TECHNISCHE HOCHSCHULE DEGGENDORF

Module Guide
Artificial Intelligence

Faculty Computer Science
Examination regulations 15.04.2021
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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	5/120
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. Patrick Glauner
Course number and name	AIN-B-2 Programming 1
Lecturer	Michael Thurner
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
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.
Language of Instruction	English

Module Objective

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	5/120
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. Peter Faber
Course number and name	AIN-B-4 Operating Systems and Networks
Lecturers	Prof. Dr. Peter Faber Prof. Dr. Terezia Toth
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	
Language of Instruction	English

Module Objective

Part Networks:

After completing the lecture students will be able to name and describe the major network protocols and technologies for building networks. They will be able to explain the fundamental architectural principles in networks, such as the ISO/OSI model and the Internet protocol stack. Students participating in this lecture can name the different network topologies, describe different network architectures and performance metrics. Participants of this lecture will be able to explain all relevant aspects of connecting to a network. They will be able to use different network analysing tools, such as Wireshark and

Windows networking utilities for getting system information and troubleshooting networking problems.

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 network protocols and technologies. (2 - Understanding)

Methodological competency

Students will have the ability to explain the steps of connecting to a network and check a connection. (3 - Apply)

Personal competency

Students will be able to use network analyzing tools and troubleshooting networking problems. (6 - Create)

Social competency

Lab practices take place as part of the course. Students are thus able to understand, critique the solutions of other students. (5 - Assess)

Entrance Requirements

none

Learning Content

Part Networks:

The lecture is an introduction to networks used today. It deals with the construction, the functionality and the design of networks and protocols. On the basis of the ISO/OSI Model network and computer protocols are discussed. Media Access Control protocols of the lower layer are discussed together with network topologies with respect to their medium access mechanism. Topics of discussion include classic technologies like Ethernet. On network and transport layer, the TCP/IP protocol is introduced. The Exercise component of the module will help students reflect the content of the lecture. The Lab Practice component of the module faces practical aspects including use of network analyzing tools. The lecture and lab practice also includes topics such specialized industrial networks or protocols, e.g. the CAN and PROFINET.

Teaching Methods

Part Networks:

- Lecture
- Exercise
- Lab Practice

Recommended Literature

Part Networks:

- L. Peterson: Computer Networks: A Systems Approach, 5th edition
- Tannenbaum: Computer Networks, 5th edition

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
Lecturer	Prof. Dr. Javier Valdes
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
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.
Language of Instruction	English

Module Objective

AIN-B-6 Key Competencies 1

Module code	AIN-B-6
Module coordination	Kathrin Auer
Course number and name	AIN-B-6 Media Skills and Self-Organization AIN-B-6 Business Administration
Lecturer	Kathrin Auer
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

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
-

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. Ruzin Aganoglu
Course number and name	AIN-B-7 Mathematics 2
Lecturer	Prof. Dr. Ruzin Aganoglu
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	
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	
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. Florian Wahl
Course number and name	AIN-B-8 Programming 2
Lecturer	Prof. Dr. Florian Wahl
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	
Language of Instruction	English

Module Objective

Entrance Requirements

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
Lecturer	Prof. Dr. Patrick Glauner
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, 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 algorithms: fast matrix multiplication, string matching, prime numbers
- 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, "Algorithms", Addison Wesley, fourth edition, 2011.
- M. Sipser, "Introduction to the Theory of Computation", Cengage Learning, third edition, 2012.

AIN-B-10 Internet Technologies

Module code	AIN-B-10
Module coordination	Prof. Dr. Andreas Wölfl
Course number and name	AIN-B-10 Internet Technologies
Lecturer	Prof. Dr. Andreas Wölfl
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Practical Performance, written ex. 90 min.
Duration of Examination	90 min.
Language of Instruction	English

Module Objective

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
Lecturers	Prof. Dr. Cezar Ionescu Prof. Dr. Josef Schneeberger
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)
Lecturer	Tanja Mertadana
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
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.
Language of Instruction	English

Module Objective

AIN-B-13 Databases

Module code	AIN-B-13
Module coordination	Sabine Vogl
Course number and name	AIN-B-13 Databases
Lecturer	NN NN PK WI/KI
Semester	3
Duration of the module	1 semester
Module frequency	annually
Course type	required course
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.
Language of Instruction	English

Module Objective

AIN-B-14 Statistics

Module code	AIN-B-14
Module coordination	Sabine Vogl
Course number and name	AIN-B-14 Statistics
Lecturer	NN NN PK WI/KI
Semester	3
Duration of the module	1 semester
Module frequency	annually
Course type	required course
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.
Language of Instruction	English

Module Objective

AIN-B-15 Project Management

Module code	AIN-B-15
Module coordination	Sabine Vogl
Course number and name	AIN-B-15 Project Management
Lecturer	NN NN PK WI/KI
Semester	3
Duration of the module	1 semester
Module frequency	annually
Course type	required course
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.
Language of Instruction	English

