

Learning Content

Complex numbers

- algebraic and trigonometric forms, geometric representation
- applications to geometry
- complex functions
- complex derivative, holomorphic functions

Linear systems and matrices

- operations on matrices
- invertible matrices
- linear systems, rank, Gaussian elimination
- linear programming

Vector spaces

- axiomatic definition and examples
- linear applications, matrix form of linear applications
- operations on linear applications

Differentiability in higher-dimensional spaces and applications

- total differential and partial derivatives
- gradient, hessian, jacobian
- Lagrange multipliers
- Kuhn-Tucker conditions for optimization

Iterative methods for optimization

- conjugate gradients
- steepest descent
- convergence analysis using eigenvectors and eigenvalues

Teaching Methods

- Interactive lectures
- Exercise sessions
- Practical experience with symbolic computation packages (e.g., sympy)

Recommended Literature

- Gilbert Strang, Introduction to Linear Algebra, 5th Ed, Wellesley-Cambridge Press , 2015
- Serge Lang, Undergraduate Analysis, 2nd Ed, Springer 1983

AIN-B-8 Programming 2

Module code	AIN-B-8
Module coordination	Prof. Dr. Markus Mayer
Course number and name	AIN-B-8 Programming 2
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Exercise Performance, written ex. 90 min.
Duration of Examination	90 min.
Weight	5/210
Language of Instruction	English

Module Objective

The knowlegde of programming is deepend and extendend to advanced concepts in "Programming II". The students have the ability to design, structure and implement complex tasks in either a procedural or object oriented programming behaviour.

The specific learning goals are:

- The students understand general programming concepts by inspecting their application in different programming languages.
- The students understand advanced object oriented programming and can apply them in their own implementations of tasks.
- The students understand the basic mechanisms of graphical user interfaces, file access, and event handling.

- The students can apply the knowledge of special language features and can decide for a programming language given tasks.
- The students are able to inspect, judge and modify code that was written by others and a variety of language extensions available in libraries.
- The students are able to write code that allows for software development in a team.

Applicability in this and other Programs

Advanced concepts of programming

Entrance Requirements

Programming I

Learning Content

1) Introduction to a new programming language and revision of the concepts of "Programming I" (e.g. if "Programming I" used the Java language as an example, Python can be employed for this part):
   - Datatypes, Control structures, Functions
   - Object oriented programming
2) Advanced programming concepts:
   - File handling
   - Exceptions and events
   - Graphical user interfaces
   - Threads
   - Iterables and iterators
3) Language specific in-depth knowledge, e.g. for Python:
   - Generators and list comprehensions
   - Decorators and OOP concepts in Python
4) Software design patterns (Decorator, Observer, Factory, Singleton, Adapter...)

Teaching Methods

- Lecture with PowerPoint slides
- Live programming in the lecture
- Exercises to get practical experience that can be done in groups
- Exercises to get practical experience that are intended to work on them allone
- Etherpads to ask questions in iLearn

- Video recording of the lecture (if the lecture room supports that)

Remarks

None

Recommended Literature

- "Design Patterns", Eric Freeman and Elisabeth Robson, O'Reilly, 2004
- "Dead Simple Python", Jason C. McDonald, United States, No Starch Press, 2023
- "Python Crash Course: A Hands-On, Project-Based Introduction to Programming", Eric Matthes, United States, No Starch Press, 2016.

AIN-B-9 Algorithms and Data Structures

Module code	AIN-B-9
Module coordination	Prof. Dr. Patrick Glauner
Course number and name	AIN-B-9 Algorithms and Data Structures
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Exercise Performance, written ex. 90 min.
Duration of Examination	90 min.
Weight	5/210
Language of Instruction	English

Module Objective

The aim of this class is to provide an introduction to one of the most important foundations of a computer science degree: algorithms and data structures. A data structure enables a programmer to structure data into conceptually manageable relationships. An algorithm is a finite sequence of well-defined, computer-implementable instructions to solve a class of problems or to perform a computation. Algorithms often operate on data structures. This course provides a journey through computer science. Students will acquire a solid foundation in how the most important algorithms and data structures work. They will also learn how to design efficient algorithms and data structures.

Specifically, students will have achieved the following learning outcomes upon completion of the module:

Subject competency

Students will understand the concepts of the most common algorithms and data structures. (2 - Understanding)

Methodological competency
Students will have the ability to develop high-quality programs using algorithms and data structures. (3 - Apply)

Personal competency
Students will be able to implement their own algorithms and data structures and defend them against competing approaches. (6 - Create)

Social competency
Programming exercises take place as part of the course. Students are thus able to understand, critique, and complement algorithms and data structures of other students. (5 - Assess)

Applicability in this and other Programs

Including, but not limited to, the following modules:

- Software Engineering
- Assistance Systems
- Natural Language Processing
- Machine Learning
- Computer Vision
- Deep Learning/Big Data

Entrance Requirements

- Content of the first semester, in particular Programming 1
- (Some) mathematics

Learning Content

- Introduction: algorithm definition, classification of algorithms
- Graphs: graph definitions, applications in computer science, shortest path, lowest cost, A*
- Complexity analysis: time complexity, O, Omega, Theta, o and O tilde notations, pseudo-polynomial complexity, space complexity
- Lists: arrays, dynamic arrays/lists, amortization, fundamental operations, stacks, queues, linked lists
- Recursion: search, divide and conquer, recurrence relations, master theorem, backtracking, dynamic programming
- Sorting: bubble sort, selection sort, insertion sort, merge sort, quicksort, lower bounds

- Trees: binary trees, traversing, advanced types of trees, decision trees
- Maps and hash tables: key-value stores, hashing, collision handling
- Selected topics: fast matrix multiplication, random number generation, fast inverse square root, prime numbers, Bloom filter, union-find, median of medians, string matching
- Quantum computing: qubits, quantum logic gates, quantum computers, quantum algorithms

Teaching Methods

- Lectures
- Discussion of research papers and recent news
- Coursework, including laboratory problems (mandatory problem - "Leistungsnachweis")

Recommended Literature

- M. Goodrich, et al., " Data Structures and Algorithms in Python ", John Wiley & Sons, 2013.
- R. Sedgewick and K. Wayne, " Algorithms ", Addison Wesley, 4th edition, 2011.
- M. Sipser, " Introduction to the Theory of Computation ", Cengage Learning, 3rd edition, 2012.

AIN-B-10 Internet Technologies

Module code	AIN-B-10
Module coordination	Prof. Dr. Andreas Kassler
Course number and name	AIN-B-10 Internet Technologies
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Portfolio
Weight	5/210
Language of Instruction	English

Module Objective

Subject competency

The students know technologies that they can use when designing interactive internet applications. They are able to use them efficiently in the implementation of projects.

The students can design websites. They know how to structure pages and know basic languages to design websites (CSS, HTML, Java Script). They can write small JavaScript programs. In the project, they can set up a node.js infrastructure, integrate a socket server and implement web components to deliver content to the browser.

Methodological competency

The students can use command line tools to connect to servers and exchange data. They can use server and client technologies to establish simple communication sessions between systems. They are able to use integrated development environments.

Social competency

Based on their knowledge, the students can carry out their own project. They can apply their knowledge of web technologies. They can evaluate the results of other groups and are evaluated themselves with their project. The students can use standard web programming tools (GIT, visual code, command line).

Personal competency

After completing the course, the students can carry out their own projects and develop Internet (web) applications. The course does not deal with databases and network technologies, as these topics are covered in other lectures.

Applicability in this and other Programs

This module is the basis for other computer science subjects and can be used in other programs, such as Ba. Media Technology, Ba. Interactive Systems or Ba. Cyber Security.

Entrance Requirements

- Programming 1
- Operating Systems and Networks

Learning Content

The module consists of two parts:
Part I: Internet technologies basics and part II: project work Internet technologies
Content part 1
(1) Tools and Installation
(2) Basics client - server, protocols for internet technologies
(3) Client-based Web Technologies
- HTML
- CSS
- JavaScript
(4) Server-side Technologies
(5) Proprietary Applications
- WebSockets
- data formats (JSON; XML)
- Session management
Contents part 2
Workshop: Setup Infrastructure - Cloud based Services
Project: Realization of a web application

Teaching Methods

Lecture, tutorials, practice session. In the second part of the course, a project is developed. The infrastructure will be set up during the lecture.

Remarks

The grading is divided into project and written examination. The project performance is evaluated according to a grading scheme. The written exam tests basic understanding.

Recommended Literature

(1) Turorials available from **https://www.w3schools.com/**

(2) Jonathan Wexler: Get Programming with Node.js, 978-1617294747

(3) Murach?s HTML and CSS: Training & Reference

(4) Adam Boduch et.al.: Learning jQuery 3 - Fifth Edition

(5) Responsive Web Design with HTML5 and CSS: Develop future-proof responsive websites using the latest HTML5 and CSS techniques, 3rd Edition, 2020, 978-1839211560

AIN-B-11 Computational Logic

Module code	AIN-B-11
Module coordination	Prof. Dr. Cezar Ionescu
Course number and name	AIN-B-11 Computational Logic
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weight	5/120
Language of Instruction	English

Module Objective

Students aquire understanding and hands-on experience of various logical systems and their usage in artificial intelligence applications..

Specifically, students will have achieved the following outcomes upon completion of the module:

Subject competency

Students understand the significance of logic for intelligent problem-solving.

