MODULE HANDBOOK

Bachelor of Science

Bachelor Data Science (FS-FI-BADSC-01)

180 CP

Fernstudium

As of September 25th, 2024

INTERNATIONAL
UNIVERSITY OF
APPLIED SCIENCES

Classification: Grundständig

Contents

3. Semester

4. Semester

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5. Semester

6. Semester

1. Semester

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

Prof. Dr. Thomas Zöller (Introduction to Data Science)

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

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

Introduction to Programming with Python

Module Code: DLBDSIPWP

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)

Contributing Courses to Module
▪ Introduction to Programming with Python (DLBDSIPWP01)

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

<table>
<tr><td colspan="2">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.</td></tr>
<tr><td>Links to other Modules within the Study Program

This module is similar to other modules in the field of Data Science & Artificial Intelligence</td><td>Links to other Study Programs of the University

All Bachelor Programs in the IT & Technology field</td></tr>
</table>

Introduction to Programming with Python

Course Code: DLBDSIPWP01

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 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 ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ 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	☑ Online Tests
☑ Recorded Live Sessions	☑ Audio	
	☑ Slides	

Mathematics: Linear Algebra

Module Code: DLBDSMFLA

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)

Contributing Courses to Module

- Mathematics: Linear Algebra (DLBDSMFLA01)

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

- 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 This module is similar to other modules in the field of Methods	**Links to other Study Programs of the University** All Bachelor Programs in the Business & Management field

Mathematics: Linear Algebra

Course Code: DLBDSMFLA01

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 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	☑ Audio	☑ Online Tests
	☑ 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	☑ Review Book
☑ Recorded Live Sessions	☑ Audio	☑ Online Tests
	☑ Slides	

Introduction to Academic Work for IT and Technology

Module Code: DLBIAWITT

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)

Contributing Courses to Module

- Introduction to Academic Work for IT and Technology (DLBIAWITT01)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Advanced Workbook	

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 This module is similar to other modules in the field of Methods	**Links to other Study Programs of the University** All Bachelor Programs in the Business and Management field

Introduction to Academic Work for IT and Technology

Course Code: DLBIAWITT01

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 Distance Learning

Study Format Distance Learning	**Course Type** 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 ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video	☑ Online Tests ☑ Guideline

Project: Object Oriented and Functional Programming with Python

Module Code: DLBDSOOFPP

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)

Contributing Courses to Module

- Project: Object Oriented and Functional Programming in Python (DLBDSOOFPP01)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Portfolio Study Format: myStudies Portfolio	

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: DLBDSOOFPP01

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 Distance Learning

Study Format	Course Type
Distance Learning	Project

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

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	Portfolio

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

2. Semester

Mathematics: Analysis

Module Code: DLBDSMFC

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)

Contributing Courses to Module

- Mathematics: Analysis (DLBDSMFC01)

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

- 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 This module is similar to other modules in the field of Methods	**Links to other Study Programs of the University** All Bachelor Programs in the IT & Technology field

Mathematics: Analysis

Course Code: DLBDSMFC01

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 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	☑ Audio	☑ Online Tests
	☑ 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	☑ Review Book
☑ Recorded Live Sessions	☑ Audio	☑ Online Tests
	☑ Slides	

Statistics: Probability and Descriptive Statistics

Module Code: DLBDSSPDS-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)

Contributing Courses to Module

- Statistics: Probability and Descriptive Statistics (DLBDSSPDS01-01)

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

- 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 This module is similar to other modules in the field of Methods	**Links to other Study Programs of the University** All Bachelor Programs in the Business & Management field

Statistics: Probability and Descriptive Statistics

Course Code: DLBDSSPDS01-01

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

Database Modeling and Database Systems

Module Code: DLBCSDMDS

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)

Contributing Courses to Module

- Database Modeling and Database Systems (DLBCSDMDS01)

Module Exam Type	
Module Exam Study Format: myStudies Exam, 90 Minutes Study Format: Distance Learning 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 This module is similar to other modules in the field of Data Science & Artificial Intelligence	**Links to other Study Programs of the University** All Bachelor Programs in the IT & Technology field

Database Modeling and Database Systems

Course Code: DLBCSDMDS01

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 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	

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)

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 This module is similar to other modules in the field of Computer Science & Software Development	**Links to other Study Programs of the University** 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
☑ Recorded Live Sessions	☑ Audio	
	☑ Slides	

Project: Build a Data Mart in SQL

Module Code: DLBDSPBDM

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)

Contributing Courses to Module

- Project: Build a Data Mart in SQL (DLBDSPBDM01)

Module Exam Type

Module Exam	Split Exam
<u>Study Format: Distance Learning</u> Portfolio <u>Study Format: myStudies</u> Portfolio	

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.

<table>
<tr><td colspan="2">

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.

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Links to other Modules within the Study Program

This module is similar to other modules in the field of Data Science & Artificial Intelligence

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Links to other Study Programs of the University

All Bachelor Programs in the IT & Technology field

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Project: Build a Data Mart in SQL

Course Code: DLBDSPBDM01

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 Distance Learning

Study Format	Course Type
Distance Learning	Project

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

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	Portfolio

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

3. Semester

Statistics - Inferential Statistics

Module Code: DLBDSSIS

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLBDSSPDS01-01	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)

Contributing Courses to Module

- Statistics - Inferential Statistics (DLBDSSIS01)

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

- 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

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	DLBDSSPDS01-01

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 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 ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Review Book ☑ Online Tests

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	☑ Audio	☑ Online Tests
	☑ Slides	

Machine Learning - Supervised Learning

Module Code: DLBDSMLSL

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLBDSMFC01, DLBDSMFLA01, DLBDSSPDS01-01, DLBDSSIS01	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)

Contributing Courses to Module
▪ Machine Learning - Supervised Learning (DLBDSMLSL01)

Module Exam Type	
Module Exam Study Format: myStudies Exam, 90 Minutes Study Format: Distance Learning Exam, 90 Minutes	**Split Exam**
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 This module is similar to other modules in the field of Data Science & Artificial Intelligence	**Links to other Study Programs of the University** 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	DLBDSMFC01, DLBDSMFLA01, DLBDSSPDS01-01, DLBDSSIS01

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

Literature

Compulsory Reading

Further Reading

- Bishop, C. M. (2006). Pattern recognition and machine learning. Springer.
- Grus, J. (2019). Data science from scratch: First principles with Python (2nd ed.). O'Reilly.
- Mitchell, T. M. (1997). Machine learning. McGraw-Hill.

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	DLBDSMFC01, DLBDSMFLA01, DLBDSSPDS01-01, DLBDSSIS01	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)

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 This module is similar to other modules in the field of Data Science & Artificial Intelligence	**Links to other Study Programs of the University** 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	DLBDSMFC01, DLBDSMFLA01, DLBDSSPDS01-01, DLBDSSIS01

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 Ltd.
- Celebi, M. E., & Aydin, K. (Eds.). (2016). Unsupervised learning algorithms. Springer International Publishing.
- Kane, F. (2017). Hands-on data science and Python machine learning. Packt Publishing Ltd.
- Patel, A. A. (2019). Hands-on unsupervised learning using Python: How to build applied machine learning solutions from unlabeled data. 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 ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Online Tests ☑ Guideline

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 ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Online Tests ☑ Guideline

Neural Nets and Deep Learning

Module Code: DLBDSNNDL

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

Prof. Dr. Bertram Taetz (Neural Nets and Deep Learning)

Contributing Courses to Module

- Neural Nets and Deep Learning (DLBDSNNDL01)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Oral Assignment Study Format: myStudies Oral Assignment	

Weight of Module

see curriculum

Module Contents

- Introduction to neural networks
- Feed-forward networks
- Avoiding overtraining
- Convolutional neural networks
- Recurrent neural networks

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 and recurrent neural networks. ▪ 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

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 and recurrent neural networks. 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 and recurrent neural networks.
- 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 The biological brain
   - 1.2 Building blocks of neural networks
   - 1.3 Deep versus shallow networks
   - 1.4 Supervised learning
   - 1.5 Reinforcement learning

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 Memory cells
   5.3 LSTMs
   5.4 Training RNNs: Unrolling through time

Literature

Compulsory Reading

Further Reading

- Aggarwal, C. C. (2018). Neural networks and deep learning: A textbook. Springer.
- Chollet, F. (2017). Deep learning with Python. Manning Publications.
- 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.

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

Project: Business Intelligence

Module Code: DLBCSEBI2

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. Neil Arvin Bretana (Project: Business Intelligence)

Contributing Courses to Module

- Project: Business Intelligence (DLBCSEBI02)

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

Module Contents

Possible topics for the BI project include “Management of BI projects”, “Design of multidimensional data models” and “Prototypical implementation of small BI applications”.

<table>
<tr><td colspan="2">Learning Outcomes

Project: Business Intelligence

On successful completion, students will be able to
independently design a solution to a practical problem in the field of Business Intelligence in order to then implement a prototype and document the results.
identify and explain typical problems and challenges in the design and practical implementation of small BI solutions.</td></tr>
<tr><td>Links to other Modules within the Study Program
This module is similar to other modules in the field of Computer Science & Software Development</td><td>Links to other Study Programs of the University
All Bachelor Programs in the IT & Technology field</td></tr>
</table>

Project: Business Intelligence

Course Code: DLBCSEBI02

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

Course Description

Using well-known methods and techniques from the field of Business Intelligence, students will work independently on a practical question in this course.At the end of the course you will be able to independently design and prototype Business Intelligence applications based on concrete requirements.

Course Outcomes

On successful completion, students will be able to

- independently design a solution to a practical problem in the field of Business Intelligence in order to then implement a prototype and document the results.
- identify and explain typical problems and challenges in the design and practical implementation of small BI solutions.

Contents

- Implementation and documentation of practical questions regarding the use of Business Intelligence applications. Typical scenarios are, for example, “Management of BI projects”, “Design of multidimensional data models” and “Prototypical implementation of small BI applications”.

Literature

Compulsory Reading

Further Reading

- Liedtka, J. (2018). Why design thinking works. Harvard Business Review, 2018(9), 72–79.
- Meinel, C., & Leifer, L. J. (2021). Design thinking research: Interrogating the doing. Springer International Publishing.
- Meinel, C., Plattner, H., & Leifer, L. (2011). Design thinking: Understand – Improve – Apply. Springer Berlin Heidelberg.

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 ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	**Learning Material** ☑ Slides	**Exam Preparation** ☑ 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

4. Semester

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)

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
☑ 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	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	

Cloud Computing

Module Code: DLBDSCC

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. Tianxiang Lu (Cloud Computing)

Contributing Courses to Module

- Cloud Computing (DLBDSCC01)

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

- Cloud computing fundamentals
- Relevant enabling technologies for cloud computing
- Introduction to serverless computing
- Established cloud platforms
- Cloud offerings for data science and analytics

Learning Outcomes	
Cloud Computing On successful completion, students will be able to ▪ understand the fundamentals of cloud computing and cloud service models. ▪ recognize enabling technologies that underlie current cloud offerings. ▪ cite the principles of serverless computing. ▪ analyze characteristics of established cloud offerings. ▪ describe cloud options for data science and machine learning	
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

Cloud Computing

Course Code: DLBDSCC01

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

Course Description

Many of the recent advances in data science, particularly machine learning and artificial intelligence, rely on comprehensive data storage and computing power. Cloud computing is one way of providing that power in a scalable way, without considerable upfront investment in hardware and software resources. This course introduces the area of cloud computing together with its enabling technologies. Moreover, the most cutting-edge advances like serverless computing and storage are illustrated. Finally, a thorough overview on popular cloud offerings, especially in regard to analytics capabilities, is given.

Course Outcomes

On successful completion, students will be able to

- understand the fundamentals of cloud computing and cloud service models.
- recognize enabling technologies that underlie current cloud offerings.
- cite the principles of serverless computing.
- analyze characteristics of established cloud offerings.
- describe cloud options for data science and machine learning

Contents

1. Introduction to Cloud Computing
   - 1.1 Fundamentals of Cloud computing
   - 1.2 Cloud Service Models
   - 1.3 Benefits and Risks

2. Enabling Technology
   - 2.1 Virtualization and Containerization
   - 2.2 Storage Technology
   - 2.3 Networks and RESTful Services

3. Serverless Computing
   - 3.1 Introduction to Serverless Computing
   - 3.2 Benefits
   - 3.3 Limitations

4. Established Cloud Platforms
    - 4.1 General Overview
    - 4.2 Google Cloud Platform
    - 4.3 Amazon Web Services
    - 4.4 Microsoft Azure
    - 4.5 Platform Comparison

5. Data Science in the Cloud
    - 5.1 Provider-independent services and tools
    - 5.2 Google Data Science and Machine Learning Services
    - 5.3 Amazon Web Services Data Science and Machine Learning Services
    - 5.4 Microsoft Azure Data Science and Machine Learning Services

Literature

Compulsory Reading

Further Reading

- Goessling, S., & Jackson, K. L. (2018). Architecting cloud computing solutions. Packt Publishing.
- Mahmood, Z., Puttini, R., & Erl, T. (2013). Cloud computing: Concepts, technology & architecture. Prentice Hall.
- Sehgal, N. K., & Bhatt, P. C. P. (2023). Cloud computing with security and scalability: Concepts and practices.
- Zonooz, P., Farr, E., Arora, K., & Laszewski, T. (2018). Cloud native architectures. Packt Publishing.

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 ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Exploratory Data Analysis and Visualization

Module Code: DLBDSEDAV

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLBDSIPWP01 or DLBDSIPWP01_D, DLBDSOOFPP01	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)

Contributing Courses to Module

- Exploratory Data Analysis and Visualization (DLBDSEDAV01)

Module Exam Type

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

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	DLBDSIPWP01 or DLBDSIPWP01_D, DLBDSOOFPP01

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 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	

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	

Seminar: Ethical Considerations in Data Science

Module Code: DLBDSSECDS

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

Tamir Libel (Seminar: Ethical Considerations in Data Science)

Contributing Courses to Module

- Seminar: Ethical Considerations in Data Science (DLBDSSECDS01)

Module Exam Type

Module Exam	Split Exam
Study Format: myStudies Written Assessment: Research Essay Study Format: Distance Learning Written Assessment: Research Essay	

Weight of Module

see curriculum

Module Contents

This course aims at creating an awareness of the ethical implications of data science techniques and methodologies. To this end, students will be given the opportunity to acquaint themselves with current literature on the topic and explore the pertinent lines of thinking.

Learning Outcomes	
Seminar: Ethical Considerations in Data Science On successful completion, students will be able to ▪ contemplate ethical considerations in the field of data science. ▪ descibe how the application of data science methodology may have adverse ethical effects. ▪ reason about the ethical impacts of data science, both on a personal level and for society at large. ▪ explain how existing biases and inequalities could be amplified by technology. ▪ treat in a scientific manner a selected topic in the form of a written 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 Data Science & Artificial Intelligence	All Bachelor Programs in the IT & Technology field

Seminar: Ethical Considerations in Data Science

Course Code: DLBDSSECDS01

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

Course Description

Online trade, social media, media delivery, mass consumption, customer relationship management, hiring decisions, and more: There are hardly any aspects of contemporary life that are not affected by the application of data science methodologies and techniques. Thus, it is of central importance to gain an awareness of these implications and a thorough understanding of the ethical issues in question in order to be an informed practitioner in this field.

Course Outcomes

On successful completion, students will be able to

- contemplate ethical considerations in the field of data science.
- descibe how the application of data science methodology may have adverse ethical effects.
- reason about the ethical impacts of data science, both on a personal level and for society at large.
- explain how existing biases and inequalities could be amplified by technology.
- treat in a scientific manner a selected topic in the form of a written essay.

Contents

- This seminar covers ethical implications of the use of data science methods and techniques. Each participant is expected to write a paper on an assigned topic.

Literature
Compulsory Reading
Further Reading ▪ Association for Computing Machinery. (2018). ACM code of ethics and professional conduct. https://www.acm.org/code-of-ethics ▪ Baer, T. (2019). Understand, manage, and prevent algorithmic bias: A guide for business users and data scientists. Apress. ▪ Bloom, P. (2019). Monitored: Business and surveillance in a time of big data. Pluto Press; Knowledge Unlatched. ▪ Garzcarek, U., & Steuer, D. (2019). Approaching ethical guidelines for data scientists. In N. Bauer, K. Ickstadt, K. Lübke, G. Szepannek, H. Trautmann, & M. Vichi (Eds.), Applications in statistical computing: From music data analysis to industrial quality improvement (pp. 151–169). Springer. ▪ O'Neil, C. (2017). Weapons of math destruction: How big data increases inequality and threatens democracy. Broadway Books. ▪ Yarali, A., Joyce, R., & Dixon, B. (2020, April 22–24). Ethics of big data: Privacy, security, and trust. 2020 Wireless Telecommunications Symposium (WTS), Washington, DC, United States.

Study Format myStudies

Study Format	Course Type
myStudies	Seminar

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

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 Distance Learning

Study Format	Course Type
Distance Learning	Seminar

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

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

Project: NLP

Module Code: DLBAIPNLP

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
Aditya Mushyam (Project: NLP)

Contributing Courses to Module
▪ Project: NLP (DLBAIPNLP01)

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
In this module students learn to put their theoretical knowledge in the field of NLP into practice. In this process, students learn to proceed analytically in order to find the optimal solution for a specific NLP task.

Learning Outcomes	
Project: NLP On successful completion, students will be able to ▪ apply knowledge of NLP methods to practical problems. ▪ evaluate and apply different methods, algorithms, and approaches to solve a given problem, taking into account its constraints. ▪ recognize the benefits and shortcomings of options and decisions. ▪ implement real-world NLP applications.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Data Science & Artificial Intelligence	**Links to other Study Programs of the University** All Bachelor Programs in the IT & Technology field

Project: NLP

Course Code: DLBAIPNLP01

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

Course Description

This course gives students the opportunity to apply their knowledge in NLP to a real implementation task. This requires finding an appropriate solution for a given task and associated constraints. Methodological and algorithmic choices must be appropriately evaluated to find the optimal way. The investigated solution will be implemented as executable software which promotes the students' programming skills.

Course Outcomes

On successful completion, students will be able to

- apply knowledge of NLP methods to practical problems.
- evaluate and apply different methods, algorithms, and approaches to solve a given problem, taking into account its constraints.
- recognize the benefits and shortcomings of options and decisions.
- implement real-world NLP applications.

Contents

- In this course, students put into practice the NLP knowledge acquired in previous courses by implementing a project of their choice.

Literature

Compulsory Reading

Further Reading

- Bird, S., Klein, E., & Loper, E. (2009). Natural language processing with Python. O'Reilly.
- Jurafsky, D., & Martin, J. H. (2020). Speech and language processing (3rd ed.). Prentice Hall.
- Kamath, U., Liu, J., & Whitaker, J. (2019). Deep learning for NLP and speech recognition: Practical NLP, speech, and deep learning using Python-based open source tools. Springer.

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

5. Semester

Data Engineering

Module Code: DLBDSEDE1

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

Sahar Qaadan (Data Engineering)

Contributing Courses to Module

- Data Engineering (DLBDSEDE01)

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

- Core concepts of data engineering and data-intensive applications
- Current storage technology and architectural patterns for data at scale
- Container technology
- Operational aspects of data pipelines
- Data security and protection

Learning Outcomes	
Data Engineering On successful completion, students will be able to ▪ understand important foundational concepts in data engineering. ▪ recognize established and commonly-employed NoSQL datastores and their salient characteristics. ▪ comprehend common architectural patterns for data processing at scale. ▪ explain the concept of containerization as a virtualization approach. ▪ analyze operational challenges in the set-up and maintenance of data pipelines. ▪ demonstrate familiarity with concepts relating to data security and protection.	
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 Engineering

Course Code: DLBDSEDE01

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

Course Description

This course explores concepts of data engineering. Data engineering is concerned with the infrastructure aspects of data science such as data storage and provision, as well as the provisioning of suitable operational environments.After laying out foundational notions and concepts of the discipline, this course addresses important developments in storage technology; aspects of systems architecture for processing data at scale; containerization as a modern take on virtualization; and the logic of data pipelines and associated operational aspects. Important issues pertaining to data security and protection are also given appropriate attention.

