MODULE HANDBOOK

Bachelor of Science

Bachelor Computer Science (CSE-BACS-01)

180 CP

Campus Studies

As of October 1st, 2026

INTERNATIONAL
UNIVERSITY OF
APPLIED SCIENCES

Classification: Undergraduate

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1. Semester

Introduction to Computer Science

Module Code: CSEBCSICS

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Carsten Skerra (Introduction to Computer Science)

Information about the Module Coordinator without guarantee

Contributing Courses to Module

- Introduction to Computer Science (CSEBCSICS01)

Module Exam Type

Module Exam	Split Exam
Study Format: Campus Studies Exam, 90 Minutes	

Weight of Module

see curriculum

Module Contents

- Information representation
- Algorithms and data structures
- Propositional logic / Boolean algebra
- Hardware
- Networks and the internet
- Software
- Computer science as a discipline

Learning Outcomes

Introduction to Computer Science

On successful completion, students will be able to

- understand basic algorithms and data structures.
- apply basic constructs of propositional logic in programming.
- describe the structure of computer hardware systems.
- specify the structure and the main services of the internet.
- discuss professional conduct in computer science.

Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Computer Science & Software Development.	All Bachelor Programs in the IT & Technology field.

Introduction to Computer Science

Course Code: CSEBCSICS01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The goal of this course is to provide an introduction to computer science and its main concepts. It covers basic topics such as information representation and an introduction to algorithms and data structures. Propositional logic and Boolean algebra are also introduced, both of which form an important basis in computer science, e.g., for expressing conditions in programming. Furthermore, the course introduces the three main components of computing infrastructures: hardware, networks, and software. Finally, the course covers the meta level by looking at the role of computer science as a discipline as well as ethics and professional conduct.

Course Outcomes

On successful completion, students will be able to

- understand basic algorithms and data structures.
- apply basic constructs of propositional logic in programming.
- describe the structure of computer hardware systems.
- specify the structure and the main services of the internet.
- discuss professional conduct in computer science.

Contents

1. Basic concepts of data processing
   - 1.1 Data, information and messages
   - 1.2 Software, firmware and hardware
   - 1.3 Languages, syntax and semantics
   - 1.4 Historical overview
2. Information representation
   - 2.1 Number representation formats
   - 2.2 Representation of non-numerical information
   - 2.3 Data types
   - 2.4 Redundancy and error tolerance
3. Algorithms and data structures
   - 3.1 Algorithms and flow diagrams

- 3.2 Simple data structures
- 3.3 Searching and sorting
- 3.4 Quality of algorithms (correctness, termination, efficiency/complexity)

4. Propositional logic, Boolean algebra and circuit design
   - 4.1 Propositions and logical conclusions
   - 4.2 Conjunctive and disjunctive normal form
   - 4.3 Digital circuit design

5. Hardware and computer architectures
   - 5.1 Computer types and their architecture
   - 5.2 Processors and memory
   - 5.3 Input and output
   - 5.4 Interfaces and drivers
   - 5.5 High-performance computing

6. Networks and the internet
   - 6.1 Wired and wireless networks and their topologies
   - 6.2 The TCP/IP and the ISO/OSI model
   - 6.3 Internet structure and services
   - 6.4 The internet of things

7. Software
   - 7.1 BIOS and operating systems
   - 7.2 Application software and information systems
   - 7.3 Apps
   - 7.4 Embedded systems
   - 7.5 Software development

8. Computer Science as a discipline
   - 8.1 The role and sub-disciplines of computer science
   - 8.2 Artificial intelligence, data science and computer science
   - 8.3 Ethical aspects of computer science
   - 8.4 The ACM Code of Ethics and Professional Conduct

Literature
Compulsory Reading
Further Reading ▪ Dale, N., & Lewis, J. (2020). Computer science illuminated (7th ed.). Jones & Bartlett Learning. ▪ Downey, A. B., & Mayfield, C. (2020). Think Java: How to think like a computer scientist. O'Reilly. ▪ Filho, W. F. (2018). Computer science distilled: Learn the art of solving computational problems. Code Energy LLC. ▪ Petzold, C. (2000). Code: The hidden language of computer hardware and software. Microsoft Press. ▪ Whitington, J. (2016). A machine made this book: Ten sketches of computer science. Coherent Press.

Study Format Campus Studies

Study Format	Course Type
Campus Studies	Campus Lecture

Information about the examination	
Examination Admission Requirements	
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
84 h	36 h	0 h	30 h	0 h	150 h

Instructional Methods

Learning Material
- ☑ Course Book
- ☑ Video
- ☑ Slides

Exam Preparation
- ☑ Practice Exam
- ☑ Online Tests

Software Engineering Principles

Module Code: CSEIGIS-01_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Markus Kleffmann (Software Engineering Principles)

Information about the Module Coordinator without guarantee

Contributing Courses to Module

- Software Engineering Principles (CSEIGIS01-01_E)

Module Exam Type

Module Exam	Split Exam
Study Format: Campus Studies Exam, 90 Minutes	

Weight of Module

see curriculum

Module Contents

- Risks and challenges of Software Engineering
- Software Lifecycle
- Roles, Phases, Activites in Software Engineering
- Process Models

Learning Outcomes

Software Engineering Principles

On successful completion, students will be able to

- explain the challenges that have emerged in the scientific discourse of software engineering regarding the development of complex IT systems.
- distinguish the fundamental phases of the software lifecycle from one another at an appropriate level of abstraction.
- understand the core activities of software development, from requirements engineering to deployment.
- differentiate between the various roles involved in a software development process and understand their logical dependencies.
- understand the fundamental concepts and methods established in both academia and industry for organizing software development projects.
- be familiar with and categorize various agile and plan-driven software development process models, with their differing levels of abstraction—from broad process paradigms to process model frameworks and enterprise-specific development processes.

Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the fields of Computer Science & Software Development	All Bachelor Programs in the IT & Technology field

Software Engineering Principles

Course Code: CSEIGIS01-01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The goal of the course is to provide students with a scientifically grounded overview of the technical and theoretical foundations of software engineering. Starting from the typical current challenges in developing complex IT systems—challenges that are recognized in the scientific discourse of software engineering—students will learn about methods and concepts that can be used in practice to effectively address these risks. This includes not only the phases and activities of a software product lifecycle, but also the roles involved within these processes. The course concludes with an overview of agile and plan-driven software development approaches that are well-established in practice. The course content presents scientifically recognized solution strategies that are generally applicable through the use of modeling, and which abstract away from company-specific details.

Course Outcomes

On successful completion, students will be able to

- explain the challenges that have emerged in the scientific discourse of software engineering regarding the development of complex IT systems.
- distinguish the fundamental phases of the software lifecycle from one another at an appropriate level of abstraction.
- understand the core activities of software development, from requirements engineering to deployment.
- differentiate between the various roles involved in a software development process and understand their logical dependencies.
- understand the fundamental concepts and methods established in both academia and industry for organizing software development projects.
- be familiar with and categorize various agile and plan-driven software development process models, with their differing levels of abstraction—from broad process paradigms to process model frameworks and enterprise-specific development processes.

Contents

1. Risks and challenges of enterprise software engineering
    - 1.1 Properties of enterprise software systems
    - 1.2 Software Engineering
    - 1.3 Risks and typical problems

- 1.4 Root cause analysis
- 1.5 Challenges in Software Engineering

2. Software life cycle: from planning to replacement
   - 2.1 The software life cycle at a glance
   - 2.2 Planning
   - 2.3 Development
   - 2.4 Operation
   - 2.5 Maintenance
   - 2.6 Shutdown

3. Requirements engineering and specification
   - 3.1 requirements engineering
   - 3.2 Specification

4. Architecture and implementation
   - 4.1 Architecture
   - 4.2 Implementation

5. Testing, operation and evolution
   - 5.1 Testing
   - 5.2 Operation
   - 5.3 Evolution

6. Roles in Software Engineering
   - 6.1 Idea of the role-based approach
   - 6.2 Typical roles

7. Organization of software projects
   - 7.1 From process paradigm towards software process
   - 7.2 Process Paradigms

8. Software Process Model Frameworks
   - 8.1 V-Model XT
   - 8.2 Scrum and Kanban
   - 8.3 Scalable Agility
   - 8.4 Hybrid Processes

Literature
Compulsory Reading
Further Reading ▪ Pohl, K., & Rupp., C. (2015). Requirements engineering (2nd ed.). Rocky Nook. ▪ Sommerville, I. (2016). Software engineering (10th ed.). Pearson. ▪ Sommerville, I. (2019). Engineering software products: An introduction to modern software engineering. Pearson. ▪ Jacobson, I., Lawson, H., & Ng, P.-W. (2019). The essentials of modern software engineering. ACM Books.

Study Format Campus Studies

Study Format	Course Type
Campus Studies	Campus Lecture

Information about the examination	
Examination Admission Requirements	
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
84 h	36 h	0 h	30 h	0 h	150 h

Instructional Methods

Learning Material
- ☑ Course Book
- ☑ Video
- ☑ Slides

Exam Preparation
- ☑ Practice Exam
- ☑ Online Tests

Introduction to Programming with Python

Module Code: CSEBDSIPWP

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Dr. Cosmina Croitoru (Introduction to Programming with Python)
Information about the Module Coordinator without guarantee

Contributing Courses to Module
▪ Introduction to Programming with Python (CSEBDSIPWP01)

Module Exam Type	
Module Exam Study Format: Campus Studies Exam, 90 Minutes	**Split Exam**
Weight of Module see curriculum	

Module Contents

- Python as a programming language for data science
- Variables and built-in datatypes
- Statements and functions
- Error and exception handling
- Important Python data science modules

Learning Outcomes

Introduction to Programming with Python

On successful completion, students will be able to

- use fundamental Python syntax.
- recollect common elementary data types.
- recognize foundational programming concepts and their realization in Python.
- understand error handling and logging.
- create working programs.
- list the most important libraries and packages for data science.

Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Data Science & Artificial Intelligence	All Bachelor Programs in the IT & Technology field

Introduction to Programming with Python

Course Code: CSEBDSIPWP01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

This course provides students with a foundational understanding of the Python programming language. Following an introductory exposition to the importance of Python for data science-related programming tasks, students will be acquainted with fundamental programming concepts like variables, data types, and statements. Building on this basis, the important notion of a function is explained and errors, exception handling, and logging are explicated. The course concludes with an overview of the most widely-used library packages for data science.

Course Outcomes

On successful completion, students will be able to

- use fundamental Python syntax.
- recollect common elementary data types.
- recognize foundational programming concepts and their realization in Python.
- understand error handling and logging.
- create working programs.
- list the most important libraries and packages for data science.

Contents

1. Introduction
   - 1.1 Why Python?
   - 1.2 Obtaining and installing Python
   - 1.3 The Python interpreter , IPython, and Jupyter
2. Variables and Data Types
   - 2.1 Variables and value assignment
   - 2.2 Numbers
   - 2.3 Strings
   - 2.4 Collections
   - 2.5 Files
3. Statements
   - 3.1 Assignment, expressions, and print

3.2 Conditional statements
3.3 Loops
3.4 Iterators and comprehensions

4. Functions
   4.1 Function declaration
   4.2 Scope
   4.3 Arguments

5. Errors and Exceptions
   5.1 Errors
   5.2 Exception handling
   5.3 Logs

6. Modules and Packages
   6.1 Usage
   6.2 Namespaces
   6.3 Documentation
   6.4 Popular data science packages

Literature

Compulsory Reading

Further Reading

- Barry, P. (2016). Head first Python: A brain-friendly guide. O'Reilly Media, Inc.
- Kapil, S. (2019). Clean Python: Elegant coding in Python. Apress.
- Lubanovic, B. (2019). Introducing Python (2nd ed.). O'Reilly.
- Lutz, M. (2013). Learning Python (5th ed.). O'Reilly.
- Matthes, E. (2015). Python crash course: A hands-on, project-based introduction to programming. No Starch Press.
- Müller, A. C., & Guido, S. (2016). Introduction to machine learning with Python: A guide for data scientists. O'Reilly Media, Inc.
- Ramalho, L. (2015). Fluent Python: Clear, concise, and effective programming. O'Reilly.

Study Format Campus Studies

Study Format	Course Type
Campus Studies	Campus Lecture

Information about the examination	
Examination Admission Requirements	Mandatory attendance of at least 60% of the lectures
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
84 h	36 h	0 h	30 h	0 h	150 h

Mathematics: Analysis

Module Code: CSEBDSMFC

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Robert Graf (Mathematics: Analysis)

Information about the Module Coordinator without guarantee

Contributing Courses to Module

- Mathematics: Analysis (CSEBDSMFC01)

Module Exam Type

Module Exam	Split Exam
Study Format: Campus Studies Exam, 90 Minutes	

Weight of Module

see curriculum

Module Contents

- Sequences and Series
- Functions and Inverse Functions
- Differential Calculus
- Integral Calculus
- Differential Equations

Learning Outcomes

Mathematics: Analysis

On successful completion, students will be able to

- summarize the basic concepts of analysis.
- illustrate the terms "sequences" and "series".
- explain the concept of a function and determine the inverse function where possible.
- compute derivatives and integrals using the standard rules of differentiation and integration.
- explain the relationship between differentiation and integration.
- solve simple linear differential equations.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Methods	All Bachelor Programs in the Business field

Mathematics: Analysis

Course Code: CSEBDSMFC01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Analysis is one of the essential basic subjects of mathematics. Originally developed to be able to formulate and solve problems of classical mechanics mathematically, in its present rigorous form it has become indispensable in numerous applications in the natural sciences and technology. This module aims to introduce the basic tool of differential and integral calculus and to explain their mutual interrelations. In addition, the concept of differential equations is explained and corresponding solution methods are discussed for simple cases.

Course Outcomes

On successful completion, students will be able to

- summarize the basic concepts of analysis.
- illustrate the terms "sequences" and "series".
- explain the concept of a function and determine the inverse function where possible.
- compute derivatives and integrals using the standard rules of differentiation and integration.
- explain the relationship between differentiation and integration.
- solve simple linear differential equations.

Contents

1. Sequences and Series
   - 1.1 Sequences: Convergence and Monotony
   - 1.2 Definition and Convergence
   - 1.3 Specific Sequences and Series
2. Functions and Inverse Functions
   - 2.1 Functions and Their Properties
   - 2.2 Exponential and Logarithmic Functions
   - 2.3 Trigonometric Functions
3. Differential Calculus
   - 3.1 First Derivative and Power Rule
   - 3.2 Differentiation Rules and Higher Derivatives
   - 3.3 Taylor Series and Taylor Polynomial

3.4 Curve Sketching
3.5 Outlook: Partial Derivatives

4. Integral Calculus
   4.1 The Indefinite Integral and Integration Rules
   4.2 The Definite Integral and the Fundamental Theorem of Calculus
   4.3 Volume and Lateral Surface of Solids of Revolution and Arc Length

5. Differential Equations
   5.1 Introduction and Basic Terms
   5.2 Solution of First-Order Linear Homogeneous Differential Equations
   5.3 Solution of First-Order Linear Non-Homogeneous Differential Equations
   5.4 Outlook: Partial Differential Equations

Literature

Compulsory Reading

Further Reading

- HELM Project (n.d.). Helping Engineers Learn Mathematics: 50 Workbooks. Available Online.
- Magnus, R. (2020). Fundamental Mathematical Analysis. Springer International Publishing.
- Pal Srimanta, & Bhunia Subodh C. (2015). Engineering Mathematics. Oxford University Press.
- Sydsæter, K., Hammond, P., Strom, A., & Carvajal, A. (2016). Essential mathematics for economic analysis (Fifth edition). Pearson Education.

Study Format Campus Studies

Study Format	Course Type
Campus Studies	Campus Lecture

Information about the examination	
Examination Admission Requirements	Mandatory attendance of at least 60% of the lectures
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
84 h	36 h	0 h	30 h	0 h	150 h

Introduction to Academic Work for IT and Technology

Module Code: CSEBIAWITT

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Markus Christof Hemmer (Introduction to Academic Work for IT and Technology)
Information about the Module Coordinator without guarantee

Contributing Courses to Module
▪ Introduction to Academic Work for IT and Technology (CSEBIAWITT01)

Module Exam Type	
Module Exam Study Format: Campus Studies Advanced Workbook	**Split Exam**
Weight of Module see curriculum	

Module Contents

- Everyday Knowledge vs. Academic Work
- Academic Work
- Working with Sources and Literature
- Research Design
- Writing an Academic Paper
- Academic Work in IT and Technology in Practice

Learning Outcomes

Introduction to Academic Work for IT and Technology

On successful completion, students will be able to

- explain what science is and why science is needed (including in practice-based studies and professional practice).
- name and apply theories, methods, and models in IT and technology.
- find, analyze, and classify academic literature and types of sources.
- prepare academic papers independently.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Methods	All Bachelor Programs in the Business field

Introduction to Academic Work for IT and Technology

Course Code: CSEBIAWITT01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

As researchers and students, we do not want to take arguments for true simply because they sound interesting but to get to the bottom of them systematically. For this, we must think scientifically. But what exactly is science? The course teaches the basics of scientific thinking and working and uses concrete examples from IT and technology to show which standards academic papers must meet and how they are structured. Students learn important aspects of academic work, such as handling sources, basic formats for papers in IT and technology, and the methods and techniques necessary to write their academic papers.

Course Outcomes

On successful completion, students will be able to

- explain what science is and why science is needed (including in practice-based studies and professional practice).
- name and apply theories, methods, and models in IT and technology.
- find, analyze, and classify academic literature and types of sources.
- prepare academic papers independently.

Contents

1. Everyday Knowledge vs. Academic Work
    - 1.1 What is True?
    - 1.2 What are Trustworthy Sources?
    - 1.3 Critical Use of Primary and Secondary Sources
    - 1.4 Developing and Arguing Your Point of View
    - 1.5 Aspects of Academic Work
2. Academic Work
    - 2.1 Finding a Topic
    - 2.2 Formats of Academic Works
    - 2.3 Example: The Structure of an Academic Work
    - 2.4 Standards in IT and Technology
3. Working with Sources and Literature

3.1 Acquire Information: Search for, Find, and Evaluate Sources and Literature
3.2 Literature Management
3.3 Reading Academic Texts
3.4 Citation
3.5 Avoiding Plagiarism

4. Research Design
4.1 Important Formats
4.2 Methods: Quantitative or Qualitative?
4.3 Data Collection Methods
4.4 Data Evaluation Methods
4.5 Choosing a Research Design

5. Writing an Academic Paper
5.1 Project Plan and Schedule
5.2 Structure
5.3 Format and Style
5.4 Developing an Academic Argument

6. Academic Work in IT and Technology in Practice
6.1 Becoming a Billionaire Through Research: Brin & Page, 1998
6.2 A Systematic Literature Review: Jansen-Preilowski et al., 2020
6.3 Design Science Research: Kunzmann, 2022

Literature

Compulsory Reading

Further Reading

- Creswell, J. W. (2014). Research design: Qualitative, quantitative, and mixed methods approaches (4th ed., Int. Student Ed.). Sage Publications.
- Hemmer, M. C., & Fröhlich, T. (2023). The art of thesis writing: A comprehensive guide to authoring graduate theses with foundations of research. Hemmer Fröhlich Publishing.
- Paul, J., & Criado, A. R. (2020). The art of writing literature review: What do we know and what do we need to know? Elsevier Ltd.
- Pears, R., & Shields, G. J. (2022). Cite them right: The essential referencing guide (12th ed.). Bloomsbury Publishing.
- Silvia, P. J. (2019). How to write a lot: A practical guide to productive academic writing (2nd ed.). APA LifeTools.