Methodological competency

Students select the most appropriate logical system for solving a concrete practical problem, and use it to implement software-based solutions.

Personal competency

Students understand complex theoretical concepts and apply them to problems arising in practice.

Social competency

Students communicate clearly, argue and criticize logically and constructively, contribute to reasoned, team-oriented problem solving processes in the group.

Applicability in this and other Programs

Logic is foundational for all computer science courses and programmes. This module is a pre-requisite for the more advanced artificial intelligence lectures that build upon it.

Entrance Requirements

Recommended:

- Mathematics 1
- Foundations of Computer Science

Learning Content

Formal Logic: Syntax and Semantics

- Introduction to logical languages
- Basic concepts of logic
- Propositional logic
- Predicate (first-order) logic
- Formal proofs
- Set theory
- Classical semantics for first-order logic
- Resolution for propositional and first-order logic
- Semantics of logic programming

Logical Programming

- Prolog
- Answer Set Programming

Teaching Methods

- Interactive lectures
- Practical exercises using automatic proof checkers and theorem provers
- Software implementation of application-oriented examples

Recommended Literature

- Barwise, J und Etchemendy, J: Language, Proof and Logic , CSLI 2003 (or newer)
- Lifschitz, V.: Answer Set Programming , Springer Verlag 2019
- Gebser, M., Kaminski, R., Kaufmann, B., Schaub, T.: Answer Set Solving in Practice , Morgan & Claypool Publishers, 2013

AIN-B-12 Key Competencies 2

Module code	AIN-B-12
Module coordination	Tanja Mertadana
Course number and name	AIN-B-12 Foreign Language (German or English)
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	See examination schedule AWP and languages
Weight	5/210
Language of Instruction	German

Module Objective

The module Key Competencies 2 aims to provide students with specialised language skills. International students have to complete at least level A2 of German in the course of their studies. In addition, students can choose either courses offered by the faculty or German for Key Competencies 3, Key Competencies 4 and Key Competencies 5.

As part of this module, native German speakers shall instead take the course "Key Competency 2 - Subject-specific English" of the Cyber Security and Artificial Intelligence programmes.

The module covers the four basic language skills - listening, reading, speaking and writing. Students expand their subject-specific vocabulary and deepen their knowledge of the linguistic structures.

The learning outcomes of the respective German courses can be found in the corresponding course description on the homepage of the Language Centre:

https://www.th-deg.de/en/students/language-electives#languages

Applicability in this and other Programs

Applicability of this module in other degree programmes is guaranteed.

Entrance Requirements

When registering for a course, the students' German language skills are assessed. Depending on the results, students are either allocated to a course corresponding to their language level or start with German A1/ part 1 + 2 if they are total beginners. After successful completion of a course, students can attend an advanced German course.

Learning Content

The course content can be found in the corresponding course description on the homepage of the Language Centre:
https://www.th-deg.de/en/students/language-electives#languages

Teaching Methods

The teaching methods focus on improving the four main language skills (listening, speaking, reading and writing). Examples of teaching methods used include various forms of group and individual work, mini-presentations, intensive reading and listening exercises, role-play and grammar games, loci method, dictation exercises, translations, peer feedback, work with learning stations, and various writing activities to consolidate the knowledge gained.

Students will be given weekly assignments for self-study.

Remarks

For course-specific details, please refer to the corresponding course description on the homepage of the Language Centre:
https://www.th-deg.de/en/students/language-electives#languages

All language courses require a compulsory attendance rate of 75% in order to be allowed to take the examination.

Recommended Literature

A list of the reading recommendations can be found in the corresponding course description on the homepage of the Language Centre:

https://www.th-deg.de/en/students/language-electives#languages

AIN-B-13 Databases

Module code	AIN-B-13
Module coordination	Prof. Dr. Michael Scholz
Course number and name	AIN-B-13 Databases
Semester	3
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weight	5/210
Language of Instruction	English

Module Objective

The students learn basic concepts of database systems and how to use them.

After completing the module, the graduates have achieved the following teaching objectives:

- They can describe the development process for databases.
- They know the basic concepts of DBMS architecture.
- They know the elements of an entity relationship model.
- An entity relationship model can be set up for a database.
- The graduate can detect anomalies and normalize tables.
- Databases can be managed with a database management system (DBMS).
- Database queries with SQL can be performed.
- The graduate knows the functions of a DBMS.

Method competence:

The student learns a simple version of the Backus-Naur form and can derive the syntax of SQL commands from it.

From a task, the student can develop a solution for a relational DB system using methods such as ER modeling.

For the DB system SQL statements to create an application can be develpoped.

Applicability in this and other Programs

Bachelor Applied Computer Science, Bachelor Interactive Systems, Artificial Intelligence, Bioinformatik, Cyber Security

Entrance Requirements

Programming 1 and 2

Learning Content

1 Introduction
2 Architecture of RDBMS
3 Relational Design
4 Relational Model
5 Data Definition Language (SQL)
6 Data Manipulation Language (SQL)
7 Transaction Management

Teaching Methods

- Lectures
- Exercises (Learning Labs)
- Home Work

Remarks

Students of Master AID may take this course as specific selection. Then they have to ask the professor about an additional work to achieve the credits.

Recommended Literature

- Thomas M. Connolly and Carolyn E. Begg. 2004:Database Solutions, A step-by-step guide to building databases, Pearson Education Limited, Harlow, Essex, England, 2nd Edition.
- Connolly, Thomas M., and Carolyn E. Begg. 2015. Database Systems: A Practical Approach to Design, Implementation, and Management. Global Edition (Englisch). 6th ed. Harlow, Essex, England: Pearson Education.
- Kifer, Michael, Arthur Bernstein, and Philip M. Lewis. 2006. Database Systems: An Application-Oriented Approach. 2nd ed. Boston, San Francisco, New York: Pearson Education.

AIN-B-14 Statistics

Module code	AIN-B-14
Module coordination	Prof. Dr. Markus Mayer
Course number and name	AIN-B-14 Statistics
Semester	3
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weight	5/210
Language of Instruction	English

Module Objective

The main focus is the subject and methodological competency in the field of probability and statistics. By the nature of the subject, the gain of social compentences is not a major goal of the lecture, but is still supported by cooperative work on tasks. Personal competences are developed and refined by autonomous development of solutions to complex problems.

In detail, objectives of the lecture are:
- The students know solution templates to a variety of tasks in the field of probability computations and can select the appropriate ones for tasks that are described in natural language

- The students know the methods from the field of statistic, specifically Bayesian statistics and can select the appropriate ones for tasks that are described in natural language.

Applicability in this and other Programs

Within the Bachelor AIN-B applicable for Machine Learning, Computer Vision

Entrance Requirements

Math 1 and 2

Learning Content

Probability:
- The difference between probability and statistics
- Counting and sets
- Probability experiments, Toy examples (coin, dice, urn)
- Conditional probability, independence and Bayes theorem
- Discrete and continuous random variables
- Expected value, standard deviation and variance
- Central limit theorem and the Law of large numbers
- Joint distributions and independence
- Covariance and correlation

Bayesian statistics:
- Maximum likelihood estimates
- Bayesian updating with discrete and continuous priors
- Probabilistic prediction
- Continuous data
- Conjugate priors
- How to choose priors
- Probability intervals

In terms of continuous random variables and conjugate priors, the focus is on the Gaussian distribution.

Teaching Methods

- Lecture with PowerPoint slides
- Script for self study
- Solution methods presented by the lecturer on the whiteboard and developed in group work
- Exercises in the lecture
- Exercises for self-study

Remarks

None

Recommended Literature

The course uses the script of the MIT Open CourseWare course " Introduction To Probability And Statistics ", https://ocw.mit.edu/courses/18-05-introduction-to-probability-and-statistics-spring-2014/. The script was developed by Dr. Jeremy Orloff and Jonathan Bloom and can be downloaded under a CC license.

AIN-B-15 Project Management

Module code	AIN-B-15
Module coordination	Prof. Dr. Markus Mayer
Course number and name	AIN-B-15 Project Management
Semester	3
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Portfolio
Weight	5/210
Language of Instruction	English

Module Objective

One focus is the subject and methodological competency in the field of project management. But contrary to the more technical subjects, social competences in the field of team development and personal competences in self assessment and resilience are also objectives.

In detail, objectives of the lecture are:

- The students know the inner workings of companies with development departments that are based on traditional or agile project based work.
- They understand the responsibilities and tasks of a traditional project manager and can exemplary perform a selection of them.
- They know the responsibilities and tasks of the positions in an example for agile project management (e.g. Scrum) and understand the differences to traditional project management.

- They know the techniques that lead to the formation of successful teams and the hindrances that prevent teams from being successful. They experienced team work in larger groups.
- They know techniques that help the developer/researcher/worker/ manager in a modern work environment to make valuable decisions and how to deal with situations of high pressure.

Applicability in this and other Programs

Applicable in Machine Learning, Computer Vision, Software Engineering, Natural Language Processing, Autonomous Robotics, Deep Learning etc. (in every course in AIN-B in the upcoming semesters). In addition, also applicable in the internship.

