MODULE HANDBOOK

Master of Science

Business Intelligence (FS-OI-MABUI-120)

120 CP

Distance Learning

iu INTERNATIONAL UNIVERSITY OF APPLIED SCIENCES

2

Contents

1. Semester

Business Intelligence I
Module Code: DLMDSEBA1

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	MA	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 (Business Intelligence I)

Contributing Courses to Module

▪ Business Intelligence I (DLMDSEBA01)

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

▪ Data acquisition and dissemination
▪ Data warehouse and multidimensional modeling
▪ Analytical systems
▪ Future Business Intelligence Application Areas

Learning Outcomes

Business Intelligence I

On successful completion, students will be able to

- understand the motivations and use cases for, as well as fundamentals of, business intelligence.
- explain relevant types of data.
- know and disambiguate techniques and methods for modeling and dissemination of data.
- expound upon the techniques and methods for the generation and storage of information.
- select apposite business intelligence methods for given requirements.
- explain current and future business intelligence application areas.

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

Business Intelligence I

Course Code: DLMDSEBA01

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

Course Description

Business Intelligence is about the generation of information based on operational data. It is used to enable goal-oriented management practices as well as the optimization of relevant business activities. This course introduces and discusses techniques, methods, and models for data provisioning and the generation, analysis, and dissemination of information.

Course Outcomes

On successful completion, students will be able to

- understand the motivations and use cases for, as well as fundamentals of, business intelligence.
- explain relevant types of data.
- know and disambiguate techniques and methods for modeling and dissemination of data.
- expound upon the techniques and methods for the generation and storage of information.
- select apposite business intelligence methods for given requirements.
- explain current and future business intelligence application areas.

Contents

1. Motivation and Introduction
    1.1 Motivation and Historical Development of the Field
    1.2 Business Intelligence as a Framework

2. Data Provisioning
    2.1 Operative and Dispositive Systems
    2.2 The Data Warehouse Concept
    2.3 Architecture Variants

3. Data Warehouse
    3.1 The ETL-Process
    3.2 DWH and Data-Mart Concepts
    3.3 ODS and Meta-Data

4. Modeling Multidimensional Dataspaces

4.1 Data Modeling

4.2 OLAP-Cubes

4.3 Physical Storage Concepts

4.4 Star-Schema and Snowflake-Schema

4.5 Historization

5. Analytical Systems

5.1 Freeform Data Analysis and OLAP

5.2 Reporting Systems

5.3 Model-Based Analytical Systems

5.4 Concept-Oriented Systems

6. Distribution and Access

6.1 Information Distribution

6.2 Information Access

7. Current and Future Business Intelligence Application Areas

7.1 Mobile Business Intelligence

7.2 Predictive and Prescriptive Analytics

7.3 Artificial Intelligence

7.4 Agile Business Intelligence

Literature

Compulsory Reading

Further Reading

- Grossmann, W., Rinderle-Ma, S. (2015). Fundamentals of Business Intelligence. Berlin/ Heidelberg: Springer.
- Kolb, J. (2013). Business intelligence in plain language: A practical guide to data mining and business analytics. Createspace.
- Sharda, R., Delen, D., & Turban, E. (2014). Business intelligence and analytics: Systems for decision support. Pearson.
- Sharda, R., Delen, D., & Turban, E. (2017). Business intelligence, analytics, and data science: A managerial perspective. Pearson.
- Sherman, R. (2014). Business intelligence guidebook: From data integration to analytics. Morgan Kaufmann.
- Turban, E., Sharda, R., Aronson, J., & King, D. (2010). Business intelligence. A managerial approach (2nd ed.). Prentice Hall.
- Vaisman, A., & Zimányi, E. (2016). Data warehouse systems: Design and implementation. Springer.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

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
Learning Material ☑ Course Book ☑ Video ☑ Audio ☑ Slides　　**Exam Preparation** ☑ Online Tests ☑ Guideline

Study Format myStudies

Study Format	Course Type
myStudies	

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
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

Concepts in Data Management

Module Code: DLMDMCDM

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	MA	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 (Concepts in Data Management)

Contributing Courses to Module

- Concepts in Data Management (DLMDMCDM01)

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

Module Contents

- The Data Processing Lifecycle
- Data Protection and Security
- Distributed Data
- Data Quality and Data Governance
- Data Modeling
- Metadata Management

Learning Outcomes

Concepts in Data Management

On successful completion, students will be able to

- explain the steps of the data processing lifecycle and organize and adapt suitable techniques for each of these steps.
- evaluate suitable data protection and security measures for data-intensive systems to comply with ethics in data handling considering varying cultural perspectives on this topic.
- consider interdisciplinary requirements towards data-intensive systems as expressed by the end-users of these systems.
- describe the advantages and apply techniques for distributing data over multiple machines.
- assess and apply suitable techniques which comply with principles of data governance and data quality.
- explain and apply common data modeling techniques.
- describe different types of metadata, explain the meaning and importance of metadata and organize metadata for data-intensive systems.

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

Concepts in Data Management

Course Code: DLMDMCDM01

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

Course Description

In data-intensive systems, there are concepts and principles which are universal for almost all projects. Data management usually spans over all stages of the data processing lifecycle including working in an interdisciplinary way to meet the diverse requirements of the end-users. In this course, students learn the meaning of each step of the data processing lifecycle and are enabled to use suitable techniques for each of these steps. In data ingestion and integration, students learn principles and techniques which enable them to ingest and integrate heterogeneous data from various data sources. As the core of most data management projects, students will learn data processing and storage techniques. To build data-intensive systems in an effective and goal-oriented way, students are presented with principles and techniques for data analysis and reporting. As storing and processing data becomes more prevalent in organizations as well as in everyday life, students learn about ethics in data handling in varying cultural contexts and about complying with legal regulations and corresponding techniques. As far as scalability and reliability is concerned, students learn how distributing data across multiple machines can increase the performance of the system and the resilience and ease of recovery from failovers. With respect to organizing data for interdisciplinary usages in organizations and businesses, students learn principles and techniques for data governance, data modeling and data quality. Finally, students are enabled to understand different types of metadata and their respective meaning and organization in data management projects.

Course Outcomes

On successful completion, students will be able to

- explain the steps of the data processing lifecycle and organize and adapt suitable techniques for each of these steps.
- evaluate suitable data protection and security measures for data-intensive systems to comply with ethics in data handling considering varying cultural perspectives on this topic.
- consider interdisciplinary requirements towards data-intensive systems as expressed by the end-users of these systems.
- describe the advantages and apply techniques for distributing data over multiple machines.
- assess and apply suitable techniques which comply with principles of data governance and data quality.
- explain and apply common data modeling techniques.
- describe different types of metadata, explain the meaning and importance of metadata and organize metadata for data-intensive systems.

Contents

Literature
Compulsory Reading
Further Reading ▪ Kleppmann, M. (2017): Designing data-intensive applications: The big ideas behind reliable, scalable, and maintainable systems. 1st Edition, O'Reilly, Sebastopol, CA. ▪ Plotkin, D. (2020): Data Stewardship: An Actionable Guide to Effective Data Management and Data Governance. 2nd Edition, Academic Press, Cambridge, MS ▪ Strengholt, P. (2020): Data Management at Scale: Best Practices for Enterprise Architecture. 1st Edition, O'Reilly, Sebastopol, CA ▪ Van Gils, B. (2020): Data Management: a gentle introduction. 1st Edition, Van Haren Publishing, 's-Hertogenbosch, NL ▪ Sebastian-Coleman, L. (2018): Navigating the Labyrinth: An Executive Guide to Data Management. 1st Edition, Technics Publications, Basking Ridge, NJ. ▪ Steenbeek, I. (2019): The Data Management Toolkit: A step-by-step implementation guide for the pioneers of data management. 1st Edition, Independently Published, n. p. ▪ Strengholt, P. (2020): Data Management at Scale: Best Practices for Enterprise Architecture. 1st Edition, O'Reilly, Sebastopol, CA. ▪ Van Gils, B. (2020): Data Management: a gentle introduction. 1st Edition, Van Haren Publishing, 's-Hertogenbosch, NL.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

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

Corporate Governance of IT, Compliance, and Law
Module Code: DLMIGCR-01_E

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

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

Module Coordinator

Johannes Kent Walter (Corporate Governance of IT, Compliance, and Law)

Contributing Courses to Module

- Corporate Governance of IT, Compliance, and Law (DLMIGCR01-01_E)

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

Module Contents

- IT Governance: Motivation and Challenges
- COBIT Framework
- IT Compliance
- IT basic protection according to BSI IT law

Learning Outcomes

Corporate Governance of IT, Compliance, and Law

On successful completion, students will be able to

- explain the terms IT governance and IT compliance.
- categorize typical processes and activities from the area of IT governance and IT compliance.
- give an overview of the COBIT framework and its elements.
- give an overview of IT-Governance and explain its structure.
- reproduce important laws and regulations in the field of IT law and explain their areas of 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 fields of Computer Science & Software Development	All Master Programs in the IT & Technology fields

Corporate Governance of IT, Compliance, and Law

Course Code: DLMIGCR01-01_E

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

Course Description

In this course, students learn terms and frameworks related to IT governance and IT compliance. First, a short introduction and an overview of the different aspects of IT governance and IT compliance are given; then, COBIT and IT basic protection are explained as two frameworks that are used in industrial practice. In addition, this course will introduce and discuss important legal frameworks and standards related to IT law.

Course Outcomes

On successful completion, students will be able to

- explain the terms IT governance and IT compliance.
- categorize typical processes and activities from the area of IT governance and IT compliance.
- give an overview of the COBIT framework and its elements.
- give an overview of IT-Governance and explain its structure.
- reproduce important laws and regulations in the field of IT law and explain their areas of application.

Contents

1. IT Governance: Motivation and Challenges
    1.1 Governance and IT Governance
    1.2 Frameworks for IT Governance
    1.3 Typical IT Governance, Service Management, and Security Frameworks and Standards

2. COBIT Framework
    2.1 Overview of the Elements of COBIT
    2.2 Governance and Management Objectives
    2.3 Use of COBIT and COBIT Design Factors
    2.4 The Target Cascade of COBIT

3. IT Compliance
    3.1 Introduction to IT Compliance
    3.2 Examples of National and International Guidelines: Risk Management Standards and Frameworks

Literature
Compulsory Reading
Further Reading
▪   Cervone, H. F. (2017). Implementing IT governance: A primer for informaticians. Digital Library Perspectives, 33(4), 282—287.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

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

Study Format myStudies

Study Format	Course Type
myStudies	Lecture

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

Relational and NoSQL Databases
Module Code: DLMBIRND

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	None	MA	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 (Relational and NoSQL Databases)

Contributing Courses to Module

- Relational and NoSQL Databases (DLMBIRND01)

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

Module Contents

- Database Concepts
- Database Physiology
- Selected Relational Databases in Practice
- NoSQL Concepts
- Selected NoSQL Databases in Practice

Learning Outcomes

Relational and NoSQL Databases

On successful completion, students will be able to

- differentiate types of databases, evaluate their respective usages, and describe their major components.
- explain and apply common database principles and technologies, such as the ACID principle and indexing strategies.
- explain and apply techniques for distributed databases, such as fragmentation, sharding and the assessment of consistency levels.
- differentiate between Relational Databases and NoSQL Databases in terms of usage and underlying principles.
- explain the concepts of key-value-oriented, document-oriented, column-oriented and graph-oriented Databases, use common databases of these kinds in data-intensive projects and assess their suitability for specific use cases.
- differentiate between common relational and NoSQL databases and conduct basic tasks in these databases.

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

Relational and NoSQL Databases

Course Code: DLMBIRND01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
MA	English		5	None

Course Description

Storing and managing data in databases is at its very heart of all data-related projects. In this course, students learn concepts and technologies for the management and usage of relational and NoSQL databases. Students are provided with an in-depth look into the concepts and inner workings of databases and their major components. Students learn to differentiate between different categories of databases, and they are enabled to understand and use database principles and technologies such as the ACID principle, the differentiation between OLAP and OLTP systems, indexing strategies and industry standards for connecting to databases. As modern systems tend to increase in volume of data, students learn how distributing databases across clusters of machines can increase the scalability and reliability. Students learn concepts and techniques for distributing data across clusters, such as fragmentation and sharding, as well as the challenges and strategic decisions to be made within this context. The usefulness of relational SQL databases has been proven by their universal distribution and diverse applications. In some aspects, however, relational SQL databases do not meet the requirements of modern applications in terms of, for instance, flexibility and cardinality. This gave birth to a family of database concepts which became known as NoSQL databases. Students will learn how traditional SQL databases are different from these NoSQL databases which usually, and as one of the most noticeable characteristics, do not enforce a data schema on write. Students acquire a thorough understanding of the concepts of NoSQL databases and learn how to evaluate the suitability of various NoSQL databases for specific data-intensive projects. Students are enabled to explain the main concepts of Key-Value-oriented, Document-oriented, Column-oriented and Graph-oriented Databases and will be provided with applied examples for each of these database types. Finally, students are enabled to differentiate between common relational and NoSQL databases and learn how to practically perform common database tasks in each respective database.

Course Outcomes

On successful completion, students will be able to

- differentiate types of databases, evaluate their respective usages, and describe their major components.
- explain and apply common database principles and technologies, such as the ACID principle and indexing strategies.
- explain and apply techniques for distributed databases, such as fragmentation, sharding and the assessment of consistency levels.
- differentiate between Relational Databases and NoSQL Databases in terms of usage and underlying principles.
- explain the concepts of key-value-oriented, document-oriented, column-oriented and graph-oriented Databases, use common databases of these kinds in data-intensive projects and assess their suitability for specific use cases.
- differentiate between common relational and NoSQL databases and conduct basic tasks in these databases.

Contents

1. Database Concepts
    1.1   The ACID Principle for Databases
    1.2   OLAP and OLTP
    1.3   Data Handling Ethics
    1.4   Cardinality and its Limits

2. Database Physiology
    2.1   Database Components
    2.2   Database Categorization
    2.3   Indexing
    2.4   Vertical Fragmentation and Sharding
    2.5   Connecting to Databases

3. Selected Relational Databases in Practice
    3.1   Introduction to SQL
    3.2   Data Schemas
    3.3   MySQL
    3.4   PostgreSQL
    3.5   SQL Server
    3.6   Snowflake

4. NoSQL Concepts
    4.1   Schemaless Data and the ACID Principle

Literature
Compulsory Reading
Further Reading

- Petrov, A. (2019): Database Internals: A deep-dive into how distributed data systems work. 1st Edition, O'Reilly, Sebastapol, CA
- Lemahieu, W. (2018): Principles of Database Management: The Practical Guide to Storing, Managing and Analyzing Big and Small Data. 1st Edition, Cambridge University Press, Cambridge, UK
- Beaulieu, A. (2020): Learning SQL. 3rd Edition, O'Reilly, Sebastopol, CA.
- Kelly, A./McCreary, D. (2013): Making Sense of NoSQL. 1st Edition, O'Reilly, Sebastopol, CA.
- Sadalage, P. (2009): NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence. 1st Edition, Addison-Wesley Professional, Boston, MS
- Ploetz, A./Kandhare, D./Kadambi, S./Wu, X. (2018): Seven NoSQL Databases in a Week. 1st Edition, Packt Publishing, Birmingham, UK
- Harrison, G. (2016): Next Generation Databases: NoSQL, NewSQL, and Big Data. 1st Edition, Apress, New York, NY
- Bradshaw, S./Brazil, E./Chodorow, K. (2019): MongoDB: The Definite Guide. 3rd Edition, O'Reilly, Sebastopol, CA
- Carpenter, J./Hewitt, E. (2020): Cassandra: The Definite Guide. 3rd Edition, O'Reilly, Sebastopol, CA
- Nelson, J. (2016): Mastering Redis. 1st Edition, Packt Publishing, Birmingham, UK
- George, L. (2011): HBase: The Definitive Guide. 1st Edition, O'Reilly, Sebastopol, CA
- Hodler, A. (2019): Graph Algorithms: Practical Examples in Apache Spark and Neo4j. 1st Edition, O'Reilly, Sebastopol, CA

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

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

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

Instructional Methods		
Tutorial Support ☑ Course Feed	**Learning Material** ☑ Course Book ☑ Video ☑ Audio ☑ Slides	**Exam Preparation** ☑ Online Tests ☑ Guideline

Data Query Languages
Module Code: DLMDMDQL

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	MA	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. Thomas Kopsch (Data Query Languages)

Contributing Courses to Module
▪ Data Query Languages (DLMDMDQL01)

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

Module Contents
▪ Definition of Data Query Languages and Typical Examples   ▪ Different Types of Data and the Role of Databases   ▪ Data Query Languages and Standards   ▪ Fundamentals of SQL   ▪ Use of Data Query Languages for NoSQL Database and other Purposes   ▪ Data Query Languages in the Context of Application Programming

Learning Outcomes

Data Query Languages

On successful completion, students will be able to

- understand the basics of data query languages.
- understand different data structuring options and types of data sources.
- explain the difference between various data query languages, their application and their distinction from other programming languages.
- review and determine data query languages for appropriate use.
- apply and create SQL queries on self-created and given data in relational databases.
- understand the use of data query languages for application programming.

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 Master Programs in the IT & Technology field

Data Query Languages

Course Code: DLMDMDQL01

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

Course Description

The course is a general introduction to data query languages and the use by application interface-oriented and programming-oriented approaches, with a focus on SQL for relational databases.

Course Outcomes

On successful completion, students will be able to

- understand the basics of data query languages.
- understand different data structuring options and types of data sources.
- explain the difference between various data query languages, their application and their distinction from other programming languages.
- review and determine data query languages for appropriate use.
- apply and create SQL queries on self-created and given data in relational databases.
- understand the use of data query languages for application programming.

Contents

1. Introduction to Data Query Languages
    1.1 Definition of Data Query Languages
    1.2 Differentiation to other Languages
    1.3 Typical Examples of Data Query Languages

2. Data Management
    2.1 Data Life Cycle
    2.2 Types of Datasets (Structured, Semi-Structured and Unstructured Data)
    2.3 Role of Databases (SQL & NoSQL Databases)

3. Fundamentals of SQL
    3.1 Brief Overview
    3.2 Data Definition Language (DDL)
    3.3 Data Query Language (DQL)
    3.4 Data Manipulation Language (DML)

4. Advanced SQL

4.1   Transaction Control Language (TCL)
4.2   Data Control Language (DCL)
4.3   Differences between various SQL Versions (MSSQL, PL/SQL, etc.)
5.   Data Query Languages for NoSQL Database and other Purposes
5.1   Document Databases (N1QL/couchbase and MongoDB)
5.2   Graph Databases (Cypher/Neo4j)
5.3   GraphQL for APIs
6.   Using Data Query Languages within Application Programming
6.1   Special Aspects (Architecture, Connection Management, Coding and Testing)
6.2   Examples (SQL in Python and SQL in Java)

Literature
Compulsory Reading
Further Reading
▪   Meier, A., & Kaufmann, M. (2019). SQL & NoSQL databases: Models, languages, consistency options and architectures for big data management (pp. 1–83). Springer Vieweg. ▪   Beaulieu, A. (2020). Learning SQL: Generate, manipulate, and retrieve data (3rd ed.). O'Reilly. ▪   Perkins, L., Wilson, J. R., & Redmond, E. (2018). Seven databases in seven weeks: A guide to modern databases and the NoSQL movement (2nd ed.). Pragmatic Bookshelf.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

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

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

Instructional Methods		
Tutorial Support ☑ Course Feed	**Learning Material** ☑ Course Book ☑ Video ☑ Audio ☑ Slides	**Exam Preparation** ☑ Online Tests ☑ Guideline

Project: Business Intelligence
Module Code: DLMDSEBA2

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLMDSEBA01	MA	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: Business Intelligence)

Contributing Courses to Module
▪ Project: Business Intelligence (DLMDSEBA02)

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

Module Contents
Implementation of a business intelligence use case.