Study Format Campus Studies

Study Format	Course Type
Campus Studies	Campus Lecture

Information about the examination	
Examination Admission Requirements	
Type of Exam	Advanced Workbook

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
94 h	36 h	0 h	20 h	0 h	150 h

Instructional Methods	
Learning Material	**Exam Preparation**
☑ Course Book	☑ Online Tests
☑ Video	
☑ Slides	

Project: Programming with Python

Module Code: CSEBFTPPP_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Gabriele Bleser-Taetz (Project: Programming with Python)
Information about the Module Coordinator without guarantee

Contributing Courses to Module
▪ Project: Programming with Python (CSEBFTPPP01_E)

Module Exam Type	
Module Exam Study Format: Campus Studies Oral Project Report	**Split Exam**
Weight of Module see curriculum	

Module Contents
This module deals with the application of basic Python Programming in the field of finance.

Learning Outcomes

Project: Programming with Python

On successful completion, students will be able to

- acquire financial data with the help of an API.
- perform basic data preparation and analysis with the Pandas and NumPy libraries.
- calculate and present basic key figures on the return and risk of a share.
- independently create suitable data visualizations.
- present analysis results and visualizations in a Jupyter notebook.

Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Computer Science & Software Development	All Bachelor Programs in the IT & Technology field

Project: Programming with Python

Course Code: CSEBFTPPP01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Python is by far the most widely used programming language in industry and research. In finance, the quantitative analysis of a stock is often the first step in many investment decisions. This course focuses on the application of basic Python programming in the context of quantitative stock analysis.

Course Outcomes

On successful completion, students will be able to

- acquire financial data with the help of an API.
- perform basic data preparation and analysis with the Pandas and NumPy libraries.
- calculate and present basic key figures on the return and risk of a share.
- independently create suitable data visualizations.
- present analysis results and visualizations in a Jupyter notebook.

Contents

- This course provides a quantitative analysis of a share listed on a stock exchange (e.g., Apple). The analysis is carried out in an interactive Jupyter notebook. With the help of an API (e.g., Nasdaq Data Link), price and return time series for the selected stock are loaded and analyzed using the pandas and NumPy libraries. Basic calculations for the return and risk of the share are displayed, and price time series and key figures are visualized using suitable methods.

Literature
Compulsory Reading
Further Reading ▪ Lewinson, E. (2020). Python for finance cookbook: Over 50 recipes for applying modern Python libraries to financial data analysis. Packt Publishing Limited. ▪ Martelli, A., Ravenscroft, A. M., Holden, S., & McGuire, P. (2023). Python in a nutshell: A desktop quick reference [electronic resource]. O'Reilly. ▪ VanderPlas, J. (2023). Python data science handbook: Essential tools for working with data [electronic resource]. O'Reilly. ▪ Walker, M. (2024). Python data cleaning cookbook: Prepare your data for analysis with pandas, NumPy, Matplotlib, scikit-learn, and OpenAI. Packt Publishing Limited.

Study Format Campus Studies

Study Format	Course Type
Campus Studies	Campus Lecture

Information about the examination	
Examination Admission Requirements	
Type of Exam	Oral Project Report

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
114 h	36 h	0 h	0 h	0 h	150 h

Instructional Methods	
Learning Material	**Exam Preparation**
☑ Slides	☑ Guideline

2. Semester

Collaborative Work

Module Code: CSEBCSCW-01

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Karin Halbritter (Collaborative Work)

Information about the Module Coordinator without guarantee

Contributing Courses to Module

- Collaborative Work (CSEBCSCW01-01)

Module Exam Type

Module Exam	Split Exam
Study Format: Campus Studies Exam, 90 Minutes	

Weight of Module

see curriculum

Module Contents

- Self-Directed and Collaborative Learning
- Networking and Cooperation
- Performance in (Virtual) Teams
- Communication, Arguments, and Being Convincing
- Potentials for Conflict and Managing Conflicts
- Self-Management and Personal Skills

Learning Outcomes

Collaborative Work

On successful completion, students will be able to

- design their own learning processes both self-directed and collaborative with analog and digital media.
- initiate face-to-face and virtual cooperation and select suitable methods for shaping collaboration even in an intercultural context and across disciplinary boundaries.
- assess different forms of communication in relation to the goals and requirements of different situations and to reflect on their own communication and argumentation behavior in order to be able to shape conducive collaboration also in an interdisciplinary context.
- recognize social diversity including cultural and professional differences as a value, and to name and apply tools to deal with them constructively.
- explain conflict potentials and the role of emotions in conflicts and to describe the use of systemic methods in the target- and solution-oriented handling of conflicts.
- analyze one's own resources, present methods of self-leadership and self-motivation, and derive appropriate strategies.

Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the fields of Business Administration & Management	All Bachelor Programmes in the Business field

Collaborative Work

Course Code: CSEBCSCW01-01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The course supports the students in building up and expanding important interdisciplinary competences for our networked world, and in doing so, students can take advantage of the opportunities for constructive cooperation with others. It presents essential forms and design possibilities of collaborative learning and working, imparts basic knowledge and tools for self-managed, flexible, and creative thinking, learning and acting and familiarizes students with the topics of empathy and emotional intelligence. Students are also encouraged to use the course contents. In this way, they promote their autonomous competence to act and their competence in the interactive application of tools and in interacting in heterogeneous groups.

Course Outcomes

On successful completion, students will be able to

- design their own learning processes both self-directed and collaborative with analog and digital media.
- initiate face-to-face and virtual cooperation and select suitable methods for shaping collaboration even in an intercultural context and across disciplinary boundaries.
- assess different forms of communication in relation to the goals and requirements of different situations and to reflect on their own communication and argumentation behavior in order to be able to shape conducive collaboration also in an interdisciplinary context.
- recognize social diversity including cultural and professional differences as a value, and to name and apply tools to deal with them constructively.
- explain conflict potentials and the role of emotions in conflicts and to describe the use of systemic methods in the target- and solution-oriented handling of conflicts.
- analyze one's own resources, present methods of self-leadership and self-motivation, and derive appropriate strategies.

Contents

1. Learning for a Networked World, in a Networked World
    - 1.1 Requirements and Opportunities in the “VUCA” World
    - 1.2 Learning, Knowing and Not-Knowing
    - 1.3 The 4C Model: Collective, Collaborative, Continuous, and Connected
    - 1.4 Monitoring Learning Behaviour

2. Networking & Cooperation
   - 2.1 Cooperation Partners
   - 2.2 Sustainable Relationships: Digital Interaction and Trust Building
   - 2.3 Organizing Collaboration
   - 2.4 Social Learning

3. Performance in (Online) Teams
   - 3.1 Goals, Roles, Organization and Performance Measurement
   - 3.2 Team Building and Team Flow
   - 3.3 Agile Project Management with Scrum
   - 3.4 Other Agile Methods

4. Communicating and Convincing
   - 4.1 Communication as Social Interaction
   - 4.2 Language, Images, Metaphors, and Stories
   - 4.3 Attitude: Open, Empathetic, and Appreciative Communication
   - 4.4 Active Listening
   - 4.5 Analyze Your Conversational and Argumentative Skills

5. Recognizing Conflict Potential — Managing Conflicts — Negotiating Effectively
   - 5.1 Respecting Diversity and Seizing Opportunities
   - 5.2 Empathy
   - 5.3 Systemic Solution Process Work
   - 5.4 Constructive Negotiation

6. Achieving Your Goals
   - 6.1 Effective Goal Setting
   - 6.2 The Agile Use of Time
   - 6.3 (Self-)Coaching Methods
   - 6.4 Self-Management and Motivation Strategies

7. Mobilizing Resources
   - 7.1 Recognizing Resources
   - 7.2 Reflection and Innovation
   - 7.3 Transfer Strength and Willpower

Literature
Compulsory Reading
Further Reading ▪ Baber, A., Waymon, L., Alphonso, A., & Wylde, J. (2015). Strategic connections: The new face of networking in a collaborative world. AMACOM. ▪ Kaats, E., & Opheij, W. (2014). Creating conditions for promising collaboration: Alliances, networks, chains, strategic partnerships. Springer. ▪ Martin, S. J., Goldstein, N. J., & Cialdini, R. B. (2014). The small BIG: Small changes that spark BIG influence. Profile Books. ▪ Oettingen, G. (2014). Rethinking positive thinking: Inside the new science of motivation. Current.

Study Format Campus Studies

Study Format	Course Type
Campus Studies	Campus Lecture

Information about the examination	
Examination Admission Requirements	
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
84 h	36 h	0 h	30 h	0 h	150 h

Instructional Methods	
Learning Material	**Exam Preparation**
☑ Course Book	☑ Practice Exam
☑ Video	☑ Online Tests
☑ Slides	

Statistics: Probability and Descriptive Statistics

Module Code: CSEBDSSPDS-01

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Veronica Mas (Statistics: Probability and Descriptive Statistics)
Information about the Module Coordinator without guarantee

Contributing Courses to Module
▪ Statistics: Probability and Descriptive Statistics (CSEBDSSPDS01-01)

Module Exam Type	
Module Exam Study Format: Campus Studies Exam, 90 Minutes	**Split Exam**
Weight of Module see curriculum	

Module Contents

- Probability
- Random variables
- Joint distributions
- Expectation and variance
- Inequalities and limit theorems

Learning Outcomes

Statistics: Probability and Descriptive Statistics

On successful completion, students will be able to

- define probability, random variable, and probability distribution.
- understand the concept of Bayesian statistics.
- grasp the definition of joint and marginal distributions.
- calculate expectation values and higher moments.
- comprehend important inequality equations and limit theorems.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Methods	All Bachelor Programs in the Business field

Statistics: Probability and Descriptive Statistics

Course Code: CSEBDSSPDS01-01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Statistical description and analysis are the foundations for data-driven analysis and prediction methods. This course introduces the fundamentals, beginning with a formal definition of probabilities and introduction to the concepts underlying Bayesian statistics.Random variables and probability density distributions are then discussed, as well as the concept of joint and marginal distributions. The importance of various discrete and continuous distributions and their applications is stressed.Characterizing distributions is an important aspect of describing the behavior of probability distributions. Students are familiarized with expectation values, variance, and covariance. The concepts of algebraic and central moments and moment-generating functions complement the characterization of probability distributions.Finally, this course focuses on important inequalities and limit theorems such as the law of large numbers or the central limit theorem.

Course Outcomes

On successful completion, students will be able to

- define probability, random variable, and probability distribution.
- understand the concept of Bayesian statistics.
- grasp the definition of joint and marginal distributions.
- calculate expectation values and higher moments.
- comprehend important inequality equations and limit theorems.

Contents

1. Probability
   - 1.1 Definitions
   - 1.2 Independent events
   - 1.3 Conditional probability
   - 1.4 Bayesian statistics
2. Random Variables
   - 2.1 Random Variables
   - 2.2 Distribution functions and probability mass functions
   - 2.3 Important discrete probability distributions
   - 2.4 Important continous probability distributions

3. Joint Distributions
   - 3.1 Joint distributions
   - 3.2 Marginal distributions
   - 3.3 Independent random variables
   - 3.4 Conditional distributions

4. Expectation and Variance
   - 4.1 Expectation of a random variable, conditional expectations
   - 4.2 Variance and covariance
   - 4.3 Expectations and variances of important probability distributions
   - 4.4 Algebraic and central moments
   - 4.5 Moment-generating functions

5. Inequalities and Limit Theorems
   - 5.1 Probability inequalities
   - 5.2 Inequalities for expectations
   - 5.3 The law of large numbers
   - 5.4 Central limit theorem

Literature

Compulsory Reading

Further Reading

- Downey, A.B. (2014). Think stats (2nd ed.). O'Reilly.
- Rohatgi, V. K., & Saleh, A. K. E. (2015). An introduction to probability and statistics. John Wiley & Sons, Incorporated.
- Triola , M.F. (2013). Elementary statistics. Pearson Education.
- Wagaman, A.S & Dobrow, R.P. (2021). Probability: With applications and R. Wiley.

Study Format Campus Studies

Study Format	Course Type
Campus Studies	Campus Lecture

Information about the examination	
Examination Admission Requirements	Mandatory attendance of at least 60% of the lectures
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
84 h	36 h	0 h	30 h	0 h	150 h

Web Application Development

Module Code: CSEBCSWAD

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Sebastian Werning (Web Application Development)
Information about the Module Coordinator without guarantee

Contributing Courses to Module
▪ Web Application Development (CSEBCSWAD01)

Module Exam Type	
Module Exam Study Format: Campus Studies Advanced Workbook	**Split Exam**
Weight of Module see curriculum	

Module Contents

- Architectural Foundations
- Tools of web development
- HTML
- CSS
- Javascript
- Web application testing and security

Learning Outcomes

Web Application Development

On successful completion, students will be able to

- identify important elements and describe the structure of current web application architectures.
- write simple static web pages using HTML.
- design simple web pages using CSS.
- store and handle structured information using XML.
- program simple dynamic web content using PHP.

Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Computer Science & Software Development.	All Bachelor Programmes in the IT & Technology field.

Web Application Development

Course Code: CSEBCSWAD01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

TThis course aims to empower students to program simple web applications using established technologies. At first, they will gain important insights into the typical structure of current web application architectures. Based on that knowledge, the students will learn the hypertext markup language (HTML) to develop simple web pages. Next, they will familiarize themselves with the most important and common elements of the cascading stylesheet (CSS) standard to layout the content written in HTML. To implement simple dynamic web pages, students learn how to use Javascript and exemplary supporting frameworks. This is combined with the use of relevant tools for the development and source code management of web pages. Finally, they will learn the very basics of the web page testing and security.

Course Outcomes

On successful completion, students will be able to

- identify important elements and describe the structure of current web application architectures.
- write simple static web pages using HTML.
- design simple web pages using CSS.
- store and handle structured information using XML.
- program simple dynamic web content using PHP.

Contents

1. Architectural Foundations
   - 1.1 Structure and History of the Internet
   - 1.2 Internet protocols and URIs
   - 1.3 Web application architecture
   - 1.4 Current trends
2. Tools of web development
   - 2.1 Development Tools
   - 2.2 Version management
   - 2.3 Package Manager
   - 2.4 Upload/Deployment

3. Static web pages developement
   - 3.1 Fundamentals of HTML5
   - 3.2 Fundamentals of CSS

4. Advanced design techniques
   - 4.1 Responsive web design
   - 4.2 Page layout
   - 4.3 Media queries
   - 4.4 CSS Frameworks (Bootstrap)

5. Web page development with JavaScript
   - 5.1 JavaScript history, ES5/ES6
   - 5.2 JavaScript fundamentals
   - 5.3 Use of JSON
   - 5.4 Common JavaScript Frameworks

6. Web application testing and security
   - 6.1 Testing of web applications
   - 6.2 Basic security concepts and principles

Literature

Compulsory Reading

Further Reading

- Ferguson, R. (2019). Beginning JavaScript: The ultimate guide to modern JavaScript development (3rd ed.). Apress.
- Sunyaev, A. (2020). Internet computing: Principles of distributed systems and emerging internet based technologies. Springer

Study Format Campus Studies

Study Format	Course Type
Campus Studies	Campus Lecture

Information about the examination	
Examination Admission Requirements	Mandatory attendance of at least 60% of the lectures
Type of Exam	Advanced Workbook

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
94 h	36 h	0 h	20 h	0 h	150 h

Mathematics: Linear Algebra

Module Code: CSEBDSMFLA

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Robert Graf (Mathematics: Linear Algebra)

Information about the Module Coordinator without guarantee

Contributing Courses to Module

- Mathematics: Linear Algebra (CSEBDSMFLA01)

Module Exam Type

Module Exam	Split Exam
Study Format: Campus Studies Exam, 90 Minutes	

Weight of Module

see curriculum

Module Contents

- Matrix Algebra
- Vector Spaces
- Linear and Affine Transformations
- Analytical Geometry
- Matrix Decomposition

Learning Outcomes

Mathematics: Linear Algebra

On successful completion, students will be able to

- explain fundamental notions in the domain of linear equation systems.
- exemplify properties of vectors and vector spaces.
- summarize characteristics of linear and affine mappings.
- identify important relations in analytical geometry.
- utilize different methods for matrix decomposition.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Methods	All Bachelor Programs in the Business field

Mathematics: Linear Algebra

Course Code: CSEBDSMFLA01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Linear algebra is a fundamental subject in mathematics. Its historical origin lies in the development of solution techniques for systems of linear equations arising from geometric problems. Numerous scientific and engineering applications can be solved using its methods. This course introduces the foundations of linear algebra and its basic notions like vectors and matrices. It then builds upon this foundation by introducing the derivation of solution techniques for problems in analytical geometry.

Course Outcomes

On successful completion, students will be able to

- explain fundamental notions in the domain of linear equation systems.
- exemplify properties of vectors and vector spaces.
- summarize characteristics of linear and affine mappings.
- identify important relations in analytical geometry.
- utilize different methods for matrix decomposition.

Contents

1. Foundations
    - 1.1 Systems of Linear Equations
    - 1.2 Matrices: Basic Terms
    - 1.3 Matrix algebra
    - 1.4 Matrices as compact representations of linear equations
    - 1.5 Inverse and trace
2. Vector Spaces
    - 2.1 Definition
    - 2.2 Linear Combination and Linear Dependance
    - 2.3 Basis, Linear Envelope, and Rank
3. Linear and Affine Mapping
    - 3.1 Matrix Representation of Linear Mappings
    - 3.2 Image and Kernel

3.3 Affine Spaces and Subspaces
3.4 Affine Mapping

4. Analytical Geometry
   4.1 Norm
   4.2 Scalar Product
   4.3 Orthogonal Projections
   4.4 Outlook: Complex Numbers

5. Matrix Decomposition
   5.1 Determinant
   5.2 Eigenvalues and Eigenvectors
   5.3 Cholesky Decomposition
   5.4 Eigenvalue Decomposition and Diagonalisation
   5.5 Singular Value Decomposition

Literature

Compulsory Reading

Further Reading

- Aggarwal, C.C. (2020). Linear Algebra and Optimization for Machine Learning: A Textbook. Springer.
- Mathai, A. M., & Haubold, H. J. (2017). Linear algebra, a course for physicists and engineers (1st ed.) De Gruyter.
- Neri, F. (2019). Linear algebra for computational sciences and engineering (2nd ed.) Springer.