Entrance Requirements

None

Learning Content

- What is a project? What is project management?
- Project surroundings in a company
- Meetings
- Project Manager: Ethics, performance domains
- Traditional project management
    - Starting a project
    - Project planning
    - Carrying out the work
    - Project monitoring
    - Project closing
- Roles and responsibility, Team development, Conflict
- Leadership
- Agile project management:
    - Comparison to traditional methods
    - The agile manifesto
    - Scrum (Artifacts, Workflow, Roles)

During the lecture, exercises are done in groups of 4-5 and the groups have to organize themself with recommendations given by the lecturer how to encourage a team building process. In addition, an agile experience day is scheduled to get insights into team building and task assignments under agile conditions.

Teaching Methods

- Lecture with PowerPoint slides
- Exercises for large group work
- Presentations of group work results by students
- Use of project management software
- Agile experience (Gamification elements)

Remarks

None

Recommended Literature

- "The Fast Forward MBA in Project Management: The Comprehensive, Easy-to-Read Handbook for Beginners and Pros" by Eric Verzuh, 5th edition, 2015, Whiley
- "Project management for Dummies" by Jonathan L. Portny and Stanley E. Portny, 6th edition, 2022
- "The Professional Scrum Team: Growing and Empowering Cross-functionality and Resiliency in a Complex World" by Peter Götz, Uwe M. Schirmer and Kurt Bittner, 2020, Scrum.org

AIN-B-16 Assistance Systems

Module code	AIN-B-16
Module coordination	Prof. Dr. Udo Garmann
Course number and name	AIN-B-16 Assistance Systems
Semester	3
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	project work
Weight	5/210
Language of Instruction	English

Module Objective

The students have the necessary skills to plan and create assistance systems. You know different definitions of the term "assistance system" as well as different forms of assistance systems such as language assistants or assistance systems for decision support.

Professional competence

The students know the history of language assistants.
The students know the basics of game and decision theory.
Students can plan a dialogue for a language assistant. They use aspects of "conversational design".
Students can develop a decision support system; this includes planning, algorithm development and implementation of a user interface.

Social skills

As part of the lectures, there are many exercises on project work. The students are thus able to understand and evaluate similar work by their fellow students. You are able to create documentation and software in a form that allows cooperation in a team. (5 - judge)

Methodical competence

The students have the ability to plan assistance systems and create them using Python or R. (3 - Apply)

Personal competence

The students can implement their own ideas and defend them against other approaches. (6 - Create)

Applicability in this and other Programs

Bachelor thesis

Entrance Requirements

Recommended:
Mathematics 2
Programming 2

Learning Content

Language processing basics
Conversational design
Development of a language assistant
Fundamentals of game and decision theory
Graphic representation of data and calculation results of machine learning methods
Development of a decision assistant including user interface

Teaching Methods

Instruction seminars
marketplace
discussions
presentations

Recommended Literature

May vary, because it is project-oriented lecture

- Moore R.J.. Conversational UX Design: Association for Computing Machinery. 2019
- Moore, R. J., Szymanski, M. H., Arar, R., & Ren, G. J. (Eds.) Studies in Conversational UX Design. Cham: Springer. 2018
- Pearl, C.. Designing voice user interfaces: Principles of conversational experiences. Beijing: O'Reilly. 2017
- Sievert Carson. Interactive Web-Based Data Visualization with R, plotly, and shiny. Chapman and Hall, 2020.

AIN-B-17 AI Programming

Module code	AIN-B-17
Module coordination	Prof. Dr. Cezar Ionescu
Course number and name	AIN-B-17 AI Programming
Semester	3
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Portfolio
Weight	5/120
Language of Instruction	English

Module Objective

Students design, implement and test AI-based applications, both individually and in teams.

Specifically, students will have achieved the following outcomes upon completion of the module:

Subject competency

Students understand the fundamental AI methods and algorithms, and their implementation.

Methodological competency

Students develop programs using the appropriate AI tools (such as libraries, frameworks, programming languages).

Personal competency

Students understand the fundamentals of AI programming and apply them to problems arising in practice.

Social competency

Within the practical sessions that are an integral part of the course, students analyze the programs of their colleagues, communicate clearly, argue and criticize logically and constructively, contribute to reasoned, team-oriented problem solving processes in the group.

Applicability in this and other Programs

This module is foundational for further AI modules, such as Big Data/Deep Learning, New Topics in AI, etc.

Entrance Requirements

empfohlen:

Recommended:

AIN-1 Mathematics 1

AIN-2 Programming I

AIN-7 Mathematics 2

AIN-8 Programming II

AIN-9 Algorithms and Data Structures

AIN-11 Computational Logic

Learning Content

- Introduction to the programming language Python
- Neural networks and backpropagation
- Implementation of LLMs
- Symbolic computation
- Constraint-based programming
- SAT-Solvers
- SMT-Solvers

Teaching Methods

- Interactive lectures
- Exercise sessions
- Practical experience with AI tools (e.g., Z3)

Recommended Literature

- Thorsten Altenkirch und Isaac Triguero: *Conceptual Programming with Python* , Lulu 2019.
- Russell, S., Norvig, P. (2012), Künstliche Intelligenz, 3. Aufl., Pearson, München

AIN-B-18 Key Competencies 3

Module code	AIN-B-18
Module coordination	Prof. Dr. Javier Valdes
Course number and name	AIN-B-18 Academic Writing AIN-B-18 Technology Ethics and Sustainability
Semester	3
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Examination form of the chosen module
Weight	5/210
Language of Instruction	English

Module Objective

The content of the module is divided into two subjects "Technology ethics and sustainability" (subject A) and "Scientific work" (subject B).

Subject A

With the formulation of the Sustainable Development Goals (SDGs) by the United Nations in 2015, there is a comprehensive orientation framework for how humanity should develop in the future and how people's actions and behavior should be evaluated with regard to these development goals. This also applies in particular to technical developments, as it must be constantly checked whether the new technologies meet both ethical and sustainable requirements. In the course of the lectures, the need for sustainable development is linked to the digital transformation of our society and econom. Ethical aspects of technological development are also addressed, with a focus on Artificial

Intelligence and associated possible risks: systemic, human, algorithmical and data bias. In addition to an introduction to ethical principles, the ACM Code of Ethics and Professional Conduct (The Code) is discussed.

Professional competences:

o Students understand the role of Artificial Intelligence in sustainable development.
o Students are familiar with the global development goals (SDGs) and are able to evaluate their own behavior and both existing technologies and potential inventions within the framework.
o Students are familiar with ethical principles and requirements in the context of technical innovations and development and can apply these in their studies and later professional activities
o Students are familiar with possible sources of bias in Artificial Intelligence applications and can identify, evaluate and respond to them in their later professional activities

Subject B
"Being able to write academically or technically is a key skill that is crucial for progressing in your studies and career. As a rule, students do not bring these academic writing skills with them from school, but acquire them parallel to their acculturation in the subject."
This quote from the brochure of the Center for University Didactics (DIZ, 2016) shows the content orientation of the module. The content is intended to prepare students for their studies and academic work at an early stage. The course covers everything from the requirements for academic work to the process flow, research methods and quality criteria for academic work.
Students learn how to find suitable scientific literature, how to manage it and how to use it for scientific work (e.g. reading, understanding, citing). In exercises, students practise scientific writing, research data management and scientific data visualization.

Professional competences

o Students are familiar with the requirements and quality criteria of academic work.
o Students develop the process flow of scientific work and the structuring of scientific work.
o Students will be able to work independently in academic work, in particular: research methods, literature reviews, and academic writing.
o Students know the rules for writing student essays and quality criteria for academic work in a student context and are able to apply them.

Applicability in this and other Programs

Applicability of this module in other degree programmes is guaranteed.

The module lays the foundations for the degree program and is linked in particular with the following advanced modules:
CY-B and KI-B: Key qualification 5
CY-B and KI-B: Bachelor module

Degree programs: BA Artificial Intelligence and BA Cyber Security

Entrance Requirements

None

Learning Content

Subject A
o Concepts and definitions of sustainability and sustainable development
o Sustainability models
o Digital transformation and ethical and sustainable aspects
o Artificial intelligence and sustainability
o Ethical foundations
o Bias in artificial intelligence
o Evaluating Artificial Intelligence Applications
o Ethical aspects for computer scientists and programmers
o ACM Code of Ethics and Professional Conduct
o The European Approach to the governance of Artificial Intelligence

Subject B
o Science and research
o Scientific work: Requirements, process and quality criteria
o Literature search, assessment and evaluation
o State of research and theory
o Scientific methods
o Academic writing
o Basics of scientific data visualization
o Preparing a scientific paper

Teaching Methods

Seminar-based teaching with group and team work
Project work
Blended learning

Remarks

For Key Competencies 3, students can choose either courses offered by the faculty or German.

Recommended Literature

Standars and Norms:

VCIO based description of systems for AI trustworthiness characterisation. VDE SPEC 90012. (2023).

Artificial Intelligence Risk Management Framework. AI RMF 1.0. (2023).

Research Articles:

Blondeel, Mathieu, et al. "The geopolitics of energy system transformation: A review." *Geography Compass* 15.7 (2021): e12580.

Cowls, Josh, et al. "The AI gambit: leveraging artificial intelligence to combat climate changeopportunities, challenges, and recommendations." *Ai & Society* (2021): 1-25.

Grober, Ulrich. "Deep roots-a conceptual history of'sustainable development'(Nachhaltigkeit)." Wissenschaftszentrum Berlin für Sozialforschung (WZB). (2007)

Siau, Keng, and Weiyu Wang. "Artificial intelligence (AI) ethics: ethics of AI and ethical AI." *Journal of Database Management (JDM)* 31.2 (2020): 74-87.