Learning Outcomes

Project: Business Intelligence

On successful completion, students will be able to

- transfer knowledge of business intelligence methodology to real-world use cases.
- analyze the suitability of different approaches with respect to the project task.
- critically reason about relevant design choices.
- make apposite architectural choices.
- formulate and implement a business intelligence use case.

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

Project: Business Intelligence

Course Code: DLMDSEBA02

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
MA	English		5	DLMDSEBA01

Course Description

In this course the students will transfer knowledge of business intelligence approaches and methods to the implementation of a real-world business analytical use case. To accomplish this goal, students must look closely at the given task and find an apposite approach by analyzing, evaluating, and comparing different solution strategies and their constituent parts. The found solution then has to be implemented in order to arrive at a running business analytical system.

Course Outcomes

On successful completion, students will be able to

- transfer knowledge of business intelligence methodology to real-world use cases.
- analyze the suitability of different approaches with respect to the project task.
- critically reason about relevant design choices.
- make apposite architectural choices.
- formulate and implement a business intelligence use case.

Contents

- This second course in the Business Analyst specialization aims at the practical implementation of a business intelligence project. Students can choose from a list of project topics or contribute their own ideas.

Literature
Compulsory Reading
Further Reading

- Kimball, R. (2013). The data warehouse toolkit: The definitive guide to dimensional modeling (3rd ed.). Indianapolis, IN: Wiley.
- Linstedt, D., & Olschimke, M. (2015). Building a scalable data warehouse with Data Vault 2.0. Waltham, MA: Morgan Kaufmann.
- Provost, F. (2013). Data science for business: What you need to know about data mining and data-analytic thinking. Sebastopol, CA: O'Reilly.
- Sherman, R. (2014). Business intelligence guidebook: From data integration to analytics. Waltham, MA: Morgan Kaufmann.

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

Instructional Methods		
Tutorial Support ☑ Course Feed	**Learning Material** ☑ Slides	**Exam Preparation** ☑ Guideline

Study Format myStudies

Study Format myStudies	Course Type

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

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

Instructional Methods

2. Semester

Seminar: Ethic & Societal Considerations in Data Management
Module Code: DLMDMSESC

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	MA	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. Sibylle Kunz (Seminar: Ethic & Societal Considerations in Data Management)

Contributing Courses to Module

▪ Seminar: Ethic & Societal Considerations in Data Management (DLMDMSESC01)

Module Exam Type

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

Weight of Module
see curriculum

Module Contents

At the end of the module "Ethic & Societal Considerations in Data Management" students are able to identify and explain the societal, political and economic effects and side-effects of data management. They also know about adequate solution approaches addressing those effects. During the course they write a scientific paper on a specialist topic proving their ability to independently analyze selected topics and link them with well-known concepts, as well as to critically question and discuss them.

Learning Outcomes

Seminar: Ethic & Societal Considerations in Data Management

On successful completion, students will be able to

- explain the influence and impact of 'Big Data' applications on societal, economic, and political topics.
- understand the general ethical relevance of data management techniques.
- explain the critical data study approach and its main drivers.
- name selected current societal topics and issues in data management in the fields of privacy, health, social media, personal finance etc.
- describe approaches and methods to solve the identified problems.
- treat a selected topic in a scientific manner in the form of a written essay.
- critically question and discuss current societal and political issues arising from the recent advances in data management.
- develop problem-solving skills and processes through reflection on the possible impact of their future occupation in the sector of data management.

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

Seminar: Ethic & Societal Considerations in Data Management

Course Code: DLMDMSESC01

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

Course Description

Over the last decade Big Data applications have become an underlying matter of course for many activities in private, professional, and social life. This course discusses impacts and side-effects of data management applications from an ethical and societal perspective and provides adequate solution approaches.

Course Outcomes

On successful completion, students will be able to

- explain the influence and impact of 'Big Data' applications on societal, economic, and political topics.
- understand the general ethical relevance of data management techniques.
- explain the critical data study approach and its main drivers.
- name selected current societal topics and issues in data management in the fields of privacy, health, social media, personal finance etc.
- describe approaches and methods to solve the identified problems.
- treat a selected topic in a scientific manner in the form of a written essay.
- critically question and discuss current societal and political issues arising from the recent advances in data management.
- develop problem-solving skills and processes through reflection on the possible impact of their future occupation in the sector of data management.

Contents

- The course covers current topics concerning the societal impact of data management.
- Problems like violation of privacy, surveillance capitalism, invasive marketing, misuse of health records and data, algorithmic discrimination concerning race, gender, religion or sexual attitude, political persecution or dissemination of fake news are among the topics the students have to analyze. Solution approaches like privacy concepts and compliance, legal regulations, codes of conduct or counter mapping should be identified and mapped to the specific problem field.

Literature
Compulsory Reading
Further Reading

- Boyd, D./Crawford, K. (2012): Critical Questions for Big Data. In: Information, Communication & Society, 15:5, p. 662-679.
- Clegg, B. (2017): Big data. How the information revolution is transforming our lives. London: Icon Books Ltd (Hot Science).
- Collman, J./Matei, S. A. (2018): Ethical Reasoning in Big Data: An Exploratory Analysis. Springer, Basel.
- Dalton, C./Thatcher, J. (2014): What does a critical data studies look like, and why do we care? (URL: https://www.societyandspace.org/articles/what-does-a-critical-data-studies-look-like-and-why-do-we-care, [Retrieved 28.02.2021])
- Davis, K. (2012): Ethics of Big Data: Balancing Risk and Innovation. O'Reilly, USA.
- Franks, B. (2020): 97 Things About Ethics Everyone in Data Science Should Know: Collective Wisdom from the Experts. O'Reilly, USA.
- Iliadis, A./Russo, F. (2016): Critical data studies: An introduction. In: Big Data & Society 3 (2), 205395171667423.
- Kitchen, R. (2014): The Data Revolution. SAGE Publications Ltd, USA.
- Loukides, M./Mason, H./Patil, DJ. (2018): Ethics and Data Science. O'Reilly, USA.
- O'Keefe, C./Brien D. O. (2018): Ethical Data and Information Management: Concepts, Tools and Methods. Kogan Page, London UK.
- Schäfer, M. T./van Es, K. (Hg.) (2017): The datafied society. Studying culture through data. Amsterdam: Amsterdam University Press.

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

Strategic Management
Module Code: DLMBSME

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	None	MBA	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 (Strategic Management)

Contributing Courses to Module
- Strategic Management (DLMBSME01)

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
- Foundations and concepts of strategic management
- Strategic planning process
- International challenges of strategic management

Learning Outcomes

Strategic Management

On successful completion, students will be able to

- understand the entire process of strategic planning from the organizational planning, the implementation to the evaluation and controlling.
- apply appropriate analysis tools in order to methodically address specific business decisions in the international business environment, taking intercultural aspects into account.
- analyze the capabilities of various organizations, that operate in different fields, from a functional and resource perspective by evaluating its strengths and weaknesses.
- develop a better understanding of the wider business environment by analyzing the opportunities and threats facing their organization.
- evaluate strategies by employing appropriate controlling 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 Business Administration & Management.	All Master Programmes in the Business & Management field.

Strategic Management

Course Code: DLMBSME01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
MBA	English		5	None

Course Description

Various methods of strategic market analysis are presented in this course so as to allow students to evaluate risks and opportunities in global markets, highlighting intercultural aspects, by looking at organizations operating in different countries. Students learn to analyze and understand strengths and weaknesses of organizations from various disciplines (products, services, NGOs etc.) that face specific market situations. Supported by new developments in the field of market research, the process for identifying and analyzing core competencies and competitive advantages in national and international environments is discussed at length. Students are supported to plan strategic alternatives and to implement and control these by taking on fictitious roles within various different organizations. Exercises and international case studies help students to identify with the role of management and participate in the strategic planning process as well as in operational management. This helps students understand the problems companies regularly face and comprehend how methods of modern management can be used in order to solve these.

Course Outcomes

On successful completion, students will be able to

- understand the entire process of strategic planning from the organizational planning, the implementation to the evaluation and controlling.
- apply appropriate analysis tools in order to methodically address specific business decisions in the international business environment, taking intercultural aspects into account.
- analyze the capabilities of various organizations, that operate in different fields, from a functional and resource perspective by evaluating its strengths and weaknesses.
- develop a better understanding of the wider business environment by analyzing the opportunities and threats facing their organization.
- evaluate strategies by employing appropriate controlling tools.

Contents

1. What is Strategy?
    1.1 What is a Corporate Strategy?
    1.2 What Has to be Taken into Consideration when Making Strategic Decisions?
    1.3 Who Takes Part in Developing a Strategy?
    1.4 What is Included in a Solid Strategic Plan?

Literature
Compulsory Reading
Further Reading ▪ Hooley, G. J., Piercy, N., Nicoulaud, B., & Rudd, J. M. (2017). Marketing strategy and competitive positioning (6th ed.). Harlow: Pearson Education. ▪ Johnson, G., Whittington, R., Scholes, K., Angwin, D., & Regnér, P. (2017). Exploring strategy: Text and cases (10th ed.). Harlow: Pearson Education. ▪ Kotler, P. T., & Keller, K. L. (2015). Marketing management (15th ed.). Harlow: Pearson. ▪ Porter, M. (2004). Competitive strategy: Techniques for analyzing industries and competitors. New York, NY: Free Press. ▪ Porter, M. (2008). On competition (2nd ed.). Boston: Harvard Business Review Press.

Study Format myStudies

Study Format	Course Type
myStudies	Lecture

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

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

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

Data Warehousing Architecture Types
Module Code: DLMBIDWAT

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLMDSEBA01, DLMBIRND01	MA	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 (Data Warehousing Architecture Types)

Contributing Courses to Module

- Data Warehousing Architecture Types (DLMBIDWAT01)

Module Exam Type

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

Weight of Module

see curriculum

Module Contents

- Traditional and Big Data Warehousing
- Data Warehouse Architecture (DWHA): Single-Layer, Two-Layer and Three-Layer Architectures
- Data Warehouse Components
- The Two Main Classification Models
- Representatives of these Models
- DWHA „Big Picture" (Representatives in the Context of Structured and Unstructured Data, New Technologies and the Business Intelligence Process Components)

Learning Outcomes

Data Warehousing Architecture Types

On successful completion, students will be able to

- understand relevant types of data, as well as fundamentals of traditional and NoSQL Data Warehousing.
- explain framewoks to address big data challenges in particular of unstructured data.
- explain the two main DWHA classifications views and the inter-relations between them that observe DWHAs from different views.
- identify the main types of architecture belonging to the above classifications and view their characteristics.
- transfer knowledge of application- specific Data Warehouse methodology to implementations that are particularly relevant in practice.
- explain where the typical application scenarios differ in terms of data provision.

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

Data Warehousing Architecture Types

Course Code: DLMBIDWAT01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
MA	English		5	DLMDSEBA01, DLMBIRND01

Course Description

Nowadays, Data Warehouses, DWHs for short, are faced with big data namely with structured and unstructured data. In order to address this challenges, DWHs are extended and merged with state-of-the art technology. In addition, a variety of practical applications has resulted in different architectures. The course covers techniques for the technical processing of data, explains the two main Data Warehousing Architecture (DWHA) classifications and introduces the main representatives of these two classes.

Course Outcomes

On successful completion, students will be able to

- understand relevant types of data, as well as fundamentals of traditional and NoSQL Data Warehousing.
- explain frameworks to address big data challenges in particular of unstructured data.
- explain the two main DWHA classifications views and the inter-relations between them that observe DWHAs from different views.
- identify the main types of architecture belonging to the above classifications and view their characteristics.
- transfer knowledge of application- specific Data Warehouse methodology to implementations that are particularly relevant in practice.
- explain where the typical application scenarios differ in terms of data provision.

Contents

1. Introduction
    1.1 Big data: Structured, Semi-Structured and Unstructured Data Types
    1.2 Unstructured Big Data Challenges
    1.3 Characteristics of Data Warehouses
    1.4 RDBMS-Based Data Warehousing
    1.5 NoSQL-Based Data Warehousing

2. Classification
    2.1 Layer-Based Classification
    2.2 Component-Based Classification

Literature
Compulsory Reading
Further Reading

- Ariyachandra, T./ Watson, H. J. (2008). Which data warehouse architecture is the best? In Communications of the ACM, 51(10), p.146. ACM.
- Ariyachandra, T. / Watson, H. (2010). Key organizational factors in data warehouse architecture selection. In Decision support systems. 2010 31;49(2):200-12.
- Devlin, B. / Cote, L. (1996). Data warehouse: from architecture to implementation. Addison-Wesley Longman Publishing Co., Inc.
- George, S. (2012). Inmon vs. kimball: Which approach is suitable for your data warehouse. Data warehous. In pp.1-12.
- Kimball, R. / Ross, M. (2013). The data warehouse toolkit: the complete guide to dimensional modeling, John Wiley & Sons.
- Pasupuleti, P / Purra, B. (2015). Data Lake Development with Big Data, Packt Publishing Ltd.
- Yang Q. / Ge M. / Helfert M. (2019) Analysis of Data Warehouse Architectures: Modeling and Classification, International Conference on Enterprise Information Systems (ICEIS)
- Senapati, R. / Kumar, D. A. (2014). A survey on data warehouse architecture. In International Journal of Innovative Research in Computer and Communication Engineering.
- Scheibe, K. / Nilakanta, S. (2008). Dimensional issues in agricultural data warehouse designs, In pp.263-278, Electronics in agriculture, 60(2).

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

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
	☑ Video	☑ Online Tests
	☑ Audio	
	☑ Slides	

Extract, Transform and Load Technologies

Module Code: DLMBIETLT

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLMDSEBA01, DLMDMDQL01	MA	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 (Extract, Transform and Load Technologies)

Contributing Courses to Module

- Extract, Transform and Load Technologies (DLMBIETLT01)

Module Exam Type

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

Module Contents

- ETL-Process for SQL- and NoSQL Warehousing
- Main Features and Functions of ETL-Tools
- Practical Implementation Scenarios of ETL
- Common ETL Test Procedures

Learning Outcomes

Extract, Transform and Load Technologies

On successful completion, students will be able to

- illustrate and explain the general ETL process issues and its three essential steps.
- explain the main differences between SQL- and NoSQL-Warehousing.
- understand the ETL construction process for SQL- Data Warehousing and, in contrast, the main properties of NoSQL-Warehousing ETL framework.
- compare some ETL-Tools and their main features and functions.
- formulate and implement an ETL-testing use case.
- explain where to pay attention to data protection aspects within the ETL process.

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

Extract, Transform and Load Technologies

Course Code: DLMBIETLT01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
MA	English		5	DLMDSEBA01, DLMDMDQL01

Course Description

In order to merge and prepare data from several operational data sources, it is converted into management-relevant information via a process of targeted conversion. This is carried out using three steps (extract, transform, and load) which are collectively known as the ETL process. The modeling of the process depends, among other things, on the structure of the underlying data and can also have different structures depending on the requirements. Extensive tests are therefore an essential part of the overall concept.

Course Outcomes

On successful completion, students will be able to

- illustrate and explain the general ETL process issues and its three essential steps.
- explain the main differences between SQL- and NoSQL-Warehousing.
- understand the ETL construction process for SQL- Data Warehousing and, in contrast, the main properties of NoSQL-Warehousing ETL framework.
- compare some ETL-Tools and their main features and functions.
- formulate and implement an ETL-testing use case.
- explain where to pay attention to data protection aspects within the ETL process.

Contents

1. Introduction
    1.1 The Typical Real-Life ETL Cycle in the Data Warehouses
    1.2 Step 1: Data Extraction
    1.3 Step 2: Transformation
    1.4 Step 3: Loading
    1.5 SQL and NoSQL Warehousing

2. ETL-Process for SQL Data Warehousing
    2.1 Building Dimensions and Fact Tables
    2.2 Building Dimensions Referential Integrity
    2.3 Types of Data Sources
    2.4 Modeling the Extract Process
    2.5 Common Transformations

Literature
Compulsory Reading

Further Reading
• Berkani N. / Bellatreche L. (2017): A Variety-Sensitive ETL Processes, International Conference on Database and Expert Systems Applications, DEXA 2017: Database and Expert Systems Applications pp 201-216
• Dahaoui FZ., Demraoui L., Chbihi Louhdi M.R., Behja H. (2021) Toward Data Warehouse Modeling in the Context of Big Data. In: Saeed F., Al-Hadhrami T., Mohammed F., Mohammed E. (eds) Advances on Smart and Soft Computing. Advances in Intelligent Systems and Computing, vol 1188. Springer, Singapore.
  https://doi.org/10.1007/978-981-15-6048-4_21
  .
• Mallek H. / Ghozzi F. / Gargouri F. (2020): Towards Extract-Transform-Load Operations in a Big Data context, International Journal of Sociotechnology and Knowledge Development (IJSKD) 12(2).
• Martinez-Mosquera, D. / Lurjan-Mora, S. / Recalde, H. (2017): Conceptual modeling of Big Data extract processes. In: 2017 International Conference on Information Systems and Computer Science (INCISCOS). Edicator.
• Vaishnav P. (2009): A Survey of Extract-Transform-Load Technology, International Journal of Data Warehousing & Mining, 5(3), 1-27.
• Oditis I. / Bicevska Z. / Bicevskis J. / Karnitis G. (2018), Implementation of NoSQL-based Data Warehouses, Baltic J. Modern Computing, Vol. 6, No. 1, 45-55, https://doi.org/10.22364/bjmc.2018.6.1.04
• Vyas S. / Vaishnav P. (2017): A comparative study of various ETL process and their testing techniques in data warehouse, Jounal of Statistics and Management Systems.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

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

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

Instructional Methods

Learning Material
☑ Course Book
☑ Video
☑ Audio
☑ Slides

Exam Preparation
☑ Online Tests
☑ Guideline

Advanced Research Methods

Module Code: DLMARM

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	MA	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. Tamara Wehrstein (Advanced Research Methods)

Contributing Courses to Module

- Advanced Research Methods (DLMARM01)

Module Exam Type

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

Weight of Module

see curriculum

Module Contents

- Social Sience and Research Paradigms
- Case Study Research
- Specific Topics of Qualitative Research
- Advanced Issues of Qualitative Research Conceptualization and Data Analysis
- Underlying Assumptions of Quantitative Research: Concepts and Consequences
- Evaluation Research

Learning Outcomes

Advanced Research Methods

On successful completion, students will be able to

- understand and apply scientific methodologies in conducting empirical research.
- plan, design, and prepare research proposals.
- differentiate between different types of case studies, select and apply different data collection strategies.
- plan, conduct, and analyze case studies and surveys.
- scientifically analyze quantitative and qualitative data.
- conduct evaluation research to determine quality of research.