Course Outcomes

On successful completion, students will be able to

- understand important foundational concepts in data engineering.
- recognize established and commonly-employed NoSQL datastores and their salient characteristics.
- comprehend common architectural patterns for data processing at scale.
- explain the concept of containerization as a virtualization approach.
- analyze operational challenges in the set-up and maintenance of data pipelines.
- demonstrate familiarity with concepts relating to data security and protection.

Contents

1. Foundations of Data Engineering
   - 1.1 Reliability
   - 1.2 Scalability
   - 1.3 Maintainability

2. NoSQL In Depth
   - 2.1 Fundamentals of NoSQL
   - 2.2 Established NoSQL solutions

3. Architectures for Data Processing at Scale
   - 3.1 Batch processing architectures
   - 3.2 Architectures for stream and complex event processing
   - 3.3 Lambda architecture

4. Containerization In Depth
   4.1 Docker containers
   4.2 Container management

5. Governance & Security
   5.1 Data protection
   5.2 Data security
   5.3 Data governance

6. Operational Aspects
   6.1 Defining principles of DataOps
   6.2 Building and maintaining data pipelines
   6.3 Metrics and monitoring

Literature

Compulsory Reading

Further Reading

- Adkins, H., Beyer, B., Blankinship, P., Lewandowski, P., Oprea, A., & Stubblefield, A. (2020). Building secure and reliable systems. O'Reilly.
- Franks, B. (2020). 97 things about ethics everyone in data science should know. O'Reilly.
- Kane, S. P., & Matthias, K. (2018). Docker: Up and running (2nd ed.). O'Reilly.
- Kleppmann, M. (2017). Designing data-intensive applications: The big ideas behind reliable, scalable, and maintainable systems. O'Reilly.
- Narkhede, N., Palino, T., & Shapira, G. (2017). Kafka: 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
☑ 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	

Project: Data Engineering

Module Code: DLBDSEDE2

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

Sahar Qaadan (Project: Data Engineering)

Contributing Courses to Module

- Project: Data Engineering (DLBDSEDE02)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Portfolio	

Weight of Module

see curriculum

Module Contents

Transfer of methodological knowledge to the implementation of real-world data engineering use cases from the above-mentioned problem domains.

Learning Outcomes	
Project: Data Engineering On successful completion, students will be able to ▪ formulate and implement a real-world data engineering use case. ▪ select appropriate resources for the task at hand. ▪ transfer acquired specialized knowledge in data engineering to a real-world use case. ▪ derive relevant design choices from the given project setting. ▪ analyze the suitability of different solution options with respect to the project task. ▪ make apposite choices with respect to implementation alternatives.	
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: Data Engineering

Course Code: DLBDSEDE02

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

Course Description

The focus of this course is the implementation of a real-world data engineering use case in the form of a student portfolio. To this end, students choose a project subject from the various sub-domains of data engineering. Examples include setting up a Docker container environment or dockerized service; implementing a data pipeline according to DataOps principles; and setting up an NoSQL data store.The goal is for students to demonstrate they can transfer theoretical knowledge to an implementation scenario that closely mimics practical work in a professional data engineering setting.

Course Outcomes

On successful completion, students will be able to

- formulate and implement a real-world data engineering use case.
- select appropriate resources for the task at hand.
- transfer acquired specialized knowledge in data engineering to a real-world use case.
- derive relevant design choices from the given project setting.
- analyze the suitability of different solution options with respect to the project task.
- make apposite choices with respect to implementation alternatives.

Contents

- This course covers the practical implementation of approaches and techniques covered in the preceding methodological course in a project-oriented setting. Each participant must produce a portfolio detailing and documenting the work. Porfolio themes are chosen from a list, or suggested by the students in accord with the tutor.

Literature

Compulsory Reading

Further Reading

- Kane, S. P., & Matthias, K. (2018). Docker: Shipping reliable containers in production (2nd ed.). O'Reilly.
- Kleppmann, M. (2017). Designing data-intensive applications: The big ideas behind reliable, scalable, and maintainable systems (1st ed.). O'Reilly.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Project

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

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	Exam Preparation
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Guideline

Advanced Data Analysis

Module Code: DLBDSEDA1

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. Thomas Zöller (Advanced Data Analysis)

Contributing Courses to Module

- Advanced Data Analysis (DLBDSEDA01)

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

- Business performance analytics
- Text mining
- Web- and social media analytics
- Experimentation and testing

Learning Outcomes	
Advanced Data Analysis On successful completion, students will be able to ▪ identify important design considerations for business KPIs. ▪ explain various topics in business process analytics. ▪ utilize established techniques for web data analytics. ▪ understand analytical approaches to text mining and semantic analysis. ▪ disambiguate relevant questions in social media analytics. ▪ use the techniques and methods for experimentation and testing.	
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

Advanced Data Analysis

Course Code: DLBDSEDA01

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

Course Description

This course introduces several advanced analytics subjects of practical relevance. The subject areas covered span from business performance measurement and analytics, text mining, and web- and social media analytics to current trends in experimental design and setup. Along this journey topics such as the design of key performance indicators (KPIs), business process analytics, word frequency and semantic analysis, data science on clickstreams, social media interactions, and multi-armed bandit testing are addressed.

Course Outcomes

On successful completion, students will be able to

- identify important design considerations for business KPIs.
- explain various topics in business process analytics.
- utilize established techniques for web data analytics.
- understand analytical approaches to text mining and semantic analysis.
- disambiguate relevant questions in social media analytics.
- use the techniques and methods for experimentation and testing.

Contents

1. Business Performance Analytics
   - 1.1 KPI design considerations
   - 1.2 Common business performance indicators
   - 1.3 Business process mining
2. Text Analytics
   - 2.1 Word and document frequency (TF-IDF)
   - 2.2 Semantic analysis
3. Web Analytics
   - 3.1 Web metrics
   - 3.2 Clickstream analytics
   - 3.3 Recommender systems
4. Social Network Mining

Literature

Compulsory Reading

Further Reading

- Kaushik, A. (2009). Web analytics 2.0: The art of online accountability & science of customercentricity. Wiley.
- Lane, H., Howard, C., & Hapke, H. (2019). Natural language processing in action: Understanding, analyzing, and generating text with Python. Manning.
- Parmenter, D. (2019). Key performance indicators: Developing, implementing, and using winning KPIs (4th ed.). Wiley.
- Russell, M. A., & Klassen, M. (2019). Mining the social web: Data mining Facebook, Twitter, Linkedin, Instagram, Github, and more (3rd ed.). O'Reilly.
- Siroker, D., & Koomen, P. (2013). A/B testing: The most powerful way to turn clicks into customers. Wiley.

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	

Project: Data Analysis

Module Code: DLBDSEDA2

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. Frank Passing (Project: Data Analysis)

Contributing Courses to Module

- Project: Data Analysis (DLBDSEDA02)

Module Exam Type

Module Exam	Split Exam
Study Format: myStudies Portfolio Study Format: Distance Learning Portfolio	

Weight of Module

see curriculum

Module Contents

Transfer of methodological knowledge to the implementation of real-world analytics use cases from the above-mentioned problem domains.

<table>
<tr><td colspan="2">

Learning Outcomes

Project: Data Analysis

On successful completion, students will be able to

- formulate and implement a real-world analytical use case.
- analyze the suitability of different possible approaches with respect to the project task.
- transfer acquired specialized analytical knowledge to real-world use cases.
- derive relevant design choices from the given project setting.
- make apposite choices with respect to implementation alternatives.
- select appropriate resources

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<tr><td>

Links to other Modules within the Study Program

This module is similar to other modules in the field of Data Science & Artificial Intelligence

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Links to other Study Programs of the University

All Bachelor Programs in the IT & Technology field

</td></tr>
</table>

Project: Data Analysis

Course Code: DLBDSEDA02

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

Course Description
The focus of this course is the implementation of a real-world, advanced analytics use case in the form of a student project. Primary subject areas for this practical work include business performance analytics, text mining, web- and social analytics, and experimentation and testing.The goal is for students to demonstrate they can transfer the theoretical knowledge acquired in Advanced Data Analysis (DLBDSEDA01) to an implementation scenario that closely mimics project work in a professional data science setting.

Course Outcomes

On successful completion, students will be able to

- formulate and implement a real-world analytical use case.
- analyze the suitability of different possible approaches with respect to the project task.
- transfer acquired specialized analytical knowledge to real-world use cases.
- derive relevant design choices from the given project setting.
- make apposite choices with respect to implementation alternatives.
- select appropriate resources

Contents

- This course covers the practical implementation of the approaches and techniques covered in the course Advanced Data Analysis (DLBDSEDA01) in a project-oriented setting. Each participant must produce a project report detailing and documenting their work. Project tasks are chosen from a list or suggested by the students in accord with the tutor.

Literature

Compulsory Reading

Further Reading

- Hapke, H., Howard, C., & Lane, H. (2019). Natural language processing in action. Manning Publications.
- Klassen, M., & Russell, M. A. (2019). Mining the social web (3rd ed.). O'Reilly Media.
- Ojeda, T., Bilbro, R., & Bengfort, B. (2018). Applied text analysis with Python. O'Reilly Media.
- Parmenter, D. (2020). Key performance indicators: Developing, implementing, and using winning KPIs (3rd ed.). John Wiley & Sons.

Study Format myStudies

Study Format	Course Type
myStudies	Project

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

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 Distance Learning

Study Format	Course Type
Distance Learning	Project

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

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

Artificial Intelligence

Module Code: DLBDSEAIS1

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)

Contributing Courses to Module

- Artificial Intelligence (DLBDSEAIS01)

Module Exam Type

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

Weight of Module

see curriculum

Module Contents

- 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.

<table>
<tr><td colspan="2">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.</td></tr>
<tr><td>Links to other Modules within the Study Program

This module is similar to other modules in the field of Data Science & Artificial Intelligence</td><td>Links to other Study Programs of the University

All Bachelor Programs in the IT & Technology field</td></tr>
</table>

Artificial Intelligence

Course Code: DLBDSEAIS01

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.This 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.This 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 Time-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

5. Computer Vision
   5.1 Introduction to Computer Vision
   5.2 Image Representation and Geometry
   5.3 Feature Detection
   5.4 Semantic Segmentation

Literature

Compulsory Reading

Further Reading

- Bear, F., Barry, W., & Paradiso, M. (2020). Neuroscience: Exploring the brain (4th ed.). Lippincott Williams & Wilkins.
- Chollet, F. (2018). Deep learning with Python. Manning.
- Géron, A. (2017). Hands-on machine learning with Scikit-Learn and TensorFlow. O'Reilly.
- 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.
- 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.
- 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.). MIT Press. (Adaptive Computation and Machine Learning series).
- Szeliski, R. (2022). Computer vision: Algorithms and applications (2nd ed.). Springer. (Texts in Computer Science series).

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	

Study Format Duales myStudium

Study Format	**Course Type**
Duales myStudium	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	

Project: Artificial Intelligence

Module Code: DLBDSEAIS2

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: Artificial Intelligence)

Contributing Courses to Module

- Project: Artificial Intelligence (DLBDSEAIS02)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Portfolio Study Format: myStudies Portfolio Study Format: Duales myStudium Portfolio	

Weight of Module

see curriculum

Module Contents

This course focuses on developing a simple AI system for a specific application and domain. A current list of topics is located in the Learning Management System.

Learning Outcomes	
Project: Artificial Intelligence On successful completion, students will be able to ▪ determine the requirements for building an artificial intelligence system. ▪ evaluate an application for an AI system. ▪ transfer theoretically-sound and practically-proven methods and tools to an application domain. ▪ create an AI system for a chosen application.	
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: Artificial Intelligence

Course Code: DLBDSEAIS02

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

Course Description

This project course will give students hands-on experience in the challenging task of designing and developing an AI system for a specific application and domain. Students will need to consider requirements and practical constraints as well as the desired output of the AI system.Following this course the students will get holistic overview of developing a specific AI-based application.

Course Outcomes

On successful completion, students will be able to

- determine the requirements for building an artificial intelligence system.
- evaluate an application for an AI system.
- transfer theoretically-sound and practically-proven methods and tools to an application domain.
- create an AI system for a chosen application.

Contents

- This project course focuses on understanding and implementing a simple AI system. Based on the course Artificial Intelligence (DLBDSEAI01), students will design and implement a simple AI system. In the first step, students will choose a specific application and domain and then use the methods from the course to analyze the requirements and outcomes before implementing their own AI application. All relevant artifacts and considerations are documented by the students in a course portfolio.

Literature
Compulsory Reading
Further Reading ▪ Bear, M. F., Barry, W. S., & Paradiso, M. A. (2020). Neuroscience: Exploring the brain (4th ed.). Lippincott Williams & Wilkins. ▪ Chollet, F. (2018). Deep learning with Python. Manning. ▪ 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. ▪ 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. ▪ Russell, S. J., & Norvig, P. (2022). Artificial intelligence: A modern approach (4th ed., global ed.). Pearson. ▪ Szeliski, R. (2022). Computer vision: Algorithms and applications (2nd ed. 2022). Springer.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Project

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

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

Study Format myStudies

Study Format	Course Type
myStudies	Project

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

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 Duales myStudium

Study Format	Course Type
Duales myStudium	Project

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

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

Data Engineering

Module Code: DLBDSEDE1

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

Sahar Qaadan (Data Engineering)

Contributing Courses to Module

- Data Engineering (DLBDSEDE01)

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

- Core concepts of data engineering and data-intensive applications
- Current storage technology and architectural patterns for data at scale
- Container technology
- Operational aspects of data pipelines
- Data security and protection

Learning Outcomes	
Data Engineering On successful completion, students will be able to ▪ understand important foundational concepts in data engineering. ▪ recognize established and commonly-employed NoSQL datastores and their salient characteristics. ▪ comprehend common architectural patterns for data processing at scale. ▪ explain the concept of containerization as a virtualization approach. ▪ analyze operational challenges in the set-up and maintenance of data pipelines. ▪ demonstrate familiarity with concepts relating to data security and protection.	
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 Engineering

Course Code: DLBDSEDE01

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

Course Description

This course explores concepts of data engineering. Data engineering is concerned with the infrastructure aspects of data science such as data storage and provision, as well as the provisioning of suitable operational environments.After laying out foundational notions and concepts of the discipline, this course addresses important developments in storage technology; aspects of systems architecture for processing data at scale; containerization as a modern take on virtualization; and the logic of data pipelines and associated operational aspects. Important issues pertaining to data security and protection are also given appropriate attention.

Course Outcomes

On successful completion, students will be able to

- understand important foundational concepts in data engineering.
- recognize established and commonly-employed NoSQL datastores and their salient characteristics.
- comprehend common architectural patterns for data processing at scale.
- explain the concept of containerization as a virtualization approach.
- analyze operational challenges in the set-up and maintenance of data pipelines.
- demonstrate familiarity with concepts relating to data security and protection.

Contents

1. Foundations of Data Engineering
   - 1.1 Reliability
   - 1.2 Scalability
   - 1.3 Maintainability

2. NoSQL In Depth
   - 2.1 Fundamentals of NoSQL
   - 2.2 Established NoSQL solutions

3. Architectures for Data Processing at Scale
   - 3.1 Batch processing architectures
   - 3.2 Architectures for stream and complex event processing
   - 3.3 Lambda architecture

4. Containerization In Depth
   4.1 Docker containers
   4.2 Container management

5. Governance & Security
   5.1 Data protection
   5.2 Data security
   5.3 Data governance

6. Operational Aspects
   6.1 Defining principles of DataOps
   6.2 Building and maintaining data pipelines
   6.3 Metrics and monitoring

Literature

Compulsory Reading

Further Reading

- Adkins, H., Beyer, B., Blankinship, P., Lewandowski, P., Oprea, A., & Stubblefield, A. (2020). Building secure and reliable systems. O'Reilly.
- Franks, B. (2020). 97 things about ethics everyone in data science should know. O'Reilly.
- Kane, S. P., & Matthias, K. (2018). Docker: Up and running (2nd ed.). O'Reilly.
- Kleppmann, M. (2017). Designing data-intensive applications: The big ideas behind reliable, scalable, and maintainable systems. O'Reilly.
- Narkhede, N., Palino, T., & Shapira, G. (2017). Kafka: 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
☑ 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 ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video ☑ Slides	☑ Practice Exam ☑ Online Tests

Project: Data Engineering

Module Code: DLBDSEDE2

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
Sahar Qaadan (Project: Data Engineering)

Contributing Courses to Module
▪ Project: Data Engineering (DLBDSEDE02)

Module Exam Type	
Module Exam Study Format: Distance Learning Portfolio	**Split Exam**
Weight of Module see curriculum	

Module Contents
Transfer of methodological knowledge to the implementation of real-world data engineering use cases from the above-mentioned problem domains.

Learning Outcomes

Project: Data Engineering

On successful completion, students will be able to

- formulate and implement a real-world data engineering use case.
- select appropriate resources for the task at hand.
- transfer acquired specialized knowledge in data engineering to a real-world use case.
- derive relevant design choices from the given project setting.
- analyze the suitability of different solution options with respect to the project task.
- make apposite choices with respect to implementation alternatives.

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: Data Engineering

Course Code: DLBDSEDE02

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

Course Description

The focus of this course is the implementation of a real-world data engineering use case in the form of a student portfolio. To this end, students choose a project subject from the various sub-domains of data engineering. Examples include setting up a Docker container environment or dockerized service; implementing a data pipeline according to DataOps principles; and setting up an NoSQL data store.The goal is for students to demonstrate they can transfer theoretical knowledge to an implementation scenario that closely mimics practical work in a professional data engineering setting.

Course Outcomes

On successful completion, students will be able to

- formulate and implement a real-world data engineering use case.
- select appropriate resources for the task at hand.
- transfer acquired specialized knowledge in data engineering to a real-world use case.
- derive relevant design choices from the given project setting.
- analyze the suitability of different solution options with respect to the project task.
- make apposite choices with respect to implementation alternatives.

Contents

- This course covers the practical implementation of approaches and techniques covered in the preceding methodological course in a project-oriented setting. Each participant must produce a portfolio detailing and documenting the work. Porfolio themes are chosen from a list, or suggested by the students in accord with the tutor.

Literature

Compulsory Reading

Further Reading

- Kane, S. P., & Matthias, K. (2018). Docker: Shipping reliable containers in production (2nd ed.). O'Reilly.
- Kleppmann, M. (2017). Designing data-intensive applications: The big ideas behind reliable, scalable, and maintainable systems (1st ed.). O'Reilly.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Project

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

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 ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	**Exam Preparation** ☑ Guideline

Advanced Data Analysis

Module Code: DLBDSEDA1

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. Thomas Zöller (Advanced Data Analysis)

Contributing Courses to Module

- Advanced Data Analysis (DLBDSEDA01)

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

- Business performance analytics
- Text mining
- Web- and social media analytics
- Experimentation and testing

Learning Outcomes	
Advanced Data Analysis On successful completion, students will be able to ▪ identify important design considerations for business KPIs. ▪ explain various topics in business process analytics. ▪ utilize established techniques for web data analytics. ▪ understand analytical approaches to text mining and semantic analysis. ▪ disambiguate relevant questions in social media analytics. ▪ use the techniques and methods for experimentation and testing.	
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

Advanced Data Analysis

Course Code: DLBDSEDA01

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

Course Description

This course introduces several advanced analytics subjects of practical relevance. The subject areas covered span from business performance measurement and analytics, text mining, and web- and social media analytics to current trends in experimental design and setup. Along this journey topics such as the design of key performance indicators (KPIs), business process analytics, word frequency and semantic analysis, data science on clickstreams, social media interactions, and multi-armed bandit testing are addressed.