Zajko, Mike. "Conservative AI and social inequality: conceptualizing alternatives to bias through social theory." *Ai & Society* (2021): 1047-1056.

Additionally, online resources in the form of podcast, videos, blogs and specialized websites for academic writing will be provide during the course

AIN-B-19 Natural Language Processing

Module code	AIN-B-19
Module coordination	Prof. Dr. Udo Garmann
Course number and name	AIN-B-19 Natural Language Processing
Semester	4
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Exercise Performance, written ex. 90 min.
Duration of Examination	90 min.
Weight	5/210
Language of Instruction	English

Module Objective

The goal of this module is to learn Natural Language Processing (NLP), which enables computers to process human language. We engage in NLP dozens of times a day, such as performing a Google search, correcting spelling on a smartphone, classifying email as spam, or recognizing handwriting. Modern NLP algorithms are heavily based on machine learning methods. The students acquire knowledge of NLP and can deepen this in the future, e.g. in projects or further studies.

The students know terms from linguistics such as syntax, semantics, etc. They understand the different structures of language. Understand and apply regular expressions (analysis and application) in Python. The students know the Natural Language Toolkit (NLTK). You can use the NLTK for different forms of language processing.

In detail, the students have achieved the following learning outcomes after completing the module:

Professional competence

Students understand the concepts of the most common approaches to language processing. (2 - understanding)

Methodical competence

Students have the ability to create high quality programs using speech understanding technologies. (3 - Apply)

Personal competence

The students can implement their own methods and defend them against competing approaches. (6 - Create)

Social skills

Programming exercises take place as part of the course. The students are thus able to understand, criticize and complement the programs of other students. (5 - judge)

Applicability in this and other Programs

AI-Project

Deep Learning/Big Data

Entrance Requirements

Recommended:

Mathematics 2

Programming 2

Algorithms and Data structures

Learning Content

Basics: stemming, stopwords, n-grams
Text classification: Naïve Bayes, spam filtering, speech recognition, logistic regression spelling correction
Search engines: ranking, vector space model, PageRank
Basics of formal languages (related to NLP problems)
Regular Expressions and Finite State Machines (Related to NLP Problems)
Context-free grammars (related to NLP problems)
Analysis of the speech signal
Outlook: Embeddings, current advances in NLP

Teaching Methods

Lectures
Discussion of scientific articles and breaking news
Exercises, including computer exercises (proof of achievement)

Recommended Literature

- S. Bird, E. Klein and E. Loper, " Natural Language Processing with Python Analyzing Text with the Natural Language Toolkit ", Online at [NLTK website](https://www.nltk.org/book), visited 20/03/31.
- C. Bishop, " Pattern Recognition and Machine Learning ", Springer, 2006.
- D. Jurafsky, " Speech and Language Processing, An Introduction to Natural Language Processing ", Computational Linguistics, and Speech Recognition, Third Edition draft, available online at [Jurafsky:Homepage] (https://web.stanford.edu/~jurafsky), visited 20/03/31.
- C. Manning, P. Raghavan and H. Sch#ütze, " Introduction to Information Retrieval ", Cambridge University Press, 2008.
- B. Pfister und T. Kaufmann, " Sprachverarbeitung, Grundlagen und Methoden der Sprachsynthese und Spracherkennung ", 2., aktualisierte und erweiterte Auflage, Springer-Verlag GmbH Deutschland 2017, ISBN 978-3-662-52837-2.
- S. Russel and P. Norvig, " Artificial Intelligence: A Modern Approach ", Prentice Hall, third edition, 2009.

AIN-B-20 Human Factors and Human-Machine Interaction

Module code	AIN-B-20
Module coordination	Prof. Dr. Christina Bauer
Course number and name	AIN-B-20 Human Factors and Human-Machine Interaction
Semester	4
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Portfolio
Weight	5/210
Language of Instruction	English

Module Objective

Students understand and communicate the fundamental concepts of human-machine Interaction.

Specifically, students will have achieved the following outcomes upon completion of the module:

Subject competency

- Application of human factor principles to a specific domain
- Identification of various influences on the quality of work and interaction

Methodological competency

- Knowledge of various methodological approaches for investigating and evaluating human-machine interaction

- Systematic analysis and classification of situational influences
- Systematic analysis of error sources and types

Personal competency

- Realistic assessment of systemic influences on the work situation
- Improvement of team skills through knowledge of group mechanisms

Social competency

Students evaluate different user interface designs in exercise sessions. Thus, they able to understand and criticize different design decision and can justify their analyses.

Applicability in this and other Programs

All modules in which the consideration of human-computer-interaction mechanisms is a central subject.

Entrance Requirements

none

Learning Content

Introduction to the field of human-machine interaction

- Design of everyday objects
- Cognitive fundamentals
- Phenomena and mechanisms of attention

Information design

- Presentation of information
- Display design principles

Usability, UX

- Terms, models, processes
- Analysis methods
- Evaluation methods

Teaching Methods

- Interactive lectures
- Exercise sessions
- Group work

Recommended Literature

- Krug, S. (2013), Dont Make Me Think: A Common Sense Approach to Web Usability, 3rd revised edition, New Riders
- Norman, D. A. (2013), The design of everyday things, Basic Books, New York, NY
- Shneiderman, B., & Plaisant, C. (2010), Designing the user interface: strategies for effective human-computer interaction, Addison-Wesley, Boston

AIN-B-21 Machine Learning

Module code	AIN-B-21
Module coordination	Prof. Dr. Markus Mayer
Course number and name	AIN-B-21 Machine Learning
Semester	4
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	project work
Weight	5/210
Language of Instruction	English

Module Objective

The main focus is the subject and methodological competency in the field of machine learning. By the nature of the subject, the gain of social compentences is not a major goal of the lecture, but is still supported by cooperative work on tasks and a project work done in teams. Personal competences are developed and refined by autonomous development of solutions to complex problems and the presentation of solutions within the class.

In detail, objectives of the lecture are:

- The students understand how to analyse a given dataset for its predictive quality and know how to motivate a classification or regression problem. They can perform the computation of statistics and programming of visualizations and can select the appropriate methods for given datasets.
- The students can present a problem of supervised learning with remarks on predictive quality and the motivation.

- The students understand the basic methods of feature engineering and the construction of machine learning evaluations in a scientific, rigid way. They can apply this knowledge and implement the methods in code.
- The students understand the basic classification methods and their advantages and disadvantages. For a given problem, they can decide which to include in an evaluation and appropriatly parameterize library methods.
- The students know unsupervised learning and some of its usages. They understand an exemplary algorithm from this field and can do the implementation.

Applicability in this and other Programs

Applicable in AIN-B in Deep Learning, AI in Industry, AI in Gaming

Entrance Requirements

Math 1 and 2, Programming 1 and 2, Statistics

Learning Content

- Machine Learning Introduction
- Machine Learning Overview: Exemplary problems and solution classes
- Supervised learning experiment: Motivation
- Error and quality measures
- Bayes classifier, kNN classifier
- Training and test data selection
- Bayesian type classifiers
- Linear regression
- Feature engineering (Creation, Lifting, Selection)
- Outliers, Cross validation, Resampling
- Unsupervised Learning, K-Means clustering
- Gradient descent
- Support vector machines
- Decision tree classifiers

The main body of the lecture is supervised learning. Undsupervised learning is motivated and only exemplary shown.

Teaching Methods

- Lecture with PowerPoint slides
- Exercises in the lecture and for self study
- Presentation of the exercises by students with discussion

- Online course material for self study
- GIT repository for collectivelly setting up a code base

Remarks

None

Recommended Literature

- An Introduction to Statistical Learning, James, Witten, Hastie, Rob Tishirani, 2nd Edition, 2021, available online: https://www.statlearning.com
- MIT Open learning library: Introduction to machine learning. Online course, available at https://openlearninglibrary.mit.edu/courses/course-v1:MITx+6.036+1T2019/about

AIN-B-22 Computer Vision

Module code	AIN-B-22
Module coordination	Prof. Dr. Patrick Glauner
Course number and name	AIN-B-22 Computer Vision
Semester	4
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	project work
Weight	5/210
Language of Instruction	English

Module Objective

The aim of this class is to discuss Computer Vision (CV), which allows computers to process visual inputs. We deal every day dozens of times with CV, such as facial recognition, real-time translating camera input or auto-tagging friends in photos. Modern CV algorithms are strongly based on machine learning methods, in particular deep neural networks. Students will acquire knowledge in CV and be able to elaborate it further in the future, for example in projects or further studies. Overall, CV is a cutting-edge eld, with many high-pay opportunities for graduates.