Module Objective

AIN-B-16 Assistance Systems

Module code	AIN-B-16
Module coordination	Sabine Vogl
Course number and name	AIN-B-16 Assistance Systems
Lecturer	NN NN PK WI/KI
Semester	3
Duration of the module	1 semester
Module frequency	annually
Course type	required course
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
Language of Instruction	English

Module Objective

AIN-B-17 AI Programming

Module code	AIN-B-17
Module coordination	Sabine Vogl
Course number and name	AIN-B-17 AI Programming
Lecturer	NN NN PK WI/KI
Semester	3
Duration of the module	1 semester
Module frequency	annually
Course type	required course
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
Language of Instruction	English

Module Objective

AIN-B-18 Key Competencies 3

Module code	AIN-B-18
Module coordination	Sabine Vogl
Course number and name	AIN-B-18 Technology Ethics and Sustainability AIN-B-18 Academic Writing
Lecturer	NN NN PK WI/KI
Semester	3
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Language of Instruction	English

Module Objective

AIN-B-19 Natural Language Processing

Module code	AIN-B-19
Module coordination	Sabine Vogl
Course number and name	AIN-B-19 Natural Language Processing
Lecturer	NN NN PK WI/KI
Semester	4
Duration of the module	1 semester
Module frequency	annually
Course type	required course
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.
Language of Instruction	English

Module Objective

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

Module code	AIN-B-20
Module coordination	Sabine Vogl
Course number and name	AIN-B-20 Human Factors and Human-Machine Interaction
Lecturer	NN NN PK WI/KI
Semester	4
Duration of the module	1 semester
Module frequency	annually
Course type	required course
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.
Language of Instruction	English

Module Objective

AIN-B-21 Machine Learning

Module code	AIN-B-21
Module coordination	Sabine Vogl
Course number and name	AIN-B-21 Machine Learning
Lecturer	NN NN PK WI/KI
Semester	4
Duration of the module	1 semester
Module frequency	annually
Course type	required course
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
Language of Instruction	English

Module Objective

AIN-B-22 Computer Vision

Module code	AIN-B-22
Module coordination	Sabine Vogl
Course number and name	AIN-B-22 Computer Vision
Lecturer	NN NN PK WI/KI
Semester	4
Duration of the module	1 semester
Module frequency	annually
Course type	required course
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
Language of Instruction	English

Module Objective

AIN-B-23 Software Engineering

Module code	AIN-B-23
Module coordination	Sabine Vogl
Course number and name	AIN-B-23 Software Engineering
Lecturer	NN NN PK WI/KI
Semester	4
Duration of the module	1 semester
Module frequency	annually
Course type	required course
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
Language of Instruction	English

Module Objective

AIN-B-24 Key Competencies 4

Module code	AIN-B-24
Module coordination	Sabine Vogl
Course number and name	AIN-B-24 Compliance, Data Protection and IT Law
Lecturer	NN NN PK WI/KI
Semester	4
Duration of the module	1 semester
Module frequency	annually
Course type	required course
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.
Language of Instruction	English

Module Objective

AIN-B-25 Internship (Module)

Module code	AIN-B-25
Module coordination	Prof. Dr. Patrick Glauner
Course number and name	AIN-B-25 Internship AIN-B-25 Internship-Accompanying Course 1 AIN-B-25 Internship-Accompanying Course 2
Lecturers	Prof. Dr. Patrick Glauner NN NN PK WI/KI
Semester	5
Duration of the module	1 semester
Module frequency	annually
Course type	PLV, required course
Semester periods per week (SWS)	4
ECTS	30
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Language of Instruction	English

Module Objective

AIN-B-26 Current Topics in AI

Module code	AIN-B-26
Module coordination	Sabine Vogl
Course number and name	AIN-B-26 Current Topics in AI
Lecturer	NN NN PK WI/KI
Semester	6
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	oral examination, Exercise Performance
Language of Instruction	English

Module Objective

AIN-B-27 Autonomous Robotics

Module code	AIN-B-27
Module coordination	Sabine Vogl
Course number and name	AIN-B-27 Autonomous Robotics
Lecturer	NN NN PK WI/KI
Semester	6
Duration of the module	1 semester
Module frequency	annually
Course type	required course
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.
Language of Instruction	English

Module Objective

AIN-B-28 AI Project

Module code	AIN-B-28
Module coordination	Sabine Vogl
Course number and name	AIN-B-28 AI Project
Lecturer	NN NN PK WI/KI
Semester	6
Duration of the module	1 semester
Module frequency	annually
Course type	required course
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
Language of Instruction	English

Module Objective

AIN-B-29 Deep Learning/Big Data

Module code	AIN-B-29
Module coordination	Sabine Vogl
Course number and name	AIN-B-29 Deep Learning/Big Data
Lecturer	NN NN PK WI/KI
Semester	6
Duration of the module	1 semester
Module frequency	annually
Course type	required course
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
Language of Instruction	English