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 Master Programmes in the Business & Management fields

Advanced Research Methods

Course Code: DLMARM01

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

Course Description

Advanced research methods, specifically business research, is scientific inquiry that attempts to uncover new information which helps a business improve performance, maximizing shareholder value while adhering to ethical and moral compliance standards.Managers seeking to conduct empirical research must maintain validity, reliability, and trustworthiness when utilizing scientific methodologies in order to produce meaningful and actionable results. Research proposals are typically written prior to conducting research, which have a certain structure, enabling the researcher to properly plan, conduct, and analyze case studies and surveys. Different data collection strategies are used to collect both qualitative and quantitative data, depending on the research proposal goals. Managers utilize their understanding of research methodologies to accurately assess the quality of research.

Course Outcomes

On successful completion, students will be able to

- understand and apply scientific methodologies in conducting empirical research.
- plan, design, and prepare research proposals.
- differentiate between different types of case studies, select and apply different data collection strategies.
- plan, conduct, and analyze case studies and surveys.
- scientifically analyze quantitative and qualitative data.
- conduct evaluation research to determine quality of research.

Contents

1. Theoretical Background: Social Science and Research Paradigms
    1.1 What is a Paradigm?
    1.2 Empiricism
    1.3 Critical Rationalism
    1.4 Epistemological Anarchism
    1.5 Structural Functionalism
    1.6 Symbolic Interactionism
    1.7 Ethnomethodology

2. Case Study Research

Literature
Compulsory Reading
Further Reading

- Babbie, E. R. (2021). The practice of social research (15th ed.). Cengage Learning. - 14th ed. (2016)
- Crossman, A. (2019) How to conduct an index for research. (URL: https://www.thoughtco.com/index-for-research-3026543 [last accessed on 15.03.2023]).
- Eurostat (n.d.) Beginners: Statistical concept - Index and base year (URL: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Beginners:Statistical_concept_-_Index_and_base_year [last accessed on 15.03.2023]).
- Giles, D. (2004). Advanced research methods in psychology (Reprint). Psychology Press.
- Rea, L.M. & Parker, R.A. (2014). Designing and conducting survey research: A comprehensive guide, (4th ed). Jossey-Bass.
- Saunders, M., Thornhill, A., & Lewis, P. (2019). Research methods for business students (8th ed). Pearson
- Takahashi, A. R. W., & Araujo, L. (2019). Case study research: Opening up research opportunities. RAUSP Management Journal, 55(1), 100–111.
- Widner, J., Woolcock, M., & Ortega Nieto, D. (Eds.). (2022). The case for case studies: Methods and applications in international development (strategies for social inquiry). Cambridge University Press.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

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

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

Instructional Methods		
Tutorial Support ☑ Course Feed	**Learning Material** ☑ Course Book ☑ Video ☑ Audio ☑ Slides	**Exam Preparation** ☑ Online Tests ☑ Guideline

Study Format myStudies

Study Format	Course Type
myStudies	Lecture

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

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

Instructional Methods		
Tutorial Support ☑ Course Feed	**Learning Material** ☑ Course Book ☑ Video ☑ Audio ☑ Slides	**Exam Preparation** ☑ Online Tests ☑ Guideline

Seminar: Data Warehouse Approaches and Methodologies

Module Code: DLMBISDWAM

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLMDSEBA01, DLMBIDWAT01	MA	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 (Seminar: Data Warehouse Approaches and Methodologies)

Contributing Courses to Module

- Seminar: Data Warehouse Approaches and Methodologies (DLMBISDWAM01)

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

Module Contents

In this course, students research, explore and present data warehouse approaches and methods.

Learning Outcomes

Seminar: Data Warehouse Approaches and Methodologies

On successful completion, students will be able to

- demonstrate the ability to conduct research, read critically, and evaluate sources.
- reflect on the exploration of data warehousing approaches and methods.
- evaluate data warehousing methods based on a common set of attributes.
- describe data warehousing methods including business requirements analysis, data design, architectural design, implementation and deployment.
- explain the major techniques of data warehousing and all related procedures.
- demonstrate the meaningful use of technical skills through documentation.
- explain which methods can be relevant in the context of data warehousing data 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 fields of Data Science & Artificial Intelligence	All Master Programs in the IT & Technology fields

Seminar: Data Warehouse Approaches and Methodologies

Course Code: DLMBISDWAM01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
MA	English		5	DLMDSEBA01, DLMBIDWAT01

Course Description

The focus of this course is to explore and present data warehouse approaches and methods in a research project. In doing so, students will examine and reflect on data warehouse methods and their impact on project success.

Course Outcomes

On successful completion, students will be able to

- demonstrate the ability to conduct research, read critically, and evaluate sources.
- reflect on the exploration of data warehousing approaches and methods.
- evaluate data warehousing methods based on a common set of attributes.
- describe data warehousing methods including business requirements analysis, data design, architectural design, implementation and deployment.
- explain the major techniques of data warehousing and all related procedures.
- demonstrate the meaningful use of technical skills through documentation.
- explain which methods can be relevant in the context of data warehousing data protection.

Contents

- In this course, students conduct a research project by researching and documenting existing literature and known platforms and products on data warehouse approaches and methods.

Literature
Compulsory Reading
Further Reading ▪ Corr, Lawrence / Stagnitto, Jim. (2011): Agile Data Warehouse Design: Collaborative Dimensional Modeling, from Whiteboard to Star. DecisionOne Press. ▪ Jukic , Nenad / Vrbsky, Susan / Nestorov, Svetlozar. (2016): Database Systems: Introduction to Databases and Data Warehouses. Prospect Press. ▪ Lakshmanan , Valliappa / Tigani, Jordan. (2019): Google BigQuery: The Definitive Guide: Data Warehousing, Analytics, and Machine Learning at Scale. O'Reilly Media. ▪ Rainardi , Vincent. (2014): Building a Data Warehouse: With Examples in SQL Server. Apress. ▪ tutorialspoint (2021): Data Warehousing – Concepts. (URL: https://www.tutorialspoint.com/dwh/dwh_data_warehousing.htm)

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

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

3. Semester

Data Modeling and Reporting

Module Code: DLMBIDMR

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	None	MA	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 (Data Modeling and Reporting)

Contributing Courses to Module

- Data Modeling and Reporting (DLMBIDMR01)

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

Module Contents

- Basic Concepts
- Data Modeling Life Cycle
- Data Model Types
- Data Extraction Using SQL
- NoSQL Data Extraction
- Data Reporting
- Online Transactional Processing
- Online Analytical Processing

Learning Outcomes

Data Modeling and Reporting

On successful completion, students will be able to

- discuss the basic concepts of data modeling.
- comprehend the life cycle of data modeling.
- understand the different data model types.
- summarize the main SQL and NoSQL data extraction techniques.
- explain the main methods of online transaction processing.
- describe the main concepts of online analytical processing.
- explain what needs to be considered when providing a wide variety of data types with regard to data protection.
- explain which disciplines play an essential role in the context of applied data modeling and reporting.

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

Data Modeling and Reporting

Course Code: DLMBIDMR01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
MA	English		5	None

Course Description

Interdisciplinary working methods and ways of thinking are often decisive for the success of sustainable IT solutions. The topic of business intelligence combines various areas from computer and natural sciences, as well as studies of business administration. This course provides an overview of data modeling and its key aspects and methods. To this end, data modeling concepts are introduced, the data modeling lifecycle is learned, and some important data modeling techniques and data extraction for SQL and NoSQL databases are presented. In addition, the concepts of online transactional processing and online analytical processing are discussed.

Course Outcomes

On successful completion, students will be able to

- discuss the basic concepts of data modeling.
- comprehend the life cycle of data modeling.
- understand the different data model types.
- summarize the main SQL and NoSQL data extraction techniques.
- explain the main methods of online transaction processing.
- describe the main concepts of online analytical processing.
- explain what needs to be considered when providing a wide variety of data types with regard to data protection.
- explain which disciplines play an essential role in the context of applied data modeling and reporting.

Contents

1. Basic Concepts
    1.1 Batch Data Processing
    1.2 Relational Data
    1.3 Non-Relational Data
    1.4 Streaming Data
    1.5 Big Data

2. Data Modeling Life Cycle
    2.1 Understand the Business
    2.2 Acquire and Explore Data

Literature
Compulsory Reading
Further Reading

- Agiledata. (2021). Data Modeling 101. http://agiledata.org/essays/dataModeling101.html
- Jukic, N., Vrbsky, S., & Nestorov, S. (2016). Database Systems, Introduction to Databases and Data Warehouses. Prospect Press.
- Meier, A., & Kaufmann, M. (2019). SQL & NoSQL Databases - Models, Languages, Consistency Options and Architectures for Big Data Management. Springer.
- Molinaro, A., & de Graaf, R. (2020). SQL Cookbook: Query Solutions and Techniques for All SQL Users. O'Reilly UK Ltd.
- Vasilik, S. M. (2020). SQL Practice Problems: 57 beginning, intermediate, and advanced challenges for you to solve using a "learn-by-doing" approach.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

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

Project: Data Modeling and Reporting
Module Code: DLMBIPDMR

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLMDSEBA01, DLMBIDMR01	MA	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. Peter Poensgen (Project: Data Modeling and Reporting)

Contributing Courses to Module

- Project: Data Modeling and Reporting (DLMBIPDMR01)

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

Module Contents

In this course, students will learn to apply the data modeling and reporting methods learned in the previous course to a hands-on project.

Learning Outcomes

Project: Data Modeling and Reporting

On successful completion, students will be able to

- implement a project with a focus on data modeling using SQL.
- practice and refine the knowledge they have learned about modeling data.
- demonstrate how to query, filter, sort, and report on data.
- customize output and evaluate results.
- show meaningful application of technical skills through documentation.
- introduce the major data modeling techniques and any associated procedures.
- consider the provision of a wide variety of data sources with regard to data protection in case 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 fields of Data Science & Artificial Intelligence	All Master Programs in the IT & Technology fields

Project: Data Modeling and Reporting

Course Code: DLMBIPDMR01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
MA	English		5	DLMDSEBA01, DLMBIDMR01

Course Description

The focus of this course is to apply the previously acquired knowledge on data modeling, reporting to a practical project implementation and to reflect on the results. Students will carry out the project based on a given set of requirements and document the results.

Course Outcomes

On successful completion, students will be able to

- implement a project with a focus on data modeling using SQL.
- practice and refine the knowledge they have learned about modeling data.
- demonstrate how to query, filter, sort, and report on data.
- customize output and evaluate results.
- show meaningful application of technical skills through documentation.
- introduce the major data modeling techniques and any associated procedures.
- consider the provision of a wide variety of data sources with regard to data protection in case studies.

Contents

- In this course, students conduct and document a data modeling project, applying the topics covered in previous modules based on a given set of requirements. They use SQL to implement the designed model.

Literature
Compulsory Reading
Further Reading

- Agiledata. (2021): Data Modeling 101. (URL:http://agiledata.org/essays/dataModeling101.html)
- Jukic , Nenad / Vrbsky , Susan / Nestorov , Svetlozar. (2016): Database Systems, Introduction to Databases and Data Warehouses. Prospect Press.
- Meier, Andreas / Kaufmann, Michael. (2019): SQL & NoSQL Databases - Models, Languages, Consistency Options and Architectures for Big Data Management. Springer.
- Molinaro , Anthony / de Graaf , Robert. (2020): SQL Cookbook: Query Solutions and Techniques for All SQL Users. O'Reilly UK Ltd.
- Vasilik , Sylvia Moestl. (2020): SQL Practice Problems: 57 beginning, intermediate, and advanced challenges for you to solve using a "learn-by-doing" approach.

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

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

Data Engineer

Module Code: DLMDSEDE

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	▪ DLMDSEDE01 ▪ none	MA	10	300 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 (Data Engineering) / Prof. Dr. Max Pumperla (Project: Data Engineering)

Contributing Courses to Module
▪ Data Engineering (DLMDSEDE01) ▪ Project: Data Engineering (DLMDSEDE02)

Module Exam Type	
Module Exam	**Split Exam** Data Engineering • Study Format "Distance Learning": Oral Assignment • Study Format "myStudies": *Type of examination* Project: Data Engineering • Study Format "Distance Learning": Portfolio • Study Format "myStudies": *Type of examination*
Weight of Module see curriculum	

Module Contents

Data Engineering

- Principles of data engineering
- Paradigms for data processing at scale
- Overview on data governance, security, and protection
- Common cloud platforms
- DataOps approach

Project: Data Engineering

- Knowledge transfer and application to practical problems
- Implementation of a data infrastructure building block

Learning Outcomes

Data Engineering

On successful completion, students will be able to

- understand the foundational concepts in data engineering.
- categorize important data-processing classes.
- summarize common approaches to data governance and security and contribute to the broader societal discussion on an academic level.
- compare different common public cloud offerings.
- recognize current approaches to data operations (DataOps) including productivity tools to facilitate working in interdisciplinary teams.

Project: Data Engineering

On successful completion, students will be able to

- apply the principles of data engineering to a practical application.
- analyze data engineering approaches with respect to a given project task.
- reason about the benefits and drawbacks of solution alternatives for a given implementation task.
- make apposite architectural choices.
- implement aspects of a modern data pipeline abiding by strict data protection principles.

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 Master Programmes in the IT & Technology field.

Data Engineering

Course Code: DLMDSEDE01

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

Course Description

The focus of this first course in the Data Engineering elective module is to introduce students to important principles, concepts, methods and approaches in this subject domain. In order to achieve this goal, the course moves from an exposition of the foundational principles of data engineering to a thorough treatment of the core data processing classes. Modern architectural paradigms such as Microservices are explained, and important factors in data governance and protection are addressed. In this context, students are enabled to reflect on modern data protection principles and their societal implications and implement these principles into large-scale data-intensive systems. Aspects of cloud computing are introduced via an overview of the most common offerings on the market. Finally, a state-of-the-art agile perspective on the operation of data pipelines is given by an exposition to the emerging notion of DataOps and the productivity tools around it to facilitate working in interdisciplinary teams.

Course Outcomes

On successful completion, students will be able to

- understand the foundational concepts in data engineering.
- categorize important data-processing classes.
- summarize common approaches to data governance and security and contribute to the broader societal discussion on an academic level.
- compare different common public cloud offerings.
- recognize current approaches to data operations (DataOps) including productivity tools to facilitate working in interdisciplinary teams.

Contents

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

2. Data Processing at Scale
    - 2.1 Batch Processing
    - 2.2 Stream and Complex Event Processing

3.   Microservices

    3.1   Introduction to Microservices

    3.2   Implementing Microservices

4.   Governance & Security

    4.1   Data Protection

    4.2   Data Security

    4.3   Data Governance

5.   Common Cloud Platforms & Services

    5.1   Amazon AWS

    5.2   Google Cloud

    5.3   Microsoft Azure

6.   Data Ops

    6.1   Defining Principles

    6.2   Containerization

    6.3   Building Data Pipelines

Literature

Compulsory Reading

Further Reading

- Andrade, H., Gedik, B., & Turaga, D. (2014). Fundamentals of stream processing: Application design, systems, and analytics. Cambridge University Press.
- Axelrod, C. W. (2013). Engineering safe and secure software systems. Artech House.
- Kleppmann, M. (2017). Designing data-intensive applications: The big ideas behind reliable, scalable, and maintainable systems. O'Reilly.
- Newman, S. (2015). Building microservices: Designing fine-grained systems. O'Reilly.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

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

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

Instructional Methods
Learning Material   **Exam Preparation**

Learning Material
☑ Course Book
☑ Video
☑ Audio
☑ Slides

Exam Preparation
☑ Online Tests
☑ Guideline

Study Format myStudies

Study Format myStudies	Course Type

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

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

Instructional Methods

Project: Data Engineering

Course Code: DLMDSEDE02

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
MA	English		5	DLMDSEDE01

Course Description

The second course of the Data Engineering elective module builds upon theoretical and methodological insights from the first course. It provides opportunities for students to put their newly-acquired knowledge into practical application by completing a data engineering project.In order to find an appropriate and viable approach, students will have to reason about and evaluate the benefits and drawbacks of possible architectural choices. Once an informed decision has been met, the chosen approach is implemented as a running piece of data infrastructure.

Course Outcomes

On successful completion, students will be able to

- apply the principles of data engineering to a practical application.
- analyze data engineering approaches with respect to a given project task.
- reason about the benefits and drawbacks of solution alternatives for a given implementation task.
- make apposite architectural choices.
- implement aspects of a modern data pipeline abiding by strict data protection principles.

Contents

- The second course of the Data Engineering elective revolves around the implementation of a data engineering project chosen from a set of project suggestions. Students can also contribute their own project ideas.

Literature
Compulsory Reading
Further Reading

- Kleppmann, M. (2017). Designing data intensive applications: The big ideas behind reliable, scalable, and maintainable systems. Sebastopol, CA: O'Reilly.
- Farcic, V. (2016). The DevOps 2.0 toolkit: Automating the continuous deployment pipeline with containerized microservices. Scotts Valley, CA: CreateSpace Independent Publishing Platform.
- White, T. (2015). Hadoop: The definitive guide: Storage and analysis at Internet scale. Sebastopol, CA: O'Reilley.
- Karau, H., Konwinski, A., Wendell, P., & Zaharia, M. (2015). Learning Spark: Lightning fast data analysis. Sebastopol, CA: O'Reilley.
- Narkhede, N., Shapira, G., & Palino, T. (2017). Kafka: The definitive guide: Real-time data and stream processing at scale. Sebastopol, CA: O'Reilley.

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	☑ Slides	☑ Guideline

Study Format myStudies

Study Format myStudies	Course Type

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

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

Instructional Methods

Big Data Engineering

Module Code: DLMBIEBDE

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	▪ none ▪ DLMDSBDT01	MA	10	300 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) / Prof. Dr. Thomas Zöller (Project: Big Data Technologies)

Contributing Courses to Module

▪ Big Data Technologies (DLMDSBDT01)
▪ Project: Big Data Technologies (DLMBIEBDE01)

Module Exam Type	
Module Exam	**Split Exam** Big Data Technologies • Study Format "myStudies": Oral Assignment • Study Format "Distance Learning": Oral Assignment Project: Big Data Technologies • Study Format "Distance Learning": Written Assessment: Project Report
Weight of Module see curriculum	

Module Contents

Big Data Technologies

- Data types and data sources
- Databases
- Modern storage frameworks
- Data formats
- Distributed computing

Project: Big Data Technologies

The module is designed to give the students the opportunity to practice what they have learned in the previous course and encounter a number of practical problems that are new for them.

Learning Outcomes

Big Data Technologies

On successful completion, students will be able to

- identify different types and sources of data.
- understand different database concepts.
- learn to build new database structures.
- evaluate various data storage frameworks w.r.t. project requirements.
- analyze which data format to use for a given project.
- understand what roles you could take in such projects.
- create a distributed computing environment for a given project.
- understand the ethical impact of big data technology choices.