Applicability in this and other Programs

Including, but not limited to, the following modules:

- AI Project
- Deep Learning/Big Data

Entrance Requirements

- Programming, ideally in Python
- Algorithms and data structures
- (Some) mathematics

Learning Content

- Introduction: applications, computational models for vision, perception and prior knowledge, levels of vision, how humans see
- Pixels and filters: digital cameras, image representations, noise, filters, edge detection
- Regions of images and segmentation: segmentation, perceptual grouping, Gestalt theory, segmentation approaches, image compression
- Feature detection: RANSAC, Hough transform, Harris corner detector
- Object recognition: challenges, template matching, histograms, machine learning
- Convolutional neural networks: neural networks, loss functions and optimization, backpropagation, convolutions and pooling, hyperparameters, AutoML, efficient training, selected architectures
- Image sequence processing: motion, tracking image sequences, Kalman filter, correspondence problem, optical flow
- Foundations of mobile robotics: robot motion, sensors, probabilistic robotics, particle filters, SLAM
- Outlook: 3D vision, generative adversarial networks, self-supervised learning, vision transformers

Teaching Methods

- Lectures
- Projects

Recommended Literature

- C. Bishop and H. Bishop, " Deep Learning: Foundations and Concepts ", Springer, 2024.
- R. C. Gonzalez and R. Woods, " Digital Image Processing ", Pearson, 4th edition, 2018.
- I. Goodfellow, Y. Bengio and A. Courville, " Deep Learning ", MIT Press, 2016.
- S. Russell and P. Norvig, " Artificial Intelligence: A Modern Approach ", Pearson, 4th edition, 2021.

AIN-B-23 Software Engineering

Module code	AIN-B-23
Module coordination	Prof. Dr. Christoph Schober
Course number and name	AIN-B-23 Software Engineering
Semester	4
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Portfolio
Weight	5/120
Language of Instruction	English

Module Objective

Students will aquire knowledge and understanding of the fundamental concepts and methods of software engineering.

Specifically, students will have achieved the following learning outcomes upon completion of the module:

Subject competency

- Students know and understand the fundamental concepts and methods of software engineering
- Students are able to apply fundamentals of project management
- Students are able to specify requirements
- Students are able to perform reviews
- Students know how to transform a machine learning model from proof of concept to production

Methodological competency

- Students are able to define and conduct different test strategies based on requirements
- Students are able to automatically test and deploy software using CI/CD pipelines
- Students are able to work with version control
- Students are able to containerize and deploy software using Docker

Personal competency

- Students work goal-oriented and acquire a high degree of determination
- Using agile methods fosters self-motivation
- Working in a task-oriented way helps to empower a problem-solving way of thinking

Social competency

- Students are able to organize themselves in small groups to conduct a software project
- Students actively participate in team meetings fostering their ability to work in teams

Applicability in this and other Programs

-

Entrance Requirements

- Knowledge of the following modules:
  - Foundations of Computer Science
  - Programming 1
  - Programming 2
  - Internet Technologies

Learning Content

1 Motivation and Definition
2 Software Engineering Lifecycle
3 Software Process Models
4 Methodology
  - Requirements Engineering
  - Software Design
5 Implementation
  - Coding conventions
  - Static code analysis

- Code metrics

6 Software Test
- Testing process
- Testing methods and strategies
- Unit-, Integration- and End2End testing

7 Software Quality Assurance
- Definition
- Reviews

8 MLOps
- Workflow tools (Airflow, Daggster)
- Reproducible models

Teaching Methods

- Interactive lectures
- Practical exercises using CASE tools
- Conducting a small software project in a team

Remarks

-

Recommended Literature

- H. Balzert, Lehrbuch der Software-Technik, Spektrum Akademischer Verlag
- I. Sommerville, Software Engineering, Addison Wesley Verlag
- A. Spillner, T. Linz, Basiswissen Softwaretest, dpunkt Verlag
- B. Beizer, Black - Box Testing: Techniques for Functional Testing of Software and Systems, Wiley Verlag
- P. Liggesmeyer, Software - Qualität: Testen, Analysieren und Verifizieren von Software, Spektrum Verlag
- H. Sneed, M. Winter, Testen objektorientierter Software, Hanser Verlag

AIN-B-24 Key Competencies 4

Module code	AIN-B-24
Module coordination	Dr. David Bomhard
Course number and name	AIN-B-24 Compliance, Data Protection and IT Law
Semester	4
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Examination form of the chosen module
Weight	5/210
Language of Instruction	English

Module Objective

In this lecture, students gain an in-depth overview of the most important legal framework conditions in the area of AI, data and IT law. Current legal developments are presented in depth, in particular the planned EU AI Act. Through interactive discussions, students learn the basics for drafting and negotiating IT contracts and ensuring compliance within a company.

Applicability in this and other Programs

-

Entrance Requirements

None

Learning Content

- Data Law (GDPR, draft Data Act, data license agreements)
- AI Law (Liability, IP regulations, draft AI Act)
- IT Contracts (legal basics, drafting, negotiation)
- Current legal developments in Compliance and EU legislation

Teaching Methods

Interactive lecture, strong involvement of students through questions and selective group work

Remarks

For Key Competencies 4, students can choose either courses offered by the faculty or German.

Recommended Literature

The lecturer will discuss selected legal texts in the original version.

AIN-B-25 Internship (Module)

Module code	AIN-B-25
Module coordination	Prof. Dr. Patrick Glauner
Course number and name	AIN-B-25 Internship-Accompanying Course 2 AIN-B-25 Internship AIN-B-25 Internship-Accompanying Course 1
Semester	5
Duration of the module	1 semester
Module frequency	annually
Course type	PLV, required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	30
Workload	Time of attendance: 60 hours self-study: 840 hours Total: 900 hours
Type of Examination	project work, Exercise Performance,
Weight	30/210
Language of Instruction	English

Module Objective

The practical semester is an integral part of the course of study. The aim is to gain practical experience in an industrial environment.

Applicability in this and other Programs

- Courses in later semesters
- Bachelor thesis

Entrance Requirements

Entry into the practical semester requires that at least 70 ECTS points have been earned.

Learning Content

The practical semester is an integral part of the course of study. It is supervised by the university and accompanied by courses according to the curriculum. The internships are primarily to be carried out in companies in Germany and abroad. The aim is to gain practical experience in an industrial environment. The students have the opportunity to get to know different companies during their studies.

Teaching Methods

- Internship
- Two accompanying one-week block courses

Recommended Literature

None

AIN-B-26 Current Topics in AI

Module code	AIN-B-26
Module coordination	Chukwuebuka Ezelu
Course number and name	AIN-B-26 Current Topics in AI
Semester	6
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Portfolio
Weight	5/210
Language of Instruction	English

Module Objective

The aim of the module is to provide an overview of current topics in artificial intelligence. This is done by analyzing current scientific works, summarizing and presenting the results in plenary sessions. In detail, students will have achieved the following learning outcomes after completing the module:

1 Professional competence
   - Students understand the current scientific trends and topics in the field of artificial intelligence. (2 - Understanding)

2 Methodological competence
   - Students are able to analyze and understand the scientific work of others and present it in a way that is understandable to others. (4 - Analyze)

3 Personal competence

- Students generate summaries of current scientific work in the field of artificial intelligence in a team. (6 - Creating)

4 Social competence
- Students can present the knowledge they have acquired in a team and thus communicate it to other students. (2 -Understanding)
- Students discuss the results of their scientific research and are able to evaluate and defend them. (5 - Evaluate)

Applicability in this and other Programs

Module can be used for the Bachelor's thesis and in other degree programs.

Entrance Requirements

Recommendation:

- AIN-B-1 Mathematics 1
- AIN-B-7 Mathematics 2
- AIN-B-9 Algorithms and Data Structures
- AIN-B-11 Computational Logic
- AIN-B-17 AI Programming
- AIN-B-23 Software Engineering

Learning Content

The content depends on the current topics and developments in the field of artificial intelligence. In the summer semester 2022, the following topics were discussed:

- AutoML
- Natural Language Processing
- LSTMs and GRUs
- Autoencoders
- Generative Advesarial Networks
- Deep Learning Frameworks

In addition to the current scientific topics, there will be an introduction to scientific work and guest lectures on the use of artificial intelligence in business and science.

Teaching Methods

Seminar-style teaching, research, development and presentation of current topics in AI topics, practical exercises, guest lectures.

Recommended Literature

Articles from the following journals, among others, will be reviewed:

- Proceedings of the IEEE/CVF International Conference on Computer Vision
- Neural computation, MIT Press
- Natural Language Engineering, Cambridge University Press
- Knowledge-Based Systems
- Elsevier Journal of Ubiquitous Computing and Communication Technologies (UCCT)
- Advances in neural information processing systems

AIN-B-27 Autonomous Robotics

Module code	AIN-B-27
Module coordination	Prof. Dr. Simon Zabler
Course number and name	AIN-B-27 Autonomous Robotics
Semester	6
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weight	5/210
Language of Instruction	English

Module Objective

Students should

- Know the basic notations and arithmetics in robot forward as well as inverse kinematics
- Be capable of computing tool trajectories in work- as well as in joint coordinates
- Know the Physics of Lagrange Mechanics for calculating /computating torque and force
- Know and apply several strategies for path and trajectory planning for robots
- Know all common representations of maps as well as strategies for computing the latter

- Understand the challenges of real-time pose estimation (e.g. of humans or random obstacles)
- Know all common sensors for mapping the robot's environment as well as sensors for self-monitoring
- Be able to name and explain common examples for robot applications / tasks involving machine learning
- Be familier with the environment ROS (robot operating system) and its common tools
- Know the basics of image processing (e.g. for detecting edges, lines, etc.)