Study Format Campus Studies

Study Format	Course Type
Campus Studies	Campus Lecture

Information about the examination	
Examination Admission Requirements	Mandatory attendance of at least 60% of the lectures
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
84 h	36 h	0 h	30 h	0 h	150 h

Algorithms, Data Structures, and Programming Languages

Module Code: CSEBCSL-01

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimaldauer: 1 Semester	WiSe/SoSe	English

Module Coordinator

Musharaf Ahmed Doger (Algorithms, Data Structures, and Programming Languages)

Information about the Module Coordinator without guarantee

Contributing Courses to Module

- Algorithms, Data Structures, and Programming Languages (CSEBCSL01-01)

Module Exam Type

Module Exam	Split Exam
Study Format: Campus Studies Exam or Advanced Workbook, 90 Minutes	

Weight of Module

see curriculum

Module Contents

- Data Structures
- Algorithm Design
- Important Algorithms
- Programming Paradigms and the Basic Terms of Programming Languages
- Programme Analysis Tools
- Overview of Common Programming Languages

Learning Outcomes

Algorithms, Data Structures, and Programming Languages

On successful completion, students will be able to

- explain basic data structures and compare and apply them in concrete applications.
- explain basic algorithms.
- design, select and apply suitable algorithms and data structures for specific applications
- analyse sketched or programmed algorithms when or before running them
- explain and compare the common programming paradigms and programming languages.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Computer Science & Software Development	All Bachelor Programmes in the IT & Technology field

Algorithms, Data Structures, and Programming Languages

Course Code: CSEBCSL01-01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Programming essentially consists of selecting suitable algorithms and data structures for a specific task and converting them into program code. There are many different programming languages, which are based on different procedures and in which algorithms and data structures are implemented differently. In this module, these concepts, which have so far been dealt with using concrete examples, are systematically presented and applied more broadly in order to give students the necessary tools to develop a systematic approach to programming.

Course Outcomes

On successful completion, students will be able to

- explain basic data structures and compare and apply them in concrete applications.
- explain basic algorithms.
- design, select and apply suitable algorithms and data structures for specific applications
- analyse sketched or programmed algorithms when or before running them
- explain and compare the common programming paradigms and programming languages.

Contents

1. Basic Concepts
   - 1.1 Algorithms, Data Structures, and Programming Languages as the Basics of Programming
   - 1.2 Detailing and Abstraction
   - 1.3 Control Structures
   - 1.4 Types of Data
   - 1.5 Basic Data Structures (List, Chain, Tree)
2. Data Structures
   - 2.1 Advanced Data Structures: Queue, Heap, Stack, Graph
   - 2.2 Abstract Data Types, Objects, and Classes
   - 2.3 Polymorphism
3. Algorithm Design

- 3.1 Induction, Iteration, and Recursion
- 3.2 Methods of Algorithm Design
- 3.3 Correctness and Verification of Algorithms
- 3.4 Efficiency (Complexity) of Algorithms

4. Basic Algorithms
   - 4.1 Traversing and Linearization of Trees
   - 4.2 Search Algorithms
   - 4.3 Sorting Algorithms
   - 4.4 Search in Strings
   - 4.5 Hash Algorithms
   - 4.6 Pattern Recognition

5. Representing Structured Data
   - 5.1 Structure of XML Documents
   - 5.2 Accessing XML Documents Programmatically
   - 5.3 Transformation of XML Documents Using XSL
   - 5.4 JSON as an Alternative to XML

6. Measuring Programmes
   - 6.1 Type Inference and IDE Interactive Support
   - 6.2 Cyclomatic and Referential Complexity
   - 6.3 Digesting Code Documentation
   - 6.4 Compiler Optimization
   - 6.5 Code Coverage
   - 6.6 Unit and Integration Testing
   - 6.7 Heap Analysis

7. Programming Languages
   - 7.1 Programming Paradigms
   - 7.2 Execution of Programs
   - 7.3 Types of Programming Languages
   - 7.4 Syntax, Semantics, and Pragmatics
   - 7.5 Variables and Type Systems

8. Overview of Important Programming Languages
   - 8.1 Assembler and Webassembly
   - 8.2 C and C++

8.3 Java and C#
8.4 Haskell and Lisp
8.5 JavaScript and Its Relatives
8.6 Other Imperative Programming Languages

Literature

Compulsory Reading

Further Reading

- Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C. (2022). Introduction to algorithms (4th ed.). MITPress.
- Sebesta, R. W. (2016). Concepts of programming languages (11th ed.). Pearson.

Study Format Campus Studies

Study Format	Course Type
Campus Studies	Campus Lecture

Information about the examination	
Examination Admission Requirements	Mandatory attendance of at least 60% of the lectures
Type of Exam	Exam or Advanced Workbook, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
89 h	36 h	0 h	25 h	0 h	150 h

Project: Object Oriented and Functional Programming with Python

Module Code: CSEBDSOOFPP

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Max Pumperla (Project: Object Oriented and Functional Programming in Python)
Information about the Module Coordinator without guarantee

Contributing Courses to Module
▪ Project: Object Oriented and Functional Programming in Python (CSEBDSOOFPP01)

Module Exam Type	
Module Exam Study Format: Campus Studies Portfolio	**Split Exam**
Weight of Module see curriculum	

Module Contents
The students are being introduced to the advanced programming concepts of object orientation and functional programming and how they are realized in the Python programming language.

Learning Outcomes

Project: Object Oriented and Functional Programming in Python

On successful completion, students will be able to

- explain basic notions in object-oriented programming such as functions and classes.
- understand object-oriented programming concepts and their relation to software design and engineering.
- describe advanced function concepts in Python.
- recognize important ideas from functional programming.
- recall important libraries for functional programming in Python.

Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Data Science & Artificial Intelligence	All Bachelor Programs in the IT & Technology field

Project: Object Oriented and Functional Programming in Python

Course Code: CSEBDSOOFPP01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Students will build upon their foundational knowledge of Python programming, by exploring advanced Python programming concepts. To this end, important notions of object-oriented programming like classes and objects and pertaining design principles are outlined. Starting from an in-depth discussion of advanced features of Python functions, functional programming concepts and their implementation in Python are conveyed.

Course Outcomes

On successful completion, students will be able to

- explain basic notions in object-oriented programming such as functions and classes.
- understand object-oriented programming concepts and their relation to software design and engineering.
- describe advanced function concepts in Python.
- recognize important ideas from functional programming.
- recall important libraries for functional programming in Python.

Contents

- Students are being provided with a thorough introduction to important notions and concepts from the domain of object-oriented programming such as classes, objects, abstraction, encapsulation, inheritance, polymorphism, composition, and delegation. Additionally, the functional programming paradigm and pertaining ideas like functions as first class objects, decorators, pure functions, immutability and higher order functions are conveyed. Pursuant to the portfolio course type, the aforementioned concepts and ideas are explored by hands-on programming projects.

Literature
Compulsory Reading
Further Reading ▪ Lott, S. F. (2018). Functional Python programming: Discover the power of functional programming, generator functions, lazy evaluation, the built-in itertools library, and monads (2nd ed.). Packt Publishing. ▪ Lutz, M. (2013). Learning Python (5th ed.). O'Reilly. ▪ Phillips, D. (2018). Python 3 object-oriented programming: Build robust and maintainable software with object-oriented design patterns in Python 3.8 (3rd ed.). Packt Publishing. ▪ Ramalho, L. (2015). Fluent Python: Clear, concise, and effective programming. O'Reilly.

Study Format Campus Studies

Study Format	Course Type
Campus Studies	Campus Lecture

Information about the examination	
Examination Admission Requirements	
Type of Exam	Portfolio

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
114 h	36 h	0 h	0 h	0 h	150 h

Instructional Methods	
Learning Material	**Exam Preparation**
☑ Slides	☑ Guideline

3. Semester

Computer Architecture and Operating Systems

Module Code: CSEBCSCAOS

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLBCSICS01 or CSEBCSICS01	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Paul Libbrecht (Computer Architecture and Operating Systems)
Information about the Module Coordinator without guarantee

Contributing Courses to Module
▪ Computer Architecture and Operating Systems (CSEBCSCAOS01)

Module Exam Type	
Module Exam Study Format: Campus Studies Exam, 90 Minutes	**Split Exam**
Weight of Module see curriculum	

Module Contents

- Basic Concepts for Computer Architecture
- Computer Architecture
- Computer Hardware
- Assembly Languages
- Operating Systems Basics
- Popular Operating Systems

Learning Outcomes

Computer Architecture and Operating Systems

On successful completion, students will be able to

- to explain the basic concepts of computer architecture.
- compare the different types of computer hardware.
- describe the meaning and functionality of simple assembly programs.
- explain the basic functions of operating systems.
- compare the different types of operating systems.

Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Computer Science & Software Development.	All Bachelor Programs in the IT & Technology field.

Computer Architecture and Operating Systems

Course Code: CSEBCSCAOS01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	DLBCSICS01 or CSEBCSICS01

Course Description

This course introduces a fundamental topic of computer science.The architecture of computers and the inner workings of operating systems are fundamental concepts of computer science. This course introduces this topic, including an overview of the various types of computer hardware and an overview of assembly languages, which form a link between computer architecture and operating systems.

Course Outcomes

On successful completion, students will be able to

- to explain the basic concepts of computer architecture.
- compare the different types of computer hardware.
- describe the meaning and functionality of simple assembly programs.
- explain the basic functions of operating systems.
- compare the different types of operating systems.

Contents

1. Basic Concepts for Computer Architecture
   - 1.1 Historical Overview
   - 1.2 Digital Logic and Binary Arithmetic
   - 1.3 Semiconductor Technology
   - 1.4 Hardware Design and Hardware Description Languages
2. Computer Architecture
   - 2.1 Computer Architecture Design Goals
   - 2.2 Instruction Set Architecture
   - 2.3 Microarchitecture
   - 2.4 System Design
3. Computer Hardware
   - 3.1 Personal Computers
   - 3.2 Mainframes
   - 3.3 Servers

3.4 Supercomputers
3.5 Mobile Systems
3.6 Embedded Systems

4. Assembly Languages
   4.1 Role and Importance of Assembly Languages
   4.2 Introduction to Programming in Assembly Languages
   4.3 Compiling and Linking
   4.4 Application of Assembly Languages

5. Operating Systems Basics
   5.1 Role and Types of Operating Systems
   5.2 Operating System Kernel
   5.3 File Systems
   5.4 Memory Management
   5.5 Processes and Threads
   5.6 Security

6. Popular Operating Systems
   6.1 Basic Concepts of Windows
   6.2 Basic Concepts of Unix and Linux
   6.3 Basic Concepts of Apple Operating Systems
   6.4 Basic Concepts of Mobile Operating Systems

Literature

Compulsory Reading

Further Reading

- Harris, D.M./Harris, S.L. (2013): Digital Design and Computer Architecture. 2nd edition, Morgan Kaufman, Waltham, MA.
- Patt, Y.N./Patel, S.J. (2019): Introduction to Computing Systems: From Bits & Gates to C/C++ & Beyond. 3rd edition, McGraw-Hill Education, New York.
- Tanenbaum, A.S./Bos, H. (2014): Modern Operating Systems. 4th edition, Pearson Education, Harlow.
- Tutorials Point (2020): Assembly Programming Tutorial. (URL: [last access 2020-02-04]).

Study Format Campus Studies

Study Format	Course Type
Campus Studies	Campus Lecture

Information about the examination	
Examination Admission Requirements	Mandatory attendance of at least 60% of the lectures
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
84 h	36 h	0 h	30 h	0 h	150 h

Intercultural and Ethical Decision-Making

Module Code: CSEBCSIDM

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Zeljko Sevic (Intercultural and Ethical Decision-Making)
Information about the Module Coordinator without guarantee

Contributing Courses to Module
▪ Intercultural and Ethical Decision-Making (CSEBCSIDM01)

Module Exam Type	
Module Exam Study Format: Campus Studies Written Assessment: Case Study	**Split Exam**
Weight of Module see curriculum	

Module Contents

- Basics of Intercultural Competence
- Cultural Concepts
- Culture and Ethics
- Implications of Current Ethical Problems in the Area of Interculturality, Ethics, and Diversity
- Intercultural Learning and Working
- Case Studies for Cultural and Ethical Conflicts

Learning Outcomes

Intercultural and Ethical Decision-Making

On successful completion, students will be able to

- explain the most important terms in the areas of interculturality, diversity, and ethics.
- distinguish different explanatory patterns of culture.
- understand culture at different levels.
- plan processes of intercultural learning and working.
- understand the interdependencies of culture and ethics.
- independently work on a case study on intercultural competence.

Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Business Administration & Management	All Bachelor Programs in the Business field

Intercultural and Ethical Decision-Making

Course Code: CSEBCSIDM01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

In this course, students acquire the necessary knowledge to understand intercultural competencies and current developments in the fields of diversity and ethics. Students will understand how to systematically plan and implement learning processes for the development of competences important in these areas. First, important terms are clarified and differentiated from each other, and cultural aspects are explained from different perspectives. In addition, students learn that cultural issues are relevant at different levels, for example, within a state, company, or other group. In this context, students also recognize the connection between ethics and culture with different interdependencies. On the basis of this knowledge, students are then familiarized with the different possibilities and potentials of intercultural and ethical learning and working. Practical cases are used to illustrate the importance of the relationships learned for today's work context in many companies. The students then work on a case study in which the acquired knowledge is systematically applied.

Course Outcomes

On successful completion, students will be able to

- explain the most important terms in the areas of interculturality, diversity, and ethics.
- distinguish different explanatory patterns of culture.
- understand culture at different levels.
- plan processes of intercultural learning and working.
- understand the interdependencies of culture and ethics.
- independently work on a case study on intercultural competence.

Contents

1. Basics of Intercultural and Ethical Competence to Act
    - 1.1 Subject Areas, Terms, and Definitions
    - 1.2 Relevance of Intercultural and Ethical Action
    - 1.3 Intercultural Action - Diversity, Globalization, Ethics
2. Cultural Concepts
    - 2.1 Hofstedes Cultural Dimensions
    - 2.2 Culture Differentiation According to Hall
    - 2.3 Locus of Control Concept to Rotter

3. Culture and Ethics
   - 3.1 Ethics - Basic Terms and Concepts
   - 3.2 Interdependence of Culture and Ethics
   - 3.3 Ethical Concepts in Different Regions of the World

4. Current Topics in the Area of Interculturality, Ethics, and Diversity
   - 4.1 Digital Ethics
   - 4.2 Equality and Equal Opportunities
   - 4.3 Social Diversity

5. Intercultural Learning and Working
   - 5.1 Acculturation
   - 5.2 Learning and Working in Intercultural Groups
   - 5.3 Strategies for Dealing with Cultural Conflicts

6. Case Studies for Cultural and Ethical Conflicts
   - 6.1 Case Study: Interculturality
   - 6.2 Case Study: Diversity
   - 6.3 Case Study: Interculturality and Ethics

Literature

Compulsory Reading

Further Reading

- Al-Ali, E., & Masmoudi, M. (2023). Leadership and Workplace Culture in the Digital Era. Business Science Reference.
- Barmeyer, C., Bausch, M., & Mayrhofer, U. (2021). Constructive Intercultural Management.
- Berrones-Flemmig, N., Contreras, F., & Dornberger, U. (2022). Business in the 21st century: A sustainable approach (1st ed.). Emerald Publishing Limited.
- Rossouw, J., & Van Vuuren, L. (2017). Business ethics (6th ed.). Oxford University Press Southern Africa.

Study Format Campus Studies

Study Format	Course Type
Campus Studies	Campus Lecture

Information about the examination	
Examination Admission Requirements	Mandatory attendance of at least 60% of the lectures
Type of Exam	Written Assessment: Case Study

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
94 h	36 h	0 h	20 h	0 h	150 h

Database Modeling and Database Systems

Module Code: CSEBCSDMDS

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Carsten Skerra (Database Modeling and Database Systems)
Information about the Module Coordinator without guarantee

Contributing Courses to Module
▪ Database Modeling and Database Systems (CSEBCSDMDS01)

Module Exam Type	
Module Exam Study Format: Campus Studies Exam, 90 Minutes	**Split Exam**
Weight of Module see curriculum	

Module Contents

- Fundamentals of Relational Databases
- Simple Database Queries
- Entity/Relationship (E/R) Diagrams
- Database Development
- Complex Database Queries Across Multiple Tables
- Changing Data in Databases
- NoSQL Database Systems

Learning Outcomes

Database Modeling and Database Systems

On successful completion, students will be able to

- describe the basic concepts of the relational data model and distinguish them from each other.
- visually model data schemas.
- know SQL queries, read data from databases, change the data stock, and have experience in their use.
- design, create, and modify SQL queries and data schemas for SQL databases, and have experience using them.
- independently design database schemas and create database queries to solve concrete problems.
- know the most important NoSQL concepts and distinguish them from each other.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Data Science & Artificial Intelligence	All Bachelor Programs in the IT & Technology field

Database Modeling and Database Systems

Course Code: CSEBCSDMDS01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Stored data form the basis of many value chains of an information and knowledge society. The methodical structuring of data through data schemas therefore forms an important basis for storing information in such a way that it can be retrieved and processed quickly and easily. In addition to the structured storage of data, structured access to large amounts of data must also be possible.This course teaches students how to store data in relational data models and how to access stored data with SQL. In addition to relational database systems, modern DB systems (NoSQL) for storing and accessing data will be presented.

Course Outcomes

On successful completion, students will be able to

- describe the basic concepts of the relational data model and distinguish them from each other.
- visually model data schemas.
- know SQL queries, read data from databases, change the data stock, and have experience in their use.
- design, create, and modify SQL queries and data schemas for SQL databases, and have experience using them.
- independently design database schemas and create database queries to solve concrete problems.
- know the most important NoSQL concepts and distinguish them from each other.

Contents

1. Fundamentals of Relational Databases
    - 1.1 Basic Concepts of the Relational Data Model
    - 1.2 Find and Delete Records in the Database
    - 1.3 SQL and Relational Database Systems
2. Querying Data from a Single Table
    - 2.1 Query Data (SELECT)
    - 2.2 Query Data With Condition (WHERE)
    - 2.3 Sort Query Output (ORDER BY)
    - 2.4 Queries With Group Formation (GROUP BY)

2.5 Subqueries With Nested SELECT Statements

3. Conception and Modeling of Relational Databases
   - 3.1 The Entity Relationship Model
   - 3.2 Relationships and Cardinalities in E/R Models
   - 3.3 Normal Forms of Databases

4. Creation of Relational Databases
   - 4.1 Logical Database Design Activities
   - 4.2 Mapping of the Conceptual Data Model into the Physical Data Model
   - 4.3 Generation of Tables in SQL Databases from E/R Diagrams

5. Complex Database Queries on Multiple Tables
   - 5.1 Composite Quantities (JOIN)
   - 5.2 Set Operations
   - 5.3 Data Views With CREATE VIEW

6. Manipulating Records in Databases
   - 6.1 Insert New Data Records (INSERT)
   - 6.2 Change Existing Records
   - 6.3 Transactions

7. NoSQL Database Systems
   - 7.1 Motivation and Basic Idea
   - 7.2 Selected Groups of NoSQL Systems

Literature

Compulsory Reading

Further Reading

- Date, C.J. (2019). Database design and relational theory: Normal forms and all that jazz (2nd ed.). Apress.
- Elmasri, R., & Navathe, S. (2017). Fundamentals of database systems (7th ed., global ed.). Pearson.
- Esakkirajan, S., & Sumathi, S. (2007). Fundamentals of relational database management systems [electronic resource] : Springer.
- Foster, E. C., & Godbole, S. V. (2016). Database systems: a pragmatic approach (2nd ed.). Apress.
- W3Schools (2020). SQL Tutorial.