Project: Big Data Technologies

On successful completion, students will be able to

- experience the learned big data technologies in a project.
- design a Big Data architecture based on given requirements and conditions.
- investigate and gather information from a variety of sources to build a Big Data application.
- apply appropriate techniques and methods to create an Apache Spark cluster.
- demonstrate meaningful use of technical skills by documentation.
- explain which disciplines play an essential role in the context of Big Data Engineering.

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

Big Data Technologies

Course Code: DLMDSBDT01

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

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. This course then discusses how data are stored in databases. Particular focus is given to database structures and different types of databases, e.g., relational, noSQL, NewSQL, and time-series.Beyond classical and modern databases, this course covers a wide range of storage frameworks such as distributed filesystems, streaming, and query frameworks. This is complemented by a detailed discussion of data storage formats ranging from classical approaches such as CSV and HDF5 to more modern approaches like Apache Arrow and Parquet.Finally, this course gives an overview of distributed computing environments based on local clusters, cloud computing facilities, and container-based approaches.

Course Outcomes

On successful completion, students will be able to

- identify different types and sources of data.
- understand different database concepts.
- learn to build new database structures.
- evaluate various data storage frameworks w.r.t. project requirements.
- analyze which data format to use for a given project.
- understand what roles you could take in such projects.
- create a distributed computing environment for a given project.
- understand the ethical impact of big data technology choices.

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. Databases
    2.1 Database structures
    2.2 Introduction to SQL

2.3   Relational databases

2.4   nonSQL, NewSQL databases

2.5   Timeseries DB

3.   Modern data storage frameworks

3.1   Distributed Filesystems

3.2   Streaming frameworks

3.3   Query frameworks

4.   Data formats

4.1   Traditional data exchange formats

4.2   Apache Arrow

4.3   Apache Parquet

5.   Distributed Computing

5.1   Cluster-based approaches

5.2   Containers

5.3   Cloud-based approaches

Literature
Compulsory Reading
Further Reading

- Date, C. J. (2003). An introduction to database systems. Pearson.
- Kleppmann, M. (2017). Designing data-intensive applications. O'Reilly.
- Wiese, L. (2015). Advanced data management. De Gruyter.

Study Format myStudies

Study Format	Course Type
myStudies	Lecture

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

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

Instructional Methods		
Tutorial Support ☑ Course Feed	**Learning Material** ☑ Course Book ☑ Video ☑ Audio ☑ Slides	**Exam Preparation** ☑ Online Tests ☑ Guideline

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

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

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

Instructional Methods		
Tutorial Support ☑ Course Feed ☑ Creative Lab	**Learning Material** ☑ Course Book ☑ Reader ☑ Video	**Exam Preparation** ☑ Guideline

Project: Big Data Technologies

Course Code: DLMBIEBDE01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
MA	English		5	DLMDSBDT01

Course Description

The course is designed to give the students the opportunity to practice what they have learned and encounter a set of practical problems that are new for them. The goal is to implement an Apache Spark project with the learned knowledge.

Course Outcomes

On successful completion, students will be able to

- experience the learned big data technologies in a project.
- design a Big Data architecture based on given requirements and conditions.
- investigate and gather information from a variety of sources to build a Big Data application.
- apply appropriate techniques and methods to create an Apache Spark cluster.
- demonstrate meaningful use of technical skills by documentation.
- explain which disciplines play an essential role in the context of Big Data Engineering.

Contents

- In this course, students will conduct and document a Big Data project using the topics covered in the previous course. They will explore and collect information from a variety of sources and design an application using Apache Spark. They will design the architecture and document the implementation of the application.

Literature
Compulsory Reading
Further Reading

- Kleppmann, Martin. (2017): Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems. O'Reilly Media.
- Marz , Nathan / Warren, James. (2015): Big Data: Principles and best practices of scalable realtime data systems. Manning Publications.
- Sachdev , Dinesh. (2021): Thinking Big: Developers Guide for Big Data Engineering & Analytics. Independently published.
- SparkByExamples. (2021): Spark By Examples. (URL: https://sparkbyexamples.com/)
- Weber , Hans. (2020): Big Data and Artificial Intelligence: Complete Guide to Data Science, AI, Big Data and Machine Learning. Independently published.

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

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

Big Data

Module Code: DLMBBD-01

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

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

Module Coordinator
Radiah Rivu (Data Utilization) / Dr. Cosmina Croitoru (Application Scenarios and Case Studies)

Contributing Courses to Module
▪ Data Utilization (DLMBBD01)   ▪ Application Scenarios and Case Studies (DLMBBD02-01)

Module Exam Type	
Module Exam	**Split Exam**
	<u>Data Utilization</u>
	• Study Format "myStudies": Exam, 90 Minutes • Study Format "Distance Learning": Exam, 90 Minutes
	<u>Application Scenarios and Case Studies</u>
	• Study Format "myStudies": Written Assessment: Written Assignment • Study Format "Distance Learning": Written Assessment: Case Study
Weight of Module see curriculum	

Module Contents

Data Utilization

- Pattern recognition
- Natural language processing
- Image recognition
- Detection and sensing
- Problem-solving
- Decision-making

Application Scenarios and Case Studies

- Agile development
- Workflow overview
- Fields of application
- Sprint Planning; Sprint
- Sprint Retrospective
- Committee presentation

Learning Outcomes

Data Utilization

On successful completion, students will be able to

- understand how identity, similarity, and diversity of data can be utilized in problem-solving approaches.
- differentiate between complicated and complex systems of investigation.
- identify the variability of a problem under investigation.
- distinguish between invariant and dynamic features of an investigated system.
- synthesize gained insights to propose a reliable data analytics solution.
- apply different approaches for acquiring and using a knowledge management system.

Application Scenarios and Case Studies

On successful completion, students will be able to

- establish an application scenario for data science within a self-organized team.
- identify requirements and appropriate technologies for data collection.
- evaluate and select applicable technologies for data pre-processing and processing.
- assess challenges and risks of the selected approach.
- define clearly the outcome and value of the approach.
- elaborate a conceptual design document and presentation for decision-makers.

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

Data Utilization

Course Code: DLMBBD01

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

Course Description

The course Data Utilization introduces case-based applications that take advantage of regularities and patterns found within continuously generated texts, images, or sensor data. The cases solve issues of pattern recognition, natural language processing, image recognition, detection and sensing, problem-solving, and decision support. The cases are related to the application fields of cybersecurity, linguistics, augmented reality, intelligent transportation, problem-solving, and decision support.

Course Outcomes

On successful completion, students will be able to

- understand how identity, similarity, and diversity of data can be utilized in problem-solving approaches.
- differentiate between complicated and complex systems of investigation.
- identify the variability of a problem under investigation.
- distinguish between invariant and dynamic features of an investigated system.
- synthesize gained insights to propose a reliable data analytics solution.
- apply different approaches for acquiring and using a knowledge management system.

Contents

1. Introduction
   1.1 The Meaning of Identity, Similarity, and Diversity
   1.2 Data Patterns and Ontologies

2. Pattern Recognition
   2.1 Analysis of User Interaction, Attitude, and Behavior
   2.2 Predictive Analytics
   2.3 Preventing the Unknown: User Behavior Analytics in Cybersecurity

3. Natural Language Processing
   3.1 Concepts of Natural Language
   3.2 Speech Recognition and Acoustic Modeling
   3.3 Discerning the Meaning: Linguistics and Social Media

4. Image Recognition

    4.1   Basics of Image Representation

    4.2   Integral Transforms and Compression

    4.3   Exploiting the Visual: Image Recognition for Augmented Reality

5. Detection and Sensing

    5.1   Sensor Construction and Techniques

    5.2   Intelligent Agents and Surveillance

    5.3   Managing the Complex: Sensor Networks in Intelligent Transportation Systems

6. Problem-solving

    6.1   Knowledge Sharing and the Cloud

    6.2   Rule-based Systems

    6.3   Learning from Nature: Expert Systems in Business

7. Decision Support

    7.1   Invariants, Determinants, and Alternatives in Decision-making

    7.2   Correlation and Causality in Strategic Decision-making

    7.3   Approaching the Crossroads: Dashboards and Visualization

8. Data Security and Data Protection

    8.1   Securing Data Storage and Processing Infrastructure Against Unauthorized Access

    8.2   Compliance and Regulations, GPDR

Literature
Compulsory Reading
Further Reading

- Bajcsy, P., Chalfoun, J., & Simon, M. (2017). Web microanalysis of big image data. Berlin:Springer. (Database: ProQuest).
- Delen, D. (2015). Real-world data mining: Applied business analytics and decision making. NewYork, NY: Pearson.
- Farzindar, A., Inkpen, D., & Hirst, G. (2017). Natural language processing for social media (2nd ed.).San Rafael, CA: Morgan & Claypool Publishers. (Database: ProQuest).
- Hsu, H., Chang, C., & Hsu, C. (Eds.). (2017). Big data analytics for sensor-network collectedintelligence. Cambridge, MA: Academic Press. (Database: ProQuest).
- Pearl, J., & Mackenzie, D. (2018). The book of why: The new science of cause and effect. New York,NY: Basic Books.

Study Format myStudies

Study Format	Course Type
myStudies	Lecture

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	
Learning Material ☑ Course Book	**Exam Preparation** ☑ Online Tests

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

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

Application Scenarios and Case Studies

Course Code: DLMBBD02-01

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

Course Description

This course provides an opportunity for students to work on application scenarios for data science in selected industry sectors. This allows the students to combine the learning objectives from the other modules in a setting which closely resembles further work applications: Starting from the identification of suitable application areas, a specific use-case is selected and a set of metrics and/or KPIs is selected which can be used whether the case study is considered successful and leads to tangible benefit. A broad discussion on which data and type of data, as well as where to obtain, store, and process the data, allows students detailed insight into many practical issues that arise when dealing with data-driven projects, ranging from technical questions about infrastructure to data quality and relevant domain expertise.The actual work on the case study begins with the creation of a detailed project plan which defines objectives, means, and outcome. The plan is then implemented using an agile project management framework.The course closes with delivery of a design document and a final presentation in front of a committee of selected lecturers.

Course Outcomes

On successful completion, students will be able to

- establish an application scenario for data science within a self-organized team.
- identify requirements and appropriate technologies for data collection.
- evaluate and select applicable technologies for data pre-processing and processing.
- assess challenges and risks of the selected approach.
- define clearly the outcome and value of the approach.
- elaborate a conceptual design document and presentation for decision-makers.

Contents

1. Introduction to Agile Frameworks

    1.1 Scrum

    1.2 Kanban

    1.3 EduScrum

2. Fields of Application & Case Study Setup

    2.1 Overview of Fields of Application

    2.2 Definition of Success

2.3   Selection of either of the fields (1 per team)

3.   Data Sources

3.1   Identifying Potential Internal and External Data Sources

3.2   Identifying Potential Data Types and Data Processing Requirements

3.3   Identifying Potential Data Quality Challenges

4.   Case Study Work

4.1   Creating a Project Plan

4.2   Implementation of the Case Study Using the Agile Approach

5.   Case Study Presentation

5.1   Case Study Presentation: Approach and Key Findings

5.2   Creation and Submission of Case Study Report

Literature
Compulsory Reading
Further Reading

- Ashmore, S. & Runyan, K. (2014). Introduction to agile methods. Addison-Wesley.
- Delhij, A., van Solingen, R., & Wijnandst, W. (2015). The eduScrum guide. Available online.
- Han, J., Kamber, M., & Pei, J. (2012). Data mining: Concepts and techniques (3rd ed.). Morgan Kaufmann.
- Schwaber, K., & Sutherland, J. (2017). The Scrum guide—The definitive guide to Scrum: The rules of the game.

Study Format myStudies

Study Format	Course Type
myStudies	Lecture

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

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

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

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

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

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

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

Data Miner

Module Code: DLMDMEDM

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	▪ DLMDMEDM01 ▪ none	MA	10	300 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 (Leveraging Data Sources & Data Mining) / Prof. Dr. Frank Passing (Project: Leveraging Data Sources & Data Mining)

Contributing Courses to Module
▪ Leveraging Data Sources & Data Mining (DLMDMEDM01) ▪ Project: Leveraging Data Sources & Data Mining (DLMDMEDM02)

Module Exam Type	
Module Exam	**Split Exam** Leveraging Data Sources & Data Mining • Study Format "Distance Learning": Exam, 90 Minutes Project: Leveraging Data Sources & Data Mining • Study Format "Distance Learning": Written Assessment: Project Report
Weight of Module see curriculum	

Module Contents

Leveraging Data Sources & Data Mining

- Data Mining Process
- Data Quality and Data Preparation
- Data Retrieval Strategies
- Types of Data Sources
- Data Mining Techniques
- Web Mining
- Data Economy
- Legal Regulations and Usage Policies

Project: Leveraging Data Sources & Data Mining

In this course, students learn to apply the data mining concepts they learned in previous modules in a real-world project using Python.

Learning Outcomes

Leveraging Data Sources & Data Mining

On successful completion, students will be able to

- explain the main concepts of data mining.
- know different strategies of data retrieval, the techniques of data preparation and data quality assurance.
- comprehend the various types of data sources used in data mining.
- apply the main techniques of data and web mining.
- summarize the key players and components of data economy.
- describe the legal regulations and usage policies in data mining.

Project: Leveraging Data Sources & Data Mining

On successful completion, students will be able to

- implement a data mining project using Python.
- practice and refine the learned knowledge.
- explore, transfer, convert and experiment with different types of data.
- evaluate the outcomes of the data mining project.
- demonstrate meaningful use of technical skills by documentation.
- present the major techniques of data mining and all related procedures.

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 Master Programs in the IT & Technology field

Leveraging Data Sources & Data Mining

Course Code: DLMDMEDM01

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

Course Description

This course provides an overview of data mining and its key aspects and methods. For this purpose, data mining processes, data retrieval strategies and data quality and preparation methods are introduced, the nature of data sources is learned, and some important data mining and web scraping techniques are discussed. In addition, the concepts of data economy and the legal requirements and usage guidelines associated with data mining are discussed.

Course Outcomes

On successful completion, students will be able to

- explain the main concepts of data mining.
- know different strategies of data retrieval, the techniques of data preparation and data quality assurance.
- comprehend the various types of data sources used in data mining.
- apply the main techniques of data and web mining.
- summarize the key players and components of data economy.
- describe the legal regulations and usage policies in data mining.

Contents

1. Data Mining Process
    1.1   The Role of Data in Businesses
    1.2   Understanding Data
    1.3   Modeling
    1.4   Evaluation
    1.5   Deployment

2. Data Quality and Data Preparation
    2.1   Gathering Data
    2.2   Data Selection
    2.3   Data Cleansing
    2.4   Sparse Data and Missing Values
    2.5   Data Consistency

Literature

Compulsory Reading

Further Reading

- Bhatia, P. (2019). Data Mining and Data Warehousing: Principles and Practical Techniques. Cambridge University Press.
- Bramer, M. (2020). Principles of Data Mining. Springer.
- Rajaraman, A., & Ullman, J. (2020). Mining of Massive Datasets. Cambridge University Press.
- Tan, P.-N., Steinbach, M., Kumar, V., & Karpatne, A. (2019). Introduction to Data Mining. Addison Wesley.
- Witten, I. H., & Frank, E. (2016). Data Mining: Practical Machine Learning Tools and Techniques. Morgan Kaufmann Publishers.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

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

Learning Material
☑ Course Book
☑ Video
☑ Audio
☑ Slides

Exam Preparation
☑ Practice Exam
☑ Online Tests

Project: Leveraging Data Sources & Data Mining

Course Code: DLMDMEDM02

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
MA	English		5	DLMDMEDM01

Course Description

The focus of this course is to apply previously acquired data mining knowledge to a project implementation and reflect on the results. Students will carry out this project and document the results. In doing so, they reflect on the data mining concepts applied and the impact of these concepts on the success of the project.

Course Outcomes

On successful completion, students will be able to

- implement a data mining project using Python.
- practice and refine the learned knowledge.
- explore, transfer, convert and experiment with different types of data.
- evaluate the outcomes of the data mining project.
- demonstrate meaningful use of technical skills by documentation.
- present the major techniques of data mining and all related procedures.

Contents

- In this course, students conduct and document a data mining project using the topics covered in previous module using Python.

Literature
Compulsory Reading
Further Reading

- Greeneltch, Nathan. (2019): Python Data Mining Quick Start Guide: A beginner's guide to extracting valuable insights from your data. Packt Publishing.
- Mitchell, Ryan. (2018): Web Scraping with Python. O'Reilly Media, Inc.
- Porcu, Valentina. (2018): Python for Data Mining Quick Syntax Reference. Apress Media LLC.
- Tan, Pang-Ning / Steinbach, Michael / Kumar, Vipin / Karpatne , Anuj. (2019): Introduction to Data Mining. Addison Wesley.
- Bramer, Max. (2020): Principles of Data Mining. 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	
Learning Material ☑ Slides	**Exam Preparation** ☑ Guideline

Digital Business and Entrepeneurship
Module Code: DLMBWWDBE_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	None	MA	10	300 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 (Digital Business Models) / Prof. Dr. Lena Bernhofer (Innovation and Entrepreneurship)

Contributing Courses to Module
▪ Digital Business Models (DLMIDBM01_E)   ▪ Innovation and Entrepreneurship (DLMBIE01-01)

Module Exam Type	
Module Exam	**Split Exam** <u>Digital Business Models</u> • Study Format "Distance Learning": Exam or Written Assessment: Case Study, 90 Minutes <u>Innovation and Entrepreneurship</u> • Study Format "myStudies": Exam, 90 Minutes • Study Format "Distance Learning": Exam, 90 Minutes
Weight of Module see curriculum	

Module Contents

Digital Business Models

- History and success factors of digital business
- Trends in Digital Business
- Knowledge and evaluation of alternative business models in digital business
- Procedure for the development of strategic corporate positioning in digital business
- Knowledge of alternative financing models
- Goals and procedures for the creation of the business plan for digital business models

Innovation and Entrepreneurship

- Innovation management and entrepreneurship in a globalized world
- Basics of entrepreneurship
- Business ideas and company foundations
- Financing sources and processes
- Internet, digital business, and artificial intelligence
- Strategic alliances
- Family-owned companies

Learning Outcomes

Digital Business Models

On successful completion, students will be able to

- know the history and framework of digital business models.
- understand the basic principles of innovation management.
- know and understand different business models of the digital economy and be able to evaluate their advantages and disadvantages.
- understand the basics of strategic and operational business model planning in e-commerce.
- independently create a business plan for a digital business model.

Innovation and Entrepreneurship

On successful completion, students will be able to

- understand the importance, fundamentals, and dimensions of entrepreneurship and its derivatives (intrapreneurship, corporate entrepreneurship, stakeholder relationships, and family businesses).
- analyze the opportunities and challenges associated with evaluating a business idea and setting up a business.
- distinguish between the different motivations behind entrepreneurial activity and develop specific objectives for new enterprises.
- develop a business model, including benchmarks for assessing desired sustainable growth.
- apply different legal forms to business start-ups and select the appropriate legal form for a specific business model.
- understand the different ways in which entrepreneurship and innovation can be financed and weigh them against each other in terms of medium- and long-term advantages and disadvantages.
- develop a rigorous business plan that can be used both as a planning and financing instrument.
- apply, in principle, an entrepreneurial mindset in a variety of different contexts of future professional development.