Applicability in this and other Programs

-

Entrance Requirements

Mathematik I & II
Measurement Science
Physics (Classical Mechanics)

Learning Content

-

Teaching Methods

Lecture, Examples for Computation, Short Seminar Presentations by small student groups

Remarks

-

Recommended Literature

Handbook of Robotics, MIT script "Autonoous Robotics"

AIN-B-28 AI Project

Module code	AIN-B-28
Module coordination	Prof. Dr. Patrick Glauner
Course number and name	AIN-B-28 AI Project
Semester	6
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	project work
Weight	5/210
Language of Instruction	English

Module Objective

This class provides students with hands-on and real-world AI development experience. They will have the opportunity to work on real data sets in order to solve real-world problems. As these projects are completed in groups, students will also have the opportunity to use professional software development tools for collaboration.

Specifically, students will have achieved the following learning outcomes upon completion of the module:

Subject competency

Students analyze problems from companies with regard to possible solutions using AI systems. (4 - Analysing)
Students assess which AI techniques are most suitable for solving problems in companies. (5 - Evaluate)

Methodological competency

Students create their own AI-based solutions for problems in companies and implement them as prototypes using suitable software. (6 - Create)

Personal competency

Students can develop their own AI systems and defend them against competing approaches. (6 - Create)

Social competency

Students can present their own results and discuss the solutions they have developed with other students. (2 - React)

Applicability in this and other Programs

Thesis

Entrance Requirements

- Artificial intelligence
- Programming
- (Some) mathematics

Learning Content

- Implementing high-tech projects in the fields of artificial intelligence, machine learning, computer vision, natural language processing and others.
- Projects can be chosen for example from Kaggle (http://www.kaggle.com/), from other sources or be done in collaboration with an industrial partner.
- Using modern high-end hardware, such as GPU clusters and cloud services.
- Utilizing an agile process framework such as Scrum.
- Understanding and using modern industrial software development tools such as work package trackers, code revision systems, debuggers, profilers and others.
- Presenting R&D outcomes to stakeholders at different levels, such as fellow students, faculty members, practitioners and executives.

Teaching Methods

- Project meetings
- Lectures

Recommended Literature

- C. Bishop and H. Bishop, " Deep Learning: Foundations and Concepts ", Springer, 2024.
- S. Chacon and B. Straub, " Pro Git ", Apress, 2nd edition, 2014.
- I. Goodfellow, Y. Bengio and A. Courville, " Deep Learning ", MIT Press, 2016.
- C. Larman, " Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development ", Prentice Hall, 3rd edition, 2004.

AIN-B-29 Deep Learning/Big Data

Module code	AIN-B-29
Module coordination	Prof. Dr. Patrick Glauner
Course number and name	AIN-B-29 Deep Learning/Big Data
Semester	6
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Portfolio
Weight	5/210
Language of Instruction	English

Module Objective

The aim of this class is to provide students with an introduction to the fields of deep learning and big data. Students will acquire a solid foundation in how to design and implement big data systems and how to use big data sets for training deep learning models. They will also learn hands-on how to use industrial tools for deep learning and big data. Furthermore, they will understand the limitations of big data-driven approaches and how they can recognize and solve typical issues in big data, such as data quality and biases. As an outcome, they will be able to work on real-world problems that not only require knowledge in AI, but also an expertise in how to use infrastructures, frameworks, libraries and tools for deep learning and big data.

Applicability in this and other Programs

Including, but not limited to, the following modules:

- AI Project
- Thesis

Entrance Requirements

- AI Programming
- Programming 1 and 2
- Mathematics 1 and 2

Learning Content

Deep Learning part:

- Feed-forward neural networks
- Tensorflow
- Convolutional neural networks
- Recurrent neural networks
- Sequence-to-sequence learning
- Deep reinforcement learning
- Unsupervised neural network models

Big Data part:

- Introduction: 3 Vs, history of big data, selected big data use cases
- Parallelism: parallelism and concurrency, creating threads, global interpreter lock (GIL)
- Big data architectures: distributed systems, MapReduce, CAP theorem, speedup through GPUs and FPGAs
- Big data, small data, all data: data quality, biases in data sets, small sample size problems
- Uncertainty in learning: confidence intervals and statistical tests, Gaussian processes, conformal prediction, model calibration
- MLOps: project lifecycle, challenges, operations, principal components, pipelines, best practices
- Big data for NLP: embeddings, recent advances in NLP, transformers
- Quantum computing: qubits, quantum logic gates, quantum computers, quantum algorithms
- Selected big data infrastructures, frameworks, libraries and tools

Teaching Methods

- Lectures
- Seminars
- Discussion of research papers and recent news

- Coursework and case studies, including laboratory problems

Recommended Literature

- E. Charniak, " Introduction to Deep Learning ", MIT Press, 2018.
- F. Chollet, " Deep learning with Python ", Simon and Schuster, 2021.
- H. Kinsley and D. Kukie#a, " Neural Networks from Scratch in Python " , NNFS.io , 2020.
- C. Bishop and H. Bishop, " Deep Learning: Foundations and Concepts ", Springer, 2024.
- A. Petrov, " Database Internals: A Deep Dive into How Distributed Data Systems Work ", O'Reilly Media, 2019.
- E. Raj, " Engineering MLOps: Rapidly build, test, and manage production-ready machine learning life cycles at scale ", Packt, 2021.
- S. Sakr and A. Zomaya (Eds.), " Encyclopedia of Big Data Technologies ", Springer, 2019.

AIN-B-30 Compulsory Elective 1 (FWP)

Module code	AIN-B-30
Module coordination	Prof. Dr. Markus Mayer
Course number and name	AIN-B-30 Compulsory Elective 1 (FWP)
Semester	6
Duration of the module	1 semester
Module frequency	annually
Course type	compulsory course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Examination form of the chosen module
Weight	5/210
Language of Instruction	English

Module Objective

In the Compulsory Elective modules (FWP), you can freely choose a subject from a given catalog of subjects. The content is therefore subject-related to the choosen course, e.g. from the fields of computer science, AI, cyber security or other relevant courses. This allows for an individual focus and deepening of knowledge.

In the FWP modules 1 & 2 you may choose another subject that interests you, *but only with consultation and agreement of the program coordinator.*

The objectives and compentences are weighted differently according to the choosen module.

Applicability in this and other Programs

Applicability is determined by the subject chosen.

Entrance Requirements

The basics of the first two semester are required because the courses are continuation of the regular curriculum. The competences from KI-B 1-18 or AIN-B 1-18 are recommended.

Learning Content

The content is determined by the choosen subject.

There is no voting on which Compulsory Elective you would like to take.

If you choose an Compulsory Elective from the subject catalog below, simply write to the relevant lecturer and ask if you can join the lecture. Then just attend the lecture. The consultation of the lecturer is mandaroy and must be done before the start of the semester, because some modules (even if this is not explicitly mentioned in the list) allow only for a limited number of students.

If you would like to take another subject that interests you for FWP 1 or 2, please contact your degree program coordinator to discuss whether the subject in question is suitable as an Compulsory Elective. In addition you have to (just like for the catalog courses) ask the respective lecturer of the course.

The courses marked with "AIX" are courses not assigned to a single study program.

The course catalogue of the FWP 1 & 2 modules is:

In the summer semester (SS):

1 Operations Research (from WI-B)
2 Business Applications (from WI-B)
3 Regelungstechnik (from AI-B-ES)
4 Numerische Methoden (from AI-B-ES)
5 Kryptologie 1 (from CY-B)
6 Penetration Testing (from CY-B)
7 Digitale Forensik (from CY-B)

In the winter semester (WS):

1 Allgemeine Psychologie 1 (from WP-B)
2 Modellbildung und Simulation (from AI-B-ES)
3 Sichere Programmierung (from CY-B)
4 Quantum Computing (from AIN-B)
5 System Design an Application for HPC/QC (RZ-Management) (from HPCQC-M. Language English): The number of students is limited!
6 Imaging Physics (from AIX. Language English)

Note that the module handbook is updated in longer time periods and the course catalogue might be in parts outdated. The most recent course catalogue can be found in the iLearn course Compulsory Elective (FWP) of AIN-B.

Teaching Methods

Usually blended learning or seminar-style teaching

Remarks

The exact form of examination (according to the study and examination regulations, 90 minutes or mdl. 15 minutes or PStA) is determined by the choosen subject.

Recommended Literature

The literature depends on the chosen subject.

AIN-B-31 Key Competencies 5

Module code	AIN-B-31
Module coordination	Prof. Dr. Johann Nagengast
Course number and name	AIN-B-31 Entrepreneurship AIN-B-31 Team Building and International Communication
Semester	6
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Examination form of the chosen module
Weight	5/210
Language of Instruction	English

Module Objective

Learning Objectives

ENTREPRENEURSHIP:

Start-ups are a crucial driver of innovation in Germany and are responsible for a portion of the economic output. Against this backdrop, students should be sensitized, qualified, and motivated for starting a business.

By developing and presenting their own business idea as part of a group project, students simulate the beginning of a business startup. The course imparts foundational knowledge relevant to starting a business. This includes the Entrepreneurial Mindset, Team Building, Idea Generation and Evaluation, Lean Start-up, Business Model Canvas, Gathering Customer Feedback, and Pitching. Through the practical application of the knowledge

taught, students train in the process of business model development and learn to understand and overcome the associated challenges. The commitment of participants and group dynamics during the project significantly contribute to the learning success.