Study Format Campus Studies

Study Format	Course Type
Campus Studies	Campus Lecture

Information about the examination	
Examination Admission Requirements	Mandatory attendance of at least 60% of the lectures
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
84 h	36 h	0 h	30 h	0 h	150 h

Project: Build a Data Mart in SQL

Module Code: CSEBDSPBDM

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Silke Vaas (Project: Build a Data Mart in SQL)
Information about the Module Coordinator without guarantee

Contributing Courses to Module
▪ Project: Build a Data Mart in SQL (CSEBDSPBDM01)

Module Exam Type	
Module Exam Study Format: Campus Studies Portfolio	**Split Exam**
Weight of Module see curriculum	

Module Contents

- This course is about the implementation of a practical database use case employing previously-acquired knowledge on pertaining approaches and methods.

Learning Outcomes

Project: Build a Data Mart in SQL

On successful completion, students will be able to

- transfer previously-acquired knowledge about database methods and approaches to practical use cases.
- design, architect, and implement a working data-mart solution.
- reason about design choices of and trade-offs between relevant implementation alternatives.
- critically evaluate said choices with respect to the stated design goal.
- describe and explain the resulting solution.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Data Science & Artificial Intelligence	All Bachelor Programs in the IT & Technology field

Project: Build a Data Mart in SQL

Course Code: CSEBDSPBDM01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

This course provides the opportunity to implement a realistic database use case scenario. A list of use case ideas is provided on the online learning platform. In addition, the students can contribute use case ideas of their own in accord with the tutor. The core aim is to apply the hitherto theoretical knowledge of database methods and approaches to solve a real-world application scenario. This entails reasoning about possible design and architectural choices in a rational way, as well as implementing them in a functioning database system.

Course Outcomes

On successful completion, students will be able to

- transfer previously-acquired knowledge about database methods and approaches to practical use cases.
- design, architect, and implement a working data-mart solution.
- reason about design choices of and trade-offs between relevant implementation alternatives.
- critically evaluate said choices with respect to the stated design goal.
- describe and explain the resulting solution.

Contents

- In this course, students apply their knowledge of data modeling and databases to implement a project use case of their choosing. All relevant artefacts, like use case evaluation, chosen implementation method, code, and outcomes, are documented in the form of a written project report.

Literature
Compulsory Reading
Further Reading ▪ Date, C. J. (2012). Database design and relational theory. O'Reilly. ▪ DeBarros, A. (2018). Practical SQL: A beginner's guide to storytelling with data. No Starch Press. ▪ Harrington, J. L. (2016). Relational database design and implementation (4th ed.). Morgan Kaufmann. ▪ Hernandez, M. J. (2013). Database design for mere mortals: A hands-on guide to relational database design (3rd ed.). Addison-Wesley. ▪ Viescas, J. (2018). SQL queries for mere mortals: A hands-on guide to data manipulation in SQL (4th ed.). Addison-Wesley.

Study Format Campus Studies

Study Format	Course Type
Campus Studies	Campus Lecture

Information about the examination	
Examination Admission Requirements	
Type of Exam	Portfolio

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
114 h	36 h	0 h	0 h	0 h	150 h

Instructional Methods	
Learning Material	**Exam Preparation**
☑ Slides	☑ Guideline

Artificial Intelligence

Module Code: DLBDSEAIS1-01

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Kristina Schaaff (Artificial Intelligence)

Information about the Module Coordinator without guarantee

Contributing Courses to Module

- Artificial Intelligence (DLBDSEAIS01-01)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Exam, 90 Minutes	

Weight of Module

see curriculum

Module Contents

- History of AI
- Modern AI Systems
- Reinforcement Learning
- Natural Language Processing (NLP)
- Computer Vision

Learning Outcomes

Artificial Intelligence

On successful completion, students will be able to

- chart the historical developments in artificial intelligence.
- understand the approach of contemporary AI systems.
- comprehend the concepts behind reinforcement learning.
- analyze natural language using basic NLP techniques.
- scrutinize images and their contents.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Data Science & Artificial Intelligence	All Bachelor Programs in the IT & Technology field

Artificial Intelligence

Course Code: DLBDSEAIS01-01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The quest for artificial intelligence (AI) has captured humanity's interest for many decades and has been an active research area since the 1960s. This course will give a detailed overview of the historical developments, successes, and set-backs in AI, as well as modern approaches in the development of artificial intelligence such as generative AI. The course gives an introduction to reinforcement learning, a process similar to how humans and animals experience the world: exploring the environment and inferring the best course of action. The course also covers the principles of natural language processing and computer vision, both of which are key ingredients for an artificial intelligence to be able to interact with its environment.

Course Outcomes

On successful completion, students will be able to

- chart the historical developments in artificial intelligence.
- understand the approach of contemporary AI systems.
- comprehend the concepts behind reinforcement learning.
- analyze natural language using basic NLP techniques.
- scrutinize images and their contents.

Contents

1. History of AI
   - 1.1 Historical Developments
   - 1.2 AI Winter
   - 1.3 Expert Systems
   - 1.4 Notable Advances
2. Modern AI Systems
   - 2.1 Narrow versus General AI
   - 2.2 Application Areas
3. Reinforcement Learning
   - 3.1 What is Reinforcement Learning?
   - 3.2 Markov Chains and Value Function

3.3 Temporal-Difference and Q Learning

4. Natural Language Processing (NLP)
   - 4.1 Introduction to NLP and Application Areas
   - 4.2 Basic NLP Techniques
   - 4.3 Vectorizing Data
   - 4.4 Advanced NLP Models

5. Computer Vision
   - 5.1 Introduction to Computer Vision
   - 5.2 Image Representation and Geometry
   - 5.3 Feature Engineering
   - 5.4 Semantic Segmentation
   - 5.5 Advanced Image Generation Techniques

Literature

Compulsory Reading

Further Reading

- Bear, M. F., Barry, W. S., & Paradiso, M. A. (2020). Neuroscience: Exploring the brain (4th ed.). Lippincott Williams & Wilkins.
- Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep learning. MIT Press.
- Grus, J. (2019). Data science from scratch: First principles with Python. O'Reilly.
- Jurafsky, D., & Martin, J. H. (2022). Speech and language processing (3rd ed.). Prentice Hall.
- Morris, M. R., Sohl-Dickstein, J., Fiedel, N., Warkentin, T., Dafoe, A., Faust, A., Farabet, C., & Legg, S. (2024). Proceedings of the 41st International Conference on Machine Learning. PMLR, 235, 36308–36321.
- Russell, S. J., & Norvig, P. (2022). Artificial intelligence: A modern approach (4th ed., global ed.). Pearson.
- Sutton, R. S., & Barto, A. G. (2018). Reinforcement learning: An introduction (2nd ed.). Adaptive Computation and Machine Learning. MIT Press.
- Szeliski, R. (2022). Computer vision: Algorithms and applications (2nd ed.). Texts in Computer Science. Springer.
- Vaswani, A., Shazeer, N., Parmar, N., Uszkoreit, J., Jones, L., Gomez, A. N., Kaiser, Ł., & Polosukhin, I. (2017). Attention is all you need. Advances in Neural Information Processing Systems, 30. Curran Associates, Inc.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
☑ Recorded Live Sessions	☑ Slides	

Statistics - Inferential Statistics

Module Code: DLBDSSIS-01

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	CSEBDSSPDS01-01	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Hashem Zarafat (Statistics - Inferential Statistics)

Information about the Module Coordinator without guarantee

Contributing Courses to Module

- Statistics - Inferential Statistics (DLBDSSIS01-01)

Module Exam Type

Module Exam	Split Exam
Study Format: myStudies Exam, 90 Minutes Study Format: Distance Learning Exam, 90 Minutes	

Weight of Module

see curriculum

Module Contents

- Point Estimation
- Uncertainties
- Bayesian Inference & Non-Parametric Techniques
- Statistical Testing
- Statistical Decision Theory

Learning Outcomes

Statistics - Inferential Statistics

On successful completion, students will be able to

- understand point estimation methods.
- apply maximum likelihood and ordinary least squares method to estimate parameters.
- comprehend the concept of statistical and systematic errors.
- employ error propagation methods.
- utilize Bayesian inference and non-parametric techniques.
- evaluate statistical tests.
- grasp the fundamentals of statistical decision theory.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Methods	All Bachelor Programs in the Business field

Statistics - Inferential Statistics

Course Code: DLBDSSIS01-01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	CSEBDSSPDS01-01

Course Description

Statistical analysis and understanding are the foundations of data-driven methods and machine learning approaches.This course gives a thorough introduction to point estimators and discusses various techniques to estimate and optimize parameters. Special focus is given to a detailed discussion of both statistical and systematic uncertainties as well as propagation of uncertainties.Bayesian statistics is fundamental to data-driven approaches, and this course takes a close look at Bayesian techniques such as Bayesian parameter estimation and prior probability functions.Furthermore, this course gives an in-depth overview of statistical testing and decision theory, focusing on aspects such as A/B testing, hypothesis testing, p-values, and multiple testing which are fundamental to statistical analysis approaches in a broad range of practical applications.

Course Outcomes

On successful completion, students will be able to

- understand point estimation methods.
- apply maximum likelihood and ordinary least squares method to estimate parameters.
- comprehend the concept of statistical and systematic errors.
- employ error propagation methods.
- utilize Bayesian inference and non-parametric techniques.
- evaluate statistical tests.
- grasp the fundamentals of statistical decision theory.

Contents

1. Point Estimation
    - 1.1 Method of moments
    - 1.2 Sufficient statistics
    - 1.3 Maximum likelihood
    - 1.4 Ordinary least squares
    - 1.5 Resampling techniques
2. Uncertainties
    - 2.1 Statistical and systematic uncertainties
    - 2.2 Propagation of uncertainties

3. Bayesian Inference & Non-parametric Techniques
   - 3.1 Bayesian parameter estimation
   - 3.2 Prior probability functions
   - 3.3 Parzen windows
   - 3.4 K-nearest-neighbours

4. Statistical Testing
   - 4.1 A/B testing
   - 4.2 Hypothesis tests & test statistics
   - 4.3 P-values & confidence intervals
   - 4.4 Multiple testing

5. Statistical Decision Theory
   - 5.1 The risk function
   - 5.2 Maximum likelihood, Minimax, and Bayes
   - 5.3 Admissibility and Stein's paradox

Literature

Compulsory Reading

Further Reading

- Hogg, R. V., McKean, J., & Craig, A. T. (2020). Introduction to mathematical statistics, global edition. Pearson.
- Gutman, Alex J., Goldmeier, Jordan. (2021). Becoming a Data Head – How to Think, Speak, and Understand Data Science, Statistics, and Machine Learning. John Wiley & Sons.
- Borek Puza. (2015). Bayesian Methods for Statistical Analysis. ANU eView.

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Review Book
☑ Recorded Live Sessions	☑ Slides	☑ Online Tests

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Review Book
☑ Recorded Live Sessions	☑ Slides	☑ Online Tests

Introduction to Data Science

Module Code: DLBDSIDS-01

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Ha Ngo (Introduction to Data Science)

Information about the Module Coordinator without guarantee

Contributing Courses to Module

- Introduction to Data Science (DLBDSIDS01-01)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Advanced Workbook Study Format: myStudies Advanced Workbook	

Weight of Module

see curriculum

Module Contents

- Introduction to Data Science
- Data
- Data Science in Business
- Statistics
- Machine Learning

Learning Outcomes

Introduction to Data Science

On successful completion, students will be able to

- define data science and its relation to other fields.
- comprehend data science activities.
- recognize the origins of data and the challenges of working with data.
- understand how data science methods are integrated into business settings.
- grasp fundamental statistical concepts.
- appreciate the importance of machine learning in data science.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Data Science & Artificial Intelligence	All Bachelor Programs in the IT & Technology field

Introduction to Data Science

Course Code: DLBDSIDS01-01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Data science emerged as a multi-disciplinary field aimed at creating value from data. This course starts with an overview of data science and related fields and then defines data types and sources. Special focus is put on the assessment of data quality and electronic data processing.Use of data-driven methods has become vital for businesses, and this course outlines how data-driven approaches can be integrated within a business context and how operational decisions can be made using data-driven methods.Finally, this course highlights the importance of statistics and machine learning in the field of data science and gives an overview of relevant methods and approaches.

Course Outcomes

On successful completion, students will be able to

- define data science and its relation to other fields.
- comprehend data science activities.
- recognize the origins of data and the challenges of working with data.
- understand how data science methods are integrated into business settings.
- grasp fundamental statistical concepts.
- appreciate the importance of machine learning in data science.

Contents

1. Introduction to Data Science
   - 1.1 Definition of the term „data science“
   - 1.2 Data science and related fields
   - 1.3 Data science activities
2. Data
   - 2.1 Data types and data sources
   - 2.2 The 5Vs of data
   - 2.3 Data curation and data quality
   - 2.4 Data engineering
3. Data Science in Business
   - 3.1 Identification of use cases

3.2 Performance evaluation
3.3 Data-driven operational decisions
3.4 Cognitive biases

4. Statistics
   4.1 Importance of statistics for data science
   4.2 Important statistical concepts

5. Machine Learning
   5.1 Role of machine learning in data science
   5.2 Overview of machine learning approaches

Literature

Compulsory Reading

Further Reading

- Akerkar, R., & Sajja, P. S. (2016). Intelligent techniques for data science. Springer International Publishing.
- Hodeghatta, U. R., & Nayak, U. (2017). Business analytics using R—A practical approach. Apress Publishing.
- Runkler, T. A. (2012). Data analytics: Models and algorithms for intelligent data analysis. Springer.
- Skiena, S. S. (2017). The data science design manual. Springer International Publishing.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Advanced Workbook

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Online Tests
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Guideline
☑ Recorded Live Sessions	☑ Slides	

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Advanced Workbook

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods

Tutorial Support
- ☑ Course Feed
- ☑ Intensive Live Sessions/Learning Sprint
- ☑ Recorded Live Sessions

Learning Material
- ☑ Course Book
- ☑ Video
- ☑ Slides

Exam Preparation
- ☑ Online Tests
- ☑ Guideline

Statistics - Inferential Statistics

Module Code: DLBDSSIS-01

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	CSEBDSSPDS01-01	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Hashem Zarafat (Statistics - Inferential Statistics)

Information about the Module Coordinator without guarantee

Contributing Courses to Module

- Statistics - Inferential Statistics (DLBDSSIS01-01)

Module Exam Type

Module Exam	Split Exam
Study Format: myStudies Exam, 90 Minutes Study Format: Distance Learning Exam, 90 Minutes	

Weight of Module

see curriculum

Module Contents

- Point Estimation
- Uncertainties
- Bayesian Inference & Non-Parametric Techniques
- Statistical Testing
- Statistical Decision Theory

Learning Outcomes

Statistics - Inferential Statistics

On successful completion, students will be able to

- understand point estimation methods.
- apply maximum likelihood and ordinary least squares method to estimate parameters.
- comprehend the concept of statistical and systematic errors.
- employ error propagation methods.
- utilize Bayesian inference and non-parametric techniques.
- evaluate statistical tests.
- grasp the fundamentals of statistical decision theory.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Methods	All Bachelor Programs in the Business field

Statistics - Inferential Statistics

Course Code: DLBDSSIS01-01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	CSEBDSSPDS01-01

Course Description

Statistical analysis and understanding are the foundations of data-driven methods and machine learning approaches.This course gives a thorough introduction to point estimators and discusses various techniques to estimate and optimize parameters. Special focus is given to a detailed discussion of both statistical and systematic uncertainties as well as propagation of uncertainties.Bayesian statistics is fundamental to data-driven approaches, and this course takes a close look at Bayesian techniques such as Bayesian parameter estimation and prior probability functions.Furthermore, this course gives an in-depth overview of statistical testing and decision theory, focusing on aspects such as A/B testing, hypothesis testing, p-values, and multiple testing which are fundamental to statistical analysis approaches in a broad range of practical applications.

Course Outcomes

On successful completion, students will be able to

- understand point estimation methods.
- apply maximum likelihood and ordinary least squares method to estimate parameters.
- comprehend the concept of statistical and systematic errors.
- employ error propagation methods.
- utilize Bayesian inference and non-parametric techniques.
- evaluate statistical tests.
- grasp the fundamentals of statistical decision theory.

Contents

1. Point Estimation
    - 1.1 Method of moments
    - 1.2 Sufficient statistics
    - 1.3 Maximum likelihood
    - 1.4 Ordinary least squares
    - 1.5 Resampling techniques
2. Uncertainties
    - 2.1 Statistical and systematic uncertainties
    - 2.2 Propagation of uncertainties

3. Bayesian Inference & Non-parametric Techniques
   - 3.1 Bayesian parameter estimation
   - 3.2 Prior probability functions
   - 3.3 Parzen windows
   - 3.4 K-nearest-neighbours

4. Statistical Testing
   - 4.1 A/B testing
   - 4.2 Hypothesis tests & test statistics
   - 4.3 P-values & confidence intervals
   - 4.4 Multiple testing

5. Statistical Decision Theory
   - 5.1 The risk function
   - 5.2 Maximum likelihood, Minimax, and Bayes
   - 5.3 Admissibility and Stein's paradox

Literature

Compulsory Reading

Further Reading

- Hogg, R. V., McKean, J., & Craig, A. T. (2020). Introduction to mathematical statistics, global edition. Pearson.
- Gutman, Alex J., Goldmeier, Jordan. (2021). Becoming a Data Head – How to Think, Speak, and Understand Data Science, Statistics, and Machine Learning. John Wiley & Sons.
- Borek Puza. (2015). Bayesian Methods for Statistical Analysis. ANU eView.

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Review Book
☑ Recorded Live Sessions	☑ Slides	☑ Online Tests

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Review Book
☑ Recorded Live Sessions	☑ Slides	☑ Online Tests

Requirements Engineering

Module Code: DLBCSRE

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Andrew Adjah Sai (Requirements Engineering)

Information about the Module Coordinator without guarantee

Contributing Courses to Module

- Requirements Engineering (DLBCSRE01)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Exam, 90 Minutes Study Format: myStudies Exam, 90 Minutes	

Weight of Module

see curriculum

Module Contents

- Basics of requirements engineering
- Enterprise modeling
- Requirement determination techniques
- Techniques of requirements documentation
- Testing and coordination of requirements
- Managing requirements

Learning Outcomes

Requirements Engineering

On successful completion, students will be able to

- describe models of enterprise modeling relevant to IT support and have experience in modeling.
- understand techniques and methods for determining requirements of IT systems and be able to distinguish them from each other.
- understand techniques for the documentation of requirements on IT systems and have experience in their use.
- describe techniques for testing, coordinating, and managing the requirements of IT systems and be able to distinguish between them.
- independently select suitable techniques and methods of requirements engineering for given project situations.

Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Computer Science & Software Development	All Bachelor Programs in the IT & Technology field

Requirements Engineering

Course Code: DLBCSRE01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The early phases of software development are largely characterized by the fact that functional and technical requirements for the IT system have to be determined. The determination of these requirements must be carried out extremely carefully because all of the following activities in the SW development process are planned and executed on the basis of documented requirements. In this course, procedures, methods, and models are covered, which make it possible to have a structured and methodical determination and documentation of requirements for operational information systems.