Course Outcomes

On successful completion, students will be able to

- identify important design considerations for business KPIs.
- explain various topics in business process analytics.
- utilize established techniques for web data analytics.
- understand analytical approaches to text mining and semantic analysis.
- disambiguate relevant questions in social media analytics.
- use the techniques and methods for experimentation and testing.

Contents

1. Business Performance Analytics
   - 1.1 KPI design considerations
   - 1.2 Common business performance indicators
   - 1.3 Business process mining

2. Text Analytics
   - 2.1 Word and document frequency (TF-IDF)
   - 2.2 Semantic analysis

3. Web Analytics
   - 3.1 Web metrics
   - 3.2 Clickstream analytics
   - 3.3 Recommender systems

4. Social Network Mining

4.1 Introduction to social media analytics
4.2 Mining common social media platforms

5. Testing and Experimentation
5.1 Practical A/B testing
5.2 Multivariate tests
5.3 Multi-armed bandit testing

Literature

Compulsory Reading

Further Reading

- Kaushik, A. (2009). Web analytics 2.0: The art of online accountability & science of customercentricity. Wiley.
- Lane, H., Howard, C., & Hapke, H. (2019). Natural language processing in action: Understanding, analyzing, and generating text with Python. Manning.
- Parmenter, D. (2019). Key performance indicators: Developing, implementing, and using winning KPIs (4th ed.). Wiley.
- Russell, M. A., & Klassen, M. (2019). Mining the social web: Data mining Facebook, Twitter, Linkedin, Instagram, Github, and more (3rd ed.). O'Reilly.
- Siroker, D., & Koomen, P. (2013). A/B testing: The most powerful way to turn clicks into customers. Wiley.

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 ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Project: Data Analysis

Module Code: DLBDSEDA2

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. Frank Passing (Project: Data Analysis)

Contributing Courses to Module

- Project: Data Analysis (DLBDSEDA02)

Module Exam Type

Module Exam	Split Exam
Study Format: myStudies Portfolio Study Format: Distance Learning Portfolio	

Weight of Module

see curriculum

Module Contents

Transfer of methodological knowledge to the implementation of real-world analytics use cases from the above-mentioned problem domains.

Learning Outcomes	
Project: Data Analysis On successful completion, students will be able to ▪ formulate and implement a real-world analytical use case. ▪ analyze the suitability of different possible approaches with respect to the project task. ▪ transfer acquired specialized analytical knowledge to real-world use cases. ▪ derive relevant design choices from the given project setting. ▪ make apposite choices with respect to implementation alternatives. ▪ select appropriate resources	
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: Data Analysis

Course Code: DLBDSEDA02

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

Course Description

The focus of this course is the implementation of a real-world, advanced analytics use case in the form of a student project. Primary subject areas for this practical work include business performance analytics, text mining, web- and social analytics, and experimentation and testing.The goal is for students to demonstrate they can transfer the theoretical knowledge acquired in Advanced Data Analysis (DLBDSEDA01) to an implementation scenario that closely mimics project work in a professional data science setting.

Course Outcomes

On successful completion, students will be able to

- formulate and implement a real-world analytical use case.
- analyze the suitability of different possible approaches with respect to the project task.
- transfer acquired specialized analytical knowledge to real-world use cases.
- derive relevant design choices from the given project setting.
- make apposite choices with respect to implementation alternatives.
- select appropriate resources

Contents

- This course covers the practical implementation of the approaches and techniques covered in the course Advanced Data Analysis (DLBDSEDA01) in a project-oriented setting. Each participant must produce a project report detailing and documenting their work. Project tasks are chosen from a list or suggested by the students in accord with the tutor.

Literature

Compulsory Reading

Further Reading

- Hapke, H., Howard, C., & Lane, H. (2019). Natural language processing in action. Manning Publications.
- Klassen, M., & Russell, M. A. (2019). Mining the social web (3rd ed.). O'Reilly Media.
- Ojeda, T., Bilbro, R., & Bengfort, B. (2018). Applied text analysis with Python. O'Reilly Media.
- Parmenter, D. (2020). Key performance indicators: Developing, implementing, and using winning KPIs (3rd ed.). John Wiley & Sons.

Study Format myStudies

Study Format	Course Type
myStudies	Project

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

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

Study Format Distance Learning

Study Format	**Course Type**
Distance Learning	Project

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

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

Artificial Intelligence

Module Code: DLBDSEAIS1

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)

Contributing Courses to Module

- Artificial Intelligence (DLBDSEAIS01)

Module Exam Type

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

Weight of Module

see curriculum

Module Contents

- 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.

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

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.This 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.This 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 Time-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

5. Computer Vision
   5.1 Introduction to Computer Vision
   5.2 Image Representation and Geometry
   5.3 Feature Detection
   5.4 Semantic Segmentation

Literature

Compulsory Reading

Further Reading

- Bear, F., Barry, W., & Paradiso, M. (2020). Neuroscience: Exploring the brain (4th ed.). Lippincott Williams & Wilkins.
- Chollet, F. (2018). Deep learning with Python. Manning.
- Géron, A. (2017). Hands-on machine learning with Scikit-Learn and TensorFlow. O’Reilly.
- 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.
- 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.
- 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.). MIT Press. (Adaptive Computation and Machine Learning series).
- Szeliski, R. (2022). Computer vision: Algorithms and applications (2nd ed.). Springer. (Texts in Computer Science series).

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	

Study Format Duales myStudium

Study Format	Course Type
Duales myStudium	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	

Project: Artificial Intelligence

Module Code: DLBDSEAIS2

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: Artificial Intelligence)

Contributing Courses to Module

- Project: Artificial Intelligence (DLBDSEAIS02)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Portfolio Study Format: myStudies Portfolio Study Format: Duales myStudium Portfolio	

Weight of Module

see curriculum

Module Contents

This course focuses on developing a simple AI system for a specific application and domain. A current list of topics is located in the Learning Management System.

Learning Outcomes	
Project: Artificial Intelligence On successful completion, students will be able to ▪ determine the requirements for building an artificial intelligence system. ▪ evaluate an application for an AI system. ▪ transfer theoretically-sound and practically-proven methods and tools to an application domain. ▪ create an AI system for a chosen application.	
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: Artificial Intelligence

Course Code: DLBDSEAIS02

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

Course Description

This project course will give students hands-on experience in the challenging task of designing and developing an AI system for a specific application and domain. Students will need to consider requirements and practical constraints as well as the desired output of the AI system.Following this course the students will get holistic overview of developing a specific AI-based application.

Course Outcomes

On successful completion, students will be able to

- determine the requirements for building an artificial intelligence system.
- evaluate an application for an AI system.
- transfer theoretically-sound and practically-proven methods and tools to an application domain.
- create an AI system for a chosen application.

Contents

- This project course focuses on understanding and implementing a simple AI system. Based on the course Artificial Intelligence (DLBDSEAI01), students will design and implement a simple AI system. In the first step, students will choose a specific application and domain and then use the methods from the course to analyze the requirements and outcomes before implementing their own AI application. All relevant artifacts and considerations are documented by the students in a course portfolio.

Literature
Compulsory Reading
Further Reading ▪ Bear, M. F., Barry, W. S., & Paradiso, M. A. (2020). Neuroscience: Exploring the brain (4th ed.). Lippincott Williams & Wilkins. ▪ Chollet, F. (2018). Deep learning with Python. Manning. ▪ 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. ▪ 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. ▪ Russell, S. J., & Norvig, P. (2022). Artificial intelligence: A modern approach (4th ed., global ed.). Pearson. ▪ Szeliski, R. (2022). Computer vision: Algorithms and applications (2nd ed. 2022). Springer.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Project

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

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

Study Format myStudies

Study Format	Course Type
myStudies	Project

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

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 Duales myStudium

Study Format	Course Type
Duales myStudium	Project

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

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

Time Series Analysis

Module Code: DLBDSTSA

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLBDSSPDS01-01 or DLBDSSPDS01_D and DLBDSSIS01 or DLBDSSIS01_D	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 (Time Series Analysis)

Contributing Courses to Module

- Time Series Analysis (DLBDSTSA01)

Module Exam Type

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

Weight of Module

see curriculum

Module Contents

- Introduction to time series analysis
- Time series components
- Simple models
- ARMA models
- Holt-Winters models
- Advanced topics

Learning Outcomes	
Time Series Analysis On successful completion, students will be able to ▪ identify the fundamental concepts of time series analysis. ▪ cite the components of time series. ▪ create simple time series models. ▪ analyze time series data with ARMA and Holt-Winter models. ▪ understand advanced topics in time series analysis.	
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

Time Series Analysis

Course Code: DLBDSTSA01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	DLBDSSPDS01-01 or DLBDSSPDS01_D and DLBDSSIS01 or DLBDSSIS01_D

Course Description

Many types of data describe patterns of events which occur sequentially and show dependencies on previous events, e.g., the number of guests in a hospitality service or the number of products sold in a retail outlet. These data show a particular temporal structure which can include additional effects such as seasonality or dependencies on external events.This course focuses on understanding time series data. After a general introduction to the elements of time series analysis, this course discusses ARMA-based models (Box-Jenkins approach) and the alternative Holt-Winters formalism, both of which are used for time series analysis and forecasting.This course also includes a discussion about advanced topics in time series analysis such as the handling of multiple seasonalities and framing a problem statement in the context of supervised learning.

Course Outcomes

On successful completion, students will be able to

- identify the fundamental concepts of time series analysis.
- cite the components of time series.
- create simple time series models.
- analyze time series data with ARMA and Holt-Winter models.
- understand advanced topics in time series analysis.

Contents

1. Introduction to Time-Series Analysis
   - 1.1 What are time series?
   - 1.2 Auto-correlation & partial auto-correlation
2. Time-Series Components
   - 2.1 Trend
   - 2.2 Seasonality
   - 2.3 Residuals
3. Simple Models
   - 3.1 Simple average

Literature

Compulsory Reading

Further Reading

- Brockwell, P. J., & Davis, R. A. (2016). Introduction to time series and forecasting (3rd ed.). Springer.
- Hyndman, R. J., & Athanasopoulos, G. (2021). Forecasting: Principles and practice (3rd ed.). OTexts.
- Nielsen, A. (2019). Practical time series analysis: Prediction with statistics & machine learning. O'Reilly.
- Shumway, R. H., & Stoffer, D. S. (2017). Time series analysis and its applications—With R examples (4th 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	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 ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video	☑ Practice Exam ☑ Online Tests

Project: AI Excellence with Creative Prompting Techniques

Module Code: DLBPKIEKPT1_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. Knut Linke (Project: AI Excellence with Creative Prompting Techniques)

Contributing Courses to Module

- Project: AI Excellence with Creative Prompting Techniques (DLBPKIEKPT01_E)

Module Exam Type

Module Exam	Split Exam
Study Format: myStudies Oral Project Report Study Format: Duales myStudium Oral Project Report Study Format: Distance Learning Oral Project Report	

Weight of Module

see curriculum

Module Contents

In this module, the students delve into the world of generative AI applications, creating AI-generated content like text, images, and videos, while learning to use, analyze, and evaluate these systems in their respective study fields.

Learning Outcomes	
Project: AI Excellence with Creative Prompting Techniques On successful completion, students will be able to ▪ comprehend and apply basic prompting techniques in generative AI applications. ▪ analyze and evaluate the effectiveness of the basic prompts. ▪ apply ethical considerations to the design and use of AI for basic prompting techniques. ▪ design, implement, and refine effective prompts to real-world scenarios through hands-on exercises. ▪ showcase creative and innovative thinking in the application of prompting techniques to solve complex problems in their field of studies.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Data Science & Artificial Intelligence	**Links to other Study Programs of the University** All Bachelor Programs in the IT & Technology field

Project: AI Excellence with Creative Prompting Techniques

Course Code: DLBPKIEKPT01_E

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

Course Description
In this course, students explore the fascinating world of prompting in generative AI applications. They engage in hands-on exercises to create new AI-generated content including text, images, and videos. Through these exercises, students learn how to effectively use, analyze, and evaluate these systems within their respective fields of study.

Course Outcomes

On successful completion, students will be able to

- comprehend and apply basic prompting techniques in generative AI applications.
- analyze and evaluate the effectiveness of the basic prompts.
- apply ethical considerations to the design and use of AI for basic prompting techniques.
- design, implement, and refine effective prompts to real-world scenarios through hands-on exercises.
- showcase creative and innovative thinking in the application of prompting techniques to solve complex problems in their field of studies.

Contents

- In this course, students work on a basic practical implementation of a generative AI use case by choosing from a selection provided in the complementary guideline. The course provides practical examples as learning materials and exercises with basic prompting techniques for open-source text, image, and video generation use cases. The exercises are designed to inspire and guide students in completing their own generative AI use case work, which includes a use case description, chosen prompting techniques, outcomes, and critical evaluations from both technical and ethical perspectives.

Literature
Compulsory Reading
Further Reading ▪ Dang, H., Mecke, L., Lehmann, F., Goller, S., & Buschek, D. (2022). How to prompt? Opportunities and challenges of zero- and few-shot learning for human-AI interaction in creative applications of generative models. arXiv. https://arxiv.org/pdf/2209.01390.pdf ▪ Eapen, T. T., Finkenstadt, D. J., Folk, J., & Venkataswamy, L. (2023). How generative AI can augment human creativity. Harvard Business Review, July–August, 56–64. ▪ Wei, J., Wang, X., Schuurmans, D., Bosma, M. Ichter, B., Xia, F., Chi, E. H., Le., Q. V., & Zhou, D. (2023). Chain-of-though prompting elicit reasoning in large language models. arXiv. https://arxiv.org/pdf/2201.11903.pdf

Study Format myStudies

Study Format	Course Type
myStudies	Project

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Oral 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 Duales myStudium

Study Format	Course Type
Duales myStudium	Project

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Oral 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 ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	**Learning Material** ☑ Slides	**Exam Preparation** ☑ Guideline

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Project

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

Smart Factory I

Module Code: DLBDSESF1

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

Sahar Qaadan (Smart Factory I)

Contributing Courses to Module

- Smart Factory I (DLBDSESF01)

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

- Motivation and Definition of Terms
- Development of Automation
- Technological Basics and Standards
- Basic concepts of a Smart Factory
- Reference Architectures
- Smart Factory Engineering
- Safety and Security

Learning Outcomes	
Smart Factory I On successful completion, students will be able to ▪ understand the term Smart Factory in the context of Industry 4.0. ▪ be able to trace the development of automation to a fully autonomous, non-centrally organized production plant. ▪ understand the basic technologies and standards used to design and operate a Smart Factory. ▪ understand the essential concepts of a Smart Factory. ▪ identify and differentiate between the individual elements of a Smart Factory using different reference architectures. ▪ understand the special engineering challenges in the Smart Energy context. ▪ understand the special safety risks of digitized and networked production plants and assign concrete recommendations for action.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Computer Science & Software Development	**Links to other Study Programs of the University** All Bachelor Programs in the IT & Technology field

Smart Factory I

Course Code: DLBDSESF01

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

Course Description

In this course, students will gain a deeper insight into the networking and digitization of production facilities by examining a Smart Factory. For this purpose, they will be familiarized with the basic goals of a Smart Factory in the context of the research complex Industry 4.0. After a brief introduction to the history of automation, students will learn the technical basics and standards required to design and operate a Smart Factory. Building on this, they will learn how these individual technologies are used to implement the central concepts of a Smart Factory. In order to understand which components a Smart Factory consists of, different reference architectures are presented and compared. The course concludes with the special engineering challenges of an autonomously acting and decentralized production plant. Above all, this includes IT security, which is particularly relevant due to the digital networking of production facilities and products.

Course Outcomes

On successful completion, students will be able to

- understand the term Smart Factory in the context of Industry 4.0.
- be able to trace the development of automation to a fully autonomous, non-centrally organized production plant.
- understand the basic technologies and standards used to design and operate a Smart Factory.
- understand the essential concepts of a Smart Factory.
- identify and differentiate between the individual elements of a Smart Factory using different reference architectures.
- understand the special engineering challenges in the Smart Energy context.
- understand the special safety risks of digitized and networked production plants and assign concrete recommendations for action.

Contents

1. Motivation and Definition of Terms
   - 1.1 Goals of Smart Factory
   - 1.2 Internet of Things
   - 1.3 Cyber-Physical Systems
   - 1.4 Cyber-Physical Production Systems
   - 1.5 Smart Factory as a Cyber-Physical (Production) System

2. Development of Automation
   - 2.1 Automation Pyramid
   - 2.2 Networked, Decentralized Organization of Production
   - 2.3 Future Challenges
3. Technological Basics and Standards
   - 3.1 Identification of Physical Objects
   - 3.2 Formal Description Languages and Ontologies
   - 3.3 Digital Object Memory
   - 3.4 Physical Situation Recognition
   - 3.5 (Partially) Autonomous Action and Cooperation
   - 3.6 Human-Machine Interaction
   - 3.7 Machine to Machine Communication
4. Basic Concepts of a Smart Factory
   - 4.1 Order-Controlled Production
   - 4.2 Bundling of Machine and Production Data
   - 4.3 Supporting People in Production
   - 4.4 Intelligent Products and Resources
   - 4.5 Smart Services
5. Reference Architectures
   - 5.1 Purpose and Properties of Reference Architectures
   - 5.2 Overview of Standardization Initiatives
   - 5.3 CyProS Reference Architecture
   - 5.4 RAMI 4.0 (DIN SPEC 91345)
6. Smart Factory Engineering
   - 6.1 Classification of Different Engineering Tools
   - 6.2 Virtual Engineering
   - 6.3 User-Centered Design
   - 6.4 Requirements Engineering
   - 6.5 Modelling
   - 6.6 Integration of Classic and Smart Components

Literature
Compulsory Reading
Further Reading ▪ Butun, I. (2020). Industrial IoT: Challenges, design principles, applications, and security. Springer. ▪ Drossel, W. G., Ihlenfeldt, S., Lanzger, T., & Dumitrescu, R. (2019). Cyber-physical systems. In R. Neugebauer (Ed.), Digital transformation (pp. 189—213). Springer. ▪ Durakbasa, N. M., & Gençyılmaz, M. G. (Eds.). (2021). Digital conversion on the way to Industry 4.0. Springer. ▪ Ustundag, A., & Cevikcan, E. (2018). Industry 4.0: Managing the digital transformation. Springer.