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

Digital Business Models

Course Code: DLMIDBM01_E

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

Course Description

This course deals with IT-driven start-ups and business models. Based on the discussion of the historical development and framework conditions of digital business, alternative business models in digital business are systematically presented, analyzed and evaluated with regard to their respective strengths and weaknesses. Students study the central approaches to developing an independent corporate positioning and are enabled to autonomously examine and evaluate the central factors influencing corporate success in digital business. Further, alternative financing concepts for digital business models are presented and critically evaluated and the central components of a business plan are detailed. In addition, the entire process of creating and defining a business plan is presented in detail and tested using practical examples.

Course Outcomes

On successful completion, students will be able to

- know the history and framework of digital business models.
- understand the basic principles of innovation management.
- know and understand different business models of the digital economy and be able to evaluate their advantages and disadvantages.
- understand the basics of strategic and operational business model planning in e-commerce.
- independently create a business plan for a digital business model.

Contents

1. Innovation Management and Business Model Definitions
    1.1 Basic Concepts of Innovation Management Regarding Digital Business Models
    1.2 Business Models: Genesis - Definition - Relation to Innovation
    1.3 Specifics of Digital Business Models and Comparison to Traditional Approaches

2. Digital Business Models: Definition and Elements
    2.1 New Elements of Digital Business Models
    2.2 Redefinition and Core Elements of Digital Business Models
    2.3 Value Architecture and Value Mechanics

3. Basic Architectures, Standard Patterns and Network Integration
    3.1 Basic Digital Business Model Architectures

Literature
Compulsory Reading
Further Reading

- Ahmed, P. K./Shepherd, C. D. (2010): Innovation Management. Context, strategies, systems and processes. Prentice Hall, Upper Saddle River, NJ.
- Bessant, J. R. / Tidd, J. (2018) : Innovation and entrepreneurship. 3rd edition, JOHN WILEY & Sons, Chichester.
- Brynjolfsson, E./Hu, J. Y./Smith, M. D. (2006): From Niches to Riches. Anatomy of the Long Tail. In: Sloan Management Review, 47. Jg., Heft 4, S. 67–71.
- Brynjolfsson, E./Smith M. D. (2000): Frictionless Commerce? A Comparison of Internet and Conventional Retailers. In: Management Science, 46. Jg., Heft 4, S. 563–585.
- Brynjolfsson, E./Hu, J. Y./Rahman, M. (2009): Battle of the Retail Channels. How Product Selection and Geography Drive Cross-Channel Competition. In: Management Science, 55. Jg., Heft 11, S. 1755–1765.
- Chaffey, D./Ellis-Chadwick, F. (2012): Digital Marketing. Strategy, Implementation and Practice. 5th edition, Pearson Education, London.
- Hanson, W./Kalyanam, K. (2007): Internet Marketing and e-Commerce. 2nd edition, Cengage, Boston, MA.
- Laudon, K./Traver, C. G. (2011): E-Commerce. 7th edition, Prentice Hall, Upper Saddle River, NJ.
- Lynch, J./Ariely, D. (2000): Wine Online. Search Costs and Competition on Price, Quality, and Distribution. In: Marketing Science, 19. Jg., Heft 1, S. 83–103.
- Osterwalder, A. / Pigneur, Y. / Clark, T. (2010): Business model generation: A handbook for visionaries, game changers, and challengers. Wiley, Hoboken, NJ.
- Rogers, D. L. (2016): The digital transformation playbook: Rethink your business for the digital age. Columbia Business School Publishing, New York.
- Varian, H. (2000): When Commerce Moves Online. Competition Can Work in Strange Ways. In: New York Times, 24 August 2000.
- Wirtz, B. W. (2019): Digital Business Models: Concepts, Models, and the Alphabet Case Study. Progress in IS. Springer International Publishing, Cham.
- Woerner, S. / Weill, P. (2018): What's Your Digital Business Model?: Six Questions to Help You Build the Next-Generation Enterprise: Harvard Business Review.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam or Written Assessment: Case Study, 90 Minutes

Student Workload					
Self Study 100 h	**Contact Hours** 0 h	**Tutorial/Tutorial Support** 25 h	**Self Test** 25 h	**Independent Study** 0 h	**Hours Total** 150 h

Instructional Methods		
Tutorial Support ☑ Course Feed	**Learning Material** ☑ Course Book ☑ Video ☑ Audio ☑ Slides	**Exam Preparation** ☑ Practice Exam ☑ Online Tests ☑ Guideline

Innovation and Entrepreneurship

Course Code: DLMBIE01-01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
MA	English		5	None

Course Description

In today's globalized and digital world, entrepreneurs have more opportunities to develop and market products and services than ever before. However, entrepreneurship, whether in the form of entrepreneurship or intrapreneurship, presents special challenges. In order to avoid the typical pitfalls of starting and growing a business, a sound understanding of innovation management and building a business is essential. Particular attention must be paid to the financing of entrepreneurial activity, both from the perspective of the entrepreneur and the investor. Innovation and entrepreneurial activity are the basis and driving force of our economy. Even looking at other economies, it is obvious that innovation and entrepreneurship are crucial at every stage of economic development. Small enterprises in developing countries initiate the development of economic institutions and create supply, demand, and markets. These enterprises lay the foundation for economic development and growth. In developed economies, innovation and entrepreneurship are the driving forces behind competition and competitiveness in the global context. In all parts of the world, family businesses play the most important role. The rapid technological and social change present in our societies requires the innovative use of digital technologies (internet and artificial intelligence), as well as flexibility in handling new forms of organization (e.g., strategic alliances between companies). This course introduces students to the ideas behind, motives, and drivers of entrepreneurial activity and innovation and teaches them the practical aspects of the identification, analysis, and development of innovations and business ideas. The core competence of the entrepreneur—the ability to negotiate with investors and partners—is also addressed.

Course Outcomes

On successful completion, students will be able to

- understand the importance, fundamentals, and dimensions of entrepreneurship and its derivatives (intrapreneurship, corporate entrepreneurship, stakeholder relationships, and family businesses).
- analyze the opportunities and challenges associated with evaluating a business idea and setting up a business.
- distinguish between the different motivations behind entrepreneurial activity and develop specific objectives for new enterprises.
- develop a business model, including benchmarks for assessing desired sustainable growth.
- apply different legal forms to business start-ups and select the appropriate legal form for a specific business model.
- understand the different ways in which entrepreneurship and innovation can be financed and weigh them against each other in terms of medium- and long-term advantages and disadvantages.
- develop a rigorous business plan that can be used both as a planning and financing instrument.
- apply, in principle, an entrepreneurial mindset in a variety of different contexts of future professional development.

Contents

1. Entrepreneurship

    1.1   Entrepreneurship and entrepreneur

    1.2   Enterprise related theories of entrepreneurship

    1.3   The economic significance of entrepreneurship

2. Company formation strategy

    2.1   Different contexts in which companies are founded

    2.2   The Entrepreneur

    2.3   Business models and strategies

3. Innovation and innovation management

    3.1   Innovation

    3.2   Innovation management

    3.3   Protection of intellectual property

    3.4   Case study: BMW Empathic Design

4. Legal form in international comparison

    4.1   Germany

    4.2   International comparison: USA

Literature
Compulsory Reading
Further Reading • Mariotti, S., & Glackin, C. (2016). Entrepreneurship: Starting & operating a small business (4th ed.). Pearson. • Parker, S. C. (2009). The economics of entrepreneurship (pp. 1–28). Cambridge University Press. • Scarborough, N. M., & Cornwall, J. R. (2019). Essentials of entrepreneurship and small business management (9th ed.). Pearson.

Study Format myStudies

Study Format	Course Type
myStudies	Lecture

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

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

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

Digital Marketing
Module Code: DLMADTWDM_E

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

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

Module Coordinator
Prof. Dr. Anne-Kristin Langner (Online and Social Media Marketing) / Rainer Lukas (Digital Analytics and Strategies)

Contributing Courses to Module
▪ Online and Social Media Marketing (DLMWOM01_E) ▪ Digital Analytics and Strategies (DLMMADAS01_E)

Module Exam Type	
Module Exam	**Split Exam**
	Online and Social Media Marketing
	• Study Format "Distance Learning": Written Assessment: Case Study
	Digital Analytics and Strategies
	• Study Format "Distance Learning": Written Assessment: Case Study
Weight of Module see curriculum	

Module Contents

Online and Social Media Marketing

- Basics of Strategic Online Marketing
- Introduction to Basic Web Technologies
- The Online Marketing Mix
- Planning, Management and Control of Online Marketing
- Outlook and Discussion: The Future of Online Marketing

Digital Analytics and Strategies

- Basics of Digital Analytics
- Metrics of Digital Analytics
- Digital key performance indicators (KPIs) and their analysis
- Digital strategy development
- Further developments and perspectives of Digital Analytics

Learning Outcomes

Online and Social Media Marketing

On successful completion, students will be able to

- familiarize themselves with the general conditions of online and social media marketing.
- know the specifics of strategic online marketing and its importance for the success of online marketing campaigns.
- have a complete overview of the instruments of online and social media marketing, critically evaluate them and use them optimally in a goal-oriented manner.
- analyze user perception processes and critically assess, control and optimize the design of online marketing instruments.
- develop a strong awareness of the need to protect privacy when using new Internet technologies.
- familiarize themselves with the legal framework of online marketing and anticipate future developments.

Digital Analytics and Strategies

On successful completion, students will be able to

- understand the scope of digital analytics and define the field of web analytics including typical goals and application areas.
- understand, select and evaluate central data sources and metrics to analyze and interpret digital marketing data.
- independently plan and conduct web analyses, interpret the results, draw conclusions and discuss these.
- define key performance indicators (KPIs) of digital analytics and derive specific KPIs to answer potential questions.
- conceptually develop, evaluate and optimize a system to measure online performance indicators.
- analyze current or newly developed online strategies by looking at the customer journey and designing targeted measures to optimize the process especially at the contact points.
- evaluate, reflect and select new digital analysis approaches.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the fields of Marketing & Sales and Business Administration & Management	All Master Programs in the Marketing & Communication and Business & Management fields

Online and Social Media Marketing

Course Code: DLMWOM01_E

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

Course Description

This course introduces both the conceptual foundations of strategic online and social media marketing and the structure, content and design options for the operational design of the respective online marketing instruments. In addition, the essential technical basics of the most common web technologies are deepened and approaches and instruments for managing, implementing and controlling the advertising impact of online media are presented. The legal framework for online and social media marketing will be considered, as well as an outlook and the discussion and initial assessment of future online developments and marketing trends.

Course Outcomes

On successful completion, students will be able to

- familiarize themselves with the general conditions of online and social media marketing.
- know the specifics of strategic online marketing and its importance for the success of online marketing campaigns.
- have a complete overview of the instruments of online and social media marketing, critically evaluate them and use them optimally in a goal-oriented manner.
- analyze user perception processes and critically assess, control and optimize the design of online marketing instruments.
- develop a strong awareness of the need to protect privacy when using new Internet technologies.
- familiarize themselves with the legal framework of online marketing and anticipate future developments.

Contents

1. Basics of Strategic Online Marketing
    1.1 Integrated Communication as the Basis for Success
    1.2 Internal and External Conditions of Online Marketing
    1.3 Situation and Environment Analysis
    1.4 Definition of Objectives of Online and Social Media Marketing in B2C and B2B Contexts

2. Introduction to Basic Web Technologies
    2.1 Web Basics
    2.2 Current Technologies and Trends

3. The Online Marketing Mix

    3.1   Fundamentals of Online Marketing Effects

    3.2   Overview of Classic Instruments of Online Marketing

    3.3   Mobile Marketing

    3.4   Social Media Marketing

    3.5   Assessment of Alternative Online Marketing Instruments Including Possible Applications and Limitations

    3.6   Integrated Online Marketing and Viral Campaigns

4. Planning, Management and Control of Online Marketing

    4.1   Planning of Online Marketing Instruments

    4.2   Essential Success Factors of Online Marketing

    4.3   Approaches and Instruments for Measuring the Success of Online and Social Media Activities

    4.4   Legal Framework for Online and Social Media Marketing

5. Outlook and Discussion: The Future of Online Marketing

    5.1   Current and Future Developments in Online Marketing

Literature
Compulsory Reading
Further Reading

- Godin, S. (2000). Unleashing the ideavirus. Hyperion.
- Kingsnorth, S. (2019). Digital marketing strategy: An integrated approach to online marketing (2nd ed.). Kogan Page.
- Scott, D. (2017). The new rules of marketing and PR (6th ed.). Wiley.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

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

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

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

Digital Analytics and Strategies

Course Code: DLMMADAS01_E

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

Course Description

Marketing has a wide range of online instruments and data at its disposal. However, due to the large number of information sources, it is a challenge to extract data, information and key figures based on their valuable contribution to online marketing strategies. Building on the theoretical foundations of suitable metrics to describe and analyze user behavior, key performance indicators (KPIs) are developed, discussed and reflected with regard to their relevance in online marketing. Subsequently, the acquired knowledge is transferred into online strategies, content marketing measures and online campaigns. The course concludes with the identification and discussion of further development possibilities and digital analytic trends in marketing.

Course Outcomes

On successful completion, students will be able to

- understand the scope of digital analytics and define the field of web analytics including typical goals and application areas.
- understand, select and evaluate central data sources and metrics to analyze and interpret digital marketing data.
- independently plan and conduct web analyses, interpret the results, draw conclusions and discuss these.
- define key performance indicators (KPIs) of digital analytics and derive specific KPIs to answer potential questions.
- conceptually develop, evaluate and optimize a system to measure online performance indicators.
- analyze current or newly developed online strategies by looking at the customer journey and designing targeted measures to optimize the process especially at the contact points.
- evaluate, reflect and select new digital analysis approaches.

Contents

1. Basics of Digital Analytics
    1.1 Introduction and Definition of Digital Analytics
    1.2 Goals of Digital Analytics
    1.3 Data and Information Sources
    1.4 Legal Framework

2. Metrics of Digital Analytics

    2.1   Fundamentals of Metrics

    2.2   Hits, Page Views, Visits and Visitors

    2.3   Other Metrics

    2.4   Limits of Metrics: Inaccuracies and Ambiguities

3. Digital Key Performance Indicators (KPIs) and Their Analysis

    3.1   Search Engine Marketing: Key Figures and Analytical Approaches

    3.2   Social Media: Monitoring and Analytical Approaches

    3.3   Website: Key Figures and Analytical Approaches

    3.4   Email: Key Figures and Analytical Approaches

4. Digital Strategy Development

    4.1   Fundamentals of the Customer Journey

    4.2   Derivation of Digital Marketing Goals Along the Customer Journey

    4.3   Application and Design Possibilities for Digital and Mobile Campaigns

    4.4   Application and Design Possibilities for Content Marketing

    4.5   Monitoring The Implementation of Strategies and Measures

5. Further Developments and Perspectives of Digital Analytics

Literature
Compulsory Reading
Further Reading
▪ Angel, G. (2016). Measuring the digital world: Using digital analytics to drive better experiences. Pearson.   ▪ Phillips, J. (2016). Ecommence analytics: Analyze and improve the impact of your digital strategy. Pearson.   ▪ Sponder, M., & Gohar, K. (2018). Digital analytics for marketing. Routledge.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

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

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

Instructional Methods		
Tutorial Support ☑ Course Feed	**Learning Material** ☑ Course Book ☑ Video ☑ Audio ☑ Slides	**Exam Preparation** ☑ Online Tests ☑ Guideline

Digital Business Models and Change

Module Code: DLMBAWDGC_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	MA	10	300 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 (Digital Business Models) / Prof. Dr. Alexander Leberling (IT Project and Change Management)

Contributing Courses to Module

- Digital Business Models (DLMIDBM01_E)
- IT Project and Change Management (DLMIPC01_E)

Module Exam Type

Module Exam	Split Exam
	Digital Business Models
	• Study Format "Distance Learning": Exam or Written Assessment: Case Study, 90 Minutes
	IT Project and Change Management
	• Study Format "Distance Learning": Exam
Weight of Module see curriculum	

Module Contents

Digital Business Models

- History and success factors of digital business
- Trends in Digital Business
- Knowledge and evaluation of alternative business models in digital business
- Procedure for the development of strategic corporate positioning in digital business
- Knowledge of alternative financing models
- Goals and procedures for the creation of the business plan for digital business models

IT Project and Change Management

- Change Management
- Success factors in Change Management
- Communication Management
- Change Management in the Context of IT
- IT Projects Designed for Change
- Selected IT Management Techniques

Learning Outcomes

Digital Business Models

On successful completion, students will be able to

- know the history and framework of digital business models.
- understand the basic principles of innovation management.
- know and understand different business models of the digital economy and be able to evaluate their advantages and disadvantages.
- understand the basics of strategic and operational business model planning in e-commerce.
- independently create a business plan for a digital business model.

IT Project and Change Management

On successful completion, students will be able to

- explain the term change management and how change management and IT projects are related to each other.
- explain success factors in change management and demonstrate how targeted communication management can be done.
- explain the term change management in the context of IT service management and explain how change management can be organized in a structured manner there.
- assess how IT projects and IT architectures can be prepared for continuous change and with which concrete management techniques the ability to change is made possible.

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

Digital Business Models

Course Code: DLMIDBM01_E

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

Course Description

This course deals with IT-driven start-ups and business models. Based on the discussion of the historical development and framework conditions of digital business, alternative business models in digital business are systematically presented, analyzed and evaluated with regard to their respective strengths and weaknesses. Students study the central approaches to developing an independent corporate positioning and are enabled to autonomously examine and evaluate the central factors influencing corporate success in digital business. Further, alternative financing concepts for digital business models are presented and critically evaluated and the central components of a business plan are detailed. In addition, the entire process of creating and defining a business plan is presented in detail and tested using practical examples.

Course Outcomes

On successful completion, students will be able to

- know the history and framework of digital business models.
- understand the basic principles of innovation management.
- know and understand different business models of the digital economy and be able to evaluate their advantages and disadvantages.
- understand the basics of strategic and operational business model planning in e-commerce.
- independently create a business plan for a digital business model.