Course Outcomes

On successful completion, students will be able to

- describe models of enterprise modeling relevant to IT support and have experience in modeling.
- understand techniques and methods for determining requirements of IT systems and be able to distinguish them from each other.
- understand techniques for the documentation of requirements on IT systems and have experience in their use.
- describe techniques for testing, coordinating, and managing the requirements of IT systems and be able to distinguish between them.
- independently select suitable techniques and methods of requirements engineering for given project situations.

Contents

1. Fundamentals and Terms of Requirements Engineering
   - 1.1 Requirements Engineering in the Software Process
   - 1.2 Core Activities in Requirements Engineering
   - 1.3 What is a Requirement?
2. Determination of Requirements
   - 2.1 Determination of the System Context
   - 2.2 Determination of the Sources of Requirements
   - 2.3 Selection of the Appropriate Investigative Techniques
   - 2.4 Determine Requirements Using Techniques

3. Selected Investigative Techniques
   - 3.1 Creativity Techniques
   - 3.2 Interview Techniques
   - 3.3 Observation Techniques
   - 3.4 Prototyping

4. Documentation of Requirements
   - 4.1 Activities for Documenting Requirements
   - 4.2 Typical Elements of Requirements Documentation
   - 4.3 Forms of Documentation

5. Modeling of Processes
   - 5.1 Basics and Terms
   - 5.2 Modeling with the Business Process Model and Notation
   - 5.3 Modeling with Event Driven Process Chains

6. Modeling of Systems
   - 6.1 Fundamentals of Unified Modeling Language
   - 6.2 UML Use Case Diagram
   - 6.3 UML Activity Diagram
   - 6.4 UML Class Diagram
   - 6.5 UML State Diagram

7. Checking and Reconciling Requirements
   - 7.1 Activities for Checking and Reconciling Requirements
   - 7.2 Test Criteria
   - 7.3 Test Principles
   - 7.4 Testing Techniques
   - 7.5 Coordination of Requirements

8. Management of Prioritization Requirements and Techniques
   - 8.1 Managing Requirements
   - 8.2 Techniques for Prioritizing Requirements

Literature
Compulsory Reading
Further Reading ▪ Dick, J., Hull, E., & Jackson, K. (2017). Requirements engineering (4th ed.). Springer. ▪ Glinz, M., van Loenhoud, H., Staal, S., & Bühne, S. (2020). Handbook for the CPRE foundation level according to the IREB standard: Education and training for certified professional for requirements engineering (CPRE): Foundation level (Version 1.0.0). InternationalRequirements Engineering Board. ▪ Pohl, K., & Rupp, C. (2015). Requirements engineering fundamentals: A study guide for the certified professional for requirements engineering exam: Foundation level—IREB compliant (2nd ed.). Rocky Nook.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
	☑ Audio	
☑ Recorded Live Sessions	☑ Slides	

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
☑ Recorded Live Sessions	☑ Audio	
	☑ Slides	

Mobile Software Engineering

Module Code: DLBCSEMSE1-01

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimaldauer: 1 Semester	WiSe/SoSe	English

Module Coordinator
(Mobile Software Engineering)
Information about the Module Coordinator without guarantee

Contributing Courses to Module
▪ Mobile Software Engineering (DLBCSEMSE01-01)

Module Exam Type	
Module Exam Study Format: Distance Learning Written Assessment: Case Study	**Split Exam**
Weight of Module see curriculum	

Module Contents

- Basics of Mobile Software Development
- Android System Architecture
- Development Environment
- Core Components of an Android App
- Interaction between Application Components
- Advanced Techniques

Learning Outcomes

Mobile Software Engineering

On successful completion, students will be able to

- recognize the differences and peculiarities of software development for mobile systems and explain them.
- differentiate between different activities, roles, and risks in the creation, operation, and maintenance of mobile software systems.
- explain and differentiate between the architecture and technical features of the Android platform.
- independently create mobile software systems to solve concrete problems for the “Android” platform.

Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Computer Science & Software Development	All Bachelor Programs in the IT & Technology field

Mobile Software Engineering

Course Code: DLBCSEMSE01-01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Using the mobile platform "Android" as an example, it will be demonstrated how the programming of mobile applications (apps) differs from the development of browser-based information systems, which technologies and programming concepts are typically used, and which typical challenges there are in app development for industrial applications.

Course Outcomes

On successful completion, students will be able to

- recognize the differences and peculiarities of software development for mobile systems and explain them.
- differentiate between different activities, roles, and risks in the creation, operation, and maintenance of mobile software systems.
- explain and differentiate between the architecture and technical features of the Android platform.
- independently create mobile software systems to solve concrete problems for the “Android” platform.

Contents

1. Basics of Mobile Software Development
   - 1.1 Special Features of Mobile Devices
   - 1.2 Special Features of Mobile Software Development
   - 1.3 Classification of Mobile Devices
   - 1.4 The Android Platform
2. Android System Architecture
   - 2.1 The Android System
   - 2.2 Safety and Security
   - 2.3 Communication with Networks
3. Development Environment
   - 3.1 Android Studio
   - 3.2 First App and Emulator Test

3.3 Application Deployment

4. Core Components of an Android App
   - 4.1 Overview of the Components of an Android App
   - 4.2 Activities, Layouts, and Views
   - 4.3 Resources
   - 4.4 Summary in an App
   - 4.5 Graphic Design

5. Interaction Between Application Components
   - 5.1 Intents
   - 5.2 Services
   - 5.3 Broadcast Receiver

6. Advanced Techniques
   - 6.1 Threading
   - 6.2 Application Memory

Literature

Compulsory Reading

Further Reading

- Allen, G. (2021). Android for absolute beginners: Getting started with mobile apps development using the Android Java SDK. Apress.
- Hagos, T. (2020): Learn Android Studio 4: Efficient Java-Based Android Apps Development. Berkeley, CA: Apress.
- Meike, B. G., & Schiefer, L. (2022). Inside the Android OS: Building, customizing, managing, and operating Android system services. Pearson.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Written Assessment: Case Study

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Review Book
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
☑ Recorded Live Sessions	☑ Audio	☑ Guideline
	☑ Slides	

4. Semester

Theoretical Computer Science and Mathematical Logic

Module Code: CSEBCSTCSML

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Robert Graf (Theoretical Computer Science and Mathematical Logic)

Information about the Module Coordinator without guarantee

Contributing Courses to Module

- Theoretical Computer Science and Mathematical Logic (CSEBCSTCSML01)

Module Exam Type

Module Exam	Split Exam
Study Format: Campus Studies Exam, 90 Minutes	

Weight of Module

see curriculum

Module Contents

- Proposition and predicate logic
- Finite automata
- Formal languages
- Computability and Turing machines
- Complexity theory
- Petri nets

Learning Outcomes

Theoretical Computer Science and Mathematical Logic

On successful completion, students will be able to

- formulate and translate predicate logical relationships into programming languages.
- use finite automatons and regular expressions to describe technical facts.
- explain the Chomsky hierarchy.
- identify the limits of provability and predictability.
- explain the meaning and relevance of the P=NP problem.
- apply Petri nets for the description of technical facts.

Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Computer Science & Software Development	All Bachelor Programs in the IT & Technology field

Theoretical Computer Science and Mathematical Logic

Course Code: CSEBCSTCSML01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Theoretical computer science and mathematical logic form the theoretical basics of computer science. However, this is not "pure theory", as these fundamentals are applied in many areas of computer science. These include, for example, the formulation of conditions in SQL queries or other programs based on statement and predicate logic, the use of finite state machines to specify systems with state transition diagrams, and the modeling of business and other processes with Petri nets. In addition, theoretical computer science and mathematical logic analyze the limits of computer science and computability, which cannot be exceeded irrespective of the technologies and algorithms used.

Course Outcomes

On successful completion, students will be able to

- formulate and translate predicate logical relationships into programming languages.
- use finite automatons and regular expressions to describe technical facts.
- explain the Chomsky hierarchy.
- identify the limits of provability and predictability.
- explain the meaning and relevance of the P=NP problem.
- apply Petri nets for the description of technical facts.

Contents

1. Propositional Logic
   - 1.1 Basic Concepts
   - 1.2 Calculation Rules and Normal Forms
   - 1.3 Interpretation and Satisfiability
   - 1.4 Proof by Contradiction and Resolution
   - 1.5 Soundness and Completeness
2. Predicate Logic
   - 2.1 Basic Concepts
   - 2.2 Resolution in Predicate Logic
   - 2.3 Completeness and Incompleteness
   - 2.4 Logic Programming with Prolog

3. Finite Automata and Regular Expressions
   - 3.1 Basic Concepts of Finite Automata
   - 3.2 Regular Expressions and Languages
   - 3.3 Practical Applications

4. Formal Languages and Grammars
   - 4.1 Basic Concepts
   - 4.2 The Chomsky Hierarchy
   - 4.3 Context Free Languages (Type-2 Grammars)
   - 4.4 Context Sensitive Languages (Type-1 Grammars)

5. Computability and Turing Machines
   - 5.1 Models of Computability
   - 5.2 Turing Machines
   - 5.3 More Models of Computability
   - 5.4 Computability and Decidability and the Halting Problem

6. Complexity Theory
   - 6.1 Landau's Big O Notation
   - 6.2 Basic Concepts of Complexity Theory
   - 6.3 P=NP?
   - 6.4 NP-Complete Problems

7. Petri Nets
   - 7.1 Basic Concepts of Graphs and Petri Nets
   - 7.2 Modeling Properties of Concurrent Systems
   - 7.3 Reachability in Petri Nets
   - 7.4 Invariants in Petri Nets

8. Applications of Mathematical Logic and Theoretical Computer Science
   - 8.1 Parser and Compiler
   - 8.2 Program Verification
   - 8.3 Artificial Intelligence
   - 8.4 Cryptology

Literature
Compulsory Reading
Further Reading ▪ Sipser, M. (2014). Introduction to the theory of computation (3rd ed.). Cengage Learning. ▪ Huth, M., & Ryan, M. (2004). Logic in computer science: Modelling and reasoning about systems (2nd ed.). Cambridge University Press. ▪ Reisig, W. (2013). Understanding Petri nets: Modeling techniques, analysis methods, case studies. Springer. ▪ Parkes, A. P. (2008). A concise introduction to languages and machines. Springer. ▪ Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C. (2022). Introduction to algorithms (4th ed.). MIT Press.

Study Format Campus Studies

Study Format	Course Type
Campus Studies	Campus Lecture

Information about the examination	
Examination Admission Requirements	Mandatory attendance of at least 60% of the lectures
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
84 h	36 h	0 h	30 h	0 h	150 h

Cryptography

Module Code: CSEBCSCT-01

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Ralf Kneuper (Cryptography)

Information about the Module Coordinator without guarantee

Contributing Courses to Module

- Cryptography (CSEBCSCT01-01)

Module Exam Type

Module Exam	Split Exam
Study Format: Campus Studies Written Assessment: Case Study	

Weight of Module

see curriculum

Module Contents

- Protection Targets, Vulnerabilities, and Threats
- Foundations of Cryptology and its Core Components
- Basic Cryptographic Applications
- Authentication
- Single Computer Security
- Security Communication Network
- Security E-Commerce
- Secure Software Development

Learning Outcomes

Cryptography

On successful completion, students will be able to

- give an overview of different classes of cryptographic systems.
- give a basic description of symmetric cryptographic methods, in particular One-Time Pad, DES, and AES, and describe their operating principles by means of simple, concrete examples.
- describe the basic hash functions.
- describe basic asymmetric cryptographic methods, especially RSA, and their operating principles by means of simple, concrete examples.
- describe the areas of application of cryptographic procedures and their application scenarios.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Computer Science & Software Developement	All Bachelor Programs in the IT & Technology field

Cryptography

Course Code: CSEBCSCT01-01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

This course covers basic and targeted in-depth knowledge of cryptographic processes and the practical use of cryptographic systems. After an overview of cryptographic methods, hash functions, symmetric methods, and asymmetric methods are presented. The theoretical basics of selected procedures are taught and practically explained using simple examples. In addition, areas of application and application scenarios for cryptographic procedures are presented.

Course Outcomes

On successful completion, students will be able to

- give an overview of different classes of cryptographic systems.
- give a basic description of symmetric cryptographic methods, in particular One-Time Pad, DES, and AES, and describe their operating principles by means of simple, concrete examples.
- describe the basic hash functions.
- describe basic asymmetric cryptographic methods, especially RSA, and their operating principles by means of simple, concrete examples.
- describe the areas of application of cryptographic procedures and their application scenarios.

Contents

1. Protection Goals, Vulnerabilities, and Threats
   - 1.1 Protection Goals
   - 1.2 Vulnerabilities and Threats
2. Foundations of Cryptology and its Core Components
   - 2.1 Encoding
   - 2.2 Symmetrical Encryption
   - 2.3 Asymmetric Encryption
   - 2.4 One-way Functions and Cryptographic Hash Functions
3. Basic Cryptographic Applications
   - 3.1 Key Exchange and Hybrid Processes
   - 3.2 Digital Signature

- 3.3 Message Authentication Code
- 3.4 Steganographic Methods

4. Authentication
   - 4.1 Passwords and Public-Key-Certificates
   - 4.2 Challenge-Response-Procedure and Zero-Knowledge-Procedure
   - 4.3 Biometric Methods
   - 4.4 Authentication in Distributed Systems
   - 4.5 Identities Through Smartcards

5. Security of Single Computers
   - 5.1 Malware and Cookies
   - 5.2 Some Special Features of Operating Systems
   - 5.3 Web Server Security

6. Security in Communication Networks
   - 6.1 Security Problems and Defense Concepts
   - 6.2 Internet Standards for Communication Security
   - 6.3 Identity and Anonymity
   - 6.4 Security in Mobile and Wireless Communications

7. Security in E-Commerce
   - 7.1 Email Security
   - 7.2 Online Banking and Online Payments
   - 7.3 Electronic Money

8. Secure Software Development
   - 8.1 Threat Modeling
   - 8.2 Secure Software Design
   - 8.3 Techniques for Safe Programming

Literature
Compulsory Reading
Further Reading ▪ Paar, C. & Pelzl, J. (2010). Understanding Cryptography. A Textbook for Students and Practitioners. Springer. ▪ Singh, S. (1999). The code book [electronic resource] : the science of secrecy from ancient Egypt to quantum cryptography (1. ed.). Anchor Books. ▪ Smart, N. P. (2016). Cryptography Made Simple. Springer.

Study Format Campus Studies

Study Format	Course Type
Campus Studies	Campus Lecture

Information about the examination	
Examination Admission Requirements	Mandatory attendance of at least 60% of the lectures
Type of Exam	Written Assessment: Case Study

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
94 h	36 h	0 h	20 h	0 h	150 h

IT Service Management

Module Code: CSEBCSITSM-02

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. André Köhler (IT Service Management)

Information about the Module Coordinator without guarantee

Contributing Courses to Module

- IT Service Management (CSEBCSITSM01-02)

Module Exam Type

Module Exam	Split Exam
Study Format: Campus Studies Exam, 90 Minutes	

Weight of Module

see curriculum

Module Contents

- IT Service Management Basics and Terms
- ITIL 4 - Basics and Four Dimensions
- ITIL 4 - Service Value System
- ITIL 4 - Principles
- ITIL 4 - Practices
- Information Security Management

Learning Outcomes

IT Service Management

On successful completion, students will be able to

- identify the fundamentals and challenges of IT service management.
- describe the motivation and structure of the IT Infrastructure Library (ITIL), distinguish four dimensions, apply the service value system and identify concrete practices.
- describe and apply fundamentals of IT security management.

Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Computer Science & Software Development	All Bachelor Programs in the IT & Technology field

IT Service Management

Course Code: CSEBCSITSM01-02

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

IT service management is an approach to align and understand a company's IT as a service provider and supporter of operational and business processes. This course uses the IT Infrastructure Library (ITIL) to teach concepts, procedures and best practices in the area of IT service management (IT operations). In other words, it looks at the management of activities that take place after an IT system has been developed: IT operations as a continuous run of the productive day-to-day business of a company's IT departments.

Course Outcomes

On successful completion, students will be able to

- identify the fundamentals and challenges of IT service management.
- describe the motivation and structure of the IT Infrastructure Library (ITIL), distinguish four dimensions, apply the service value system and identify concrete practices.
- describe and apply fundamentals of IT security management.

Contents

1. IT Service Management Basics and Terms
   - 1.1 IT Services
   - 1.2 IT Service Management
   - 1.3 ITSM Frameworks
2. ITIL 4 - Basics and Four Dimensions
   - 2.1 Stakeholders, Services and Service Management
   - 2.2 Value Contribution of IT
3. ITIL 4 - Service Value System
   - 3.1 Basics and Overview
   - 3.2 Inputs, Outcome and Governance
   - 3.3 The Service Value Chain
   - 3.4 Continual Improvement
4. ITIL 4 - Principles

4.1 Overview
4.2 Value Orientation
4.3 Iterative Procedure and Feedback
4.4 Establish Collaboration and Visibility
4.5 Optimize and Automate

5. ITIL 4 - Practices
5.1 Overview
5.2 General Management Practices
5.3 Service Management Practices
5.4 Technical Practices

6. Information Security Management
6.1 Information Security Basics
6.2 Standards, Best Practices and Legal Requirements
6.3 Information Security Management with ISO/IEC 27001

Literature

Compulsory Reading

Further Reading

- Agutter, C. (2019). ITIL® foundation essentials ITIL 4 edition: The ultimate revision guide. ITGovernance Publishing.
- Axelos Limited. (2019). ITIL 4 foundation: ITIL 4 edition. The Stationery Office.

Study Format Campus Studies

Study Format	Course Type
Campus Studies	Campus Lecture

Information about the examination	
Examination Admission Requirements	
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
84 h	36 h	0 h	30 h	0 h	150 h

Instructional Methods

Learning Material
- ☑ Course Book
- ☑ Video
- ☑ Slides

Exam Preparation
- ☑ Practice Exam
- ☑ Online Tests

Project: Software Engineering

Module Code: CSEBCSPSE

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Thorsten Fröhlich (Project: Software Engineering)

Information about the Module Coordinator without guarantee

Contributing Courses to Module

- Project: Software Engineering (CSEBCSPSE01)

Module Exam Type

Module Exam	Split Exam
Study Format: Campus Studies Written Assessment: Project Report	

Weight of Module

see curriculum

Module Contents

- The knowledge acquired in the computer science modules from study semesters 1-3 is applied in small to medium-sized projects. Implementation is carried out in groups of approximately 3-7 students. Important stages of the software life cycle are covered, and the corresponding artifacts (e.g., specification of requirements, design, implementation, tests, and documentation) are created by the students. The quality assurance of these artefacts is carried out by the tutor and by students from other project groups. The students should learn about both the creation and the quality assurance of artefacts in the SW process.

Learning Outcomes

Project: Software Engineering

On successful completion, students will be able to

- have experience working on a complex project on a practical scenario of industrial SW development.
- understand the typical risks and pitfalls of large software projects within the framework of project realization and be able to use targeted strategies to minimize risks.

Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field(s) of Computer Science & Software Development.	All Bachelor Programmes in the IT & Technology field(s).

Project: Software Engineering

Course Code: CSEBCSPSE01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The knowledge acquired in the computer science modules from study semesters 1-3 is applied in small to medium-sized projects. Implementation is carried out in groups of approximately 3-7 students. Important stages of the software life cycle are covered, and the corresponding artifacts (e.g., specification of requirements, design, implementation, tests, and documentation) are created by the students. The quality assurance of these artefacts is carried out by the tutor and by students from other project groups. Students will learn about the creation and the quality assurance of artefacts in the software process.