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 Distance Learning	**Course Type** Theory Course

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

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

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

Production Engineering Industry 4.0

Module Code: DLBDSEAR1

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. Hans Kerwat (Production Engineering Industry 4.0)

Contributing Courses to Module

- Production Engineering Industry 4.0 (DLBDSEAR01)

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

- Introduction to Manufacturing Technology
- Main Production Groups According to DIN 8580
- Additive Manufacturing Processes
- Rapid Prototyping
- Rapid Tooling
- Direct/Rapid Manufacturing
- Cyber-Physical Production Plants

Learning Outcomes	
Production Engineering Industry 4.0 On successful completion, students will be able to ▪ understand the basic concepts and interrelationships of production engineering. ▪ understand current changes in manufacturing technology due to technologies such as additive manufacturing and megatrends such as cyber physical systems. ▪ assign different manufacturing processes to the main manufacturing groups according to DIN 8580. ▪ understand the basic principle of additive manufacturing processes. ▪ distinguish between different additive manufacturing processes. ▪ understand the terms Rapid Prototyping, Rapid Tooling, and Direct Manufacturing and name individual processes and application examples. ▪ understand the elements and properties of cyber-physical production plants.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Computer Science & Software Development	**Links to other Study Programs of the University** All Bachelor Programs in the IT & Technology field

Production Engineering Industry 4.0

Course Code: DLBDSEAR01

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 provide students with an overview of the processes that have influenced and still influence production processes through technological developments under the generic term Industry 4.0, based on traditional, standardized manufacturing techniques. These include, in particular, technological advances in additive manufacturing processes that enable applications such as rapid prototyping, rapid tooling, and direct manufacturing. Finally, the course deals with the consequences of the digitalization and networking of production facilities and their elements in the sense of a cyber-physical system.

Course Outcomes

On successful completion, students will be able to

- understand the basic concepts and interrelationships of production engineering.
- understand current changes in manufacturing technology due to technologies such as additive manufacturing and megatrends such as cyber physical systems.
- assign different manufacturing processes to the main manufacturing groups according to DIN 8580.
- understand the basic principle of additive manufacturing processes.
- distinguish between different additive manufacturing processes.
- understand the terms Rapid Prototyping, Rapid Tooling, and Direct Manufacturing and name individual processes and application examples.
- understand the elements and properties of cyber-physical production plants.

Contents

1. Introduction to Manufacturing Technology
   - 1.1 Basic Terms and Contexts in Manufacturing Theory
   - 1.2 Historical Development of Production
   - 1.3 The Discussion About the Long Tail

2. Classification Of Manufacturing Processes
   - 2.1 Casting and Molding
   - 2.2 Forming
   - 2.3 Machining
   - 2.4 Joining

Literature
Compulsory Reading
Further Reading ▪ Anderson, C. (2012). Makers: The new industrial revolution. Crown Business. ▪ Gebhardt, A., Kessler, J. & Thurn, L. (2019). 3D printing: Understanding additive manufacturing (2nd ed). Hanser. ▪ Groover, M. P. (2012). Fundamentals of modern manufacturing: Materials, processes, and systems (5th ed.). Wiley.

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	

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	

Automation and Robotics

Module Code: DLBDSEAR2

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 (Automation and Robotics)

Contributing Courses to Module

- Automation and Robotics (DLBDSEAR02)

Module Exam Type	
Module Exam Study Format: Distance Learning Exam, 90 Minutes	**Split Exam**
Weight of Module see curriculum	

Module Contents

- Basics of Automation
- Fundamentals of Measurement Technology
- Sensors
- Basics of Control Engineering
- Basics of Control Technology
- Introduction to Robotics
- Kinematics of a Robot

Learning Outcomes	
Automation and Robotics On successful completion, students will be able to ▪ understand the basic aspects of automation. ▪ understand the different sizes and units in measurement technology. ▪ differentiate between different measurement methods. ▪ understand the basic structure of measuring equipment. ▪ select a suitable sensor based on various criteria. ▪ understand the elements of control systems. ▪ describe the behavior of control systems in the time and frequency domain. ▪ understand the basic principles of control technology. ▪ convert between different number systems and apply Boolean algebra. ▪ understand the structure of switching networks, plants, and storages. ▪ understand important elements of control systems such as signal generators and power amplifiers. ▪ design simple programmable logic controllers. ▪ understand the basic structure of industrial robots. ▪ calculate different movements and positions of jointed-arm robots.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Computer Science & Software Development	**Links to other Study Programs of the University** All Bachelor Programs in the IT & Technology field

Automation and Robotics

Course Code: DLBDSEAR02

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 provide students with an insight into measurement, control, and regulation technology and convey the basics of robotics. Students will be taught which methods can be used to determine certain measured variables and how measurement errors are dealt with. Based on these fundamentals, various sensors will be presented and students will be able to select suitable sensors based on predefined criteria. The course also introduces students to the basics of control engineering. The different ways of describing the structure and behaviour of control systems are illustrated to the students. The basics of control engineering are also taught. The students receive a short introduction to binary number systems and Boolean algebra, and deal with various basal circuit and control elements. Finally, students will gain an insight into robotics with a focus on industrial robots. In this context, the students learn the description and calculation of positions and movements of individual limbs of a robot arm.

Course Outcomes

On successful completion, students will be able to

- understand the basic aspects of automation.
- understand the different sizes and units in measurement technology.
- differentiate between different measurement methods.
- understand the basic structure of measuring equipment.
- select a suitable sensor based on various criteria.
- understand the elements of control systems.
- describe the behavior of control systems in the time and frequency domain.
- understand the basic principles of control technology.
- convert between different number systems and apply Boolean algebra.
- understand the structure of switching networks, plants, and storages.
- understand important elements of control systems such as signal generators and power amplifiers.
- design simple programmable logic controllers.
- understand the basic structure of industrial robots.
- calculate different movements and positions of jointed-arm robots.

Contents

1. Basics of Automation
    1.1 Basic Terms

6. Introduction to Robotics
   - 6.1 Terms and Classification
   - 6.2 Basic Elements
   - 6.3 Classification of Robots

7. Kinematics of a Robot
   - 7.1 Coordinate Systems and Reference Points
   - 7.2 Rotations
   - 7.3 Forward and Reverse Transformations
   - 7.4 Denavit-Hartenberg Transformation

Literature

Compulsory Reading

Further Reading

- Gardner, R. (2021). Introduction to plant automation and controls. Taylor & Francis.
- Jazar, R. (2010). Theory of applied robotics: Kinematics, dynamics, and control (2nd ed.). Springer.
- Moir, T. (2020). Feedback. Springer.
- Morris, A. S., & Langari, R. (2020). Measurement and instrumentation: Theory and application (3rded.). Academic Press.
- Tse, F. S., & Morse, I. E. (2009). Measurement and instrumentation in engineering. CRC Press.

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 ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video	☑ Practice Exam ☑ Online Tests

Self-Driving Vehicles

Module Code: DLBDSEAD1

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 (Self-Driving Vehicles)

Contributing Courses to Module

- Self-Driving Vehicles (DLBDSEAD01)

Module Exam Type

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

Weight of Module

see curriculum

Module Contents

- Safety Standards
- Sensor Fusion
- Computer Vision
- Localization & Motion
- Motion Planning

Learning Outcomes	
Self-Driving Vehicles On successful completion, students will be able to ▪ cite relevant safety standards. ▪ grasp the concepts of sensors and sensor fusion. ▪ apply computer vision techniques to detect features. ▪ evaluate images in terms of semantic segmentation. ▪ understand motion models and localization approaches. ▪ utilize motion planning techniques.	
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 Engineering	All Bachelor Programs in the IT & Technology field

Self-Driving Vehicles

Course Code: DLBDSEAD01

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

Course Description

This course focuses on the foundations of autonomous vehicles and starts with a detailed introduction to relevant safety standards in terms of functional and IT security.This course continues with a presentation of the concept of sensor fusion and discusses relevant aspects of computer vision techniques such as feature detection, calibration, and semantic segmentation.A large part of the course concerns localization and motion planning. Relevant motion models are introduced and localization techniques such as odometry, triangulation, and satellite-based systems are discussed in detail, along with path planning, motion prediction, and trajectory generation.

Course Outcomes

On successful completion, students will be able to

- cite relevant safety standards.
- grasp the concepts of sensors and sensor fusion.
- apply computer vision techniques to detect features.
- evaluate images in terms of semantic segmentation.
- understand motion models and localization approaches.
- utilize motion planning techniques.

Contents

1. Sensors
   - 1.1 Physical principles of sensors
   - 1.2 Types of sensors
   - 1.3 Sensor calibration
   - 1.4 Application scenarios

2. Sensor Fusion
   - 2.1 Elaborating data from sensors
   - 2.2 The Kalman filter
   - 2.3 Object tracking

3. Computer Vision
   - 3.1 Pixels and filters

3.2 Feature detection
3.3 Semantic segmentation

4. Localization & Motion
   4.1 Motion models
   4.2 Trilateration
   4.3 Satellite-based localization

5. Motion planning
   5.1 Mission planning
   5.2 Behavior Planning
   5.3 Local Planning

6. Safety Standards
   6.1 Functional Safety
   6.2 Safety of Intended Functionality
   6.3 IT Security

Literature

Compulsory Reading

Further Reading

- LaValle, S. M. (2006). Planning algorithms. Cambridge University Press.
- Sciavicco, L., Villani, L., Oriolo, G., & Siciliano, B. (2009). Robotics: modelling, planning andcontrol. Springer.
- Thrun, S. (2002). Probabilistic robotics. Communications of the ACM, 45(3), 52-57.
- Watzenig, D., & Horn, M. (2016). Automated driving: Safer and more efficient future driving. Springer.

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	

Study Format Duales myStudium

Study Format	Course Type
Duales myStudium	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 ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video ☑ Slides	☑ Practice Exam ☑ 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	☑ Online Tests
☑ Recorded Live Sessions	☑ Slides	

Seminar: Current Topics and Trends in Self-Driving Technology

Module Code: DLBDSEAD2

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 (Seminar: Current Topics and Trends in Self-Driving Technology)

Contributing Courses to Module

- Seminar: Current Topics and Trends in Self-Driving Technology (DLBDSEAD02)

Module Exam Type	
Module Exam Study Format: Distance Learning Written Assessment: Research Essay Study Format: Duales myStudium Written Assessment: Research Essay Study Format: myStudies Written Assessment: Research Essay	**Split Exam**
Weight of Module see curriculum	

Module Contents

The seminar covers current topics of autonomous vehicles. The choice of topics can include (but are not limited to) recent technical advances as well as philosophical issues or implications for society, law, or relevant industries.

<table>
<tr><td colspan="2">Learning Outcomes
Seminar: Current Topics and Trends in Self-Driving Technology
On successful completion, students will be able to
transfer theoretical knowledge and methods to new domains.
understand recent developments in self-driving vehicles.
create new insights based on detailed studies of current research and technology.</td></tr>
<tr><td>Links to other Modules within the Study Program
This module is similar to other modules in the field of Engineering</td><td>Links to other Study Programs of the University
All Bachelor Programs in the IT & Technology field</td></tr>
</table>

Seminar: Current Topics and Trends in Self-Driving Technology

Course Code: DLBDSEAD02

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

Course Description

This courses focuses on recent developments in the field of self-driving vehicles. Following the course Self-Driving Vehicles (DLBDSEAD01), in this course students will focus on a particular topic in the context of autonomous driving, applying the knowledge they have obtained in the first course.Finally, a research essay will be written.

Course Outcomes

On successful completion, students will be able to

- transfer theoretical knowledge and methods to new domains.
- understand recent developments in self-driving vehicles.
- create new insights based on detailed studies of current research and technology.

Contents

- The seminar covers current topics of autonomous vehicles. The choice of topics can include (but are not limited to) recent technical advances as well as philosophical issues or implications for society, law, or relevant industries.

Literature

Compulsory Reading

Further Reading

- Ben-Ari, M., & Mondada, F. (2018). Elements of robotics. Springer.
- European Union. (2001). Directive 2001/95/EC.
- Fisher, R. B., Breckon, T. P., Dawson-Howe, K., Fitzgibbon, A., Robertson, C., Trucco, E., & Williams, C. K. I. (2016). Dictionary of computer vision and image processing. John Wiley & Sons.
- Smith, D. J., & Simpson, K. (2016). The safety critical systems handbook (4th ed.). Elsevier.
- Smith, D. J. (2017). Reliability, maintainability, and risk (9th ed.). Elsevier.
- Society of Automobile Engineers International. (2012). SAE J3061.
- Szeliski, R. (2022). Computer vision: Algorithms and applications (2nd ed.). Springer.
- Wang, P. K.-C. (2015). Visibility-based optimal path and motion planning (Vol. 568). Springer.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Seminar

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

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 Duales myStudium

Study Format	Course Type
Duales myStudium	Seminar

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

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	Seminar

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

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

Project: From Model to Production Environment

Module Code: DLBDSMTP

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLBDSIPWP01 und DLBDSOOFPP01	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. Frank Passing (Project: From Model to Production Environment)

Contributing Courses to Module

- Project: From Model to Production Environment (DLBDSMTP01)

Module Exam Type

Module Exam	Split Exam
Study Format: myStudies Oral Project Report Study Format: Distance Learning Oral Project Report	

Weight of Module

see curriculum

Module Contents

This course focuses on creating a setup which allows the integration of a predictive model into an enterprise-grade application or service.

Learning Outcomes	
Project: From Model to Production Environment On successful completion, students will be able to ▪ understand the challenges of integrating a predictive model into an application or service. ▪ evaluate the constraints a project imposes on the execution of a predictive model. ▪ analyze the requirements regarding data acquisition, storage, and processing. ▪ identify the necessary monitoring components required for reliable execution of the predictive model. ▪ create and design a production environment for storing, accessing, and serving the predictive model.	
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: From Model to Production Environment

Course Code: DLBDSMTP01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	DLBDSIPWP01 und DLBDSOOFPP01

Course Description

This project course will give students hands-on experience in the challenging task of bringing a predictive model into a production environment. Students will need to consider practical aspects such as data storage and processing, as well as constraints such as service availability and the maximum amount of time a model is allowed to run due to external project requirements.Through this course, students will obtain holistic overview of the integration of predictive models into enterprise-grade applications or services.

Course Outcomes

On successful completion, students will be able to

- understand the challenges of integrating a predictive model into an application or service.
- evaluate the constraints a project imposes on the execution of a predictive model.
- analyze the requirements regarding data acquisition, storage, and processing.
- identify the necessary monitoring components required for reliable execution of the predictive model.
- create and design a production environment for storing, accessing, and serving the predictive model.

Contents

- This project course focuses on practical aspects of ensuring that a predictive model can run in a production environment. The students start with a chosen use case and model and then evaluate the requirements which need to be fulfilled so that the model can be used as part of an enterprise application or app. Students need to evaluate requirements in terms of data storage, processing and throughput, and availability of the service, as well as the persistency, serving, and versioning of the model itself. Monitoring the execution of model predictions and raising alerts in cases of operational issues is a core part of building a reliable model pipeline. All relevant artifacts and considerations are documented by the students in a project report.

Literature
Compulsory Reading
Further Reading ▪ Geron, A. (2017). Hands-on machine learning with Scikit-Learn and TensorFlow. O'Reilly. ▪ Karau, H., Konwinski, A., Wendell, P., & Zaharia, M. (2015). Learning spark: Lightning-fast data analysis. O'Reilly. ▪ Kleppmann, M. (2017). Designing data-intensive applications: The big ideas behind reliable, scalable, and maintainable systems. O'Reilly. ▪ Kuhn, M., & Johnson, K. (2013). Applied predictive modeling. Springer. ▪ Maydanchik, A. (2007). Data quality assessment. Technics Publications. ▪ Müller, A., & Guido, S. (2016). Introduction to machine learning with Python: A guide for data scientists. O'Reilly. ▪ Narkhede, N., Shapira, G., & Palino, T. (2017). Kafka: The definitive guide: Real-time data and stream processing at scale. O'Reilly. ▪ Psaltis, A. (2017). Streaming data: Understanding the real-time pipeline. Manning Publications. ▪ White, T. (2015). Hadoop: The definitive guide: Storage and analysis at Internet scale. O'Reilly.

Study Format myStudies

Study Format	Course Type
myStudies	Project

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Oral 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 Distance Learning

Study Format	Course Type
Distance Learning	Project

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Oral 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 ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	**Learning Material** ☑ Slides	**Exam Preparation** ☑ Guideline

6. Semester

Data Engineering

Module Code: DLBDSEDE1

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

Sahar Qaadan (Data Engineering)

Contributing Courses to Module

- Data Engineering (DLBDSEDE01)

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

- Core concepts of data engineering and data-intensive applications
- Current storage technology and architectural patterns for data at scale
- Container technology
- Operational aspects of data pipelines
- Data security and protection

Learning Outcomes	
Data Engineering On successful completion, students will be able to ▪ understand important foundational concepts in data engineering. ▪ recognize established and commonly-employed NoSQL datastores and their salient characteristics. ▪ comprehend common architectural patterns for data processing at scale. ▪ explain the concept of containerization as a virtualization approach. ▪ analyze operational challenges in the set-up and maintenance of data pipelines. ▪ demonstrate familiarity with concepts relating to data security and protection.	
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 Engineering

Course Code: DLBDSEDE01

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

Course Description

This course explores concepts of data engineering. Data engineering is concerned with the infrastructure aspects of data science such as data storage and provision, as well as the provisioning of suitable operational environments.After laying out foundational notions and concepts of the discipline, this course addresses important developments in storage technology; aspects of systems architecture for processing data at scale; containerization as a modern take on virtualization; and the logic of data pipelines and associated operational aspects. Important issues pertaining to data security and protection are also given appropriate attention.

Course Outcomes

On successful completion, students will be able to

- understand important foundational concepts in data engineering.
- recognize established and commonly-employed NoSQL datastores and their salient characteristics.
- comprehend common architectural patterns for data processing at scale.
- explain the concept of containerization as a virtualization approach.
- analyze operational challenges in the set-up and maintenance of data pipelines.
- demonstrate familiarity with concepts relating to data security and protection.

Contents

1. Foundations of Data Engineering
   - 1.1 Reliability
   - 1.2 Scalability
   - 1.3 Maintainability
2. NoSQL In Depth
   - 2.1 Fundamentals of NoSQL
   - 2.2 Established NoSQL solutions
3. Architectures for Data Processing at Scale
   - 3.1 Batch processing architectures
   - 3.2 Architectures for stream and complex event processing
   - 3.3 Lambda architecture

4. Containerization In Depth
   - 4.1 Docker containers
   - 4.2 Container management

5. Governance & Security
   - 5.1 Data protection
   - 5.2 Data security
   - 5.3 Data governance

6. Operational Aspects
   - 6.1 Defining principles of DataOps
   - 6.2 Building and maintaining data pipelines
   - 6.3 Metrics and monitoring

Literature

Compulsory Reading

Further Reading

- Adkins, H., Beyer, B., Blankinship, P., Lewandowski, P., Oprea, A., & Stubblefield, A. (2020). Building secure and reliable systems. O'Reilly.
- Franks, B. (2020). 97 things about ethics everyone in data science should know. O'Reilly.
- Kane, S. P., & Matthias, K. (2018). Docker: Up and running (2nd ed.). O'Reilly.
- Kleppmann, M. (2017). Designing data-intensive applications: The big ideas behind reliable, scalable, and maintainable systems. O'Reilly.
- Narkhede, N., Palino, T., & Shapira, G. (2017). Kafka: 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
☑ 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 ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video ☑ Slides	☑ Practice Exam ☑ Online Tests

Project: Data Engineering

Module Code: DLBDSEDE2

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
Sahar Qaadan (Project: Data Engineering)

Contributing Courses to Module
▪ Project: Data Engineering (DLBDSEDE02)

Module Exam Type	
Module Exam Study Format: Distance Learning Portfolio	**Split Exam**
Weight of Module see curriculum	

Module Contents
Transfer of methodological knowledge to the implementation of real-world data engineering use cases from the above-mentioned problem domains.