Upon completing the module, students have acquired the following competencies:

Professional Competence

Students are familiar with various methods of idea generation and evaluation. They are capable of generating and evaluating iterative solutions for a problem during idea generation. They can turn their ideas into prototypes and test and evaluate these with users. The students acquire practical knowledge and experience in developing a business model.

Methodological Competence

Each student independently develops strategic options for business management and learns to reflect on their impacts. Through group work, selected management tools are prepared and presented during the lectures. Students are able to use the Business Model Canvas as a method for business model analysis and development based on self-chosen practical examples. The business models are further developed through interaction with potential customers and users. Students can present their business models confidently and convincingly. The students have also been introduced to a start-up mindset and are enabled to understand disruptive problems and develop user-centered solutions.

Social and Personal Competence

Students work on their startup idea in a team and learn important social skills in collaboration. Through this course, they are enabled to recognize their personal core competencies, use them sensibly in a team, and learn a constructive and creative approach to a healthy feedback culture. Through the analysis of current business situations in teamwork, an in-depth exchange about different strategic concepts for business management takes place, balancing financial value orientation and value-oriented business leadership. The heterogeneity of group opinions trains discussion, teamwork, conflict, and criticism skills.

TEAM BUILDING:

By working together to solve complex problems and through structured feedback sessions, the participants become sensitized to the roles they assume in group interactions, to the limitations imposed by the German and their own cultures, and to the conditions required for effective team work.
The course supports the integration of foreign students into campus and social life and helps build lasting working relationships among all participants.
The skills of giving and receiving of feedback are learned in the protective atmosphere of small groups through intensive exchanges between instructors and participants. This leads to improved observation and communication skills.
Moreover, the group members continually switch roles. This promotes a deeper understanding of social interaction, helps members to reflect on their contribution to the

group process, encourages members to experiment with new behavioural concepts, and improves the groups capacity to cooperate and perform. Final feedback rounds offer the possibility to align the members self-images with the perception others have of them, to reduce blind spots, to increase self-confidence and their ability to reflect.
The capacity to give appropriate feedback in various situations, to monitor ones self image as well as the consequences of ones own behaviour form the basis for a successful career in management.

Applicability in this and other Programs

Applicability of the Module for This Degree Program

This module counts as interdisciplinary key qualifications.

Applicability of the Module for Other Degree Programs

This module can be used in all other technical, legal, economic psychology, and business management courses, e.g., in the Cyber Security Bachelor program.

Entrance Requirements

No prerequisites.

Learning Content

ENTREPRENEURSHIP:
- Idea Generation and Evaluation
- Lean Start-up Method
- Business Model Canvas
- Customer-Oriented Innovation Development
- Pitching & Presenting
- Feedback Techniques

TEAM BUILDING:
1. Group dynamics, processes and structures in groups
2. Roles in groups (roles in tasks and supporting roles)
3. Group leadership
4. Effect of ones actions in groups
5. The give and take of feedback
6. Self-image and how others see you
7. Communication levels (content versus relationship)
8. Conditions for successful co-operation
9. Cultural influences on teamwork

Note: The main emphasis of this course is not the conveyance of theoretical knowledge,

but rather learning directly from experience. The theories on which the intervention and evaluation sessions are based are taught in the course Human Resources Management.

Teaching Methods

Teaching and Learning Methods

ENTREPRENEURSHIP:

- Seminar-style teaching with the integration of mentors
- Guest lectures
- Group work
- Presentations

TEAM BUILDING:

This course is organized as an interactive experience and activity based training program. With the help of complex tasks, timed interaction activities combined with elements of surprise, classical outdoor training exercises, moderated feedback and reflection sessions, participants are taught the necessary conditions for effective teamwork.
The teaching methods are based on the principles of self-organized learning. The instructors define their roles in terms of Scheins model of process consultation. They intervene by questioning the participants in a manner designed not only to examine their perspectives, but to introduce new perspectives and stimulate the groups creative process. The responsibility for these process remains with the participants.
In the context of the learning environment, the students enjoy the opportunity to increase their observation, communication, co-operation, self-reflection, teamwork and management skills as well as their self-confidence.
In addition, the course offers the students the chance to develop sustainable work relationships at the start of their studies.

Remarks

For Key Competencies 5, students can choose either courses offered by the faculty or German.

Recommended Literature

Recommended Reading List

ENTREPRENEURSHIP:

Blank, S. (2013). The Four Steps to the Epiphany: Successful Strategies for Products That Win. Pescadero, CA: K & S Ranch.

Blank, S., & Dorf, B. (2020). The Startup Owner's Manual: The Step-By-Step Guide for Building a Great Company. New York, NY: John Wiley & Sons.

Doblin. (n.d.). Ten types of innovation - the building blocks of breakthroughs. Retrieved from https://doblin.com/ten-types

Doe, J. (2021). The Silicon Valley Mindset: Innovation and Entrepreneurship in the Tech World. [Location not provided]: TechPress.

Dowling, M. J. (2003). Gründungsmanagement. Berlin, Germany: Springer Verlag.

Stratfor. (2015, January 8). Scenario planning and strategic forecasting. Forbes. Retrieved from https://www.forbes.com/sites/stratfor/2015/01/08/scenario-planning-and-strategic-forecasting/#23c85a2c411a

Grichnik, D., & Hess, M. (2020). Startup Navigator: Guiding Your Entrepreneurial Journey. New York, NY: Bloomsbury Publishing.

Dyer, J., Gregersen, H., & Christensen, C. M. (2009). The Innovator's DNA. Harvard Business Review. Retrieved from https://hbr.org/2009/12/the-innovators-dna

Malik, F. (2019). Führen Leisten Leben: Wirksames Management für eine neue Welt. Frankfurt am Main, Germany: Campus Verlag.

Osterwalder, A., Pigneur, Y., Bernarda, G., & Smith, A. (2015). Value Proposition Design: Entwickeln Sie Produkte und Services, die Ihre Kunden wirklich wollen. Die Fortsetzung des Bestsellers Business Model Generation! Frankfurt am Main, Germany: Campus Verlag.

Osterwalder, A., & Pigneur, Y. (2011). Business Model Generation: Ein Handbuch für Visionäre, Spielveränderer und Herausforderer. Frankfurt am Main, Germany: Campus Verlag.

Van der Pijl, P., Lokitz, J., & Wijnen, R. (2020). Business Model Shifts: Six Ways to Create New Value For Customers. Hoboken, NJ: John Wiley & Sons.

Van der Pijl, P., Lokitz, J., & Solomon, L. K. (2016). Design a Better Business: New Tools, Skills, and Mindset for Strategy and Innovation. Hoboken, NJ: John Wiley & Sons.

Skambraks, J. (2012). 30 Minuten Elevator Pitch. Offenbach, Germany: GABAL.

Wirtz, B. W. (2019). Digital Business Models: Concepts, Models, and the Alphabet Case Study. Berlin, Germany: Springer.

TEAM BUILDING:

Forsyth, D. R.: Group Dynamics, 6th ed., Boston et al., 2013
Levi, D.: Group Dynamics for Teams, Thousand Oaks, 2017
Quick, J. C.: Nelson, D., L./ Snell, S., Morris, S., Bohlander G.: Human Resource Management, 2nd custom ed., Boston et al. 2017

AIN-B-32 Compulsory Elective 2 (FWP)

Module code	AIN-B-32
Module coordination	Prof. Dr. Markus Mayer
Course number and name	AIN-B-32 Compulsory Elective 2 (FWP)
Semester	7
Duration of the module	1 semester
Module frequency	annually
Course type	compulsory course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Examination form of the chosen module
Weight	5/210
Language of Instruction	English

Module Objective

In the Compulsory Elective modules (FWP), you can freely choose a subject from a given catalog of subjects. The content is therefore subject-related to the choosen course, e.g. from the fields of computer science, AI, cyber security or other relevant courses. This allows for an individual focus and deepening of knowledge.

In the FWP modules 1 & 2 you may choose another subject that interests you, *but only with consultation and agreement of the program coordinator.*

The objectives and compentences are weighted differently according to the choosen module.

Applicability in this and other Programs

Applicability is determined by the subject chosen.

Entrance Requirements

The basics of the first two semester are required because the courses are continuation of the regular curriculum. The competences from KI-B 1-18 or AIN-B 1-18 are recommended.

Learning Content

The content is determined by the choosen subject.

There is no voting on which Compulsory Elective you would like to take.

If you choose an Compulsory Elective from the subject catalog below, simply write to the relevant lecturer and ask if you can join the lecture. Then just attend the lecture. The consultation of the lecturer is mandaroy and must be done before the start of the semester, because some modules (even if this is not explicitly mentioned in the list) allow only for a limited number of students.

If you would like to take another subject that interests you for FWP 1 or 2, please contact your degree program coordinator to discuss whether the subject in question is suitable as an Compulsory Elective. In addition you have to (just like for the catalog courses) ask the respective lecturer of the course.

The courses marked with "AIX" are courses not assigned to a single study program.

The course catalogue of the FWP 1 & 2 modules is:

In the summer semester (SS):

1 Operations Research (from WI-B)
2 Business Applications (from WI-B)
3 Regelungstechnik (from AI-B-ES)
4 Numerische Methoden (from AI-B-ES)
5 Kryptologie 1 (from CY-B)
6 Penetration Testing (from CY-B)
7 Digitale Forensik (from CY-B)

In the winter semester (WS):

1 Allgemeine Psychologie 1 (from WP-B)
2 Modellbildung und Simulation (from AI-B-ES)
3 Sichere Programmierung (from CY-B)
4 Quantum Computing (from AIN-B)
5 System Design an Application for HPC/QC (RZ-Management) (from HPCQC-M. Language English): The number of students is limited!
6 Imaging Physics (from AIX. Language English)

Note that the module handbook is updated in longer time periods and the course catalogue might be in parts outdated. The most recent course catalogue can be found in the iLearn course Compulsory Elective (FWP) of AIN-B.