Course Outcomes

On successful completion, students will be able to

- have experience working on a complex project on a practical scenario of industrial SW development.
- understand the typical risks and pitfalls of large software projects within the framework of project realization and be able to use targeted strategies to minimize risks.

Contents

Literature

Compulsory Reading

Further Reading

- none

Study Format Campus Studies

Study Format	Course Type
Campus Studies	Campus Lecture

Information about the examination	
Examination Admission Requirements	Mandatory attendance of at least 60% of the lectures
Type of Exam	Written Assessment: Project Report

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
114 h	36 h	0 h	0 h	0 h	150 h

Machine Learning - Supervised Learning

Module Code: DLBDSMLSL

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	CSEBDSMFC01, CSEBDSMFLA01, CSEBDSSPDS01-01, DLBDSSIS01-01	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Christian Müller-Kett (Machine Learning - Supervised Learning)

Information about the Module Coordinator without guarantee

Contributing Courses to Module

- Machine Learning - Supervised Learning (DLBDSMLSL01)

Module Exam Type

Module Exam	Split Exam
Study Format: myStudies Exam, 90 Minutes Study Format: Distance Learning Exam, 90 Minutes	

Weight of Module

see curriculum

Module Contents

- Types of machine learning
- Classification
- Regression
- Support vector machines
- Decision trees

Learning Outcomes

Machine Learning - Supervised Learning

On successful completion, students will be able to

- remember central notions and paradigms of machine learning.
- describe the key ideas of regression and pertaining regularization methods.
- know basic classification techniques.
- explain tree structured machine learning models.
- understand support vector machines and the related kernel approach.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Data Science & Artificial Intelligence	All Bachelor Programs in the IT & Technology field

Machine Learning - Supervised Learning

Course Code: DLBDSMLSL01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	CSEBDSMFC01, CSEBDSMFLA01, CSEBDSSPDS01-01, DLBDSSIS01-01

Course Description

This course provides a first introduction to the field of machine learning with a focus on supervised learning (i.e., learning from labeled data), where the most commonly used models in regression and classification are being introduced. Moreover, the course provides an introduction to the concepts of large margin classifiers and tree structured models.

Course Outcomes

On successful completion, students will be able to

- remember central notions and paradigms of machine learning.
- describe the key ideas of regression and pertaining regularization methods.
- know basic classification techniques.
- explain tree structured machine learning models.
- understand support vector machines and the related kernel approach.

Contents

1. Introduction to Machine Learning
   - 1.1 Pattern recognition systems
   - 1.2 The machine learning design cycle
   - 1.3 Technical notions of learning and adaptation
   - 1.4 Under- and overfitting
2. Regression
   - 2.1 Linear regression
   - 2.2 Lasso- and ridge Regularization
   - 2.3 Generalized linear models
   - 2.4 Logistic regression
3. Basic Classification Techniques
   - 3.1 K-nearest neighbour
   - 3.2 Naive Bayes

4. Support Vector Machines
   - 4.1 Large margin classification
   - 4.2 The kernel trick

5. Decision & Regression Trees
   - 5.1 Decision & regression trees
   - 5.2 Random forest
   - 5.3 Gradient boosting

Literature

Compulsory Reading

Further Reading

- Géron, A. (2022). Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems (3rd edition). O'Reilly Media.
- McKinney, W. (2022). Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Jupyter (3rd Edition). O'Reilly Media.
- Vanderplas, J. (2022). Python Data Science Handbook: Essential Tools for Working with Data (2nd Edition). O'Reilly Media.

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
☑ Recorded Live Sessions	☑ Audio	
	☑ Slides	

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
☑ Recorded Live Sessions	☑ Audio	
	☑ Slides	

Machine Learning - Unsupervised Learning and Feature Engineering

Module Code: DLBDSMLUSL

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	CSEBDSMFC01, CSEBDSMFLA01, CSEBDSSPDS01-01, DLBDSSIS01-01	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Christian Müller-Kett (Machine Learning - Unsupervised Learning and Feature Engineering)

Information about the Module Coordinator without guarantee

Contributing Courses to Module

- Machine Learning - Unsupervised Learning and Feature Engineering (DLBDSMLUSL01)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Written Assessment: Case Study Study Format: myStudies Written Assessment: Case Study	

Weight of Module

see curriculum

Module Contents

- Unsupervised machine learning
- Clustering
- Dimensionality reduction
- Manifold learning
- Feature engineering
- Feature selection
- Automation of feature generation and selection

Learning Outcomes

Machine Learning - Unsupervised Learning and Feature Engineering

On successful completion, students will be able to

- explain the notions of unsupervised learning and feature selection.
- recall commonly-applied clustering models.
- understand the concept and utility of dimensionality reduction and manifold learning.
- describe effective approaches to feature engineering.
- discuss the methods of automatic feature generation and selection.
- reflect on societal and sustainability implications of applying the learned skills to different use cases including ethical questions.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Data Science & Artificial Intelligence	All Bachelor Programs in the IT & Technology field

Machine Learning - Unsupervised Learning and Feature Engineering

Course Code: DLBDSMLUSL01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	CSEBDSMFC01, CSEBDSMFLA01, CSEBDSSPDS01-01, DLBDSSIS01-01

Course Description

This course is concerned with the tools and techniques for unsupervised learning and feature engineering. Unsupervised learning denotes machine learning approaches that can be applied without label information. As such, the aim is to extract patterns or statistical regularities in data, and finding good features is key for the successful application of machine learning models. Therefore, having a solid set of approaches and tools for this task is of crucial importance for any data scientist. This course introduces the most relevant methods and shows how unsupervised learning techniques can be utilized to find robust and meaningful features. By doing so, concepts and techniques are demonstrated by tangible examples which reflect usage of these techniques to generate added value for the society as a whole as opposed to ethical questionable use cases.

Course Outcomes

On successful completion, students will be able to

- explain the notions of unsupervised learning and feature selection.
- recall commonly-applied clustering models.
- understand the concept and utility of dimensionality reduction and manifold learning.
- describe effective approaches to feature engineering.
- discuss the methods of automatic feature generation and selection.
- reflect on societal and sustainability implications of applying the learned skills to different use cases including ethical questions.

Contents

1. Introduction to Unsupervised Machine Learning and Feature Engineering
   - 1.1 Unsupervised machine learning
   - 1.2 Feature engineering
2. Clustering
   - 2.1 K-Means
   - 2.2 Gaussian mixture model clustering
   - 2.3 Hierarchical clustering

3. Dimensionality Reduction
   - 3.1 Principal component analysis
   - 3.2 Multi-dimensional scaling
   - 3.3 Locally linear embedding

4. Feature Engineering
   - 4.1 Numerical features
   - 4.2 Categorial features
   - 4.3 Text features

5. Feature Selection
   - 5.1 Feature importance
   - 5.2 Feature variance
   - 5.3 Correlation matrix
   - 5.4 Recursive feature selection

6. Automated Feature Generation
   - 6.1 Automated feature generation
   - 6.2 Feature engineering versus deep learning

Literature

Compulsory Reading

Further Reading

- Bonaccorso, G. (2019). Hands-on unsupervised learning with Python: Implement machine learning and deep learning models using Scikit-Learn, TensorFlow, and more. Packt Publishing.
- Géron, A. (2022). Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow: Concepts, tools, and techniques to build intelligent systems (3rd ed.). O'Reilly Media.
- McKinney, W. (2022). Python for data analysis: Data wrangling with Pandas, NumPy, and Jupyter (3rd ed.). O'Reilly Media.
- Patel, A. A. (2019). Hands-on unsupervised learning using Python: How to build applied machine learning solutions from unlabeled data. O'Reilly Media.
- Vanderplas, J. (2022). Python data science handbook: Essential tools for working with data (2nd ed.). O'Reilly Media.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Written Assessment: Case Study

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Online Tests
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Guideline
☑ Recorded Live Sessions	☑ Audio	
	☑ Slides	

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Written Assessment: Case Study

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Online Tests
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Guideline
☑ Recorded Live Sessions	☑ Audio	
	☑ Slides	

Data Quality and Data Wrangling

Module Code: DLBDSDQDW

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	CSEBDSIPWP01, CSEBDSOOFPP01	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Sahar Qaadan (Data Quality and Data Wrangling)

Information about the Module Coordinator without guarantee

Contributing Courses to Module

- Data Quality and Data Wrangling (DLBDSDQDW01)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Written Assessment: Written Assignment	

Weight of Module

see curriculum

Module Contents

- Data quality and associated management techniques
- Data acquisition from public sources
- Working with relevant data formats
- Techniques for shaping and tidying data for analysis

Learning Outcomes

Data Quality and Data Wrangling

On successful completion, students will be able to

- discuss the fundamental aspects of data quality.
- describe common approaches to data quality management.
- use various methods to gather data from websites and other public data sources.
- work with established data formats.
- explain widely-used techniques for data preparation.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Data Science & Artificial Intelligence	All Bachelor Programs in the IT & Technology field

Data Quality and Data Wrangling

Course Code: DLBDSDQDW01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	CSEBDSIPWP01, CSEBDSOOFPP01

Course Description

The goal of data science can be summarized as the extraction of insights (hence, value) from data. It is self-evident that this objective cannot be successfully achieved based on unreliable and untrustworthy data. This course aims at establishing the notion of data quality and the pertinent methods for data quality management. Furthermore, techniques for acquiring data as well as formatting and tidying data in order to make it suitable for subsequent analytical treatment are covered.

Course Outcomes

On successful completion, students will be able to

- discuss the fundamental aspects of data quality.
- describe common approaches to data quality management.
- use various methods to gather data from websites and other public data sources.
- work with established data formats.
- explain widely-used techniques for data preparation.

Contents

1. Data Quality
   - 1.1 Introduction to data quality
   - 1.2 Data quality dimensions and issue types
2. Data Quality Management
   - 2.1 Data governance and stewardship
   - 2.2 Activities and processes
3. Data Acquisition
   - 3.1 Web scraping
   - 3.2 Data APIs
4. Working with Common Data Formats
   - 4.1 Text-based formats (CSV, XML, JSON)

4.2 Binary formats (HDF 5, Parquet, Arrow)

5. Tidy Data
   - 5.1 Structuring
   - 5.2 Cleansing
   - 5.3 Enrichment

Literature
Compulsory Reading
Further Reading ▪ King, T., & Schwarzenbach, J. (2020). Managing data quality: A practical guide. BCS. ▪ Loshin, D. (2011). The practitioner's guide to data quality improvement. Morgan Kaufmann. ▪ Maydanchik, A. (2007). Data quality assessment. Technics Publications. ▪ Fürber, C. (2016). Data quality management with semantic technologies (1st ed.). Springer.

Study Format Distance Learning

Study Format	**Course Type**
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Written Assessment: Written Assignment

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Online Tests
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Guideline
☑ Recorded Live Sessions	☑ Slides	

Data Analytics and Big Data

Module Code: DLBINGDABD_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Jan Rüterbories (Data Analytics and Big Data)
Information about the Module Coordinator without guarantee

Contributing Courses to Module
▪ Data Analytics and Big Data (DLBINGDABD01_E)

Module Exam Type	
Module Exam Study Format: myStudies Written Assessment: Case Study Study Format: Distance Learning Written Assessment: Case Study	**Split Exam**
Weight of Module see curriculum	

Module Contents

- Introduction to Data Analysis
- Statistical Basics
- Data Mining
- Big Data Methods and Technologies
- Legal Aspects of Data Analysis
- Solution Scenarios
- Application of Big Data in the Industry

Learning Outcomes

Data Analytics and Big Data

On successful completion, students will be able to

- distinguish between information and data and know the meaning of these terms for decision-making.
- derive the Big Data issue, especially in connection with Internet of Things, and describe it using examples.
- identify basics from statistics, which are necessary for the analysis of large data sets.
- identify the process of data mining and classify different methods in it.
- identify selected methods and technologies that are used in the Big Data context and apply them to simple examples.
- recognize the legal framework for the application of data analysis in Germany and internationally.
- identify the specific prospects and challenges of applying Big Data analyses in industry.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Data Science & Artificial Intelligence	All Bachelor Programs in the IT & Technology field

Data Analytics and Big Data

Course Code: DLBINGDABD01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The aim of the course is to familiarize students with selected methods and techniques of data analysis in the context of continuously increasing, heterogeneous data sets. To this end, the fundamental relevance of Big Data methods is presented by drawing on the historical development of stored data. One decisive factor here is the continuous transmission Internet of Things sensor data to other systems. This is followed by a short introduction to the essential statistical fundamentals before the individual steps of the data mining process are discussed. In distinction to these classical procedures, selected methods are presented with which stored data in the Big Data context can be made analyzable. As data analysis is subject to certain legal frameworks, this course also covers legal aspects such as data protection. The course concludes with an overview of the practical application of Big Data methods and tools. In particular, fields of application in the industrial context are examined.

Course Outcomes

On successful completion, students will be able to

- distinguish between information and data and know the meaning of these terms for decision-making.
- derive the Big Data issue, especially in connection with Internet of Things, and describe it using examples.
- identify basics from statistics, which are necessary for the analysis of large data sets.
- identify the process of data mining and classify different methods in it.
- identify selected methods and technologies that are used in the Big Data context and apply them to simple examples.
- recognize the legal framework for the application of data analysis in Germany and internationally.
- identify the specific prospects and challenges of applying Big Data analyses in industry.

Contents

1. Introduction to Data Analysis
    - 1.1 Decisions, Information, Data
    - 1.2 Historical Development of Data Storage and Evaluation
    - 1.3 Big Data: Features and Examples
    - 1.4 Data Analysis

1.5 Internet of Things as Driver for Big Data

2. Statistical Basics
   - 2.1 Descriptive Data Analysis
   - 2.2 Inferential Data Analysis
   - 2.3 Explorative Data Analysis
   - 2.4 Multivariate Data Analysis

3. Data Mining
   - 3.1 Knowledge Discovery in Databases
   - 3.2 Association Analysis
   - 3.3 Correlation Analysis
   - 3.4 Forecast
   - 3.5 Cluster Analysis
   - 3.6 Classification

4. Big Data Methods and Technologies
   - 4.1 Technology Building Blocks
   - 4.2 MapReduce
   - 4.3 Text- and Semantic Analysis
   - 4.4 Audio and Video Analysis
   - 4.5 BASE and NoSQL
   - 4.6 In-Memory Databases
   - 4.7 Big Data Success Factors

5. Legal Aspects of Data Analysis
   - 5.1 Data Protection Principles in Germany
   - 5.2 Anonymization and Pseudonymization
   - 5.3 International Data Analysis
   - 5.4 Performance and Integrity Protection

6. Solution Scenarios

7. Application of Big Data in the Industry
   - 7.1 Production and Logistics
   - 7.2 Increased Efficiency in the Supply Chain
   - 7.3 Key-Factor Data
   - 7.4 Examples and Conclusion

Literature
Compulsory Reading
Further Reading ▪ Akerkar, R., & Srinivas Sajja, P. (2016). Intelligent Techniques for Data Science. Springer. ▪ Curry, E., Auer, S., Berre, A., J., Metzger, A., Perez, M., S., & Zillner, S. (2022). Technologies and Applications for big data value. Springer. Pages 1–15 & 321–344. ▪ Hoeren, T., & Kolany-Raiser, B., (Eds.). (2018). Big data in context – Legal, social and technological insights. Springer Nature. ▪ Illowsky, B., & Dean, S. (2018). Introductory statistics. OpenStax CNX. Chapters 2 & 8. ▪ Jurafsky, D., & Martin, J. H. (2013). Speech and language processing: an introduction to natural language processing, computational linguistics, and speech recognition (2. ed.). Pearson Prentice Hall.

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Written Assessment: Case Study

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Online Tests
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Guideline
☑ Recorded Live Sessions	☑ Slides	

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Written Assessment: Case Study

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods

Tutorial Support	Learning Material	Exam Preparation
☑ Course Feed	☑ Course Book	☑ Online Tests
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Guideline
☑ Recorded Live Sessions	☑ Slides	

Introduction to Data Protection and Cyber Security

Module Code: DLBCSIDPITS

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Ralf Kneuper (Introduction to Data Protection and Cyber Security)

Information about the Module Coordinator without guarantee

Contributing Courses to Module

- Introduction to Data Protection and Cyber Security (DLBCSIDPITS01)

Module Exam Type

Module Exam	Split Exam
Study Format: myStudies Exam, 90 Minutes Study Format: Distance Learning Exam, 90 Minutes	

Weight of Module

see curriculum

Module Contents

- Fundamentals of IT Security
- Data Protection
- IT Security Management
- Network and Communication Security

Learning Outcomes

Introduction to Data Protection and Cyber Security

On successful completion, students will be able to

- explain the terms and concepts of IT security and know the typical procedures and techniques which exist in each area.
- cite the legal regulations on data protection and explain their implementation.
- discuss in-depth IT security management and suitable measures for implementation.
- use their overview knowledge of activities and strategies for IT security in software and system development.

Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Computer Science & Software Development	All Bachelor Programs in the IT & Technology field

Introduction to Data Protection and Cyber Security

Course Code: DLBCSIDPITS01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

In this course, the students are familiarized with important concepts from the field of IT security. Basic terms are introduced and discussed, and typical application fields, areas of IT security application, and typical procedures and techniques are introduced and described.

Course Outcomes

On successful completion, students will be able to

- explain the terms and concepts of IT security and know the typical procedures and techniques which exist in each area.
- cite the legal regulations on data protection and explain their implementation.
- discuss in-depth IT security management and suitable measures for implementation.
- use their overview knowledge of activities and strategies for IT security in software and system development.

Contents

1. Fundamentals of Data Protection and Cyber Security
   - 1.1 Conceptual Bases, Protection Goals
   - 1.2 Attacks and Threats
   - 1.3 Security Strategy
   - 1.4 Legal Regulations
2. Data Protection
   - 2.1 Data Protection as a Personal Right
   - 2.2 Basic Principles of Data Protection
   - 2.3 EU General Data Protection Regulation
   - 2.4 Further International Regulations on Data Protection
   - 2.5 Cross-Border Data Flow
   - 2.6 Data Protection in Everyday Life
3. Basic Functions of Cyber Security and Their Implementation
   - 3.1 Identification and Authentication
   - 3.2 Rights Management

3.3 Rights Check
3.4 Preservation of Evidence

4. Cyber Security Management
   4.1 Basic Concepts and Standards in Cyber Security Management
   4.2 Series of Standards ISO 2700x

5. Cyber Security Management in Everyday Life
   5.1 Password Management
   5.2 Data Backup
   5.3 Email Security
   5.4 Protection Against Viruses and Other Malware
   5.5 Protection Against Social Engineering Attacks

6. Network and Communication Security
   6.1 Firewall Technology
   6.2 Network Separation
   6.3 Security in WLAN, Mobile Networks, Bluetooth, and NFC

7. Cyber Security in the Development of Software and Systems
   7.1 Protection of the Development Environment
   7.2 Secure Development
   7.3 Common Criteria

Literature

Compulsory Reading

Further Reading

- Arnold, R. (2017). Cybersecurity: A business solution. An executive perspective on managing cyber risk. Threat Sketch.
- European Parliament and Council of the European Union. (2016). EU General Data Protection Regulation (GDPR): Regulation 2016/679 of the European Parliament and of the council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation). Official Journal of the European Union. Chapters 1—3 .
- Mattord, H., & Whitman, M. (2017). Management of information security. Cengage.