Module Objective

AIN-B-30 Compulsory Elective 1 (FWP)

Module code	AIN-B-30
Module coordination	Prof. Dr. Patrick Glauner
Course number and name	AIN-B-30 Compulsory Elective 1 (FWP)
Lecturer	NN NN PK WI/KI
Semester	6
Duration of the module	1 semester
Module frequency	annually
Course type	compulsory course
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 0 hours Total: 0 hours
Type of Examination	Examination form of the chose module
Language of Instruction	English

Module Objective

AIN-B-31 Key Competencies 5

Module code	AIN-B-31
Module coordination	Sabine Vogl
Course number and name	AIN-B-31 Team Building and International Communication AIN-B-31 Entrepreneurship
Lecturer	NN NN PK WI/KI
Semester	6
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Language of Instruction	English

Module Objective

AIN-B-32 Compulsory Elective 2 (FWP)

Module code	AIN-B-32
Module coordination	Prof. Dr. Patrick Glauner
Course number and name	AIN-B-32 Compulsory Elective 2 (FWP)
Lecturer	NN NN PK WI/KI
Semester	7
Duration of the module	1 semester
Module frequency	annually
Course type	compulsory course
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 0 hours Total: 0 hours
Type of Examination	Examination form of the chose module
Language of Instruction	English

Module Objective

AIN-B-33 Compulsory Elective 3: AI Applications 1 (FWP)

Module code	AIN-B-33
Module coordination	Prof. Dr. Patrick Glauner
Course number and name	AIN-B-33 Quantum Computing
Lecturers	Prof. Dr. Patrick Glauner Prof. Dr. Horst Kunhardt
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 chose module
Weight	5/210
Language of Instruction	English

Module Objective

This class provides students with an introduction to Quantum Computing (QC), which looks promising to solve certain computational problems substantially faster than classical computers. QC began in the early 1980s and in recent years, investment into QC research has increased in both the public and private sectors. Students will acquire knowledge in QC and its applications in various domains such as machine learning and cryptography. They will also be able to elaborate it further in the future, for example in projects or further studies. Overall, QC is a cutting-edge field, with many high-pay opportunities for graduates.

Applicability in this and other Programs

Miscellaneous

Entrance Requirements

- Programming
- Algorithms and data structures
- Mathematics, in particular linear algebra

Learning Content

- Introduction: history, comparison to traditional computing, applications, business potentials
- Foundations: complex numbers, complex vector spaces
- Systems: deterministic systems, probabilistic systems, quantum systems, assembling systems
- Quantum theory: states, superposition, observables, measuring, dynamics, assembling quantum systems, entanglement
- Architecture: bits and qubits, classical gates, reversible gates, quantum gates, no-cloning theorem
- Selected algorithms: Deutsch's, Deutsch-Jozsa, Simon's, Grover's, Shor?s
- Theoretical computer science: limits of quantum computing, complexity classes
- Quantum computers and programming: goals and challenges, decoherence, physical realizations, quantum annealing, adiabatic quantum computing
- Applications: quantum machine learning, quantum cryptography, quantum information theory

Teaching Methods

- Lectures
- Seminars
- Discussion of research papers and recent news
- Coursework and case studies, including laboratory problems

Recommended Literature

- P. Glauner and P. Plugmann (Eds.), "Innovative Technologies for Market Leadership: Investing in the Future", Springer, 2020.
- N. S. Yanofsky and M. A. Mannucci, "Quantum Computing for Computer Scientists", Cambridge University Press, 2008.

AIN-B-34 Compulsory Elective 4: AI Applications 2 (FWP)

Module code	AIN-B-34
Module coordination	Prof. Dr. Patrick Glauner
Course number and name	AIN-B-34 Compulsory Elective 4: AI Applications 2 (FWP)
Lecturer	Prof. Dr. Patrick Glauner
Semester	7
Duration of the module	1 semester
Module frequency	annually
Course type	compulsory course
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 chose module
Language of Instruction	English

Module Objective

AIN-B-35 Bachelor Seminar

Module code	AIN-B-35
Module coordination	Prof. Dr. Patrick Glauner
Course number and name	AIN-B-35 Bachelor Seminar
Lecturer	NN NN PK WI/KI
Semester	7
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Semester periods per week (SWS)	2
ECTS	3
Workload	Time of attendance: 30 hours self-study: 45 hours Total: 75 hours
Language of Instruction	English

Module Objective

AIN-B-36 Bachelor Thesis

Module code	AIN-B-36
Module coordination	Prof. Dr. Patrick Glauner
Course number and name	AIN-B-36 Bachelor Thesis
Semester	7
Duration of the module	1 semester
Module frequency	as required
Course type	required course
Semester periods per week (SWS)	12
ECTS	12
Workload	Time of attendance: 0 hours Total: 0 hours
Language of Instruction	English

Module Objective