Learning Outcomes	
Project: Data Engineering On successful completion, students will be able to ▪ formulate and implement a real-world data engineering use case. ▪ select appropriate resources for the task at hand. ▪ transfer acquired specialized knowledge in data engineering to a real-world use case. ▪ derive relevant design choices from the given project setting. ▪ analyze the suitability of different solution options with respect to the project task. ▪ make apposite choices with respect to implementation alternatives.	
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: Data Engineering

Course Code: DLBDSEDE02

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

Course Description

The focus of this course is the implementation of a real-world data engineering use case in the form of a student portfolio. To this end, students choose a project subject from the various sub-domains of data engineering. Examples include setting up a Docker container environment or dockerized service; implementing a data pipeline according to DataOps principles; and setting up an NoSQL data store.The goal is for students to demonstrate they can transfer theoretical knowledge to an implementation scenario that closely mimics practical work in a professional data engineering setting.

Course Outcomes

On successful completion, students will be able to

- formulate and implement a real-world data engineering use case.
- select appropriate resources for the task at hand.
- transfer acquired specialized knowledge in data engineering to a real-world use case.
- derive relevant design choices from the given project setting.
- analyze the suitability of different solution options with respect to the project task.
- make apposite choices with respect to implementation alternatives.

Contents

- This course covers the practical implementation of approaches and techniques covered in the preceding methodological course in a project-oriented setting. Each participant must produce a portfolio detailing and documenting the work. Porfolio themes are chosen from a list, or suggested by the students in accord with the tutor.

Literature

Compulsory Reading

Further Reading

- Kane, S. P., & Matthias, K. (2018). Docker: Shipping reliable containers in production (2nd ed.). O'Reilly.
- Kleppmann, M. (2017). Designing data-intensive applications: The big ideas behind reliable, scalable, and maintainable systems (1st ed.). O'Reilly.

Study Format Distance Learning

Study Format	**Course Type**
Distance Learning	Project

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

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 ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	**Exam Preparation** ☑ Guideline

Advanced Data Analysis

Module Code: DLBDSEDA1

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. Thomas Zöller (Advanced Data Analysis)

Contributing Courses to Module

- Advanced Data Analysis (DLBDSEDA01)

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

- Business performance analytics
- Text mining
- Web- and social media analytics
- Experimentation and testing

Learning Outcomes	
Advanced Data Analysis On successful completion, students will be able to ▪ identify important design considerations for business KPIs. ▪ explain various topics in business process analytics. ▪ utilize established techniques for web data analytics. ▪ understand analytical approaches to text mining and semantic analysis. ▪ disambiguate relevant questions in social media analytics. ▪ use the techniques and methods for experimentation and testing.	
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

Advanced Data Analysis

Course Code: DLBDSEDA01

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

Course Description

This course introduces several advanced analytics subjects of practical relevance. The subject areas covered span from business performance measurement and analytics, text mining, and web- and social media analytics to current trends in experimental design and setup. Along this journey topics such as the design of key performance indicators (KPIs), business process analytics, word frequency and semantic analysis, data science on clickstreams, social media interactions, and multi-armed bandit testing are addressed.

Course Outcomes

On successful completion, students will be able to

- identify important design considerations for business KPIs.
- explain various topics in business process analytics.
- utilize established techniques for web data analytics.
- understand analytical approaches to text mining and semantic analysis.
- disambiguate relevant questions in social media analytics.
- use the techniques and methods for experimentation and testing.

Contents

1. Business Performance Analytics
   - 1.1 KPI design considerations
   - 1.2 Common business performance indicators
   - 1.3 Business process mining

2. Text Analytics
   - 2.1 Word and document frequency (TF-IDF)
   - 2.2 Semantic analysis

3. Web Analytics
   - 3.1 Web metrics
   - 3.2 Clickstream analytics
   - 3.3 Recommender systems

4. Social Network Mining

4.1 Introduction to social media analytics
4.2 Mining common social media platforms

5. Testing and Experimentation
5.1 Practical A/B testing
5.2 Multivariate tests
5.3 Multi-armed bandit testing

Literature

Compulsory Reading

Further Reading

- Kaushik, A. (2009). Web analytics 2.0: The art of online accountability & science of customercentricity. Wiley.
- Lane, H., Howard, C., & Hapke, H. (2019). Natural language processing in action: Understanding, analyzing, and generating text with Python. Manning.
- Parmenter, D. (2019). Key performance indicators: Developing, implementing, and using winning KPIs (4th ed.). Wiley.
- Russell, M. A., & Klassen, M. (2019). Mining the social web: Data mining Facebook, Twitter, Linkedin, Instagram, Github, and more (3rd ed.). O’Reilly.
- Siroker, D., & Koomen, P. (2013). A/B testing: The most powerful way to turn clicks into customers. Wiley.

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

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

Exam Preparation
- ☑ Practice Exam
- ☑ 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	☑ Online Tests
☑ Recorded Live Sessions	☑ Audio	
	☑ Slides	

Project: Data Analysis

Module Code: DLBDSEDA2

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. Frank Passing (Project: Data Analysis)

Contributing Courses to Module

- Project: Data Analysis (DLBDSEDA02)

Module Exam Type

Module Exam	Split Exam
Study Format: myStudies Portfolio Study Format: Distance Learning Portfolio	

Weight of Module

see curriculum

Module Contents

Transfer of methodological knowledge to the implementation of real-world analytics use cases from the above-mentioned problem domains.

Learning Outcomes	
Project: Data Analysis On successful completion, students will be able to ▪ formulate and implement a real-world analytical use case. ▪ analyze the suitability of different possible approaches with respect to the project task. ▪ transfer acquired specialized analytical knowledge to real-world use cases. ▪ derive relevant design choices from the given project setting. ▪ make apposite choices with respect to implementation alternatives. ▪ select appropriate resources	
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: Data Analysis

Course Code: DLBDSEDA02

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

Course Description

The focus of this course is the implementation of a real-world, advanced analytics use case in the form of a student project. Primary subject areas for this practical work include business performance analytics, text mining, web- and social analytics, and experimentation and testing.The goal is for students to demonstrate they can transfer the theoretical knowledge acquired in Advanced Data Analysis (DLBDSEDA01) to an implementation scenario that closely mimics project work in a professional data science setting.

Course Outcomes

On successful completion, students will be able to

- formulate and implement a real-world analytical use case.
- analyze the suitability of different possible approaches with respect to the project task.
- transfer acquired specialized analytical knowledge to real-world use cases.
- derive relevant design choices from the given project setting.
- make apposite choices with respect to implementation alternatives.
- select appropriate resources

Contents

- This course covers the practical implementation of the approaches and techniques covered in the course Advanced Data Analysis (DLBDSEDA01) in a project-oriented setting. Each participant must produce a project report detailing and documenting their work. Project tasks are chosen from a list or suggested by the students in accord with the tutor.

Literature

Compulsory Reading

Further Reading

- Hapke, H., Howard, C., & Lane, H. (2019). Natural language processing in action. Manning Publications.
- Klassen, M., & Russell, M. A. (2019). Mining the social web (3rd ed.). O'Reilly Media.
- Ojeda, T., Bilbro, R., & Bengfort, B. (2018). Applied text analysis with Python. O'Reilly Media.
- Parmenter, D. (2020). Key performance indicators: Developing, implementing, and using winning KPIs (3rd ed.). John Wiley & Sons.

Study Format myStudies

Study Format	Course Type
myStudies	Project

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

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

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Project

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

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

Artificial Intelligence

Module Code: DLBDSEAIS1

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)

Contributing Courses to Module

- Artificial Intelligence (DLBDSEAIS01)

Module Exam Type

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

Weight of Module

see curriculum

Module Contents

- 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.

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

Artificial Intelligence

Course Code: DLBDSEAIS01

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.This 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.This 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 Time-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

5. Computer Vision
   5.1 Introduction to Computer Vision
   5.2 Image Representation and Geometry
   5.3 Feature Detection
   5.4 Semantic Segmentation

Literature

Compulsory Reading

Further Reading

- Bear, F., Barry, W., & Paradiso, M. (2020). Neuroscience: Exploring the brain (4th ed.). Lippincott Williams & Wilkins.
- Chollet, F. (2018). Deep learning with Python. Manning.
- Géron, A. (2017). Hands-on machine learning with Scikit-Learn and TensorFlow. O'Reilly.
- 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.
- 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.
- 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.). MIT Press. (Adaptive Computation and Machine Learning series).
- Szeliski, R. (2022). Computer vision: Algorithms and applications (2nd ed.). Springer. (Texts in Computer Science series).

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 ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ 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 ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Study Format Duales myStudium

Study Format	**Course Type**
Duales myStudium	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	

Project: Artificial Intelligence

Module Code: DLBDSEAIS2

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: Artificial Intelligence)

Contributing Courses to Module

- Project: Artificial Intelligence (DLBDSEAIS02)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Portfolio Study Format: myStudies Portfolio Study Format: Duales myStudium Portfolio	

Weight of Module

see curriculum

Module Contents

This course focuses on developing a simple AI system for a specific application and domain. A current list of topics is located in the Learning Management System.

Learning Outcomes	
Project: Artificial Intelligence On successful completion, students will be able to ▪ determine the requirements for building an artificial intelligence system. ▪ evaluate an application for an AI system. ▪ transfer theoretically-sound and practically-proven methods and tools to an application domain. ▪ create an AI system for a chosen application.	
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: Artificial Intelligence

Course Code: DLBDSEAIS02

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

Course Description
This project course will give students hands-on experience in the challenging task of designing and developing an AI system for a specific application and domain. Students will need to consider requirements and practical constraints as well as the desired output of the AI system.Following this course the students will get holistic overview of developing a specific AI-based application.
Course Outcomes
On successful completion, students will be able to ▪ determine the requirements for building an artificial intelligence system. ▪ evaluate an application for an AI system. ▪ transfer theoretically-sound and practically-proven methods and tools to an application domain. ▪ create an AI system for a chosen application.
Contents
▪ This project course focuses on understanding and implementing a simple AI system. Based on the course Artificial Intelligence (DLBDSEAI01), students will design and implement a simple AI system. In the first step, students will choose a specific application and domain and then use the methods from the course to analyze the requirements and outcomes before implementing their own AI application. All relevant artifacts and considerations are documented by the students in a course portfolio.

Literature
Compulsory Reading
Further Reading ▪ Bear, M. F., Barry, W. S., & Paradiso, M. A. (2020). Neuroscience: Exploring the brain (4th ed.). Lippincott Williams & Wilkins. ▪ Chollet, F. (2018). Deep learning with Python. Manning. ▪ 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. ▪ 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. ▪ Russell, S. J., & Norvig, P. (2022). Artificial intelligence: A modern approach (4th ed., global ed.). Pearson. ▪ Szeliski, R. (2022). Computer vision: Algorithms and applications (2nd ed. 2022). Springer.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Project

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

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

Study Format myStudies

Study Format	Course Type
myStudies	Project

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

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 Duales myStudium

Study Format	**Course Type**
Duales myStudium	Project

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

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

Time Series Analysis

Module Code: DLBDSTSA

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLBDSSPDS01-01 or DLBDSSPDS01_D and DLBDSSIS01 or DLBDSSIS01_D	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 (Time Series Analysis)

Contributing Courses to Module

- Time Series Analysis (DLBDSTSA01)

Module Exam Type

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

Weight of Module

see curriculum

Module Contents

- Introduction to time series analysis
- Time series components
- Simple models
- ARMA models
- Holt-Winters models
- Advanced topics

Learning Outcomes	
Time Series Analysis On successful completion, students will be able to ▪ identify the fundamental concepts of time series analysis. ▪ cite the components of time series. ▪ create simple time series models. ▪ analyze time series data with ARMA and Holt-Winter models. ▪ understand advanced topics in time series analysis.	
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

Time Series Analysis

Course Code: DLBDSTSA01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	DLBDSSPDS01-01 or DLBDSSPDS01_D and DLBDSSIS01 or DLBDSSIS01_D

Course Description

Many types of data describe patterns of events which occur sequentially and show dependencies on previous events, e.g., the number of guests in a hospitality service or the number of products sold in a retail outlet. These data show a particular temporal structure which can include additional effects such as seasonality or dependencies on external events.This course focuses on understanding time series data. After a general introduction to the elements of time series analysis, this course discusses ARMA-based models (Box-Jenkins approach) and the alternative Holt-Winters formalism, both of which are used for time series analysis and forecasting.This course also includes a discussion about advanced topics in time series analysis such as the handling of multiple seasonalities and framing a problem statement in the context of supervised learning.

Course Outcomes

On successful completion, students will be able to

- identify the fundamental concepts of time series analysis.
- cite the components of time series.
- create simple time series models.
- analyze time series data with ARMA and Holt-Winter models.
- understand advanced topics in time series analysis.

Contents

1. Introduction to Time-Series Analysis
   - 1.1 What are time series?
   - 1.2 Auto-correlation & partial auto-correlation

2. Time-Series Components
   - 2.1 Trend
   - 2.2 Seasonality
   - 2.3 Residuals

3. Simple Models
   - 3.1 Simple average

3.2 Moving average
3.3 Weighted moving average

4. ARMA Models
   4.1 Box-Jenkins formalism
   4.2 Handling non-stationary models: ARIMA
   4.3 Seasonal ARIMA models: SARIMA
   4.4 Seasonal models with external variables: SARIMAX

5. Holt-Winters Models
   5.1 Simple exponential smoothing
   5.2 Dealing with trends: double exponential smoothing
   5.3 Dealing with seasonality: triple exponential smoothing

6. Advanced topics
   6.1 Multiple seasonalities
   6.2 Time series forecasting as a supervised learning problem

Literature

Compulsory Reading

Further Reading

- Brockwell, P. J., & Davis, R. A. (2016). Introduction to time series and forecasting (3rd ed.). Springer.
- Hyndman, R. J., & Athanasopoulos, G. (2021). Forecasting: Principles and practice (3rd ed.). OTexts.
- Nielsen, A. (2019). Practical time series analysis: Prediction with statistics & machine learning. O'Reilly.
- Shumway, R. H., & Stoffer, D. S. (2017). Time series analysis and its applications—With R examples (4th 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	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		

Project: AI Excellence with Creative Prompting Techniques

Module Code: DLBPKIEKPT1_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. Knut Linke (Project: AI Excellence with Creative Prompting Techniques)

Contributing Courses to Module

- Project: AI Excellence with Creative Prompting Techniques (DLBPKIEKPT01_E)

Module Exam Type

Module Exam	Split Exam
Study Format: myStudies Oral Project Report Study Format: Duales myStudium Oral Project Report Study Format: Distance Learning Oral Project Report	

Weight of Module

see curriculum

Module Contents

In this module, the students delve into the world of generative AI applications, creating AI-generated content like text, images, and videos, while learning to use, analyze, and evaluate these systems in their respective study fields.

Learning Outcomes

Project: AI Excellence with Creative Prompting Techniques

On successful completion, students will be able to

- comprehend and apply basic prompting techniques in generative AI applications.
- analyze and evaluate the effectiveness of the basic prompts.
- apply ethical considerations to the design and use of AI for basic prompting techniques.
- design, implement, and refine effective prompts to real-world scenarios through hands-on exercises.
- showcase creative and innovative thinking in the application of prompting techniques to solve complex problems in their field of studies.

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: AI Excellence with Creative Prompting Techniques

Course Code: DLBPKIEKPT01_E

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

Course Description

In this course, students explore the fascinating world of prompting in generative AI applications. They engage in hands-on exercises to create new AI-generated content including text, images, and videos. Through these exercises, students learn how to effectively use, analyze, and evaluate these systems within their respective fields of study.

Course Outcomes

On successful completion, students will be able to

- comprehend and apply basic prompting techniques in generative AI applications.
- analyze and evaluate the effectiveness of the basic prompts.
- apply ethical considerations to the design and use of AI for basic prompting techniques.
- design, implement, and refine effective prompts to real-world scenarios through hands-on exercises.
- showcase creative and innovative thinking in the application of prompting techniques to solve complex problems in their field of studies.

Contents

- In this course, students work on a basic practical implementation of a generative AI use case by choosing from a selection provided in the complementary guideline. The course provides practical examples as learning materials and exercises with basic prompting techniques for open-source text, image, and video generation use cases. The exercises are designed to inspire and guide students in completing their own generative AI use case work, which includes a use case description, chosen prompting techniques, outcomes, and critical evaluations from both technical and ethical perspectives.

Literature
Compulsory Reading
Further Reading ▪ Dang, H., Mecke, L., Lehmann, F., Goller, S., & Buschek, D. (2022). How to prompt? Opportunities and challenges of zero- and few-shot learning for human-AI interaction in creative applications of generative models. arXiv. https://arxiv.org/pdf/2209.01390.pdf ▪ Eapen, T. T., Finkenstadt, D. J., Folk, J., & Venkataswamy, L. (2023). How generative AI can augment human creativity. Harvard Business Review, July–August, 56–64. ▪ Wei, J., Wang, X., Schuurmans, D., Bosma, M. Ichter, B., Xia, F., Chi, E. H., Le., Q. V., & Zhou, D. (2023). Chain-of-though prompting elicit reasoning in large language models. arXiv. https://arxiv.org/pdf/2201.11903.pdf

Study Format myStudies

Study Format	Course Type
myStudies	Project

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Oral 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 ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	**Learning Material** ☑ Slides	**Exam Preparation** ☑ Guideline

Study Format Duales myStudium

Study Format	Course Type
Duales myStudium	Project

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Oral 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 Distance Learning

Study Format	**Course Type**
Distance Learning	Project

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

Smart Factory I

Module Code: DLBDSESF1

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

Sahar Qaadan (Smart Factory I)

Contributing Courses to Module

- Smart Factory I (DLBDSESF01)

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

- Motivation and Definition of Terms
- Development of Automation
- Technological Basics and Standards
- Basic concepts of a Smart Factory
- Reference Architectures
- Smart Factory Engineering
- Safety and Security

Learning Outcomes	
Smart Factory I On successful completion, students will be able to ▪ understand the term Smart Factory in the context of Industry 4.0. ▪ be able to trace the development of automation to a fully autonomous, non-centrally organized production plant. ▪ understand the basic technologies and standards used to design and operate a Smart Factory. ▪ understand the essential concepts of a Smart Factory. ▪ identify and differentiate between the individual elements of a Smart Factory using different reference architectures. ▪ understand the special engineering challenges in the Smart Energy context. ▪ understand the special safety risks of digitized and networked production plants and assign concrete recommendations for action.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Computer Science & Software Development	**Links to other Study Programs of the University** All Bachelor Programs in the IT & Technology field

Smart Factory I

Course Code: DLBDSESF01

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

Course Description

In this course, students will gain a deeper insight into the networking and digitization of production facilities by examining a Smart Factory. For this purpose, they will be familiarized with the basic goals of a Smart Factory in the context of the research complex Industry 4.0. After a brief introduction to the history of automation, students will learn the technical basics and standards required to design and operate a Smart Factory. Building on this, they will learn how these individual technologies are used to implement the central concepts of a Smart Factory. In order to understand which components a Smart Factory consists of, different reference architectures are presented and compared. The course concludes with the special engineering challenges of an autonomously acting and decentralized production plant. Above all, this includes IT security, which is particularly relevant due to the digital networking of production facilities and products.

Course Outcomes

On successful completion, students will be able to

- understand the term Smart Factory in the context of Industry 4.0.
- be able to trace the development of automation to a fully autonomous, non-centrally organized production plant.
- understand the basic technologies and standards used to design and operate a Smart Factory.
- understand the essential concepts of a Smart Factory.
- identify and differentiate between the individual elements of a Smart Factory using different reference architectures.
- understand the special engineering challenges in the Smart Energy context.
- understand the special safety risks of digitized and networked production plants and assign concrete recommendations for action.