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
☑ Recorded Live Sessions	☑ Audio	
	☑ Slides	

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
	☑ Audio	
☑ Recorded Live Sessions	☑ Slides	

IT Project Management

Module Code: DLBCSEITPAM1

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Johannes Kent Walter (IT Project Management)

Information about the Module Coordinator without guarantee

Contributing Courses to Module

- IT Project Management (DLBCSEITPAM01)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Exam, 90 Minutes Study Format: myStudies Exam, 90 Minutes	

Weight of Module

see curriculum

Module Contents

- Basic terms and foundations of IT project management
- Large and small planning techniques
- Techniques for prioritization, cost-estimation, and project controlling
- Techniques for stakeholder, communication, and risk management
- Organization and structure in IT project management
- Schools of thought in IT project management

Learning Outcomes

IT Project Management

On successful completion, students will be able to

- explain and differentiate between the basic principles and tasks of IT project management.
- explain the important practical techniques and methods necessary for the implementation of IT project management.
- describe the basic procedural models and explain their advantages and disadvantages as well as their possible applications.
- identify possible project risks on the basis of given practical scenarios and select suitable measures from IT project management in order to minimize them in a targeted manner.

Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the fields of Computer Science & Software Development	All Bachelor Programs in the IT & Technology fields

IT Project Management

Course Code: DLBCSEITPAM01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

In this course, typical problems in the management of Software projects are discussed and the methods and techniques used to address challenges conveyed.In addition, standard procedural models for IT project management are explained and their strengths and weaknesses specifically identified.

Course Outcomes

On successful completion, students will be able to

- explain and differentiate between the basic principles and tasks of IT project management.
- explain the important practical techniques and methods necessary for the implementation of IT project management.
- describe the basic procedural models and explain their advantages and disadvantages as well as their possible applications.
- identify possible project risks on the basis of given practical scenarios and select suitable measures from IT project management in order to minimize them in a targeted manner.

Contents

1. Basics Terms and Foundations of IT Project Management
   - 1.1 Definition of a Project and Types of IT Projects
   - 1.2 IT Project Lifecycle
   - 1.3 Multi-Project Management – The Project in the Context of the Organization
2. Planning Techniques
   - 2.1 Large-Scale Planning: Milestones, Sub-tasks, and Work Packages
   - 2.2 Large-Scale Planning: Gantt Charts
   - 2.3 Planning and Organization of Work Packages: Kanban Board
3. Prioritization, Estimation of Costs, Project Controlling
   - 3.1 Prioritization
   - 3.2 Estimation of Costs
   - 3.3 Project Controlling

4. Stakeholder, Communication and Risk Management
   - 4.1 Stakeholder Management
   - 4.2 Communication Management
   - 4.3 Risk Management

5. Organization and Structure in IT Project Management
   - 5.1 Overview and Levels of Management from PRINCE2
   - 5.2 Management Processes in PRINCE2
   - 5.3 Pragmatic IT Project Management (PITPM)
   - 5.4 Configuration of an IT Project in PITPM
   - 5.5 Management of a project in PITPM

6. Schools of Thought in IT Project Management
   - 6.1 Agile Software Development
   - 6.2 Value-Based Software Engineering

Literature

Compulsory Reading

Further Reading

- Project Management Institute. (2021). A Guide to the Project Management Body of Knowledge (PMBOK® Guide) – Seventh Edition and The Standard for Project Management (ENGLISH): Vol. Seventh edition. Project Management Institute.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
	☑ Audio	
	☑ Slides	

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
	☑ Audio	
	☑ Slides	

5. Semester

Internship: Computer Science & Business Information Systems

Module Code: DLBITPIWI_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	30	900 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Valentin Bodendörfer (Internship: Computer Science & Business Information Systems)
Information about the Module Coordinator without guarantee

Contributing Courses to Module
▪ Internship: Computer Science & Business Information Systems (DLBITPIWI01_E)

Module Exam Type	
Module Exam Study Format: Distance Learning Reflection of Practical Experiences (passed / not passed)	**Split Exam**
Weight of Module see curriculum	

Module Contents

Within the framework of this internship, students document and reflect on their everyday practical experiences. This is based on knowledge they have acquired. Students now apply this theoretical knowledge in various fields of practice and reflect upon it.

Learning Outcomes

Internship: Computer Science & Business Information Systems

On successful completion, students will be able to

- transfer theoretical knowledge to practical problems.
- depending on the tasks undertaken, independently address and manage practical challenges; to reflect on their success.
- better assess the scope, significance, and limitations of theoretical concepts in light of practical demands.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Computer Science & Software Development	All Bachelor Programs in the IT & Technology field

Internship: Computer Science & Business Information Systems

Course Code: DLBITPIWI01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		30	none

Course Description

Within the scope of this course, students document and reflect on their everyday practical experience, relating it to the subject-specific and related scientific knowledge bases they have previously learned and developed, as well as previously acquired skills and competencies for action. The students apply their theoretical knowledge in various practical fields and reflect upon it. The connection between theory and practice, the application of knowledge in the practical field, and the reflection of these experiences in relation to theory and personal development are the primary focus.

Course Outcomes

On successful completion, students will be able to

- transfer theoretical knowledge to practical problems.
- depending on the tasks undertaken, independently address and manage practical challenges; to reflect on their success.
- better assess the scope, significance, and limitations of theoretical concepts in light of practical demands.

Contents

- As part of the internship, students document and reflect on their everyday professional experiences in the field of Business Information Systems. The individual problems and questions that arise are reflected upon from the perspective of professional practice. This module provides students with the opportunity to apply the content they have learned in previous modules through practical reflection and to directly implement practical knowledge where it has been acquired. Various concepts and methods are concretely tested in practice and reflected upon in their specific applications. The basis for this is the documentation, evaluation, and presentation of approaches and methods in the chosen context of action.

Literature
Compulsory Reading
Further Reading ▪ Within the subject relation, the literature of each module in the program is relevant.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Reflection (of Practical Work) / Group Reflection

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Reflection of Practical Experiences (passed / not passed)

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
0 h	0 h	0 h	0 h	900 h	900 h

Instructional Methods

6. Semester

Project: IT Service Management

Module Code: CSEBCSPITSM

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Dr. Frank Müller (Project: IT Service Management)

Information about the Module Coordinator without guarantee

Contributing Courses to Module

- Project: IT Service Management (CSEBCSPITSM01)

Module Exam Type

Module Exam	Split Exam
Study Format: Campus Studies Written Assessment: Project Report	

Weight of Module

see curriculum

Module Contents

- All phases of an ITIL/IT project are carried out as part of an independent project.

Learning Outcomes

Project: IT Service Management

On successful completion, students will be able to

- analyze typical problems and company situations from the area of IT service management in different project variations.
- develop, plan, and implement proposed solutions.
- convert theory into a pragmatic approach to a solution with the help of methodical tools from IT service management and project management.
- draw and apply the right conclusions in relation to their specific project environment.
- conceptually apply their theoretical knowledge to company-specific environmental factors.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Computer Science & Software Development	All Bachelor Programs in the IT & Technology field

Project: IT Service Management

Course Code: CSEBCSPITSM01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Based on the contents of the course “IT Service Management”, selected aspects of the core processes of ITIL are deepened, discussed, selected, and applied within the framework of a project in a concept-related manner. All theoretical methods are considered and evaluated.

Course Outcomes

On successful completion, students will be able to

- analyze typical problems and company situations from the area of IT service management in different project variations.
- develop, plan, and implement proposed solutions.
- convert theory into a pragmatic approach to a solution with the help of methodical tools from IT service management and project management.
- draw and apply the right conclusions in relation to their specific project environment.
- conceptually apply their theoretical knowledge to company-specific environmental factors.

Contents

- Analysis, evaluation, and development of recommendations for taking action within the scope of concrete questions concerning aspects of IT Service Management. This is aided by the creation and planning of a project in the theoretical-theme context through all phases of project management.
- The quality assurance of the artefacts created is carried out both by the tutor and by students from the project groups.

Literature

Compulsory Reading

Further Reading

- Al-Ashmoery, Y., Haider, H., Haider, A., Nasser, N., & Al-Sarem, M. (2021). Impact of IT Service Management and ITIL Framework on the Businesses. 2021 International Conference of Modern Trends in Information and Communication Technology Industry (MTICTI), Modern Trends in Information and Communication Technology Industry (MTICTI), 2021 International Conference Of, 1–5.
- Limited, A. (2020). ITIL 4. Create, Deliver and Support. TSO.
- Limited, A. (2020). ITIL 4: Direct, Plan and Improve. TSO.
- Limited, A. (2019). ITIL foundation: ITIL (4th edition). The Stationery Office Ltd.
- Shastri, A., & Thampi, G. T. (2021). Automation of IT Service Management Processes. 2021 International Conference on Advances in Computing, Communication, and Control (ICAC3), Advances in Computing, Communication, and Control (ICAC3), 2021 International Conference On, 1–4.

Study Format Campus Studies

Study Format	Course Type
Campus Studies	Campus Lecture

Information about the examination	
Examination Admission Requirements	
Type of Exam	Written Assessment: Project Report

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
114 h	36 h	0 h	0 h	0 h	150 h

Instructional Methods	
Learning Material	**Exam Preparation**
☑ Slides	☑ Guideline

Seminar: Current Topics in Computer Science

Module Code: CSEBCSSCTCS

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Carsten Skerra (Seminar: Current Topics in Computer Science)

Information about the Module Coordinator without guarantee

Contributing Courses to Module

- Seminar: Current Topics in Computer Science (CSEBCSSCTCS01)

Module Exam Type

Module Exam	Split Exam
Study Format: Campus Studies Written Assessment: Research Essay	

Weight of Module

see curriculum

Module Contents

- This seminar deals with current topics of computer science. Students make a dive deep into a specific topic within a sub-discipline of their choice.

Learning Outcomes

Seminar: Current Topics in Computer Science

On successful completion, students will be able to

- discuss in-depth and insightfully a given topic in the field of computer science.
- write about a certain computer science topic in terms of important characteristics, connections, and insights in the form of a research essay.
- execute the basics of scientific work and implement them in the context of a research essay.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Computer Science & Software Developement.	All Bachelor Programmes in the IT & Technology field

Seminar: Current Topics in Computer Science

Course Code: CSEBCSSCTCS01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

This seminar is an opportunity for students to deepen the broad knowledge they will have gained over the previous four semesters of the study program. Students will choose a topic of specific individual interest that is connected to a sub-discipline of computer science. If a student, for example, is interested in the application of artificial intelligence in a specific context, elaborating context-specific use cases from a literature review can be the theme of the essay. Feedback provided by the tutor will help students strengthen any weaknesses they may have in scientific writing and academic work and prepare students for writing their bachelor thesis.

Course Outcomes

On successful completion, students will be able to

- discuss in-depth and insightfully a given topic in the field of computer science.
- write about a certain computer science topic in terms of important characteristics, connections, and insights in the form of a research essay.
- execute the basics of scientific work and implement them in the context of a research essay.

Contents

- Computer science is a broad subject area with many very different facets, depending on the specific sub-discipline. This seminar will address this diversity by taking up current trends in the context of individually-prepared texts. Each participant must create an essay for this purpose. Possible topics include Java and web development, data modeling and database systems, requirements engineering, and core computer science disciplines like operating systems, computer networks, distributed systems, algorithms, data structures, and programming languages.

Literature
Compulsory Reading
Further Reading ▪ Brookshear, G. / Bylow, D. (2014): Computer science: An overview. 12th edition, Pearson, Boston, MA. ▪ Gruhn,V. / Striemer, R. (Eds.) (2018): The essence of software engineering. Springer International Publishing, Cham. ▪ Springer. (n.d.) Lecture Notes in Computer Science. Springer, Heidelberg. ▪ Tardos, E. (Ed.). (n.d.) Journal of the ACM.

Study Format Campus Studies

Study Format	Course Type
Campus Studies	Campus Lecture

Information about the examination	
Examination Admission Requirements	Mandatory attendance of at least 60% of the lectures
Type of Exam	Written Assessment: Research Essay

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
114 h	36 h	0 h	0 h	0 h	150 h

Neural Nets and Deep Learning

Module Code: DLBDSNNDL-01

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLBDSMLSL01, DLBDSMLUSL01	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

(Neural Nets and Deep Learning)

Information about the Module Coordinator without guarantee

Contributing Courses to Module

- Neural Nets and Deep Learning (DLBDSNNDL01-01)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Oral Assignment	

Weight of Module

see curriculum

Module Contents

- Introduction to Neural Networks
- Feed-Forward Networks
- Avoiding Overtraining
- Convolutional Neural Networks
- Recurrent Neural Networks
- Transformer Architecture

Learning Outcomes

Neural Nets and Deep Learning

On successful completion, students will be able to

- understand the fundamental building blocks of neural networks.
- identify different network training approaches.
- create feed-forward neural networks.
- analyze network training and how to avoid overtraining.
- apply advanced network concepts to create convolutional, recurrent neural networks as well as models with the transformer architecture.
- reason about the influence of model design and data selection on model outcomes in terms of social and personal equity.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Data Science & Artificial Intelligence	All Bachelor Programs in the IT & Technology field

Neural Nets and Deep Learning

Course Code: DLBDSNNDL01-01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	DLBDSMLSL01, DLBDSMLUSL01

Course Description

Neural networks and deep learning approaches have revolutionized the fields of data science and artificial intelligence in recent years, and applications built on these techniques have reached or surpassed human performance in many specialized applications. After a short review of the origins of neural networks and deep learning, this course discusses in detail how feed-forward networks are set up and trained. Special focus is given on how to avoid overtraining in neural networks. In addition to feed-forward neural networks, this course covers additional common network architectures such as convolutional, recurrent neural networks and transformers. Moreover, by means of the accompanying video material and online tutorial support the impact of design choices and the data collection process on questions of algorithmic fairness both in terms of its individual as well as its societal dimension will be discussed.

Course Outcomes

On successful completion, students will be able to

- understand the fundamental building blocks of neural networks.
- identify different network training approaches.
- create feed-forward neural networks.
- analyze network training and how to avoid overtraining.
- apply advanced network concepts to create convolutional, recurrent neural networks as well as models with the transformer architecture.
- reason about the influence of model design and data selection on model outcomes in terms of social and personal equity.

Contents

1. Introduction to Neural Networks
   - 1.1 Machine Learning
   - 1.2 Biological Brain
   - 1.3 Building Blocks of Neural Networks
   - 1.4 Deep Versus Shallow Networks
2. Feed-Forward Networks
   - 2.1 Architecture and Weight Initialization
   - 2.2 Cost Functions

2.3 Backpropagation and Gradient Descent
2.4 Batch Normalization

3. Overtraining Avoidance
   3.1 What Is Overtraining?
   3.2 Early Stopping
   3.3 L1 and L2 Regularization
   3.4 Dropout
   3.5 Weight Pruning

4. Convolutional Neural Networks
   4.1 Motivation and Applications
   4.2 Convolution and Image Filtering
   4.3 CNN Architecture
   4.4 Popular Convolutional Networks

5. Recurrent Neural Networks
   5.1 Recurrent Neurons
   5.2 Training RNNs: Unrolling Through Time
   5.3 Memory Cells
   5.4 LSTMs

6. Transformer Architecture
   6.1 Introduction and Key Innovations
   6.2 Attention Mechanisms and Architecture
   6.3 Training, Applications, and Coding Insights
   6.4 Challenges and Future Directions

Literature

Compulsory Reading

Further Reading

- Aggarwal, C. C. (2023). Neural networks and deep learning: A textbook. Springer.
- Géron, A. (2019). Hands-on machine learning with Scikit-Learn, Keras and TensorFlow: Concepts, tools, and techniques to build intelligent systems (2nd ed.). O'Reilly.
- Vaswani, A., Shazeer, N., Parmar, N., Uszkoreit, J., Jones, L., Gomez, A. N., Kaiser, Ł., & Polosukhin, I. (2017). Attention is all you need. Proceedings of the 31st International Conference on Neural Information Processing Systems, 6000–6010.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Oral Assignment

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods

Tutorial Support
- ☑ Course Feed
- ☑ Intensive Live Sessions/Learning Sprint
- ☑ Recorded Live Sessions

Learning Material
- ☑ Course Book
- ☑ Video
- ☑ Slides

Exam Preparation
- ☑ Online Tests
- ☑ Guideline

Project: Edge AI

Module Code: DLBAIPEAI

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

N.N. (Project: Edge AI)

Information about the Module Coordinator without guarantee

Contributing Courses to Module

- Project: Edge AI (DLBAIPEAI01)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Written Assessment: Project Report Study Format: myStudies Written Assessment: Project Report	

Weight of Module

see curriculum

Module Contents

This project focuses on designing and prototyping an Edge AI system.

Learning Outcomes

Project: Edge AI

On successful completion, students will be able to

- combine a range of AI techniques in a technical implementation.
- explain the design choices and its implementation.
- transfer acquired theoretical knowledge to a real-world project.
- translate the learned theories into the practice of AI system building.
- critically evaluate the resulting model or system's performance.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Data Science & Artificial Intelligence	All Bachelor Programs in the IT & Technology field

Project: Edge AI

Course Code: DLBAIPEAI01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Edge AI is an important part of artificial intelligence and becomes more and more important in modern system implementations. Instead of large computers or server farms, AI inferences are calculated in the physical system where they are needed. Examples for such a setup are autonomous vehicles interpreting sensor data and images, mobile systems, but also cyber-physical systems where "intelligence" needs to be close to the physical production system.Students learn how to evaluate the requirements of a complete Edge AI system, determine its requirements, and evaluate the constraints of the intended use and available edge computing resources. In the course "Project: Edge AI", students choose a project task in accord with their tutor from a variety of options. The goal is to prototypically implement an Edge AI solution. The design and implementation choices, requirement and constraints are to be reasoned about, explained, and documented in a project report. To this end, students make practical use of the methodological knowledge acquired in the previous courses by applying them to relevant real-world problems.

Course Outcomes

On successful completion, students will be able to

- combine a range of AI techniques in a technical implementation.
- explain the design choices and its implementation.
- transfer acquired theoretical knowledge to a real-world project.
- translate the learned theories into the practice of AI system building.
- critically evaluate the resulting model or system's performance.

Contents

- In this course the students work on a practical prototype implementation of an edge AI system. All relevant artifacts such as the design documentation, chosen implementation, code and the complete system, as well as outcomes are to be documented. Depending on the exact system that is to be designed and implemented as a prototype, students will draw on the theoretical knowledge gained from some or all of the previous courses and combine them in a new way to design an edge AI system.