Contents

1. Innovation Management and Business Model Definitions
    1.1 Basic Concepts of Innovation Management Regarding Digital Business Models
    1.2 Business Models: Genesis - Definition - Relation to Innovation
    1.3 Specifics of Digital Business Models and Comparison to Traditional Approaches

2. Digital Business Models: Definition and Elements
    2.1 New Elements of Digital Business Models
    2.2 Redefinition and Core Elements of Digital Business Models
    2.3 Value Architecture and Value Mechanics

3. Basic Architectures, Standard Patterns and Network Integration
    3.1 Basic Digital Business Model Architectures

Literature
Compulsory Reading
Further Reading

- Ahmed, P. K./Shepherd, C. D. (2010): Innovation Management. Context, strategies, systems and processes. Prentice Hall, Upper Saddle River, NJ.
- Bessant, J. R. / Tidd, J. (2018) : Innovation and entrepreneurship. 3rd edition, JOHN WILEY & Sons, Chichester.
- Brynjolfsson, E./Hu, J. Y./Smith, M. D. (2006): From Niches to Riches. Anatomy of the Long Tail. In: Sloan Management Review, 47. Jg., Heft 4, S. 67–71.
- Brynjolfsson, E./Smith M. D. (2000): Frictionless Commerce? A Comparison of Internet and Conventional Retailers. In: Management Science, 46. Jg., Heft 4, S. 563–585.
- Brynjolfsson, E./Hu, J. Y./Rahman, M. (2009): Battle of the Retail Channels. How Product Selection and Geography Drive Cross-Channel Competition. In: Management Science, 55. Jg., Heft 11, S. 1755–1765.
- Chaffey, D./Ellis-Chadwick, F. (2012): Digital Marketing. Strategy, Implementation and Practice. 5th edition, Pearson Education, London.
- Hanson, W./Kalyanam, K. (2007): Internet Marketing and e-Commerce. 2nd edition, Cengage, Boston, MA.
- Laudon, K./Traver, C. G. (2011): E-Commerce. 7th edition, Prentice Hall, Upper Saddle River, NJ.
- Lynch, J./Ariely, D. (2000): Wine Online. Search Costs and Competition on Price, Quality, and Distribution. In: Marketing Science, 19. Jg., Heft 1, S. 83–103.
- Osterwalder, A. / Pigneur, Y. / Clark, T. (2010): Business model generation: A handbook for visionaries, game changers, and challengers. Wiley, Hoboken, NJ.
- Rogers, D. L. (2016): The digital transformation playbook: Rethink your business for the digital age. Columbia Business School Publishing, New York.
- Varian, H. (2000): When Commerce Moves Online. Competition Can Work in Strange Ways. In: New York Times, 24 August 2000.
- Wirtz, B. W. (2019): Digital Business Models: Concepts, Models, and the Alphabet Case Study. Progress in IS. Springer International Publishing, Cham.
- Woerner, S. / Weill, P. (2018): What's Your Digital Business Model?: Six Questions to Help You Build the Next-Generation Enterprise: Harvard Business Review.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam or Written Assessment: Case Study, 90 Minutes

Student Workload					
Self Study 100 h	**Contact Hours** 0 h	**Tutorial/Tutorial Support** 25 h	**Self Test** 25 h	**Independent Study** 0 h	**Hours Total** 150 h

Instructional Methods

Tutorial Support	Learning Material	Exam Preparation
☑ Course Feed	☑ Course Book	☑ Practice Exam
	☑ Video	☑ Online Tests
	☑ Audio	☑ Guideline
	☑ Slides	

IT Project and Change Management

Course Code: DLMIPC01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
MA	English		5	None

Course Description

In this course, students learn about the term change management and its connection with IT projects. They will also learn about success factors and how communication management can be used to support change processes in a targeted manner. Furthermore, they will learn what change management means in the context of IT service management and how IT projects and IT architectures can be specifically designed regarding continuous adaptation.

Course Outcomes

On successful completion, students will be able to

- explain the term change management and how change management and IT projects are related to each other.
- explain success factors in change management and demonstrate how targeted communication management can be done.
- explain the term change management in the context of IT service management and explain how change management can be organized in a structured manner there.
- assess how IT projects and IT architectures can be prepared for continuous change and with which concrete management techniques the ability to change is made possible.

Contents

1. Change Management
    1.1 Introduction and Examples
    1.2 Definition: Change Management
    1.3 Relationships between Change and IT Project Management
    1.4 Areas of Influence of IT Projects on Companies

2. Supporting Methods for Change Management
    2.1 Introduction
    2.2 Rapid Protoytping
    2.3 Agility and Change
    2.4 Complexity and Change
    2.5 The Process Logic of the Tetralemma and Change
    2.6 Knowledge Management and Change

Literature
Compulsory Reading

Further Reading

- Bridges, W./Bridges, S. (2009): Managing Transitions. Making the Most of Change. 3. Auflage, Da Capo, Cambridge (MA).
- Hiatt, J./Creasey, T. (2012): Change Management. The People Side of Change. 2. Auflage, Prosci, Fort Collins (CO).
- Project Management Institute (Hrsg.) (2013): A Guide to the Project Management Body of Knowledge (PMBOK Guide). 5. Auflage, Project Management Institute, Newtown (PA).

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

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

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	Learning Material	Exam Preparation
☑ Course Feed	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Technical Project Lead

Module Code: DLMDSETPL

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	▪ DLMBITPAM01 ▪ none	MA	10	300 h

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

Module Coordinator
Prof. Dr. Carsten Skerra (IT Project Management) / Prof. Dr. Dorian Mora (Project: Technical Project Planning)

Contributing Courses to Module
▪ IT Project Management (DLMBITPAM01) ▪ Project: Technical Project Planning (DLMDSETPL01)

Module Exam Type	
Module Exam	**Split Exam** IT Project Management • Study Format "myStudies": Exam, 90 Minutes • Study Format "Distance Learning": Exam, 90 Minutes Project: Technical Project Planning • Study Format "Distance Learning": Portfolio • Study Format "myStudies": *Type of examination*
Weight of Module see curriculum	

Module Contents

IT Project Management

- Organizing the work
- Cost estimation and controlling
- The human factor
- Organizing small, medium, and large projects

Project: Technical Project Planning

In this course, students learn to apply the project management concepts they learned in previous modules in a real-world project.

Learning Outcomes

IT Project Management

On successful completion, students will be able to

- critically reflect the status of knowledge on IT project management.
- set up different IT project management formats (small, medium and large projects) and know the methods for managing these different IT projects professionally.
- develop an IT management proposal as the fundament of a professional IT project management concept.
- understand and integrate different IT management project plans (e.g., time plan, cost plan, resources plan, risk plan) and use those plans in an integrative IT project planning and controlling scheme.
- organize and to lead an IT project team and its core and/or extended team members.

Project: Technical Project Planning

On successful completion, students will be able to

- apply the concepts of project management to real-world tasks and problems.
- translate the learned theories into the practice of project management.
- analyze a real-world problem and define and implement a project to resolve it.
- appraise the results of a project performed and identify what worked well and what did not.
- explain the work they perform, give its scientific background, and produce adequate documentation.

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

IT Project Management

Course Code: DLMBITPAM01

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

Course Description

The purpose of this course is to introduce students to the concepts involved in IT project management. This is achieved through the development of an understanding of the fundamental tenets of project management enhancing the students' ability to apply their knowledge, skills and competencies in analyzing and solving IT project management problems. A special focus is put on the specifics of IT project organization, cost management and the human factor within IT projects.

Course Outcomes

On successful completion, students will be able to

- critically reflect the status of knowledge on IT project management.
- set up different IT project management formats (small, medium and large projects) and know the methods for managing these different IT projects professionally.
- develop an IT management proposal as the fundament of a professional IT project management concept.
- understand and integrate different IT management project plans (e.g., time plan, cost plan, resources plan, risk plan) and use those plans in an integrative IT project planning and controlling scheme.
- organize and to lead an IT project team and its core and/or extended team members.

Contents

1. Introduction: Characteristics of IT Projects
    1.1 Defining IT Projects
    1.2 Overview on Typical Roles and Phases of IT Projects
    1.3 Risks and Challenges of IT Projects
    1.4 Role of an IT Project Manager

2. Organizing the Work
    2.1 Project Breakdown Structure, Work Packages
    2.2 Prioritization
    2.3 Time Planning, Milestones, Gantt-Diagram
    2.4 Definition of Done

3. Cost Estimation and Controlling

3.1 Challenges of Cost Estimation in IT Projects

3.2 Estimation Techniques: 3-Point Estimation, Double Blind Expert Estimation, Function Points

3.3 Cost Controlling Using Earned Value Analysis

3.4 Risk Management

4. The Human Factor

4.1 Vision Keeping

4.2 Stakeholder Management

4.3 Conflict Management

5. Organizing Small and Medium Projects

5.1 Rational Unified Process (RUP)

5.2 Agile Software Processes

5.3 Scrum

5.4 Plan-driven Project Management in Small Projects

6. Organizing Large Projects

6.1 PMBOK Guide

6.2 Prince2

6.3 Multi Project Management

6.4 Agile Software Processes in Large Projects

6.5 Selection of the Appropriate Project Management Method

Literature
Compulsory Reading
Further Reading
▪ Stephens, R. (2015). Beginning software engineering. Wrox, a Wiley Brand.

Study Format myStudies

Study Format myStudies	Course Type Lecture

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	
Learning Material ☑ Course Book	**Exam Preparation** ☑ Online Tests

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

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

Project: Technical Project Planning

Course Code: DLMDSETPL01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
MA	English		5	DLMBITPAM01

Course Description
The focus of this course is to apply the project management knowledge gained previously in a practical portfolio project and reflect on the results. Students engage in this portfolio project and document the results, reflecting on the project management concepts they apply and the influence of these concepts on the success of the project.

Course Outcomes
On successful completion, students will be able to

- apply the concepts of project management to real-world tasks and problems.
- translate the learned theories into the practice of project management.
- analyze a real-world problem and define and implement a project to resolve it.
- appraise the results of a project performed and identify what worked well and what did not.
- explain the work they perform, give its scientific background, and produce adequate documentation.

Contents
- In this course, students perform and document a portfolio project in which they apply the project management topics covered in previous modules.

Literature
Compulsory Reading
Further Reading

- Hinde, D. (2012). PRINCE2 Study Guide. West Sussex: John Wiley & Sons.
- Kneuper, R. (2018). Software processes and lifecycle models. Cham: Springer Nature Switzerland.
- Phillips, J. (2010). IT project management: On track from start to finish (3rd ed.). New York, NY: McGraw-Hill.
- Project Management Institute. (2013). A guide to the project management body of knowledge: PMBOK guide.
- Schwaber, K. (2004). Agile project management with Scrum. Redmond, WA: Microsoft Press.

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	☑ Slides	☑ Guideline

Study Format myStudies

Study Format myStudies	Course Type

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

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

Instructional Methods

Data Engineer

Module Code: DLMDSEDE

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	▪ DLMDSEDE01 ▪ none	MA	10	300 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 (Data Engineering) / Prof. Dr. Max Pumperla (Project: Data Engineering)

Contributing Courses to Module
▪ Data Engineering (DLMDSEDE01) ▪ Project: Data Engineering (DLMDSEDE02)

Module Exam Type	
Module Exam	**Split Exam** Data Engineering • Study Format "Distance Learning": Oral Assignment • Study Format "myStudies": *Type of examination* Project: Data Engineering • Study Format "Distance Learning": Portfolio • Study Format "myStudies": *Type of examination*
Weight of Module see curriculum	

Module Contents

Data Engineering

- Principles of data engineering
- Paradigms for data processing at scale
- Overview on data governance, security, and protection
- Common cloud platforms
- DataOps approach

Project: Data Engineering

- Knowledge transfer and application to practical problems
- Implementation of a data infrastructure building block

Learning Outcomes

Data Engineering

On successful completion, students will be able to

- understand the foundational concepts in data engineering.
- categorize important data-processing classes.
- summarize common approaches to data governance and security and contribute to the broader societal discussion on an academic level.
- compare different common public cloud offerings.
- recognize current approaches to data operations (DataOps) including productivity tools to facilitate working in interdisciplinary teams.

Project: Data Engineering

On successful completion, students will be able to

- apply the principles of data engineering to a practical application.
- analyze data engineering approaches with respect to a given project task.
- reason about the benefits and drawbacks of solution alternatives for a given implementation task.
- make apposite architectural choices.
- implement aspects of a modern data pipeline abiding by strict data protection principles.

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 Master Programmes in the IT & Technology field.

Data Engineering

Course Code: DLMDSEDE01

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

Course Description

The focus of this first course in the Data Engineering elective module is to introduce students to important principles, concepts, methods and approaches in this subject domain. In order to achieve this goal, the course moves from an exposition of the foundational principles of data engineering to a thorough treatment of the core data processing classes. Modern architectural paradigms such as Microservices are explained, and important factors in data governance and protection are addressed. In this context, students are enabled to reflect on modern data protection principles and their societal implications and implement these principles into large-scale data-intensive systems. Aspects of cloud computing are introduced via an overview of the most common offerings on the market. Finally, a state-of-the-art agile perspective on the operation of data pipelines is given by an exposition to the emerging notion of DataOps and the productivity tools around it to facilitate working in interdisciplinary teams.

Course Outcomes

On successful completion, students will be able to

- understand the foundational concepts in data engineering.
- categorize important data-processing classes.
- summarize common approaches to data governance and security and contribute to the broader societal discussion on an academic level.
- compare different common public cloud offerings.
- recognize current approaches to data operations (DataOps) including productivity tools to facilitate working in interdisciplinary teams.

Contents

1. Foundations of Data Systems
    1.1 Reliability
    1.2 Scalability
    1.3 Maintainability

2. Data Processing at Scale
    2.1 Batch Processing
    2.2 Stream and Complex Event Processing

3. Microservices

    3.1 Introduction to Microservices

    3.2 Implementing Microservices

4. Governance & Security

    4.1 Data Protection

    4.2 Data Security

    4.3 Data Governance

5. Common Cloud Platforms & Services

    5.1 Amazon AWS

    5.2 Google Cloud

    5.3 Microsoft Azure

6. Data Ops

    6.1 Defining Principles

    6.2 Containerization

    6.3 Building Data Pipelines

Literature
Compulsory Reading

Further Reading

- Andrade, H., Gedik, B., & Turaga, D. (2014). Fundamentals of stream processing: Application design, systems, and analytics. Cambridge University Press.
- Axelrod, C. W. (2013). Engineering safe and secure software systems. Artech House.
- Kleppmann, M. (2017). Designing data-intensive applications: The big ideas behind reliable, scalable, and maintainable systems. O'Reilly.
- Newman, S. (2015). Building microservices: Designing fine-grained systems. O'Reilly.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

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

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

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

Study Format myStudies

Study Format myStudies	Course Type

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

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

Instructional Methods

Project: Data Engineering

Course Code: DLMDSEDE02

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
MA	English		5	DLMDSEDE01

Course Description

The second course of the Data Engineering elective module builds upon theoretical and methodological insights from the first course. It provides opportunities for students to put their newly-acquired knowledge into practical application by completing a data engineering project.In order to find an appropriate and viable approach, students will have to reason about and evaluate the benefits and drawbacks of possible architectural choices. Once an informed decision has been met, the chosen approach is implemented as a running piece of data infrastructure.

Course Outcomes

On successful completion, students will be able to

- apply the principles of data engineering to a practical application.
- analyze data engineering approaches with respect to a given project task.
- reason about the benefits and drawbacks of solution alternatives for a given implementation task.
- make apposite architectural choices.
- implement aspects of a modern data pipeline abiding by strict data protection principles.

Contents

- The second course of the Data Engineering elective revolves around the implementation of a data engineering project chosen from a set of project suggestions. Students can also contribute their own project ideas.

Literature
Compulsory Reading
Further Reading

- Kleppmann, M. (2017). Designing data intensive applications: The big ideas behind reliable, scalable, and maintainable systems. Sebastopol, CA: O'Reilly.
- Farcic, V. (2016). The DevOps 2.0 toolkit: Automating the continuous deployment pipeline with containerized microservices. Scotts Valley, CA: CreateSpace Independent Publishing Platform.
- White, T. (2015). Hadoop: The definitive guide: Storage and analysis at Internet scale. Sebastopol, CA: O'Reilley.
- Karau, H., Konwinski, A., Wendell, P., & Zaharia, M. (2015). Learning Spark: Lightning fast data analysis. Sebastopol, CA: O'Reilley.
- Narkhede, N., Shapira, G., & Palino, T. (2017). Kafka: The definitive guide: Real-time data and stream processing at scale. Sebastopol, CA: O'Reilley.

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	☑ Slides	☑ Guideline

Study Format myStudies

Study Format	Course Type
myStudies	

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

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

Big Data Engineering

Module Code: DLMBIEBDE

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	▪ none ▪ DLMDSBDT01	MA	10	300 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) / Prof. Dr. Thomas Zöller (Project: Big Data Technologies)

Contributing Courses to Module
▪ Big Data Technologies (DLMDSBDT01) ▪ Project: Big Data Technologies (DLMBIEBDE01)

Module Exam Type	
Module Exam	**Split Exam** Big Data Technologies • Study Format "myStudies": Oral Assignment • Study Format "Distance Learning": Oral Assignment Project: Big Data Technologies • Study Format "Distance Learning": Written Assessment: Project Report
Weight of Module see curriculum	

Module Contents

Big Data Technologies

- Data types and data sources
- Databases
- Modern storage frameworks
- Data formats
- Distributed computing

Project: Big Data Technologies

The module is designed to give the students the opportunity to practice what they have learned in the previous course and encounter a number of practical problems that are new for them.

Learning Outcomes

Big Data Technologies

On successful completion, students will be able to

- identify different types and sources of data.
- understand different database concepts.
- learn to build new database structures.
- evaluate various data storage frameworks w.r.t. project requirements.
- analyze which data format to use for a given project.
- understand what roles you could take in such projects.
- create a distributed computing environment for a given project.
- understand the ethical impact of big data technology choices.

Project: Big Data Technologies

On successful completion, students will be able to

- experience the learned big data technologies in a project.
- design a Big Data architecture based on given requirements and conditions.
- investigate and gather information from a variety of sources to build a Big Data application.
- apply appropriate techniques and methods to create an Apache Spark cluster.
- demonstrate meaningful use of technical skills by documentation.
- explain which disciplines play an essential role in the context of Big Data Engineering.

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

Big Data Technologies

Course Code: DLMDSBDT01

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

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. This course then discusses how data are stored in databases. Particular focus is given to database structures and different types of databases, e.g., relational, noSQL, NewSQL, and time-series.Beyond classical and modern databases, this course covers a wide range of storage frameworks such as distributed filesystems, streaming, and query frameworks. This is complemented by a detailed discussion of data storage formats ranging from classical approaches such as CSV and HDF5 to more modern approaches like Apache Arrow and Parquet.Finally, this course gives an overview of distributed computing environments based on local clusters, cloud computing facilities, and container-based approaches.

Course Outcomes

On successful completion, students will be able to

- identify different types and sources of data.
- understand different database concepts.
- learn to build new database structures.
- evaluate various data storage frameworks w.r.t. project requirements.
- analyze which data format to use for a given project.
- understand what roles you could take in such projects.
- create a distributed computing environment for a given project.
- understand the ethical impact of big data technology choices.

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. Databases
    2.1 Database structures
    2.2 Introduction to SQL

Literature
Compulsory Reading
Further Reading

- Date, C. J. (2003). An introduction to database systems. Pearson.
- Kleppmann, M. (2017). Designing data-intensive applications. O'Reilly.
- Wiese, L. (2015). Advanced data management. De Gruyter.

Study Format myStudies

Study Format	Course Type
myStudies	Lecture

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	**Learning Material** ☑ Course Book ☑ Video ☑ Audio ☑ Slides	**Exam Preparation** ☑ Online Tests ☑ Guideline

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

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

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

Instructional Methods		
Tutorial Support ☑ Course Feed ☑ Creative Lab	**Learning Material** ☑ Course Book ☑ Reader ☑ Video	**Exam Preparation** ☑ Guideline

Project: Big Data Technologies

Course Code: DLMBIEBDE01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
MA	English		5	DLMDSBDT01

Course Description

The course is designed to give the students the opportunity to practice what they have learned and encounter a set of practical problems that are new for them. The goal is to implement an Apache Spark project with the learned knowledge.