Teaching Methods

Usually blended learning or seminar-style teaching

Remarks

The exact form of examination (according to the study and examination regulations, 90 minutes or mdl. 15 minutes or PStA) is determined by the choosen subject.

Recommended Literature

The literature depends on the chosen subject.

AIN-B-33 Compulsory Elective 3 (FWP)

Module code	AIN-B-33
Module coordination	Prof. Dr. Markus Mayer
Course number and name	AIN-B-33 Compulsory Elective 3 (FWP)
Semester	7
Duration of the module	1 semester
Module frequency	annually
Course type	compulsory course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Examination form of the chosen module
Weight	5/210
Language of Instruction	English

Module Objective

In the Compulsory Elective modules (FWP), you can freely choose a subject from a given catalog of subjects. The content of the FWP 3 and 4 modules is subject-related to the choosen course, but comes from the field of AI applications. This allows for an individual focus and deepening of knowledge.

The objectives and compentences are weighted differently according to the choosen module.

Applicability in this and other Programs

Applicability is determined by the subject chosen.

Entrance Requirements

The basics of the first semester are required because the courses are continuation of the regular curriculum. The course content of AIN-B/KI-B 1-18 is recommended.

Learning Content

The content is determined by the choosen subject.

There is no voting on which Compulsory Elective you would like to take.

If you choose an Compulsory Elective from the subject catalog below, simply write to the relevant lecturer and ask if you can join the lecture. Then just attend the lecture. The consultation of the lecturer is mandaroy and must be done before the start of the semester, because some modules (even if this is not explicitly mentioned in the list) allow only for a limited number of students.

In the FWP modules 3 and 4 you are limited to the offered course catalogue (with the exception of an a semester abroad).

The courses marked with "AIX" are courses not assigned to a single study program.

The course catalogue of the FWP 3 & 4 modules is:

1. AI in industry or AI in service economy (from KI-B. Language English). No upper limit for student numbers.
2. KI Anwendungen (from KI-B. Aktuell: Gaming. Language English). No upper limit for student numbers.
3. Quantum Computing (from AIN-B. Language English). There is an upper limit for student numbers!
4. Anwendungen von Künstlicher Intelligenz in der Cybersecurity (from AIX). There is an upper limit for student numbers!

All course take place in the winter semester.

Note that the module handbook is updated in longer time periods and the course catalogue might be in parts outdated. The most recent course catalogue can be found in the iLearn course Compulsory Elective (FWP) of AIN-B.

Teaching Methods

Usually blended learning or seminar-style teaching

Remarks

The exact form of examination (according to the study and examination regulations, 90 minutes or mdl. 15 minutes or PStA) is determined by the choosen subject.

Recommended Literature

The literature depends on the chosen subject.

AIN-B-34 Compulsory Elective 4 (FWP)

Module code	AIN-B-34
Module coordination	Prof. Dr. Markus Mayer
Course number and name	AIN-B-34 Compulsory Elective 4 (FWP)
Semester	7
Duration of the module	1 semester
Module frequency	annually
Course type	compulsory course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Examination form of the chosen module
Weight	5/210
Language of Instruction	English

Module Objective

In the Compulsory Elective modules (FWP), you can freely choose a subject from a given catalog of subjects. The content of the FWP 3 and 4 modules is subject-related to the choosen course, but comes from the field of AI applications. This allows for an individual focus and deepening of knowledge.

The objectives and compentences are weighted differently according to the choosen module.

Applicability in this and other Programs

Applicability is determined by the subject chosen.

Entrance Requirements

The basics of the first semester are required because the courses are continuation of the regular curriculum. The course content of AIN-B/KI-B 1-18 is recommended.

Learning Content

The content is determined by the choosen subject.

There is no voting on which Compulsory Elective you would like to take.

If you choose an Compulsory Elective from the subject catalog below, simply write to the relevant lecturer and ask if you can join the lecture. Then just attend the lecture. The consultation of the lecturer is mandaroy and must be done before the start of the semester, because some modules (even if this is not explicitly mentioned in the list) allow only for a limited number of students.

In the FWP modules 3 and 4 you are limited to the offered course catalogue (with the exception of an a semester abroad).

The courses marked with "AIX" are courses not assigned to a single study program.

The course catalogue of the FWP 3 & 4 modules is:

1. AI in industry or AI in service economy (from KI-B. Language English). No upper limit for student numbers.
2. KI Anwendungen (from KI-B. Aktuell: Gaming. Language English). No upper limit for student numbers.
3. Quantum Computing (from AIN-B. Language English). There is an upper limit for student numbers!
4. Anwendungen von Künstlicher Intelligenz in der Cybersecurity (from AIX). There is an upper limit for student numbers!

All course take place in the winter semester.

Note that the module handbook is updated in longer time periods and the course catalogue might be in parts outdated. The most recent course catalogue can be found in the iLearn course Compulsory Elective (FWP) of AIN-B.

Teaching Methods

Usually blended learning or seminar-style teaching

Remarks

The exact form of examination (according to the study and examination regulations, 90 minutes or mdl. 15 minutes or PStA) is determined by the choosen subject.

Recommended Literature

The literature depends on the chosen subject.

AIN-B-35 Bachelormodul

Module code	AIN-B-35
Module coordination	Prof. Dr. Udo Garmann
Course number and name	Bachelorarbeit AIN-B-35 Bachelorseminar
Semester	7
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	2
ECTS	15
Workload	Time of attendance: 30 hours self-study: 420 hours Total: 450 hours
Type of Examination	oral examination, bachelor thesis
Weight	15/210
Language of Instruction	German, English

Module Objective

Bachelor Thesis:

In the bachelor thesis, students should demonstrate their ability to independently apply the knowledge and skills acquired during their studies to complex tasks.

Specialist and methodological skills as well as social and personal skills are emphasised differently depending on the chosen topic.

In detail, students will have achieved the following learning outcomes after completing the module:

Expertise

- By working on the topic of the bachelor thesis, students have in-depth specialist knowledge in the respective specialization.

- Students have the competence to independently apply the knowledge and skills acquired during their studies to complex tasks and present these in an appropriate written form.

Methodological competence

- By planning the work steps, carrying them out and finalizing them in the form of a document, students have the ability to successfully complete a comprehensive project independently.

Personal competence

- By completing the bachelor thesis, students acquire a high degree of personal responsibility, self-discipline, self-reflection and self-confidence.

Social competence

- Bachelor theses often take place in cooperation with companies in the region. By being integrated into a company project team, students have the ability to master a personal challenge in a social context. Students can solve a comprehensive task and develop an argument/strategy to argue and defend their thesis.

Bachelor Seminar:

Students present the results of their bachelor thesis in an oral examination in front of two examiners. They show that they are able to present complex issues in a compact and precise manner using exemplary didactics and modern presentation tools.

Students should respond to questions from the examiners and demonstrate the depth and breadth of their subject knowledge acquired during their studies.

Expertise

- Students have the competence to independently apply the knowledge and skills acquired during their studies to complex tasks and present these in an appropriate form.

Methodological competence

- By planning the work steps, carrying them out and finalising them in the form of a document and a presentation, students have the ability to successfully complete a comprehensive project independently.

Personal competence

- By completing the Bachelor's module, students acquire a high degree of personal responsibility, self-discipline, self-reflection and self-confidence.

Social competence

- Students can solve a comprehensive task and develop an argument/ strategy to argue and defend their thesis.

Applicability in this and other Programs

None, completion of the degree programme

Entrance Requirements

Completion of a large part of the previous modules recommended, but at least 120 ECTS.

Learning Content

The bachelor thesis is a written elaboration of an individual topic. It is issued by a person authorized to conduct examinations in the degree programme (professor, lecturer) and supervised and assessed by them. Students can freely choose a topic from a catalogue of subjects provided by the respective professor or propose a topic from practice in cooperation with a company. Contents are subject-related to the degree programme.

In preparation for the presentation of the bachelor thesis, presentation techniques are discussed at the beginning. Subsequent exercises give students the opportunity to apply the methods they have learned. Furthermore, the expectations and special features of a bachelor thesis are discussed. Students also receive a review of the requirements for academic work and, if necessary, information on current problems to help them choose a topic for their bachelor thesis.

The Bachelor's seminar concludes with the presentation of the bachelor thesis by the students and a subsequent professional discussion.

Teaching Methods

- The exact form of examination is a project work, which is scientifically documented with approx. 60 pages.
- The bachelor thesis can be written in German or English in consultation with the examiner.
- The processing time for the bachelor thesis is 6 months.
- The bachelor thesis must be written in accordance with the guidelines of the Framework Examination Regulations (RaPO) and the General Examination Regulations (APO) of Deggendorf Institute of Technology.
- seminar-based teaching
- A colloquium (an oral presentation) takes place during the seminar. Students defend their final thesis during the colloquium.

Recommended Literature

To be determined in consultation with the supervising professor