Literature
Compulsory Reading
Further Reading ▪ Geron, A. (2019). Hands-on machine learning with Scikit-Learn and TensorFlow. 2nd Edition. Boston, MA: O'Reilly Publishing. ▪ Koul, A, Ganju, S & Kasam, M (2019). Practical Deep Learning for Cloud, Mobile& Edge: Computer Vision Projects Using Python, Keras & TensorFlow. Boston, MA: O'Reilly Publishing. ▪ Russel, S., & Norvig, P. (2009). Artificial intelligence: A modern approach (3rd ed.). Malaysia: Pearson. ▪ Wang, X., Han, Y., Leung, V. C., Niyato, D., Yan, X., & Chen, X. (2020). Edge AI: Convergence of Edge Computing and Artificial Intelligence. Springer Nature. ▪ Warden, P. & Situnayake, D. (2020). TinyML . Boston, MA: O'Reilly Publishing.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Project

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Written Assessment: Project Report

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Slides	☑ Guideline

Study Format myStudies

Study Format	Course Type
myStudies	Project

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Written Assessment: Project Report

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Slides	☑ Guideline

Big Data Technologies

Module Code: DLBDSBDT

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLBCSDMDS01	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Christian Müller-Kett (Big Data Technologies)

Information about the Module Coordinator without guarantee

Contributing Courses to Module

- Big Data Technologies (DLBDSBDT01)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Exam, 90 Minutes Study Format: myStudies Exam, 90 Minutes	

Weight of Module

see curriculum

Module Contents

- Data types and data sources
- Text-based and binary data formats
- Distributed systems
- Streaming frameworks
- NoSQL approach to data storage

Learning Outcomes

Big Data Technologies

On successful completion, students will be able to

- name types and sources of data.
- understand text-based and binary data formats.
- analyze the requirements and constraints of distributed analysis systems.
- evaluate the applications of streaming frameworks.
- describe the motivation for NoSQL data stores and categorize pertaining established concepts.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Data Science & Artificial Intelligence	All Bachelor Programs in the IT & Technology field

Big Data Technologies

Course Code: DLBDSBDT01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	DLBCSDMDS01

Course Description

Data are often considered the “new oil”, the raw material from which value is created. To harness the power of data, the data need to be stored and processed on a technical level. This course introduces the four “Vs” of data, as well as typical data sources and types. The course discusses the most common data storage formats encountered in modern systems, focusing both on text-based as well as binary data formats.Handling large amounts of data poses significant challenges for the underlying infrastructure. The course discusses the most important distributed and streaming data handling frameworks which are used in leading edge applications.

Course Outcomes

On successful completion, students will be able to

- name types and sources of data.
- understand text-based and binary data formats.
- analyze the requirements and constraints of distributed analysis systems.
- evaluate the applications of streaming frameworks.
- describe the motivation for NoSQL data stores and categorize pertaining established concepts.

Contents

1. Data Types and Data Sources
   - 1.1 The 4Vs of data: volume, velocity, variety, veracity
   - 1.2 Data sources
   - 1.3 Data types
2. Working with Common Data Formats
   - 2.1 Text-Based Formats (CSV, XML, JSON)
   - 2.2 Binary Formats (HDF5, Parquet, Arrow)
3. NoSQL data stores
   - 3.1 Introduction and motivation
   - 3.2 Approaches and technical concepts
4. Distributed Systems

4.1 Hadoop & MapReduce
4.2 Hadoop file system (HDFS)
4.3 Spark
4.4 DASK

5. Streaming Frameworks
5.1 Spark streaming
5.2 Kafka

Literature
Compulsory Reading
Further Reading ▪ Kleppmann, M. (2017). Designing data-intensive applications: The big ideas behind reliable, scalable, and maintainable systems. O'Reilly. ▪ White, T. (2015). Hadoop: The definitive guide. O'Reilly.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
	☑ Audio	
☑ Recorded Live Sessions	☑ Slides	

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
☑ Recorded Live Sessions	☑ Audio	
	☑ Slides	

Exploratory Data Analysis and Visualization

Module Code: DLBDSEDAV

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	CSEBDSIPWP01 and CSEBDSOOFPP01	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Visieu Lac (Exploratory Data Analysis and Visualization)
Information about the Module Coordinator without guarantee

Contributing Courses to Module
▪ Exploratory Data Analysis and Visualization (DLBDSEDAV01)

Module Exam Type	
Module Exam Study Format: Distance Learning Written Assessment: Written Assignment	**Split Exam**
Weight of Module see curriculum	

Module Contents

- Exploratory data analysis
- Principles of data visualization
- Established visualization types and apposite use cases
- Commonly-used Python modules for visualization
- Principles of effective visual communication

Learning Outcomes

Exploratory Data Analysis and Visualization

On successful completion, students will be able to

- recognize foundational concepts of exploratory data analysis.
- cite principles of data visualization.
- identify well-established types of visualizations and their appropriate uses.
- describe visualization best practices.
- understand practical data visualization fundamentals in Python.
- use different approaches for effective visual communication of data science results.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Data Science & Artificial Intelligence	All Bachelor Programs in the IT & Technology field

Exploratory Data Analysis and Visualization

Course Code: DLBDSEDAV01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	CSEBDSIPWP01 and CSEBDSOOFPP01

Course Description

Obtaining an overview of the salient characteristics of a data set is one of the core activities at the outset of any data analysis endeavour. The corresponding activities, methods, and techniques are grouped under the term “exploratory data analysis”. During exploratory data analysis, gaining insight into a given data set is often aided by the application of suitable visualization techniques. The utility of visualization, however, does not end at this stage; it is also crucial for communicating analytical outcomes. This course first introduces a set of approaches, tools, and techniques that are useful for exploring data sets. It then takes a thorough look at the subject area of visualization, which is presented in detail by an exposition arc that spans from first principles of visualization to practical implementation to insights into the communication of data science results and findings.

Course Outcomes

On successful completion, students will be able to

- recognize foundational concepts of exploratory data analysis.
- cite principles of data visualization.
- identify well-established types of visualizations and their appropriate uses.
- describe visualization best practices.
- understand practical data visualization fundamentals in Python.
- use different approaches for effective visual communication of data science results.

Contents

1. Exploratory Data Analysis
    - 1.1 Location and variability
    - 1.2 Further exploration of data distribution
    - 1.3 Covariance and correlation
2. Data Visualization Principles
    - 2.1 Coordinates and axes
    - 2.2 Color spaces
    - 2.3 Graph types
3. Data Visualization Practice

3.1 Amounts, proportions, associations, and distributions
3.2 Time series and trends
3.3 Geo-spatial data

4. Visualization in Python – Matplotlib and Seaborn
4.1 Introduction to PyPlot, Matplotlib, and Seaborn
4.2 Basic plots
4.3 Geo-spatial plots

5. Communicating Data Science
5.1 Unclutter, focus, and capture attention
5.2 Lessons from design
5.3 Principles of storytelling with data

Literature

Compulsory Reading

Further Reading

- Anderson, C. (2015). Creating a data-driven organization. O'Reilly Media.
- Bruce, A., & Bruce, P. (2017). Practical statistics for data scientists. O'Reilly Media.
- Grobmann, T., & Dobler, M. (2019). Data visualization with Python. Packt Publishing.
- Nussbaumer Knaflic, C. (2015). Storytelling with data: A data visualization guide for business professionals. John Wiley & Sons.
- Wilke, C. O. (2019). Fundamentals of data visualization. O'Reilly Media.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Written Assessment: Written Assignment

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Online Tests
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Guideline
☑ Recorded Live Sessions	☑ Audio	
	☑ Slides	

Computer Science and Society

Module Code: DLBCSCSAS

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Janki Dodiya (Computer Science and Society)

Information about the Module Coordinator without guarantee

Contributing Courses to Module

- Computer Science and Society (DLBCSCSAS01)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Written Assessment: Written Assignment Study Format: myStudies Written Assessment: Written Assignment	

Weight of Module

see curriculum

Module Contents

- The role of computer science
- The impact of the information society on the economy and society
- Infrastructure vulnerability
- Informatics and the military
- Responsibility in Information Technology

Learning Outcomes

Computer Science and Society

On successful completion, students will be able to

- name significant stages of development in computer science and the Internet.
- describe the role of computer science as a science and its relation to other sciences.
- explain and discuss the main economic and social implications of the information society.
- explain and discuss the causes and effects of infrastructure vulnerability.
- discuss and apply relevant ethical principles to issues in computer science.

Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Computer Science & Software Development.	All Bachelor Programs in the IT & Technology field.

Computer Science and Society

Course Code: DLBCSCSAS01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Computer science is a science that shapes society in a special way, and thus has a significant impact on society. Depending on its application and prevailing conditions, it can help to improve society and living conditions or cause and exacerbate surveillance, unemployment, and other social problems. In many cases, it is not the results of computer science itself that are "good" or "bad", but the results can be used to serve very different purposes ("dual use"). In this module students acquire the basic tools to understand the effects of computer science in general and its effects on their everyday work as a data scientist.

Course Outcomes

On successful completion, students will be able to

- name significant stages of development in computer science and the Internet.
- describe the role of computer science as a science and its relation to other sciences.
- explain and discuss the main economic and social implications of the information society.
- explain and discuss the causes and effects of infrastructure vulnerability.
- discuss and apply relevant ethical principles to issues in computer science.

Contents

1. Introduction
   - 1.1 Computer Science, Society, and the Information Society
   - 1.2 Historical Overview of Computer Science and the Internet
   - 1.3 What is Computer Science?
   - 1.4 Relevant Organizations
2. The Role of Data in the Information Society
   - 2.1 Data as a Commodity
   - 2.2 Data Protection and Data Spying
   - 2.3 Long-Term Archiving
3. Economic Impacts of the Information Society
   - 3.1 Globalization and the Formation of Monopolies in the Economy
   - 3.2 Open Movement

3.3 Change in the Labor Market
3.4 Intellectual Property

4. Social impacts of the Information Society
   4.1 Social Networks
   4.2 Surveillance
   4.3 Digitization of Education
   4.4 Women in Computer Science

5. Infrastructure Vulnerability
   5.1 Attacks and Accidents
   5.2 Technical Infrastructure
   5.3 Political and Social Infrastructure

6. Computer Science and the Military
   6.1 Military as the Driver of Computer Science
   6.2 Cyber War
   6.3 Dual Use

7. Responsibility in Computer Science
   7.1 Ethics of Responsibility According to Jonas
   7.2 Ethical Guidelines for Computer Science in Society
   7.3 Decision-making by Algorithms
   7.4 Mechanisms for Implementing Responsibility in Computer Science

Literature

Compulsory Reading

Further Reading

- Clegg, B. (2017): Big Data. How the Information Revolution is Transforming Our Lives. Icon Books.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Written Assessment: Written Assignment

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Online Tests
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Guideline
☑ Recorded Live Sessions	☑ Audio	
	☑ Slides	

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Written Assessment: Written Assignment

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Online Tests
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Guideline
☑ Recorded Live Sessions	☑ Audio	
	☑ Slides	

Human Computer Interaction

Module Code: DLBUXHCI1_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Janki Dodiya (Human Computer Interaction)

Information about the Module Coordinator without guarantee

Contributing Courses to Module

- Human Computer Interaction (DLBUXHCI01_E)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Exam, 90 Minutes Study Format: myStudies Exam, 90 Minutes	

Weight of Module

see curriculum

Module Contents

- Basics of Human Information Processing
- Physiological and Psychological Aspects of Human Perception, Cognition and Behavior
- Technical Framework of Human-Computer Interaction
- Trends in Human-Computer Interaction

Learning Outcomes

Human Computer Interaction

On successful completion, students will be able to

- understand the human basics of perception, information processing, cognition, and motor skills in order to apply them for a user-friendly design of user interfaces.
- understand technical frameworks in the design of user interfaces.
- know and analyze current trends in human-computer interaction.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Computer Science & Software	All Bachelor Programs in the IT & Technology field

Human Computer Interaction

Course Code: DLBUXHCI01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The objective of this course is to teach students fundamental aspects of interaction between humans and computers. For a user-friendly design of interfaces on computers, machines and devices, a precise knowledge of human abilities and skills is necessary. The main focus of the course is on teaching the basics of human information processing. Special attention is paid to the physiological and psychological aspects of perception, cognition and motor skills. In addition to basics from a human perspective, the technical conditions for the machine perspective will be introduced. Finally, trends in human-computer interaction will be discussed.

Course Outcomes

On successful completion, students will be able to

- understand the human basics of perception, information processing, cognition, and motor skills in order to apply them for a user-friendly design of user interfaces.
- understand technical frameworks in the design of user interfaces.
- know and analyze current trends in human-computer interaction.

Contents

1. Fundamentals of Human-Computer Interaction
   - 1.1 Definitions
   - 1.2 Challenges in Human Computer Interaction
   - 1.3 Basic Models of Human Information Processing
2. Perception
   - 2.1 Sight and Visual Perception
   - 2.2 „Gestaltpsychology“ laws
   - 2.3 Attentive and Preattentive Perception
   - 2.4 Auditory Sense and Auditory Perception
   - 2.5 Sense of Touch and Proprioception
   - 2.6 Smell and Taste Perception
3. Cognition, Motor Skills
   - 3.1 Memory Types and Cognitive Processes

3.2 Stress due to Multiple Tasks
3.3 Measuring Cognitive Load
3.4 Decision Making and Speed
3.5 Motor Skills

4. Mental Models and Errors
4.1 Mental Models
4.2 User Error
4.3 Basic Types of Errors
4.4 Murphy's Law

5. Technical Framework
5.1 Visual Representation and Spatial Resolution
5.2 Temporal Resolution
5.3 Representation of Color and Brightness
5.4 Acoustic Representation
5.5 Moore's Law

6. Aspects of the Interaction with Socio-Technical systems
6.1 Overview of Interaction Styles
6.2 Acceptance
6.3 Trust
6.4 Security and Data Protection

7. Trends in Human-Computer Interaction
7.1 Intelligent Systems
7.2 Ubiquitous Computing
7.3 Augmented Reality
7.4 Multimodal Interaction
7.5 Haptics

Literature
Compulsory Reading
Further Reading ▪ Sharp, H./Preece, J./Rogers, Y. (2019): Interaction Design: Beyond Human-Computer Interaction. 5. Auflage, John Wiley & Sons, Indianapolis. ▪ Shneiderman, B./Plaisant, C./Cohen, M./Jacobs, S./Elmqvist, N./Diakopoulos, N. (2017): Designing the User Interface: Strategies for Effective Human-Computer Interaction. 6. Auflage, Pearson, Harlow. ▪ Stanton, N./Salmon, P.M./Rafferty, L.A./Walker, F.H./Baber, Ch./Jenkins, D.P.. (2017): Human Factors Methods: A Practical Guide for Engineering and Design. 2. Auflage, CRC Press Taylor & Francis Group, Boca Raton

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
☑ Recorded Live Sessions	☑ Slides	

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
☑ Recorded Live Sessions	☑ Slides	

Bachelor Thesis

Module Code: DLBBT

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Degree Program Advisor (SGL) (Bachelor Thesis) / Degree Program Advisor (SGL) (Colloquium)

Information about the Module Coordinator without guarantee

Contributing Courses to Module

- Bachelor Thesis (DLBBT01)
- Colloquium (DLBBT02)

Module Exam Type

Module Exam	Split Exam
	Bachelor Thesis • Study Format "myStudies": Bachelor Thesis • Study Format "Distance Learning": Bachelor Thesis Colloquium • Study Format "myStudies": Colloquium • Study Format "Distance Learning": Colloquium

Weight of Module

see curriculum

Module Contents

Bachelor Thesis

- Bachelor's thesis
- Colloquium on the bachelor's thesis

Colloquium

Learning Outcomes

Bachelor Thesis

On successful completion, students will be able to

- work on a problem from their major field of study by applying the specialist and methodological skills they have acquired during their studies.
- independently analyze selected tasks with scientific methods, critically evaluate them, and develop appropriate solutions under the guidance of an academic supervisor.
- record and analyze existing (research) literature appropriate to the topic of their bachelor's thesis.
- prepare a detailed written elaboration in compliance with scientific methods.

Colloquium

On successful completion, students will be able to

- present a problem from their field of study using academic presentation and communication techniques.
- reflect on the scientific and methodological approach chosen in their bachelor's thesis.
- demonstrate that they can actively answer subject-related questions from the subject experts (reviewers of the bachelor’s thesis).

Links to other Modules within the Study Program	**Links to other Study Programs of the University**
All modules in the Bachelor program	All Bachelor Programs in distance learning

Bachelor Thesis

Course Code: DLBBT01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		9	none

Course Description

The aim and purpose of the bachelor's thesis is to successfully apply the subject-specific and methodological competencies acquired during the course of study in the form of an academic dissertation with a thematic reference to the major field of study. The content of the bachelor's thesis can be a practical-empirical or theoretical-scientific problem. Students should prove that they can independently analyze a selected problem with scientific methods, critically evaluate it, and work out proposed solutions under the subject-methodological guidance of an academic supervisor. The topic chosen by the student from their respective field of study should meet the acquired scientific competences, deepening their academic knowledge and skills in order to meet the future needs of the field.

Course Outcomes

On successful completion, students will be able to

- work on a problem from their major field of study by applying the specialist and methodological skills they have acquired during their studies.
- independently analyze selected tasks with scientific methods, critically evaluate them, and develop appropriate solutions under the guidance of an academic supervisor.
- record and analyze existing (research) literature appropriate to the topic of their bachelor's thesis.
- prepare a detailed written elaboration in compliance with scientific methods.

Contents

- The bachelor's thesis must be written on a topic that relates to the content of the respective major field of study. In the context of the bachelor's thesis, the problem, as well as the scientific research goal, must be clearly emphasized. The work must reflect the current state of knowledge of the topic to be examined by means of an appropriate literature analysis. The student must prove their ability to use the acquired knowledge theoretically and/or empirically in the form of an independent and problem-solution-oriented application.

Literature
Compulsory Reading
Further Reading ▪ Lipson, C. (2018). How to write a BA thesis. A practical guide from your first ideas to your finished paper (2nd ed.). University of Chicago Press. ▪ Turabian, K. L. (2013). A Manual for Writers of Research Papers, theses, and dissertations (8th ed.). University of Chicago Press. ▪ Selection of literature according to topic

Study Format myStudies

Study Format	Course Type
myStudies	Thesis Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Bachelor Thesis

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
270 h	0 h	0 h	0 h	0 h	270 h

Instructional Methods

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Thesis Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Bachelor Thesis

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
270 h	0 h	0 h	0 h	0 h	270 h

Instructional Methods

Colloquium

Course Code: DLBBT02

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		1	none

Course Description

The colloquium will take place after the submission of the bachelor's thesis. This is done at the invitation of the experts. During the colloquium, students must prove that they have independently produced the content and results of the written work. The content of the colloquium is a presentation of the most important work contents and research results by the student as well as the answering of questions by experts.

Course Outcomes

On successful completion, students will be able to

- present a problem from their field of study using academic presentation and communication techniques.
- reflect on the scientific and methodological approach chosen in their bachelor's thesis.
- demonstrate that they can actively answer subject-related questions from the subject experts (reviewers of the bachelor's thesis).

Contents

- The colloquium includes a presentation of the most important results of the bachelor's thesis, followed by the student answering the reviewers' technical questions.

Literature

Compulsory Reading

Further Reading

- Subject specific literature chosen by the student

Study Format myStudies

Study Format	Course Type
myStudies	Thesis Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Colloquium

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
30 h	0 h	0 h	0 h	0 h	30 h

Instructional Methods

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Thesis Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Colloquium

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
30 h	0 h	0 h	0 h	0 h	30 h

Instructional Methods