Contents

1. Motivation and Definition of Terms
    - 1.1 Goals of Smart Factory
    - 1.2 Internet of Things
    - 1.3 Cyber-Physical Systems
    - 1.4 Cyber-Physical Production Systems
    - 1.5 Smart Factory as a Cyber-Physical (Production) System

Literature
Compulsory Reading
Further Reading ▪ Butun, I. (2020). Industrial IoT: Challenges, design principles, applications, and security. Springer. ▪ Drossel, W. G., Ihlenfeldt, S., Lanzger, T., & Dumitrescu, R. (2019). Cyber-physical systems. In R. Neugebauer (Ed.), Digital transformation (pp. 189—213). Springer. ▪ Durakbasa, N. M., & Gençyılmaz, M. G. (Eds.). (2021). Digital conversion on the way to Industry 4.0. Springer. ▪ Ustundag, A., & Cevikcan, E. (2018). Industry 4.0: Managing the digital transformation. Springer.

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	

Production Engineering Industry 4.0

Module Code: DLBDSEAR1

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. Hans Kerwat (Production Engineering Industry 4.0)

Contributing Courses to Module

- Production Engineering Industry 4.0 (DLBDSEAR01)

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

- Introduction to Manufacturing Technology
- Main Production Groups According to DIN 8580
- Additive Manufacturing Processes
- Rapid Prototyping
- Rapid Tooling
- Direct/Rapid Manufacturing
- Cyber-Physical Production Plants

Learning Outcomes	
Production Engineering Industry 4.0 On successful completion, students will be able to ▪ understand the basic concepts and interrelationships of production engineering. ▪ understand current changes in manufacturing technology due to technologies such as additive manufacturing and megatrends such as cyber physical systems. ▪ assign different manufacturing processes to the main manufacturing groups according to DIN 8580. ▪ understand the basic principle of additive manufacturing processes. ▪ distinguish between different additive manufacturing processes. ▪ understand the terms Rapid Prototyping, Rapid Tooling, and Direct Manufacturing and name individual processes and application examples. ▪ understand the elements and properties of cyber-physical production plants.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Computer Science & Software Development	**Links to other Study Programs of the University** All Bachelor Programs in the IT & Technology field

Production Engineering Industry 4.0

Course Code: DLBDSEAR01

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 provide students with an overview of the processes that have influenced and still influence production processes through technological developments under the generic term Industry 4.0, based on traditional, standardized manufacturing techniques. These include, in particular, technological advances in additive manufacturing processes that enable applications such as rapid prototyping, rapid tooling, and direct manufacturing. Finally, the course deals with the consequences of the digitalization and networking of production facilities and their elements in the sense of a cyber-physical system.

Course Outcomes

On successful completion, students will be able to

- understand the basic concepts and interrelationships of production engineering.
- understand current changes in manufacturing technology due to technologies such as additive manufacturing and megatrends such as cyber physical systems.
- assign different manufacturing processes to the main manufacturing groups according to DIN 8580.
- understand the basic principle of additive manufacturing processes.
- distinguish between different additive manufacturing processes.
- understand the terms Rapid Prototyping, Rapid Tooling, and Direct Manufacturing and name individual processes and application examples.
- understand the elements and properties of cyber-physical production plants.

Contents

1. Introduction to Manufacturing Technology
   - 1.1 Basic Terms and Contexts in Manufacturing Theory
   - 1.2 Historical Development of Production
   - 1.3 The Discussion About the Long Tail

2. Classification Of Manufacturing Processes
   - 2.1 Casting and Molding
   - 2.2 Forming
   - 2.3 Machining
   - 2.4 Joining

Literature
Compulsory Reading
Further Reading ▪ Anderson, C. (2012). Makers: The new industrial revolution. Crown Business. ▪ Gebhardt, A., Kessler, J. & Thurn, L. (2019). 3D printing: Understanding additive manufacturing (2nd ed). Hanser. ▪ Groover, M. P. (2012). Fundamentals of modern manufacturing: Materials, processes, and systems (5th ed.). Wiley.

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	

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 ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video ☑ Slides	☑ Practice Exam ☑ Online Tests

Automation and Robotics

Module Code: DLBDSEAR2

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 (Automation and Robotics)

Contributing Courses to Module

- Automation and Robotics (DLBDSEAR02)

Module Exam Type

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

Weight of Module

see curriculum

Module Contents

- Basics of Automation
- Fundamentals of Measurement Technology
- Sensors
- Basics of Control Engineering
- Basics of Control Technology
- Introduction to Robotics
- Kinematics of a Robot

Learning Outcomes	
Automation and Robotics On successful completion, students will be able to ▪ understand the basic aspects of automation. ▪ understand the different sizes and units in measurement technology. ▪ differentiate between different measurement methods. ▪ understand the basic structure of measuring equipment. ▪ select a suitable sensor based on various criteria. ▪ understand the elements of control systems. ▪ describe the behavior of control systems in the time and frequency domain. ▪ understand the basic principles of control technology. ▪ convert between different number systems and apply Boolean algebra. ▪ understand the structure of switching networks, plants, and storages. ▪ understand important elements of control systems such as signal generators and power amplifiers. ▪ design simple programmable logic controllers. ▪ understand the basic structure of industrial robots. ▪ calculate different movements and positions of jointed-arm robots.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Computer Science & Software Development	**Links to other Study Programs of the University** All Bachelor Programs in the IT & Technology field

Automation and Robotics

Course Code: DLBDSEAR02

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 provide students with an insight into measurement, control, and regulation technology and convey the basics of robotics. Students will be taught which methods can be used to determine certain measured variables and how measurement errors are dealt with. Based on these fundamentals, various sensors will be presented and students will be able to select suitable sensors based on predefined criteria. The course also introduces students to the basics of control engineering. The different ways of describing the structure and behaviour of control systems are illustrated to the students. The basics of control engineering are also taught. The students receive a short introduction to binary number systems and Boolean algebra, and deal with various basal circuit and control elements. Finally, students will gain an insight into robotics with a focus on industrial robots. In this context, the students learn the description and calculation of positions and movements of individual limbs of a robot arm.

Course Outcomes

On successful completion, students will be able to

- understand the basic aspects of automation.
- understand the different sizes and units in measurement technology.
- differentiate between different measurement methods.
- understand the basic structure of measuring equipment.
- select a suitable sensor based on various criteria.
- understand the elements of control systems.
- describe the behavior of control systems in the time and frequency domain.
- understand the basic principles of control technology.
- convert between different number systems and apply Boolean algebra.
- understand the structure of switching networks, plants, and storages.
- understand important elements of control systems such as signal generators and power amplifiers.
- design simple programmable logic controllers.
- understand the basic structure of industrial robots.
- calculate different movements and positions of jointed-arm robots.

Contents

1. Basics of Automation
   1.1 Basic Terms

6. Introduction to Robotics
   - 6.1 Terms and Classification
   - 6.2 Basic Elements
   - 6.3 Classification of Robots

7. Kinematics of a Robot
   - 7.1 Coordinate Systems and Reference Points
   - 7.2 Rotations
   - 7.3 Forward and Reverse Transformations
   - 7.4 Denavit-Hartenberg Transformation

Literature

Compulsory Reading

Further Reading

- Gardner, R. (2021). Introduction to plant automation and controls. Taylor & Francis.
- Jazar, R. (2010). Theory of applied robotics: Kinematics, dynamics, and control (2nd ed.). Springer.
- Moir, T. (2020). Feedback. Springer.
- Morris, A. S., & Langari, R. (2020). Measurement and instrumentation: Theory and application (3rded.). Academic Press.
- Tse, F. S., & Morse, I. E. (2009). Measurement and instrumentation in engineering. CRC Press.

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		

Self-Driving Vehicles

Module Code: DLBDSEAD1

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 (Self-Driving Vehicles)

Contributing Courses to Module

- Self-Driving Vehicles (DLBDSEAD01)

Module Exam Type

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

Weight of Module

see curriculum

Module Contents

- Safety Standards
- Sensor Fusion
- Computer Vision
- Localization & Motion
- Motion Planning

Learning Outcomes	
Self-Driving Vehicles On successful completion, students will be able to ▪ cite relevant safety standards. ▪ grasp the concepts of sensors and sensor fusion. ▪ apply computer vision techniques to detect features. ▪ evaluate images in terms of semantic segmentation. ▪ understand motion models and localization approaches. ▪ utilize motion planning techniques.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Engineering	**Links to other Study Programs of the University** All Bachelor Programs in the IT & Technology field

Self-Driving Vehicles

Course Code: DLBDSEAD01

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

Course Description

This course focuses on the foundations of autonomous vehicles and starts with a detailed introduction to relevant safety standards in terms of functional and IT security.This course continues with a presentation of the concept of sensor fusion and discusses relevant aspects of computer vision techniques such as feature detection, calibration, and semantic segmentation.A large part of the course concerns localization and motion planning. Relevant motion models are introduced and localization techniques such as odometry, triangulation, and satellite-based systems are discussed in detail, along with path planning, motion prediction, and trajectory generation.

Course Outcomes

On successful completion, students will be able to

- cite relevant safety standards.
- grasp the concepts of sensors and sensor fusion.
- apply computer vision techniques to detect features.
- evaluate images in terms of semantic segmentation.
- understand motion models and localization approaches.
- utilize motion planning techniques.

Contents

1. Sensors
   - 1.1 Physical principles of sensors
   - 1.2 Types of sensors
   - 1.3 Sensor calibration
   - 1.4 Application scenarios
2. Sensor Fusion
   - 2.1 Elaborating data from sensors
   - 2.2 The Kalman filter
   - 2.3 Object tracking
3. Computer Vision
   - 3.1 Pixels and filters

3.2 Feature detection
3.3 Semantic segmentation

4. Localization & Motion
   4.1 Motion models
   4.2 Trilateration
   4.3 Satellite-based localization

5. Motion planning
   5.1 Mission planning
   5.2 Behavior Planning
   5.3 Local Planning

6. Safety Standards
   6.1 Functional Safety
   6.2 Safety of Intended Functionality
   6.3 IT Security

Literature

Compulsory Reading

Further Reading

- LaValle, S. M. (2006). Planning algorithms. Cambridge University Press.
- Sciavicco, L., Villani, L., Oriolo, G., & Siciliano, B. (2009). Robotics: modelling, planning andcontrol. Springer.
- Thrun, S. (2002). Probabilistic robotics. Communications of the ACM, 45(3), 52-57.
- Watzenig, D., & Horn, M. (2016). Automated driving: Safer and more efficient future driving. Springer.

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	

Study Format Duales myStudium

Study Format	Course Type
Duales myStudium	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 ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video ☑ Slides	☑ Practice Exam ☑ 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	☑ Online Tests
☑ Recorded Live Sessions	☑ Slides	

Seminar: Current Topics and Trends in Self-Driving Technology

Module Code: DLBDSEAD2

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 (Seminar: Current Topics and Trends in Self-Driving Technology)

Contributing Courses to Module

- Seminar: Current Topics and Trends in Self-Driving Technology (DLBDSEAD02)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Written Assessment: Research Essay Study Format: Duales myStudium Written Assessment: Research Essay Study Format: myStudies Written Assessment: Research Essay	

Weight of Module

see curriculum

Module Contents

The seminar covers current topics of autonomous vehicles. The choice of topics can include (but are not limited to) recent technical advances as well as philosophical issues or implications for society, law, or relevant industries.

Learning Outcomes	
Seminar: Current Topics and Trends in Self-Driving Technology On successful completion, students will be able to ▪ transfer theoretical knowledge and methods to new domains. ▪ understand recent developments in self-driving vehicles. ▪ create new insights based on detailed studies of current research and technology.	
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 Engineering	All Bachelor Programs in the IT & Technology field

Seminar: Current Topics and Trends in Self-Driving Technology

Course Code: DLBDSEAD02

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

Course Description

This courses focuses on recent developments in the field of self-driving vehicles. Following the course Self-Driving Vehicles (DLBDSEAD01), in this course students will focus on a particular topic in the context of autonomous driving, applying the knowledge they have obtained in the first course.Finally, a research essay will be written.

Course Outcomes

On successful completion, students will be able to

- transfer theoretical knowledge and methods to new domains.
- understand recent developments in self-driving vehicles.
- create new insights based on detailed studies of current research and technology.

Contents

- The seminar covers current topics of autonomous vehicles. The choice of topics can include (but are not limited to) recent technical advances as well as philosophical issues or implications for society, law, or relevant industries.

Literature

Compulsory Reading

Further Reading

- Ben-Ari, M., & Mondada, F. (2018). Elements of robotics. Springer.
- European Union. (2001). Directive 2001/95/EC.
- Fisher, R. B., Breckon, T. P., Dawson-Howe, K., Fitzgibbon, A., Robertson, C., Trucco, E., & Williams, C. K. I. (2016). Dictionary of computer vision and image processing. John Wiley & Sons.
- Smith, D. J., & Simpson, K. (2016). The safety critical systems handbook (4th ed.). Elsevier.
- Smith, D. J. (2017). Reliability, maintainability, and risk (9th ed.). Elsevier.
- Society of Automobile Engineers International. (2012). SAE J3061.
- Szeliski, R. (2022). Computer vision: Algorithms and applications (2nd ed.). Springer.
- Wang, P. K.-C. (2015). Visibility-based optimal path and motion planning (Vol. 568). Springer.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Seminar

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

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

Study Format Duales myStudium

Study Format	Course Type
Duales myStudium	Seminar

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

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

Study Format myStudies

Study Format	Course Type
myStudies	Seminar

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

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

International Marketing

Module Code: DLBDSEIMB1

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. Josephine Zhou-Brock (International Marketing)

Contributing Courses to Module

- International Marketing (DLBDSEIMB01)

Module Exam Type	
Module Exam <u>Study Format: myStudies</u> Exam, 90 Minutes <u>Study Format: Distance Learning</u> Exam, 90 Minutes	**Split Exam**
Weight of Module see curriculum	

Module Contents

- International marketing strategy
- Cultural differences and their significance for marketing
- International marketing mix (product, price, promotion, and distribution decisions in an international environment)
- International market research and consumer behavior
- Ethical aspects in international marketing
- International marketing controlling and six sigma

Learning Outcomes	
International Marketing On successful completion, students will be able to ▪ understand basic aspects of international strategic marketing. ▪ analyze cultural differences and their impact on international marketing. ▪ apply selected concepts of the international marketing mix. ▪ describe the possibilities of international market research and its influence on consumer behavior. ▪ recognize the necessity of international brand controlling and quality management. ▪ reproduce theoretical knowledge using case studies.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Marketing & Sales	**Links to other Study Programs of the University** All Bachelor Programs in the Marketing & Communication field

International Marketing

Course Code: DLBDSEIMB01

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

Course Description

Students are taught the necessity for strategic marketing in an international context. They will learn about essential cultural differences and their influences on international marketing management. The basic decisions, standardizations, and adaptations in international marketing are experienced by the students on the basis of different concepts in the international marketing mix. The necessity of international market research, strategic planning, and control are taught to the students, along with the ethical aspects in international marketing. The students analyze current topics in international marketing management and reflect on them in connection with the concepts they have learned in this course.

Course Outcomes

On successful completion, students will be able to

- understand basic aspects of international strategic marketing.
- analyze cultural differences and their impact on international marketing.
- apply selected concepts of the international marketing mix.
- describe the possibilities of international market research and its influence on consumer behavior.
- recognize the necessity of international brand controlling and quality management.
- reproduce theoretical knowledge using case studies.

Contents

1. Strategic International Marketing
   - 1.1 Internationalization
   - 1.2 Theoretical Foundations of International Market Entry Strategies
   - 1.3 Forms of International Market Entry
2. Cultural Differences as an Aspect of International Marketing
   - 2.1 Overview of Culture
   - 2.2 Cultural Model Based on Hofstede
   - 2.3 Cultural Model Based on Trompenaars
3. Case Studies in International Market Entry and Marketing Strategies
   - 3.1 Case Study: Nivea in South Korea

Literature
Compulsory Reading
Further Reading ▪ Armstrong, G., Kotler, P., & Opresnik, M. O. (2019). Marketing: An introduction (14th ed.). Pearson. ▪ Hofstede, G., Hofstede, G. J., & Minkov, M. (2010). Cultures and organizations—Software of the mind: Intercultural cooperation and its importance for survival. McGraw-Hill. ▪ Hollensen, S. (2020). Global marketing (8th ed.). Pearson.

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 ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video	☑ Practice Exam ☑ 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 ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video	☑ Practice Exam ☑ Online Tests

Applied Sales I

Module Code: DLBDSEAS1

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

Tanja Moehler (Applied Sales I)

Contributing Courses to Module

- Applied Sales I (DLBDSEAS01)

Module Exam Type	
Module Exam	**Split Exam**
<u>Study Format: Distance Learning</u> Exam, 90 Minutes	
Weight of Module see curriculum	

Module Contents

- Fundamentals of Applied Sales
- The Distribution System
- Personal Sales
- Sales Plans
- New Customer Acquisition
- A Sales Visit
- Conversational Tactics
- Conducting Negotiations
- Other Sales Channels

Learning Outcomes	
Applied Sales I On successful completion, students will be able to ▪ understand the fundamentals of applied sales and place them in the context of the company. ▪ understand the interaction of the individual facets of applied sales. ▪ differentiate between and evaluate individual sales systems. ▪ describe current sales types and sales characteristics. ▪ oversee and classify the entire sales process from customer acquisition to customer retention. ▪ understand the basics of sales and negotiation management and apply them. ▪ name the usual sales instruments, recognize their advantages and disadvantages, and reflect on essential fields of application and possibilities.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Marketing & Sales	**Links to other Study Programs of the University** All Bachelor Programs in the Marketing & Communication field

Applied Sales I

Course Code: DLBDSEAS01

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

Course Description

The demands on sales thinking are growing every day. Globalized demand combined with high competition is making it increasingly difficult for companies to compete for customers. At the same time, customers are becoming better informed, while traditional supply markets are saturated and at overcapacity. In order to be successful in such an environment, sales thinking and action are required along with a new type of salesperson. Within the course Applied Sales I (Introduction), the participants are familiarized with the basic concepts of applied sales. You will learn about sales organization, dealing with alternative sales channels, and get to know the dedicated sales planning process. The contents of the module are complemented by the successful acquisition of new customers, whereby particular attention is paid to the organization and implementation of customer visits and the conduct of discussions and negotiations.

Course Outcomes

On successful completion, students will be able to

- understand the fundamentals of applied sales and place them in the context of the company.
- understand the interaction of the individual facets of applied sales.
- differentiate between and evaluate individual sales systems.
- describe current sales types and sales characteristics.
- oversee and classify the entire sales process from customer acquisition to customer retention.
- understand the basics of sales and negotiation management and apply them.
- name the usual sales instruments, recognize their advantages and disadvantages, and reflect on essential fields of application and possibilities.