Course Outcomes

On successful completion, students will be able to

- experience the learned big data technologies in a project.
- design a Big Data architecture based on given requirements and conditions.
- investigate and gather information from a variety of sources to build a Big Data application.
- apply appropriate techniques and methods to create an Apache Spark cluster.
- demonstrate meaningful use of technical skills by documentation.
- explain which disciplines play an essential role in the context of Big Data Engineering.

Contents

- In this course, students will conduct and document a Big Data project using the topics covered in the previous course. They will explore and collect information from a variety of sources and design an application using Apache Spark. They will design the architecture and document the implementation of the application.

Literature
Compulsory Reading
Further Reading

- Kleppmann, Martin. (2017): Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems. O'Reilly Media.
- Marz , Nathan / Warren, James. (2015): Big Data: Principles and best practices of scalable realtime data systems. Manning Publications.
- Sachdev , Dinesh. (2021): Thinking Big: Developers Guide for Big Data Engineering & Analytics. Independently published.
- SparkByExamples. (2021): Spark By Examples. (URL: https://sparkbyexamples.com/)
- Weber , Hans. (2020): Big Data and Artificial Intelligence: Complete Guide to Data Science, AI, Big Data and Machine Learning. Independently published.

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

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

Big Data

Module Code: DLMBBD-01

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

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

Module Coordinator
Radiah Rivu (Data Utilization) / Dr. Cosmina Croitoru (Application Scenarios and Case Studies)

Contributing Courses to Module
▪ Data Utilization (DLMBBD01) ▪ Application Scenarios and Case Studies (DLMBBD02-01)

Module Exam Type	
Module Exam	**Split Exam**
	Data Utilization • Study Format "myStudies": Exam, 90 Minutes • Study Format "Distance Learning": Exam, 90 Minutes Application Scenarios and Case Studies • Study Format "myStudies": Written Assessment: Written Assignment • Study Format "Distance Learning": Written Assessment: Case Study
Weight of Module see curriculum	

Module Contents

Data Utilization

- Pattern recognition
- Natural language processing
- Image recognition
- Detection and sensing
- Problem-solving
- Decision-making

Application Scenarios and Case Studies

- Agile development
- Workflow overview
- Fields of application
- Sprint Planning; Sprint
- Sprint Retrospective
- Committee presentation

Learning Outcomes

Data Utilization

On successful completion, students will be able to

- understand how identity, similarity, and diversity of data can be utilized in problem-solving approaches.
- differentiate between complicated and complex systems of investigation.
- identify the variability of a problem under investigation.
- distinguish between invariant and dynamic features of an investigated system.
- synthesize gained insights to propose a reliable data analytics solution.
- apply different approaches for acquiring and using a knowledge management system.

Application Scenarios and Case Studies

On successful completion, students will be able to

- establish an application scenario for data science within a self-organized team.
- identify requirements and appropriate technologies for data collection.
- evaluate and select applicable technologies for data pre-processing and processing.
- assess challenges and risks of the selected approach.
- define clearly the outcome and value of the approach.
- elaborate a conceptual design document and presentation for decision-makers.

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

Data Utilization

Course Code: DLMBBD01

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

Course Description

The course Data Utilization introduces case-based applications that take advantage of regularities and patterns found within continuously generated texts, images, or sensor data. The cases solve issues of pattern recognition, natural language processing, image recognition, detection and sensing, problem-solving, and decision support. The cases are related to the application fields of cybersecurity, linguistics, augmented reality, intelligent transportation, problem-solving, and decision support.

Course Outcomes

On successful completion, students will be able to

- understand how identity, similarity, and diversity of data can be utilized in problem-solving approaches.
- differentiate between complicated and complex systems of investigation.
- identify the variability of a problem under investigation.
- distinguish between invariant and dynamic features of an investigated system.
- synthesize gained insights to propose a reliable data analytics solution.
- apply different approaches for acquiring and using a knowledge management system.

Contents

1. Introduction
    1.1 The Meaning of Identity, Similarity, and Diversity
    1.2 Data Patterns and Ontologies

2. Pattern Recognition
    2.1 Analysis of User Interaction, Attitude, and Behavior
    2.2 Predictive Analytics
    2.3 Preventing the Unknown: User Behavior Analytics in Cybersecurity

3. Natural Language Processing
    3.1 Concepts of Natural Language
    3.2 Speech Recognition and Acoustic Modeling
    3.3 Discerning the Meaning: Linguistics and Social Media

4. Image Recognition

    4.1   Basics of Image Representation

    4.2   Integral Transforms and Compression

    4.3   Exploiting the Visual: Image Recognition for Augmented Reality

5. Detection and Sensing

    5.1   Sensor Construction and Techniques

    5.2   Intelligent Agents and Surveillance

    5.3   Managing the Complex: Sensor Networks in Intelligent Transportation Systems

6. Problem-solving

    6.1   Knowledge Sharing and the Cloud

    6.2   Rule-based Systems

    6.3   Learning from Nature: Expert Systems in Business

7. Decision Support

    7.1   Invariants, Determinants, and Alternatives in Decision-making

    7.2   Correlation and Causality in Strategic Decision-making

    7.3   Approaching the Crossroads: Dashboards and Visualization

8. Data Security and Data Protection

    8.1   Securing Data Storage and Processing Infrastructure Against Unauthorized Access

    8.2   Compliance and Regulations, GPDR

Literature
Compulsory Reading
Further Reading

- Bajcsy, P., Chalfoun, J., & Simon, M. (2017). Web microanalysis of big image data. Berlin:Springer. (Database: ProQuest).
- Delen, D. (2015). Real-world data mining: Applied business analytics and decision making. NewYork, NY: Pearson.
- Farzindar, A., Inkpen, D., & Hirst, G. (2017). Natural language processing for social media (2nd ed.).San Rafael, CA: Morgan & Claypool Publishers. (Database: ProQuest).
- Hsu, H., Chang, C., & Hsu, C. (Eds.). (2017). Big data analytics for sensor-network collectedintelligence. Cambridge, MA: Academic Press. (Database: ProQuest).
- Pearl, J., & Mackenzie, D. (2018). The book of why: The new science of cause and effect. New York,NY: Basic Books.

Study Format myStudies

Study Format	Course Type
myStudies	Lecture

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	
Learning Material ☑ Course Book	**Exam Preparation** ☑ Online Tests

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

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

Application Scenarios and Case Studies

Course Code: DLMBBD02-01

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

Course Description

This course provides an opportunity for students to work on application scenarios for data science in selected industry sectors. This allows the students to combine the learning objectives from the other modules in a setting which closely resembles further work applications: Starting from the identification of suitable application areas, a specific use-case is selected and a set of metrics and/or KPIs is selected which can be used whether the case study is considered successful and leads to tangible benefit. A broad discussion on which data and type of data, as well as where to obtain, store, and process the data, allows students detailed insight into many practical issues that arise when dealing with data-driven projects, ranging from technical questions about infrastructure to data quality and relevant domain expertise.The actual work on the case study begins with the creation of a detailed project plan which defines objectives, means, and outcome. The plan is then implemented using an agile project management framework.The course closes with delivery of a design document and a final presentation in front of a committee of selected lecturers.

Course Outcomes

On successful completion, students will be able to

- establish an application scenario for data science within a self-organized team.
- identify requirements and appropriate technologies for data collection.
- evaluate and select applicable technologies for data pre-processing and processing.
- assess challenges and risks of the selected approach.
- define clearly the outcome and value of the approach.
- elaborate a conceptual design document and presentation for decision-makers.

Contents

1. Introduction to Agile Frameworks
    1.1 Scrum
    1.2 Kanban
    1.3 EduScrum

2. Fields of Application & Case Study Setup
    2.1 Overview of Fields of Application
    2.2 Definition of Success

2.3 Selection of either of the fields (1 per team)

3. Data Sources

3.1 Identifying Potential Internal and External Data Sources

3.2 Identifying Potential Data Types and Data Processing Requirements

3.3 Identifying Potential Data Quality Challenges

4. Case Study Work

4.1 Creating a Project Plan

4.2 Implementation of the Case Study Using the Agile Approach

5. Case Study Presentation

5.1 Case Study Presentation: Approach and Key Findings

5.2 Creation and Submission of Case Study Report

Literature
Compulsory Reading
Further Reading

- Ashmore, S. & Runyan, K. (2014). Introduction to agile methods. Addison-Wesley.
- Delhij, A., van Solingen, R., & Wijnandst, W. (2015). The eduScrum guide. Available online.
- Han, J., Kamber, M., & Pei, J. (2012). Data mining: Concepts and techniques (3rd ed.). Morgan Kaufmann.
- Schwaber, K., & Sutherland, J. (2017). The Scrum guide—The definitive guide to Scrum: The rules of the game.

Study Format myStudies

Study Format	Course Type
myStudies	Lecture

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

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

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

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

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
Learning Material   **Exam Preparation** ☑ Course Book   ☑ Online Tests ☑ Video   ☑ Guideline ☑ Audio ☑ Slides

Data Miner

Module Code: DLMDMEDM

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	▪ DLMDMEDM01 ▪ none	MA	10	300 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 (Leveraging Data Sources & Data Mining) / Prof. Dr. Frank Passing (Project: Leveraging Data Sources & Data Mining)

Contributing Courses to Module
▪ Leveraging Data Sources & Data Mining (DLMDMEDM01) ▪ Project: Leveraging Data Sources & Data Mining (DLMDMEDM02)

Module Exam Type	
Module Exam	**Split Exam** Leveraging Data Sources & Data Mining • Study Format "Distance Learning": Exam, 90 Minutes Project: Leveraging Data Sources & Data Mining • Study Format "Distance Learning": Written Assessment: Project Report
Weight of Module see curriculum	

Module Contents

Leveraging Data Sources & Data Mining

- Data Mining Process
- Data Quality and Data Preparation
- Data Retrieval Strategies
- Types of Data Sources
- Data Mining Techniques
- Web Mining
- Data Economy
- Legal Regulations and Usage Policies

Project: Leveraging Data Sources & Data Mining

In this course, students learn to apply the data mining concepts they learned in previous modules in a real-world project using Python.

Learning Outcomes

Leveraging Data Sources & Data Mining

On successful completion, students will be able to

- explain the main concepts of data mining.
- know different strategies of data retrieval, the techniques of data preparation and data quality assurance.
- comprehend the various types of data sources used in data mining.
- apply the main techniques of data and web mining.
- summarize the key players and components of data economy.
- describe the legal regulations and usage policies in data mining.

Project: Leveraging Data Sources & Data Mining

On successful completion, students will be able to

- implement a data mining project using Python.
- practice and refine the learned knowledge.
- explore, transfer, convert and experiment with different types of data.
- evaluate the outcomes of the data mining project.
- demonstrate meaningful use of technical skills by documentation.
- present the major techniques of data mining and all related procedures.

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 Master Programs in the IT & Technology field

Leveraging Data Sources & Data Mining

Course Code: DLMDMEDM01

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

Course Description

This course provides an overview of data mining and its key aspects and methods. For this purpose, data mining processes, data retrieval strategies and data quality and preparation methods are introduced, the nature of data sources is learned, and some important data mining and web scraping techniques are discussed. In addition, the concepts of data economy and the legal requirements and usage guidelines associated with data mining are discussed.

Course Outcomes

On successful completion, students will be able to

- explain the main concepts of data mining.
- know different strategies of data retrieval, the techniques of data preparation and data quality assurance.
- comprehend the various types of data sources used in data mining.
- apply the main techniques of data and web mining.
- summarize the key players and components of data economy.
- describe the legal regulations and usage policies in data mining.

Contents

1. Data Mining Process
    1.1 The Role of Data in Businesses
    1.2 Understanding Data
    1.3 Modeling
    1.4 Evaluation
    1.5 Deployment

2. Data Quality and Data Preparation
    2.1 Gathering Data
    2.2 Data Selection
    2.3 Data Cleansing
    2.4 Sparse Data and Missing Values
    2.5 Data Consistency

Literature

Compulsory Reading

Further Reading

- Bhatia, P. (2019). Data Mining and Data Warehousing: Principles and Practical Techniques. Cambridge University Press.
- Bramer, M. (2020). Principles of Data Mining. Springer.
- Rajaraman, A., & Ullman, J. (2020). Mining of Massive Datasets. Cambridge University Press.
- Tan, P.-N., Steinbach, M., Kumar, V., & Karpatne, A. (2019). Introduction to Data Mining. Addison Wesley.
- Witten, I. H., & Frank, E. (2016). Data Mining: Practical Machine Learning Tools and Techniques. Morgan Kaufmann Publishers.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

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

Project: Leveraging Data Sources & Data Mining

Course Code: DLMDMEDM02

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
MA	English		5	DLMDMEDM01

Course Description

The focus of this course is to apply previously acquired data mining knowledge to a project implementation and reflect on the results. Students will carry out this project and document the results. In doing so, they reflect on the data mining concepts applied and the impact of these concepts on the success of the project.

Course Outcomes

On successful completion, students will be able to

- implement a data mining project using Python.
- practice and refine the learned knowledge.
- explore, transfer, convert and experiment with different types of data.
- evaluate the outcomes of the data mining project.
- demonstrate meaningful use of technical skills by documentation.
- present the major techniques of data mining and all related procedures.

Contents

- In this course, students conduct and document a data mining project using the topics covered in previous module using Python.

Literature
Compulsory Reading
Further Reading
- Greeneltch, Nathan. (2019): Python Data Mining Quick Start Guide: A beginner's guide to extracting valuable insights from your data. Packt Publishing. - Mitchell, Ryan. (2018): Web Scraping with Python. O'Reilly Media, Inc. - Porcu, Valentina. (2018): Python for Data Mining Quick Syntax Reference. Apress Media LLC. - Tan, Pang-Ning / Steinbach, Michael / Kumar, Vipin / Karpatne , Anuj. (2019): Introduction to Data Mining. Addison Wesley. - Bramer, Max. (2020): Principles of Data Mining. 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 120 h	**Contact Hours** 0 h	**Tutorial/Tutorial Support** 30 h	**Self Test** 0 h	**Independent Study** 0 h	**Hours Total** 150 h

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

Digital Business and Entrepeneurship
Module Code: DLMBWWDBE_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	None	MA	10	300 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 (Digital Business Models) / Prof. Dr. Lena Bernhofer (Innovation and Entrepreneurship)

Contributing Courses to Module
▪ Digital Business Models (DLMIDBM01_E) ▪ Innovation and Entrepreneurship (DLMBIE01-01)

Module Exam Type	
Module Exam	**Split Exam**
	Digital Business Models • Study Format "Distance Learning": Exam or Written Assessment: Case Study, 90 Minutes Innovation and Entrepreneurship • Study Format "myStudies": Exam, 90 Minutes • Study Format "Distance Learning": Exam, 90 Minutes
Weight of Module	
see curriculum	

Module Contents

Digital Business Models

- History and success factors of digital business
- Trends in Digital Business
- Knowledge and evaluation of alternative business models in digital business
- Procedure for the development of strategic corporate positioning in digital business
- Knowledge of alternative financing models
- Goals and procedures for the creation of the business plan for digital business models

Innovation and Entrepreneurship

- Innovation management and entrepreneurship in a globalized world
- Basics of entrepreneurship
- Business ideas and company foundations
- Financing sources and processes
- Internet, digital business, and artificial intelligence
- Strategic alliances
- Family-owned companies

Learning Outcomes

Digital Business Models

On successful completion, students will be able to

- know the history and framework of digital business models.
- understand the basic principles of innovation management.
- know and understand different business models of the digital economy and be able to evaluate their advantages and disadvantages.
- understand the basics of strategic and operational business model planning in e-commerce.
- independently create a business plan for a digital business model.

Innovation and Entrepreneurship

On successful completion, students will be able to

- understand the importance, fundamentals, and dimensions of entrepreneurship and its derivatives (intrapreneurship, corporate entrepreneurship, stakeholder relationships, and family businesses).
- analyze the opportunities and challenges associated with evaluating a business idea and setting up a business.
- distinguish between the different motivations behind entrepreneurial activity and develop specific objectives for new enterprises.
- develop a business model, including benchmarks for assessing desired sustainable growth.
- apply different legal forms to business start-ups and select the appropriate legal form for a specific business model.
- understand the different ways in which entrepreneurship and innovation can be financed and weigh them against each other in terms of medium- and long-term advantages and disadvantages.
- develop a rigorous business plan that can be used both as a planning and financing instrument.
- apply, in principle, an entrepreneurial mindset in a variety of different contexts of future professional development.

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

Digital Business Models

Course Code: DLMIDBM01_E

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

Course Description

This course deals with IT-driven start-ups and business models. Based on the discussion of the historical development and framework conditions of digital business, alternative business models in digital business are systematically presented, analyzed and evaluated with regard to their respective strengths and weaknesses. Students study the central approaches to developing an independent corporate positioning and are enabled to autonomously examine and evaluate the central factors influencing corporate success in digital business. Further, alternative financing concepts for digital business models are presented and critically evaluated and the central components of a business plan are detailed. In addition, the entire process of creating and defining a business plan is presented in detail and tested using practical examples.

Course Outcomes

On successful completion, students will be able to

- know the history and framework of digital business models.
- understand the basic principles of innovation management.
- know and understand different business models of the digital economy and be able to evaluate their advantages and disadvantages.
- understand the basics of strategic and operational business model planning in e-commerce.
- independently create a business plan for a digital business model.