Contents

1. Fundamentals of Applied Sales and Distribution
   - 1.1 Tasks and Forms of Applied Distribution
   - 1.2 Marketing as the Basis of Sales
   - 1.3 Distribution, Sales, and Other Terms
   - 1.4 Sales in Different Economic Sectors

2. The Distribution System

9. Other Sales Channels
   - 9.1 Telemarketing
   - 9.2 Catalogue and Brochure Sales
   - 9.3 Internet and E-Commerce

Literature

Compulsory Reading

Further Reading

- Bloomfield, J. (2020). NeuroSelling: Mastering the customer conversation using the surprising science of decision making. Axon Publishing.
- Jobber, D., Lancaster, G., & Le Meunier-FitzHugh, K. (2019). Selling and sales management (10th ed.). Pearson.
- Peppers, D., & Rogers, M. (2016). Managing customer experience and relationships: A strategic framework (3rd ed.). Wiley.
- Pink, D. H. (2012). To sell is human: The surprising truth about moving others. Riverhead 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	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	

Applied Sales II

Module Code: DLBDSEAS2

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

Tanja Moehler (Applied Sales II)

Contributing Courses to Module

- Applied Sales II (DLBDSEAS02)

Module Exam Type	
Module Exam Study Format: Distance Learning Exam or Advanced Workbook, 90 Minutes	**Split Exam**
Weight of Module see curriculum	

Module Contents

- Marketing and Sales
- Customer Satisfaction as a Success Factor
- Personalities in Sales
- Customer-Oriented Communication
- Presentation and Rhetoric
- Customer Loyalty
- Networking
- Case Study

Learning Outcomes	
Applied Sales II On successful completion, students will be able to ▪ understand the interaction and the respective areas of responsibility of marketing and sales. ▪ reflect on and classify the goals and measures within the framework of the applied sales system. ▪ assess the relevance of customer satisfaction and retention. In addition, the students will be familiar with the central design elements of CRM. ▪ reflect on and assess alternative approaches to customer loyalty and relationship management and apply them in business practice. ▪ understand the meaning of the terms customer life cycle and customer value, and develop approaches to manage them in the sense of the respective sales targets. ▪ use descriptive presentation techniques in order to convince customers and other sales partners. ▪ understand the relevance of networking and develop strategies to broaden the contact base. ▪ develop and evaluate their own market analyses and sales concepts on the basis of practical experience within the framework of the case study.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Marketing & Sales	**Links to other Study Programs of the University** All Bachelor Programs in the Marketing & Communication field

Applied Sales II

Course Code: DLBDSEAS02

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

Course Description

The course Applied Sales II builds on the basics taught in the course "Applied Sales I" and broadens and deepens them. First, the tension between marketing and sales is examined in more detail. Based on this, essential backgrounds and central target figures for successful sales management (e.g., customer satisfaction and loyalty as well as the customer life cycle) are derived and operationalized in order to create the basis for efficient and effective customer relationship management. As the process progresses, attention will also be paid to mental processes and consumer behavior in general. In addition, strategies and paths to successful negotiation are deepened and supplemented by convincing communication techniques. The course concludes with a case study in the course of which the students have the opportunity to apply what they have learned in a practice-oriented manner.

Course Outcomes

On successful completion, students will be able to

- understand the interaction and the respective areas of responsibility of marketing and sales.
- reflect on and classify the goals and measures within the framework of the applied sales system.
- assess the relevance of customer satisfaction and retention. In addition, the students will be familiar with the central design elements of CRM.
- reflect on and assess alternative approaches to customer loyalty and relationship management and apply them in business practice.
- understand the meaning of the terms customer life cycle and customer value, and develop approaches to manage them in the sense of the respective sales targets.
- use descriptive presentation techniques in order to convince customers and other sales partners.
- understand the relevance of networking and develop strategies to broaden the contact base.
- develop and evaluate their own market analyses and sales concepts on the basis of practical experience within the framework of the case study.

Contents

1. Marketing and Sales
    - 1.1 Marketing and Business Philosophy
    - 1.2 Sales Marketing in Different Economic Sectors
    - 1.3 Relationship Marketing

Literature
Compulsory Reading
Further Reading ▪ Homburg, C., Schäfer, H., & Schneider, J. (2012). Sales excellence: Systematic sales management. Springer Science & Business Media. ▪ Ingram, T. N., Schwepker, C. H., Williams, M. R., Avila, R. A., & LaForge, R. W. (2020). Salesmanagement: Analysis and decision making (10th ed.). Routledge, Taylor & Francis Group. ▪ Kotler, P., & Keller, K. L. (2021). Marketing management (16th, global ed.). Pearson Education.

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 or Advanced Workbook, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
100 h	0 h	25 h	25 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	☑ Guideline
	☑ Slides	

Managerial Economics

Module Code: DLBBWME_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

Tolga Ülkü (Managerial Economics)

Contributing Courses to Module

- Managerial Economics (DLBBWME01_E)

Module Exam Type

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

Weight of Module

see curriculum

Module Contents	
▪ Basics ▪ The Invisible Hand of the Market ▪ Consumer Decisions ▪ Business Decisions I: Full Competition ▪ Business Decisions II: Partial Competition ▪ Business Decisions III: Game Theory ▪ Advanced Microeconomics	
Learning Outcomes **Managerial Economics** On successful completion, students will be able to ▪ understand basic economic interrelationships and apply them to different markets. ▪ explain the importance of supply, demand and market balance. ▪ assess the determinants of consumers' willingness to pay. ▪ discuss the determinants of production decisions and identify peak entrepreneurial strategies. ▪ assess the influence of different types of markets on production and price decisions. ▪ analyse strategic interactions between companies. ▪ critically question traditional economic models on the basis of findings from information and behavioural economics.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Economics	**Links to other Study Programs of the University** All Bachelor Programs in the Business field

Managerial Economics

Course Code: DLBBWME01_E

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

Course Description

The source for (almost) all economic questions is the issue of scarcity. Building on this insight, this course considers three central elements. First, an analysis of the interplay between supply and demand on markets is made. Secondly, the course will consider the development of insights into the behaviour of consumers in markets. In a third part, the course will focus on entrepreneurial decisions that depend, among other things, on production technology available and competitive conditions in markets. These three core elements are taught from an application-oriented standpoint, in which references to (current) challenges of the management of companies are established. The course includes both the examination of economic theories and their application in business practice.

Course Outcomes

On successful completion, students will be able to

- understand basic economic interrelationships and apply them to different markets.
- explain the importance of supply, demand and market balance.
- assess the determinants of consumers' willingness to pay.
- discuss the determinants of production decisions and identify peak entrepreneurial strategies.
- assess the influence of different types of markets on production and price decisions.
- analyse strategic interactions between companies.
- critically question traditional economic models on the basis of findings from information and behavioural economics.

Contents

1. Basics
   - 1.1 Definitions & Main Topics of Economics
   - 1.2 Thinking like an Economist

2. The Invisible Hand of the Market
   - 2.1 Supply and Demand
   - 2.2 Market Balance
   - 2.3 Flexibility
   - 2.4 Applications

3. Consumer Decisions
   - 3.1 Utility Theory
   - 3.2 Willingness to Pay
   - 3.3 Demand
   - 3.4 Applications

4. Business Decisions I: Full Competition
   - 4.1 Production
   - 4.2 Costs
   - 4.3 Supply
   - 4.4 Applications

5. Business Decisions II: Partial Competition
   - 5.1 Monopoly
   - 5.2 Monopolistic Competition
   - 5.3 Oligopoly

6. Business Decisions III: Game Theory
   - 6.1 Methodology
   - 6.2 Simultaneous Games
   - 6.3 Sequential Games

7. Advanced Microeconomics
   - 7.1 Information Economics
   - 7.2 Behavioural Economics

Literature
Compulsory Reading
Further Reading ▪ Acemoglu, D., Laibson, D., & List, J. A. (2018). Microeconomics (Global edition, 2nd ed.). Pearson. ▪ Case, K. E., Fair, R. C., & Osten, S. M. (2019). Principles of economics (Global edition, 13th ed.). Harlow. ▪ Keat, P. G., & Young, P. K. Y. (2013). Managerial economics (Global Edition, 7th ed.). Pearson Education Limited. ▪ Leyton-Brown, K., & Shoham, Y. (2008). Essentials of game theory: A concise multidisciplinary introduction. Morgan & Claypool. ▪ Parkin, M. (2019). Economics (13th ed.). Harlow. ▪ Pindyck, R. S., & Rubinfeld, D. L. (2017). Microeconomics (9th ed.). Pearson.

Study Format Duales myStudium

Study Format	Course Type
Duales myStudium	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		

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		

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 ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	**Learning Material** ☑ Course Book ☑ Video	**Exam Preparation** ☑ Practice Exam ☑ Online Tests

Supply Chain Management I

Module Code: DLBDSESCM1

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. Alex Leberling (Supply Chain Management I)

Contributing Courses to Module

- Supply Chain Management I (DLBDSESCM01)

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

- Historical and terminological aspects of the SCM concept
- Motives for the creation of cross-company value creation networks
- Design principles and effects of value creation networks
- Logistical core processes and SCM
- Information technology aspects of the SCM concept
- Coordination and collaboration of the network partners
- Industry-specific solutions of the SCM

Learning Outcomes	
Supply Chain Management I On successful completion, students will be able to ▪ explain the importance of cross-company value creation processes. ▪ understand common concepts for modeling cross-company value creation processes. ▪ understand dynamic effects in supply chains and can systematize their causes and effects. ▪ explain important theoretical concepts for describing the characteristics and challenges of cross-company value creation processes. ▪ explain the approaches and problem categories commonly used in the context of supply chain management. ▪ understand important reference and/or management models for the concretization of supply chain systems. ▪ name and detail important roles and tasks in the SCM network. ▪ deal with the coordination problem of SCM and describe the common solution approaches.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Transportation & Logistics	**Links to other Study Programs of the University** All Bachelor Programs in the Transport & Logistics field

Supply Chain Management I

Course Code: DLBDSESCM01

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

Course Description

SCM proves to be an extremely multi-faceted construct from both a theoretical and a practical point of view. An adequate understanding of the problem dimensions and modes of action of (global) cross-company value creation networks requires a multidimensional approach. It starts by considering logistical processes, with modern process, flow, and network standards forming an important basis for SCM. On the basis of such an approach, students should gain a fundamental understanding of SCM. From the point of view of a holistic approach, it also makes sense to also examine a number of other typical problem areas in addition to the logistical challenges of this concept. This includes IT aspects of SCM (e.g., APS systems), and questions to do with the collaboration and coordination of network partners. This course also considers selected industry specific SCM solutions (ECR or VMI).

Course Outcomes

On successful completion, students will be able to

- explain the importance of cross-company value creation processes.
- understand common concepts for modeling cross-company value creation processes.
- understand dynamic effects in supply chains and can systematize their causes and effects.
- explain important theoretical concepts for describing the characteristics and challenges of cross-company value creation processes.
- explain the approaches and problem categories commonly used in the context of supply chain management.
- understand important reference and/or management models for the concretization of supply chain systems.
- name and detail important roles and tasks in the SCM network.
- deal with the coordination problem of SCM and describe the common solution approaches.

Contents

1. Fundamentals of the Supply Chain Concept
   - 1.1 Terminological and Conceptual Fundamentals
   - 1.2 Supply Chain Typology According to Otto
   - 1.3 Supply Chain Typology According to Bechtel/Jayaram
   - 1.4 Dynamic Aspects of Supply Chains

Literature

Compulsory Reading

Further Reading

- Bowersox, J., Closs, D., & Cooper, M. B. (2020). Supply chain logistics management (5th ed.). McGraw Hill Education.
- Chopra, S., & Meindl, P. (2019). Supply chain management: Strategy, planning, and operation (7th ed., Global ed.). Pearson Education.
- Es-Satty, Asmaa; Lemghari, Radouane; Okar, Chafik. (2020). Supply Chain Digitalization Overview SCOR model implication. In: 2020 IEEE 13th International Colloquium of Logistics and Supply Chain Management (LOGISTIQUA) Logistics and Supply Chain Management (LOGISTIQUA), 2020 IEEE 13th International Colloquium of. :1-7 Dec, 2020; IEEE Language: English, Datenbank: IEEE Xplore Digital Library.
- Tarigan, Z. J. H., Siagian, H., & Jie, F. (2021). Impact of enhanced enterprise resource planning (ERP) on firm performance through green supply chain management. Sustainability, 13(8), article 4358.

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	

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 ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video ☑ Slides	☑ Practice Exam ☑ Online Tests

Supply Chain Management II

Module Code: DLBDSESCM2

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. (Supply Chain Management II)

Contributing Courses to Module
▪ Supply Chain Management II (DLBDSESCM02)

Module Exam Type	
Module Exam Study Format: myStudies Exam or Advanced Workbook, 90 Minutes Study Format: Distance Learning Exam or Advanced Workbook, 90 Minutes	**Split Exam**
Weight of Module see curriculum	

Module Contents

- Strategic aspects of SCM
- SCM Practice: Tasks and Activities in the Core Planning Process
- SCM Practice: Tasks and Activities in the Core Process of Procurement
- SCM Practice: Tasks and Activities in the Core Process Production
- SCM Practice: Tasks and Activities in the Core Distribution Process

Learning Outcomes

Supply Chain Management II

On successful completion, students will be able to

- systematically explain the strategic relevance of enterprise-wide value creation processes.
- understand the most important tasks and problems in the SCM core process planning.
- systematize the elements and interrelationships in the CPFR model in a differentiated way.
- be familiar with the characteristics and peculiarities of contract logistics.
- understand the most important tasks and problems in the SCM core process procurement.
- explain central elements and characteristics of a procurement strategy.
- understand the most important tasks and problems in the SCM core process production.
- explain central elements and characteristics of a modern production strategy.
- understand the most important tasks and problems in the SCM core process distribution.
- explain central elements and characteristics of the so-called ECR concept.

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 Transportation & Logistics	All Bachelor Programs in the Transport & Logistics field

Supply Chain Management II

Course Code: DLBDSESCM02

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

Course Description

From the perspective of strategic management research and practice, the activities covered by the term SCM are closely related to efforts to build and/or maintain a stable operational competitive advantage. A fundamental discussion of this relationship forms the starting point for the course. On this basis, a differentiated analysis of strategy-relevant activities and instruments in the Plan, Source, Make, Deliver, and Return process categories is then carried out using the SCOR model. Special attention is given to the practice-relevant areas of SCM, e.g., order-promising (plan), supplier-relation-management (source), postponement (make), and the ECR-concept (deliver).

Course Outcomes

On successful completion, students will be able to

- systematically explain the strategic relevance of enterprise-wide value creation processes.
- understand the most important tasks and problems in the SCM core process planning.
- systematize the elements and interrelationships in the CPFR model in a differentiated way.
- be familiar with the characteristics and peculiarities of contract logistics.
- understand the most important tasks and problems in the SCM core process procurement.
- explain central elements and characteristics of a procurement strategy.
- understand the most important tasks and problems in the SCM core process production.
- explain central elements and characteristics of a modern production strategy.
- understand the most important tasks and problems in the SCM core process distribution.
- explain central elements and characteristics of the so-called ECR concept.

Contents

1. Strategic Aspects of SCM
   - 1.1 Strategic Thinking and Action: General Information
   - 1.2 Competition Focus and SCM
   - 1.3 Competition Location and SCM
   - 1.4 Competition Rules and SCM

2. SCM Practice: Core Process Planning
   - 2.1 General Preliminary Considerations
   - 2.2 Collaborative Planning, Forecasting, and Replenishment
   - 2.3 Order Promoting

Literature

Compulsory Reading

Further Reading

- Chopra, S. (2019). Supply chain management: Strategy, planning and operation (Global ed., 7th ed.). Pearson.
- Hill, A., & Hill, T. (2018). Essential operations management (2nd ed.). Palgrave.
- Hugos, M. (2011). Essentials of supply chain management (3rd ed.). John Wiley & Sons.

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

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

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
100 h	0 h	25 h	25 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	☑ Guideline
	☑ Slides	

Study Format Distance Learning

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

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

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
100 h	0 h	25 h	25 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	☑ Guideline
	☑ Slides	

Business Intelligence and Data Visualization

Module Code: DLBAIBEBIDV

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLBDSEDA01	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. (Business Intelligence and Data Visualization)

Contributing Courses to Module

- Business Intelligence and Data Visualization (DLBAIBEBIDV01)

Module Exam Type

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

Weight of Module

see curriculum

Module Contents

- Fundamentals of Business Intelligence
- Core Principles of Data Visualization
- Comparative Study of Business Intelligence and Data Analytics
- Application of Business Intelligence Tools & Techniques
- Business Problem Solving via Data Visualization and Analytics
- Limitations and Considerations for Different Data and Visualization Tools

Learning Outcomes	
Business Intelligence and Data Visualization On successful completion, students will be able to ▪ grasp the key underlying principles and fundamentals of business intelligence and data visualization. ▪ understand and distinguish between the methodologies and applications of business intelligence and data analytics. ▪ leverage various business intelligence tools and techniques to generate data-driven results. ▪ troubleshoot and resolve typical business challenges using data visualization tools and business intelligence strategies. ▪ comprehend and investigate the limitations associated with different data types and visualization tools.	
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

Business Intelligence and Data Visualization

Course Code: DLBAIBEBIDV01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	DLBDSEDA01

Course Description

Students will explore the vast and fascinating realm of business intelligence and data visualization, holding particular relevance in the continually evolving landscape of Artificial Intelligence in business. They will be introduced to the core principles and applications of these potent tools, offering a comparative perspective on the interplay between business intelligence and data visualization. The coursework encompasses the study and understanding of various business intelligence strategies, tools, frameworks, and techniques, their practical applications in driving results backed by data, and solution-oriented strategies to mitigate typical business challenges. Emphasis will be put on understanding the architecture of data warehouses, ETL processes (Extract, Transform, Load), and the principles of data modeling. Students will also be educated about the consideration and limitations associated with various data types and visualization tools, thus fostering a comprehensive understanding of the domain.

Course Outcomes

On successful completion, students will be able to

- grasp the key underlying principles and fundamentals of business intelligence and data visualization.
- understand and distinguish between the methodologies and applications of business intelligence and data analytics.
- leverage various business intelligence tools and techniques to generate data-driven results.
- troubleshoot and resolve typical business challenges using data visualization tools and business intelligence strategies.
- comprehend and investigate the limitations associated with different data types and visualization tools.

Contents

1. Introduction to Business Intelligence and Data Visualization
   - 1.1 Understanding Business Intelligence
   - 1.2 Key Principles of Data Visualization

2. Comparative Study of Business Intelligence and Data Analytics
   - 2.1 Overview of Data Analytics
   - 2.2 Similarities and Differences between BI and DA

2.3 Data Mining Techniques

3. Business Intelligence Tools & Techniques
   - 3.1 Introduction to BI Tools & Techniques
   - 3.2 Working with Popular BI Tools.
   - 3.3 Architecture of data warehouses and data modeling

4. Application of BI and Data Visualization in Business Problem Solving
   - 4.1 Analyzing Business Problems
   - 4.2 Using BI and Data Visualization in Analytical Problem Solving

5. Investigating the limitations of different Data and Visualization Tools
   - 5.1 Understanding Various Data Types
   - 5.2 Limitations of Visualization Tools
   - 5.3 Strategies for Effective Use of Tools

6. Application and Innovation in Business Intelligence and Data Visualization
   - 6.1 Real-world Applications
   - 6.2 Innovative Approaches in BI and Data Visualization
   - 6.3 Future Directions

Literature
Compulsory Reading
Further Reading

- Charles, V. (2023). Data analytics and business intelligence: Computational frameworks, practices, and applications. CRC Press.
- Nuseir, M. T. (2021). Designing business intelligence (BI) for production, distribution and customer services: A case study of a UAE-based organization. Business Process Management Journal, 27(4), 1275-1295.
- Olszak, C. (2020). Business intelligence and big data. Taylor & Francis.
- Yan, M.-R., Hong, L.-Y., & Warren, K. (2022). Integrated knowledge visualization and the enterprise digital twin system for supporting strategic management decision. Management Decision, 60(4), 1095-1115.
- Yerpude, S. (2023). Business intelligence and its impact on decision making. In K. Sood, B. Balusamy, & S. Grima (Eds.), Digital transformation, strategic resilience, cyber security and risk management (Contemporary Studies in Economic and Financial Analysis, Vol. 111C) (pp. 209-223). Emerald Publishing Limited.
- Yousif, O. S., & Zakaria, R. (2022). Web-based big data integration visualisation solutions. In M. F. M. Din, N. E. Alias, N. Hussein, & N. S. Zaidi (Eds.), Sustainability management strategies and impact in developing countries (Community, Environment and Disaster Risk Management, Vol. 26) (pp. 103-117). Emerald Publishing Limited.

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 ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video	☑ Online Tests ☑ Guideline

Studium Generale I

Module Code: DLBSG1_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

N.N. (Studium Generale I)

Contributing Courses to Module

- Studium Generale I (DLBSG01_E)

Module Exam Type

Module Exam	Split Exam
Study Format: myStudies See Selected Course Study Format: Distance Learning See Selected Course	

Weight of Module

see curriculum

Module Contents

In principle, all IU Bachelor courses can be selected as courses for the "Studium Generale", so that the content can be chosen from the entire breadth of the IU distance learning program.

Learning Outcomes	
Studium Generale I On successful completion, students will be able to ▪ apply acquired key competencies to issues in their field of study and/or in their professional environment. ▪ to deepen one's own skills and abilities in a self-directed manner. ▪ to look beyond the boundaries of their own area of expertise.	
Links to other Modules within the Study Program It is a stand-alone offering with possible references to various required and elective modules	**Links to other Study Programs of the University** All IU Distance Learning Bachelor Programs

Studium Generale I

Course Code: DLBSG01_E

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

Course Description

In the course "Studium Generale I", students deepen their knowledge in a self-selected subject area by completing an IU course outside their applicable curriculum. This gives them the opportunity to look beyond their own subject area and acquire further competencies. The associated option enables students to self-determine their study content to focus even more on issues relevant to them and/or to strengthen or develop selected competencies.

Course Outcomes

On successful completion, students will be able to

- apply acquired key competencies to issues in their field of study and/or in their professional environment.
- to deepen one's own skills and abilities in a self-directed manner.
- to look beyond the boundaries of their own area of expertise.

Contents

- The course "Studium Generale I" offers students the opportunity to take courses outside of their curriculum and the result can be credited as an elective subject. In principle, all IU bachelor courses that fulfill the following requirements are creditable for this purpose:
  - They are not part of an integral part of the applicable mandatory curriculum.
  - They do not have admission requirements or students can prove that they have met the admission requirement.
- The examination of the selected courses must be taken in full and finally passed in order to be credited as part of the 'Studium Generale' .

Literature

Compulsory Reading

Further Reading

- See course description of the selected course

Study Format myStudies

Study Format	**Course Type**
myStudies	See Selected Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	See Selected Course

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

Instructional Methods
see selected course

Study Format Distance Learning

Study Format	**Course Type**
Distance Learning	See Selected Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	See Selected Course

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

Instructional Methods
See Selected Course

Project: Agile Project Management

Module Code: DLBCSAPM

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. Inga Schlömer (Project: Agile Project Management)

Contributing Courses to Module

- Project: Agile Project Management (DLBCSAPM01)

Module Exam Type

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

Weight of Module

see curriculum

Module Contents

- In this course, students are taught action competences in the field of agile project management. They will be familiarized with the values, activities, roles, and artifacts of agile procedures using Scrum as an example.

Learning Outcomes

Project: Agile Project Management

On successful completion, students will be able to

- explain the differences between agile and plan-driven project management.
- explain agile principles.
- work together in an agile manner according to the values defined in Scrum.
- apply the activities defined in Scrum.
- take responsibility for the roles defined in Scrum.
- create and maintain the artefacts defined in Scrum.
- consider the increasing relevance of international, intercultural and virtual collaboration in projects.

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: Agile Project Management

Course Code: DLBCSAPM01

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

Course Description

Students will receive a practical introduction to agile project management in this course. In addition to teaching its individual basic principles, the differences between agile project management and plan-driven project management will be examined in detail. In order to understand and experience agile project management, the values, activities, roles, and artefacts of typical agile procedures are presented using Scrum and then practiced on an example project.

Course Outcomes

On successful completion, students will be able to

- explain the differences between agile and plan-driven project management.
- explain agile principles.
- work together in an agile manner according to the values defined in Scrum.
- apply the activities defined in Scrum.
- take responsibility for the roles defined in Scrum.
- create and maintain the artefacts defined in Scrum.
- consider the increasing relevance of international, intercultural and virtual collaboration in projects.

Contents

- This course teaches students various skills in the field of agile project management. In contrast to plan-driven project management, the principles of agility used in modern software development are taught. Using the example of Scrum, students will acquire skills in applying an agile approach, and then apply their knowledge of respective roles and activities in a simple project to gain initial practical experience, documenting it in a project report. The content of the projects results from the individual abilities and requirements of the students.

Literature
Compulsory Reading
Further Reading ▪ Apress. Agile Alliance (2021). Subway Map to Agile Practices. ▪ Beck, K. et al. (2001). Manifesto for Agile Software Development. ▪ Chovanova, H. et al. (2020). Agile Project Management – What is It? Publisher: IEEE. In 18th International Conference on Emerging eLearning Technologies and Applications (ICETA), Emerging eLearning Technologies and Applications (ICETA), 2020 18th International Conference. ▪ Dalton, Jeff (2019). Great Big Agile. An OS for Agile Leaders. ▪ Douglass, B. P. (2016). Agile systems engineering. Morgan Kaufmann, p. 151-160. ▪ Hohl, P., Klünder, J., van Bennekum, A., Lockard, R., Gifford, J., Münch, J., Stupperich, M., & Schneider, K. (2018). Back to the future: origins and directions of the “Agile Manifesto” – views of the originators. Journal of Software Engineering Research and Development, 6(1). ▪ Project Management Institute (2017). Agile Practice Guide. Project Management Institute. ▪ Measey P., Radtac (2015). Agile Foundations - Principles, Practices and Frameworks. BCS The Chartered Institute for IT, p. 131-140, p. 148-152. ▪ Schwaber, K., Sutherland, J. (2020). The Scrum Guide. ▪ Hohl, P., Klünder, J., van Bennekum, A., Lockard, R., Gifford, J., Münch, J., Stupperich, M., & Schneider, K. (2018). Back to the future: origins and directions of the “Agile Manifesto” – views of the originators. Journal of Software Engineering Research and Development, 6(1).

Study Format myStudies

Study Format myStudies	**Course Type** 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 ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	**Exam Preparation** ☑ Guideline

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 ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	**Exam Preparation** ☑ Guideline

Internship: Bachelor Data Science

Module Code: DLBDSCIBDSC

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

(Internship: Bachelor Data Science)

Contributing Courses to Module

- Internship: Bachelor Data Science (DLBDSCIBDSC01)

Module Exam Type	
Module Exam Study Format: Distance Learning Internship Reflection Paper (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: Bachelor Data Science On successful completion, students will be able to ▪ transfer theoretical knowledge to practical problems. ▪ independently address and manage practical challenges; to reflect on their success, depending on the tasks undertaken. ▪ better assess the scope, significance, and limitations of theoretical concepts in light of practical demands. ▪ work on a project collaboratively and in an intercultural environment while complying with ethical data-handling practices. ▪ work with established data formats and apply widely-used techniques for data preparation. ▪ discuss the fundamental aspects of data quality and apply data quality-ensuring measures. ▪ apply agile approaches in all phases of a Data Science project, including business and data understanding, data preparation, model training, evaluation, and deploying models into a production environment.	
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

Internship: Bachelor Data Science

Course Code: DLBDSCIBDSC01

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.
- independently address and manage practical challenges; to reflect on their success, depending on the tasks undertaken.
- better assess the scope, significance, and limitations of theoretical concepts in light of practical demands.
- work on a project collaboratively and in an intercultural environment while complying with ethical data-handling practices.
- work with established data formats and apply widely-used techniques for data preparation.
- discuss the fundamental aspects of data quality and apply data quality-ensuring measures.
- apply agile approaches in all phases of a Data Science project, including business and data understanding, data preparation, model training, evaluation, and deploying models into a production environment.

Contents

- As part of the internship, students document and reflect on their everyday professional experiences in the field of Data Science. 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.
- The internship can/should be completed in the following companies/industries:

- Big Tech and AI-specialized companies like Microsoft, Amazon, Google, Meta, IBM, Nvidia, OpenAI, DeepMind, etc.
- Data Science consultancies, such as McKinsey/QuantumBlack/Caserta, Deloitte, Accenture, Boston Consulting Group, EY, PwC, KPMG, Trianz, Kearny/Cervello, Veeva, Infosys, and many more
- Since data science is to be understood as a cross-industry methodological discipline, an internship in any data-driven company can be suitable across almost all disciplines, e.g., in medicine, logistics, urban and regional planning, public administration, marketing, manufacturing, finance, insurance, etc.

Literature

Compulsory Reading

Further Reading

- Within the subject relation, the literature of each module in the program is relevant.
- Al-Ali, E., & Masmoudi, M. (2023). Leadership and Workplace Culture in the Digital Era. IGI Global.
- Berrones-Flemmig, N., Contreras, F., & Dornberger, U. (2022). Business in the 21st century: A sustainable approach (1st ed.). Emerald Publishing Limited.
- Grus, J. (2019). Data Science from Scratch (2nd ed.). O'Reilly.
- King, T., & Schwarzenbach, J. (2020). Managing data quality: A practical guide. BCS.
- Vanderplas, J. (2023). 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	Project

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Internship Reflection Paper (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

Collaborative Work

Module Code: DLBCSCW

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)

Contributing Courses to Module
▪ Collaborative Work (DLBCSCW01)

Module Exam Type	
Module Exam Study Format: myStudies Oral Assignment Study Format: Duales myStudium Oral Assignment Study Format: Distance Learning Oral Assignment	**Split Exam**
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 field of Business Administration & Management	All Bachelor Programs in the Business field

Collaborative Work

Course Code: DLBCSCW01

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

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 myStudies

Study Format	Course Type
myStudies	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	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Online Tests
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Guideline
☑ Recorded Live Sessions	☑ Slides	

Study Format Duales myStudium

Study Format	Course Type
Duales myStudium	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

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

Intercultural and Ethical Decision-Making

Module Code: DLBCSIDM

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)

Contributing Courses to Module
▪ Intercultural and Ethical Decision-Making (DLBCSIDM01)

Module Exam Type	
Module Exam Study Format: myStudies Written Assessment: Case Study Study Format: Distance Learning Written Assessment: Case Study Study Format: Duales myStudium 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: DLBCSIDM01

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 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 ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video ☑ Slides	☑ Online Tests ☑ Guideline

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 ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video ☑ Slides	☑ Online Tests ☑ Guideline

Study Format Duales myStudium

Study Format	Course Type
Duales myStudium	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 ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video ☑ Slides	☑ Online Tests ☑ Guideline

Business Intelligence

Module Code: DLBCSEBI1

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. Maik Drozdzynski (Business Intelligence)

Contributing Courses to Module

- Business Intelligence (DLBCSEBI01)

Module Exam Type	
Module Exam Study Format: myStudies Exam, 90 Minutes Study Format: Distance Learning Exam, 90 Minutes	**Split Exam**
Weight of Module see curriculum	

Module Contents

- Motivation and Conceptualization
- Data Provision
- Data Warehouse
- Modeling of Multidimensional Data Spaces
- Analysis Systems
- Distribution and Access

Learning Outcomes	
Business Intelligence On successful completion, students will be able to ▪ explain the motivation, use cases, and basics of Business Intelligence. ▪ identify and explain techniques and methods for providing and modeling data, as well as types of data relevant to BI, differentiating between them. ▪ explain techniques and methods for the generation and storage of information and independently select suitable methods on the basis of concrete requirements.	
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

Business Intelligence

Course Code: DLBCSEBI01

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

Course Description

Business Intelligence (BI) is used to obtain information from company data that is relevant for targeted corporate management and the optimization of business activities. This course introduces and discusses techniques, procedures, and models for data provision, information generation, and analysis, as well the distribution of the information obtained. You will then be able to explain the various subject areas of data warehousing and independently select methods and techniques to meet specific requirements.

Course Outcomes

On successful completion, students will be able to

- explain the motivation, use cases, and basics of Business Intelligence.
- identify and explain techniques and methods for providing and modeling data, as well as types of data relevant to BI, differentiating between them.
- explain techniques and methods for the generation and storage of information and independently select suitable methods on the basis of concrete requirements.

Contents

1. Motivation and Conceptualization
   - 1.1 Motivation and Historical Development
   - 1.2 BI as a Framework
2. Data Provision
   - 2.1 Operative and Dispositive Systems
   - 2.2 The Data Warehouse Concept
   - 2.3 Architectural Variations
3. Data Warehouse
   - 3.1 ETL Process
   - 3.2 DWH and Data Mart
   - 3.3 ODS and Metadata
4. Modelling of Multidimensional Data Spaces

4.1 Data Modeling
4.2 OLAP Cubes
4.3 Physical Storage
4.4 Star and Snowflake Scheme
4.5 Historicization

5. Analysis Systems
5.1 Free Data Research and OLAP
5.2 Reporting Systems
5.3 Model-Based Analysis Systems
5.4 Concept-Oriented Systems

6. Distribution and Access
6.1 Information Distribution
6.2 Information Access

Literature

Compulsory Reading

Further Reading

- Grossmann, W., & Rinderle-Ma, S. (2015). Fundamentals of business intelligence. Springer.
- Sharda, R., Delen, D., & Turban, E. (2015). Business intelligence and analytics: Systems for decision support (10th ed.). Pearson.
- Sherman, R. (2014). Business intelligence guidebook: From data integration to analytics. Morgan Kaufmann.
- Vaisman, A., & Zimányi, E. (2022). Data warehouse systems: Design and implementation. Springer.

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	

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	

Data Quality and Data Wrangling

Module Code: DLBDSDQDW

Module Type	**Admission Requirements**	**Study Level**	**CP**	**Student Workload**
see curriculum	DLBDSIPWP01 or DLBDSIPWP01_D, DLBDSOOFPP01	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)

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

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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.

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Links to other Modules within the Study Program

This module is similar to other modules in the field of Data Science & Artificial Intelligence

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Links to other Study Programs of the University

All Bachelor Programs in the IT & Technology field

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Data Quality and Data Wrangling

Course Code: DLBDSDQDW01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	DLBDSIPWP01 or DLBDSIPWP01_D, DLBDSOOFPP01

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 ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video ☑ Slides	☑ Online Tests ☑ Guideline

Data Science Software Engineering

Module Code: DLBDSDSSE

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLBDSIPWP01 or DLBDSIPWP01_D; DLBDSOOFPP01 or IOBP01	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 (Data Science Software Engineering)

Contributing Courses to Module

- Data Science Software Engineering (DLBDSDSSE01)

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

- Traditional project management
- Agile project management
- Testing
- Software development paradigms
- From model to production

Learning Outcomes	
Data Science Software Engineering On successful completion, students will be able to ▪ understand the concept of project management approaches. ▪ apply agile approaches in software development. ▪ create automated software tests. ▪ understand various software development paradigms. ▪ evaluate the necessary steps to bring models into a production environment.	
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 Science Software Engineering

Course Code: DLBDSDSSE01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	DLBDSIPWP01 or DLBDSIPWP01_D; DLBDSOOFPP01 or IOBP01

Course Description

A core part of data science is creating value from data. This means not only the creation of sophisticated predictive models but also the development of these models according to modern software development principles.This course gives a detailed overview of the relevant methods and paradigms which data scientists need to know in order to develop enterprise-grade models.This course discusses traditional and agile project management techniques, highlighting both the Kanban and Scrum approaches. It explores relevant software development paradigms such as test-driven development, pair programming, mob programming, and extreme programming.Special focus is given to the topic of testing and the consideration of how to bring a model into a production environment.

Course Outcomes

On successful completion, students will be able to

- understand the concept of project management approaches.
- apply agile approaches in software development.
- create automated software tests.
- understand various software development paradigms.
- evaluate the necessary steps to bring models into a production environment.

Contents

1. Traditional Project Management
   - 1.1 Requirements engineering
   - 1.2 Waterfall model
   - 1.3 Rational unified process
2. Agile Project Management
   - 2.1 Criticism of the waterfall model
   - 2.2 Introduction to SCRUM
   - 2.3 Introduction to Kanban
3. Testing
   - 3.1 Why testing?

3.2 Unit trests 3.3 Integration tests 3.4 Performance monitoring 4. Software Development Paradigms 4.1 Test-driven development (TDD) 4.2 Pair programming 4.3 Mob programming 4.4 Extreme programming 5. From Model to Production 5.1 Continuous delivery 5.2 Continuous integration 5.3 Building a scalable environment

Literature
Compulsory Reading
Further Reading ▪ Brookshear, G., & Brylow, D. (2019). Computer science: An overview. Pearson Education. ▪ Stephens, R. (2015). Beginning software engineering. John Wiley & Sons.

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	

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	

Model Engineering

Module Code: DLBDSME

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
Dr. Markus Pak (Model Engineering)

Contributing Courses to Module
▪ Model Engineering (DLBDSME01)

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

Module Contents

- Data science methodologies
- Model building
- Model evaluation
- Model combination
- Interpretable models

Learning Outcomes	
Model Engineering On successful completion, students will be able to ▪ understand common data science methodologies. ▪ create benchmark models. ▪ analyze models with respect to their interpretability. ▪ apply model validation techniques. ▪ recall established model combination techniques.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Data Science & Artificial Intelligence	**Links to other Study Programs of the University** All Bachelor Programs in the IT & Technology field

Model Engineering

Course Code: DLBDSME01

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

Course Description

Building high-quality predictive models is one of the core competencies of data scientists. This course begins with an introduction to relevant data science approaches such as CRISP-DM and Microsoft Team Data Science. The following section on model building focuses on the best practices that allow data scientists to build enterprise-grade models. Subsequent chapters explore techniques for model validation and model combination, also known as ensemble learning.Traditionally, the most explainable models have not been very powerful, and the most powerful models have not been very explainable. Nevertheless, interpretable models—and interpretable machine learning models in particular—are highly desirable in many areas. This course gives a detailed overview of common approaches, such as surrogate model visualizations, which illustrate the behavior of the models.

Course Outcomes

On successful completion, students will be able to

- understand common data science methodologies.
- create benchmark models.
- analyze models with respect to their interpretability.
- apply model validation techniques.
- recall established model combination techniques.

Contents

1. Data Science Methodologies
   - 1.1 CRISP-DM
   - 1.2 MS Team Data Science

2. Model Building
   - 2.1 Establishing a benchmark model
   - 2.2 Workflow automation
   - 2.3 Model persistence and model versioning

3. Model Evaluation
   - 3.1 Under- and overfitting
   - 3.2 Cross validation

4. Interpretable models
    4.1 Why interpretable models?
    4.2 Black-box versus interpretable models
    4.3 Visualizers for convolutional neural networks
    4.4 Surrogate models

5. Combining Learning Models
    5.1 Bagging
    5.2 Boosting
    5.3 Model stacking

Literature

Compulsory Reading

Further Reading

- Geron, A. (2019). Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow: Concepts, tools, and techniques to build intelligent systems (2nd ed.). O'Reilly.
- Guido, S. & Müller, A. C. (2017). Introduction to machine learning with Python: Practical knowledge data science. O'Reilly.
- Molnar, C. (2019). Interpretable machine learning: A guide for making black-box models explainable.

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

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)

Contributing Courses to Module
▪ Bachelor Thesis (DLBBT01) ▪ Colloquium (DLBBT02)

Module Exam Type	
Module Exam	**Split Exam** <u>Bachelor Thesis</u> • Study Format "myStudies": Bachelor Thesis • Study Format "Distance Learning": Bachelor Thesis <u>Colloquium</u> • 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
Exam Preparation ☑ Review Book

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
Exam Preparation ☑ Review Book

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