Contents

1. Innovation Management and Business Model Definitions
    1.1 Basic Concepts of Innovation Management Regarding Digital Business Models
    1.2 Business Models: Genesis - Definition - Relation to Innovation
    1.3 Specifics of Digital Business Models and Comparison to Traditional Approaches

2. Digital Business Models: Definition and Elements
    2.1 New Elements of Digital Business Models
    2.2 Redefinition and Core Elements of Digital Business Models
    2.3 Value Architecture and Value Mechanics

3. Basic Architectures, Standard Patterns and Network Integration
    3.1 Basic Digital Business Model Architectures

Literature
Compulsory Reading
Further Reading

- Ahmed, P. K./Shepherd, C. D. (2010): Innovation Management. Context, strategies, systems and processes. Prentice Hall, Upper Saddle River, NJ.
- Bessant, J. R. / Tidd, J. (2018) : Innovation and entrepreneurship. 3rd edition, JOHN WILEY & Sons, Chichester.
- Brynjolfsson, E./Hu, J. Y./Smith, M. D. (2006): From Niches to Riches. Anatomy of the Long Tail. In: Sloan Management Review, 47. Jg., Heft 4, S. 67–71.
- Brynjolfsson, E./Smith M. D. (2000): Frictionless Commerce? A Comparison of Internet and Conventional Retailers. In: Management Science, 46. Jg., Heft 4, S. 563–585.
- Brynjolfsson, E./Hu, J. Y./Rahman, M. (2009): Battle of the Retail Channels. How Product Selection and Geography Drive Cross-Channel Competition. In: Management Science, 55. Jg., Heft 11, S. 1755–1765.
- Chaffey, D./Ellis-Chadwick, F. (2012): Digital Marketing. Strategy, Implementation and Practice. 5th edition, Pearson Education, London.
- Hanson, W./Kalyanam, K. (2007): Internet Marketing and e-Commerce. 2nd edition, Cengage, Boston, MA.
- Laudon, K./Traver, C. G. (2011): E-Commerce. 7th edition, Prentice Hall, Upper Saddle River, NJ.
- Lynch, J./Ariely, D. (2000): Wine Online. Search Costs and Competition on Price, Quality, and Distribution. In: Marketing Science, 19. Jg., Heft 1, S. 83–103.
- Osterwalder, A. / Pigneur, Y. / Clark, T. (2010): Business model generation: A handbook for visionaries, game changers, and challengers. Wiley, Hoboken, NJ.
- Rogers, D. L. (2016): The digital transformation playbook: Rethink your business for the digital age. Columbia Business School Publishing, New York.
- Varian, H. (2000): When Commerce Moves Online. Competition Can Work in Strange Ways. In: New York Times, 24 August 2000.
- Wirtz, B. W. (2019): Digital Business Models: Concepts, Models, and the Alphabet Case Study. Progress in IS. Springer International Publishing, Cham.
- Woerner, S. / Weill, P. (2018): What's Your Digital Business Model?: Six Questions to Help You Build the Next-Generation Enterprise: Harvard Business Review.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam or Written Assessment: Case Study, 90 Minutes

Student Workload					
Self Study 100 h	**Contact Hours** 0 h	**Tutorial/Tutorial Support** 25 h	**Self Test** 25 h	**Independent Study** 0 h	**Hours Total** 150 h

Instructional Methods

Tutorial Support	Learning Material	Exam Preparation
☑ Course Feed	☑ Course Book	☑ Practice Exam
	☑ Video	☑ Online Tests
	☑ Audio	☑ Guideline
	☑ Slides	

Innovation and Entrepreneurship

Course Code: DLMBIE01-01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
MA	English		5	None

Course Description

In today's globalized and digital world, entrepreneurs have more opportunities to develop and market products and services than ever before. However, entrepreneurship, whether in the form of entrepreneurship or intrapreneurship, presents special challenges. In order to avoid the typical pitfalls of starting and growing a business, a sound understanding of innovation management and building a business is essential. Particular attention must be paid to the financing of entrepreneurial activity, both from the perspective of the entrepreneur and the investor. Innovation and entrepreneurial activity are the basis and driving force of our economy. Even looking at other economies, it is obvious that innovation and entrepreneurship are crucial at every stage of economic development. Small enterprises in developing countries initiate the development of economic institutions and create supply, demand, and markets. These enterprises lay the foundation for economic development and growth. In developed economies, innovation and entrepreneurship are the driving forces behind competition and competitiveness in the global context. In all parts of the world, family businesses play the most important role. The rapid technological and social change present in our societies requires the innovative use of digital technologies (internet and artificial intelligence), as well as flexibility in handling new forms of organization (e.g., strategic alliances between companies). This course introduces students to the ideas behind, motives, and drivers of entrepreneurial activity and innovation and teaches them the practical aspects of the identification, analysis, and development of innovations and business ideas. The core competence of the entrepreneur—the ability to negotiate with investors and partners—is also addressed.

Course Outcomes

On successful completion, students will be able to

- understand the importance, fundamentals, and dimensions of entrepreneurship and its derivatives (intrapreneurship, corporate entrepreneurship, stakeholder relationships, and family businesses).
- analyze the opportunities and challenges associated with evaluating a business idea and setting up a business.
- distinguish between the different motivations behind entrepreneurial activity and develop specific objectives for new enterprises.
- develop a business model, including benchmarks for assessing desired sustainable growth.
- apply different legal forms to business start-ups and select the appropriate legal form for a specific business model.
- understand the different ways in which entrepreneurship and innovation can be financed and weigh them against each other in terms of medium- and long-term advantages and disadvantages.
- develop a rigorous business plan that can be used both as a planning and financing instrument.
- apply, in principle, an entrepreneurial mindset in a variety of different contexts of future professional development.

Contents

1. Entrepreneurship

    1.1 Entrepreneurship and entrepreneur

    1.2 Enterprise related theories of entrepreneurship

    1.3 The economic significance of entrepreneurship

2. Company formation strategy

    2.1 Different contexts in which companies are founded

    2.2 The Entrepreneur

    2.3 Business models and strategies

3. Innovation and innovation management

    3.1 Innovation

    3.2 Innovation management

    3.3 Protection of intellectual property

    3.4 Case study: BMW Empathic Design

4. Legal form in international comparison

    4.1 Germany

    4.2 International comparison: USA

5.   Financing entrepreneurial activity I: Sources of finance

    5.1   Incubators, accelerators and crowdfunding

    5.2   Business angels

    5.3   Private equity and corporate venture capital

    5.4   Public start-up support

6.   Financing entrepreneurial activity II: Financing processes

    6.1   The investor view: Deal sourcing and deal screening

    6.2   The entrepreneurial view: Negotiations with investors

    6.3   The evaluation of business start-ups

7.   The business plan

    7.1   Purpose and objectives of the business plan

    7.2   Expectations regarding the business plan

    7.3   Structure and content of the business plan

    7.4   Guidelines for creating a business plan

8.   Digital business models and artificial intelligence

    8.1   e-Business

    8.2   Artificial intelligence

    8.3   The Globotics Evolution

9.   Cooperative strategy: Alliances and joint ventures

    9.1   Cooperative strategy

    9.2   The right "fit"

    9.3   The right "form"

10.   Family-owned company

    10.1   Definitions

    10.2   Economic significance

    10.3   Strengths and weaknesses

Literature
Compulsory Reading
Further Reading • Mariotti, S., & Glackin, C. (2016). Entrepreneurship: Starting & operating a small business (4th ed.). Pearson. • Parker, S. C. (2009). The economics of entrepreneurship (pp. 1–28). Cambridge University Press. • Scarborough, N. M., & Cornwall, J. R. (2019). Essentials of entrepreneurship and small business management (9th ed.). Pearson.

Study Format myStudies

Study Format	Course Type
myStudies	Lecture

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

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

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

Digital Marketing
Module Code: DLMADTWDM_E

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

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

Module Coordinator
Prof. Dr. Anne-Kristin Langner (Online and Social Media Marketing) / Rainer Lukas (Digital Analytics and Strategies)

Contributing Courses to Module
▪ Online and Social Media Marketing (DLMWOM01_E) ▪ Digital Analytics and Strategies (DLMMADAS01_E)

Module Exam Type	
Module Exam	**Split Exam**
	Online and Social Media Marketing • Study Format "Distance Learning": Written Assessment: Case Study Digital Analytics and Strategies • Study Format "Distance Learning": Written Assessment: Case Study
Weight of Module see curriculum	

Module Contents

Online and Social Media Marketing

- Basics of Strategic Online Marketing
- Introduction to Basic Web Technologies
- The Online Marketing Mix
- Planning, Management and Control of Online Marketing
- Outlook and Discussion: The Future of Online Marketing

Digital Analytics and Strategies

- Basics of Digital Analytics
- Metrics of Digital Analytics
- Digital key performance indicators (KPIs) and their analysis
- Digital strategy development
- Further developments and perspectives of Digital Analytics

Learning Outcomes

Online and Social Media Marketing

On successful completion, students will be able to

- familiarize themselves with the general conditions of online and social media marketing.
- know the specifics of strategic online marketing and its importance for the success of online marketing campaigns.
- have a complete overview of the instruments of online and social media marketing, critically evaluate them and use them optimally in a goal-oriented manner.
- analyze user perception processes and critically assess, control and optimize the design of online marketing instruments.
- develop a strong awareness of the need to protect privacy when using new Internet technologies.
- familiarize themselves with the legal framework of online marketing and anticipate future developments.

Digital Analytics and Strategies

On successful completion, students will be able to

- understand the scope of digital analytics and define the field of web analytics including typical goals and application areas.
- understand, select and evaluate central data sources and metrics to analyze and interpret digital marketing data.
- independently plan and conduct web analyses, interpret the results, draw conclusions and discuss these.
- define key performance indicators (KPIs) of digital analytics and derive specific KPIs to answer potential questions.
- conceptually develop, evaluate and optimize a system to measure online performance indicators.
- analyze current or newly developed online strategies by looking at the customer journey and designing targeted measures to optimize the process especially at the contact points.
- evaluate, reflect and select new digital analysis approaches.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the fields of Marketing & Sales and Business Administration & Management	All Master Programs in the Marketing & Communication and Business & Management fields

Online and Social Media Marketing

Course Code: DLMWOM01_E

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

Course Description

This course introduces both the conceptual foundations of strategic online and social media marketing and the structure, content and design options for the operational design of the respective online marketing instruments. In addition, the essential technical basics of the most common web technologies are deepened and approaches and instruments for managing, implementing and controlling the advertising impact of online media are presented. The legal framework for online and social media marketing will be considered, as well as an outlook and the discussion and initial assessment of future online developments and marketing trends.

Course Outcomes

On successful completion, students will be able to

- familiarize themselves with the general conditions of online and social media marketing.
- know the specifics of strategic online marketing and its importance for the success of online marketing campaigns.
- have a complete overview of the instruments of online and social media marketing, critically evaluate them and use them optimally in a goal-oriented manner.
- analyze user perception processes and critically assess, control and optimize the design of online marketing instruments.
- develop a strong awareness of the need to protect privacy when using new Internet technologies.
- familiarize themselves with the legal framework of online marketing and anticipate future developments.

Contents

1. Basics of Strategic Online Marketing
    1.1 Integrated Communication as the Basis for Success
    1.2 Internal and External Conditions of Online Marketing
    1.3 Situation and Environment Analysis
    1.4 Definition of Objectives of Online and Social Media Marketing in B2C and B2B Contexts

2. Introduction to Basic Web Technologies
    2.1 Web Basics
    2.2 Current Technologies and Trends

3. The Online Marketing Mix

    3.1   Fundamentals of Online Marketing Effects

    3.2   Overview of Classic Instruments of Online Marketing

    3.3   Mobile Marketing

    3.4   Social Media Marketing

    3.5   Assessment of Alternative Online Marketing Instruments Including Possible Applications and Limitations

    3.6   Integrated Online Marketing and Viral Campaigns

4. Planning, Management and Control of Online Marketing

    4.1   Planning of Online Marketing Instruments

    4.2   Essential Success Factors of Online Marketing

    4.3   Approaches and Instruments for Measuring the Success of Online and Social Media Activities

    4.4   Legal Framework for Online and Social Media Marketing

5. Outlook and Discussion: The Future of Online Marketing

    5.1   Current and Future Developments in Online Marketing

Literature
Compulsory Reading
Further Reading

- Godin, S. (2000). Unleashing the ideavirus. Hyperion.
- Kingsnorth, S. (2019). Digital marketing strategy: An integrated approach to online marketing (2nd ed.). Kogan Page.
- Scott, D. (2017). The new rules of marketing and PR (6th ed.). Wiley.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

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

Learning Material
☑ Course Book
☑ Video
☑ Audio
☑ Slides

Exam Preparation
☑ Online Tests
☑ Guideline

Digital Analytics and Strategies

Course Code: DLMMADAS01_E

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

Course Description

Marketing has a wide range of online instruments and data at its disposal. However, due to the large number of information sources, it is a challenge to extract data, information and key figures based on their valuable contribution to online marketing strategies. Building on the theoretical foundations of suitable metrics to describe and analyze user behavior, key performance indicators (KPIs) are developed, discussed and reflected with regard to their relevance in online marketing. Subsequently, the acquired knowledge is transferred into online strategies, content marketing measures and online campaigns. The course concludes with the identification and discussion of further development possibilities and digital analytic trends in marketing.

Course Outcomes

On successful completion, students will be able to

- understand the scope of digital analytics and define the field of web analytics including typical goals and application areas.
- understand, select and evaluate central data sources and metrics to analyze and interpret digital marketing data.
- independently plan and conduct web analyses, interpret the results, draw conclusions and discuss these.
- define key performance indicators (KPIs) of digital analytics and derive specific KPIs to answer potential questions.
- conceptually develop, evaluate and optimize a system to measure online performance indicators.
- analyze current or newly developed online strategies by looking at the customer journey and designing targeted measures to optimize the process especially at the contact points.
- evaluate, reflect and select new digital analysis approaches.

Contents

1. Basics of Digital Analytics
    1.1 Introduction and Definition of Digital Analytics
    1.2 Goals of Digital Analytics
    1.3 Data and Information Sources
    1.4 Legal Framework

2. Metrics of Digital Analytics

    2.1   Fundamentals of Metrics

    2.2   Hits, Page Views, Visits and Visitors

    2.3   Other Metrics

    2.4   Limits of Metrics: Inaccuracies and Ambiguities

3. Digital Key Performance Indicators (KPIs) and Their Analysis

    3.1   Search Engine Marketing: Key Figures and Analytical Approaches

    3.2   Social Media: Monitoring and Analytical Approaches

    3.3   Website: Key Figures and Analytical Approaches

    3.4   Email: Key Figures and Analytical Approaches

4. Digital Strategy Development

    4.1   Fundamentals of the Customer Journey

    4.2   Derivation of Digital Marketing Goals Along the Customer Journey

    4.3   Application and Design Possibilities for Digital and Mobile Campaigns

    4.4   Application and Design Possibilities for Content Marketing

    4.5   Monitoring The Implementation of Strategies and Measures

5. Further Developments and Perspectives of Digital Analytics

Literature
Compulsory Reading
Further Reading
▪ Angel, G. (2016). Measuring the digital world: Using digital analytics to drive better experiences. Pearson.   ▪ Phillips, J. (2016). Ecommence analytics: Analyze and improve the impact of your digital strategy. Pearson.   ▪ Sponder, M., & Gohar, K. (2018). Digital analytics for marketing. Routledge.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

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

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

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Online Tests ☑ Guideline

Digital Business Models and Change
Module Code: DLMBAWDGC_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	MA	10	300 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 (Digital Business Models) / Prof. Dr. Alexander Leberling (IT Project and Change Management)

Contributing Courses to Module
▪ Digital Business Models (DLMIDBM01_E)   ▪ IT Project and Change Management (DLMIPC01_E)

Module Exam Type	
Module Exam	**Split Exam** Digital Business Models • Study Format "Distance Learning": Exam or Written Assessment: Case Study, 90 Minutes IT Project and Change Management • Study Format "Distance Learning": Exam
Weight of Module see curriculum	

Module Contents

Digital Business Models

- History and success factors of digital business
- Trends in Digital Business
- Knowledge and evaluation of alternative business models in digital business
- Procedure for the development of strategic corporate positioning in digital business
- Knowledge of alternative financing models
- Goals and procedures for the creation of the business plan for digital business models

IT Project and Change Management

- Change Management
- Success factors in Change Management
- Communication Management
- Change Management in the Context of IT
- IT Projects Designed for Change
- Selected IT Management Techniques

Learning Outcomes

Digital Business Models

On successful completion, students will be able to

- know the history and framework of digital business models.
- understand the basic principles of innovation management.
- know and understand different business models of the digital economy and be able to evaluate their advantages and disadvantages.
- understand the basics of strategic and operational business model planning in e-commerce.
- independently create a business plan for a digital business model.

IT Project and Change Management

On successful completion, students will be able to

- explain the term change management and how change management and IT projects are related to each other.
- explain success factors in change management and demonstrate how targeted communication management can be done.
- explain the term change management in the context of IT service management and explain how change management can be organized in a structured manner there.
- assess how IT projects and IT architectures can be prepared for continuous change and with which concrete management techniques the ability to change is made possible.

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

Digital Business Models

Course Code: DLMIDBM01_E

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

Course Description

This course deals with IT-driven start-ups and business models. Based on the discussion of the historical development and framework conditions of digital business, alternative business models in digital business are systematically presented, analyzed and evaluated with regard to their respective strengths and weaknesses. Students study the central approaches to developing an independent corporate positioning and are enabled to autonomously examine and evaluate the central factors influencing corporate success in digital business. Further, alternative financing concepts for digital business models are presented and critically evaluated and the central components of a business plan are detailed. In addition, the entire process of creating and defining a business plan is presented in detail and tested using practical examples.

Course Outcomes

On successful completion, students will be able to

- know the history and framework of digital business models.
- understand the basic principles of innovation management.
- know and understand different business models of the digital economy and be able to evaluate their advantages and disadvantages.
- understand the basics of strategic and operational business model planning in e-commerce.
- independently create a business plan for a digital business model.

Contents

1. Innovation Management and Business Model Definitions
    1.1   Basic Concepts of Innovation Management Regarding Digital Business Models
    1.2   Business Models: Genesis - Definition - Relation to Innovation
    1.3   Specifics of Digital Business Models and Comparison to Traditional Approaches

2. Digital Business Models: Definition and Elements
    2.1   New Elements of Digital Business Models
    2.2   Redefinition and Core Elements of Digital Business Models
    2.3   Value Architecture and Value Mechanics

3. Basic Architectures, Standard Patterns and Network Integration
    3.1   Basic Digital Business Model Architectures

Literature
Compulsory Reading
Further Reading

- Ahmed, P. K./Shepherd, C. D. (2010): Innovation Management. Context, strategies, systems and processes. Prentice Hall, Upper Saddle River, NJ.
- Bessant, J. R. / Tidd, J. (2018) : Innovation and entrepreneurship. 3rd edition, JOHN WILEY & Sons, Chichester.
- Brynjolfsson, E./Hu, J. Y./Smith, M. D. (2006): From Niches to Riches. Anatomy of the Long Tail. In: Sloan Management Review, 47. Jg., Heft 4, S. 67–71.
- Brynjolfsson, E./Smith M. D. (2000): Frictionless Commerce? A Comparison of Internet and Conventional Retailers. In: Management Science, 46. Jg., Heft 4, S. 563–585.
- Brynjolfsson, E./Hu, J. Y./Rahman, M. (2009): Battle of the Retail Channels. How Product Selection and Geography Drive Cross-Channel Competition. In: Management Science, 55. Jg., Heft 11, S. 1755–1765.
- Chaffey, D./Ellis-Chadwick, F. (2012): Digital Marketing. Strategy, Implementation and Practice. 5th edition, Pearson Education, London.
- Hanson, W./Kalyanam, K. (2007): Internet Marketing and e-Commerce. 2nd edition, Cengage, Boston, MA.
- Laudon, K./Traver, C. G. (2011): E-Commerce. 7th edition, Prentice Hall, Upper Saddle River, NJ.
- Lynch, J./Ariely, D. (2000): Wine Online. Search Costs and Competition on Price, Quality, and Distribution. In: Marketing Science, 19. Jg., Heft 1, S. 83–103.
- Osterwalder, A. / Pigneur, Y. / Clark, T. (2010): Business model generation: A handbook for visionaries, game changers, and challengers. Wiley, Hoboken, NJ.
- Rogers, D. L. (2016): The digital transformation playbook: Rethink your business for the digital age. Columbia Business School Publishing, New York.
- Varian, H. (2000): When Commerce Moves Online. Competition Can Work in Strange Ways. In: New York Times, 24 August 2000.
- Wirtz, B. W. (2019): Digital Business Models: Concepts, Models, and the Alphabet Case Study. Progress in IS. Springer International Publishing, Cham.
- Woerner, S. / Weill, P. (2018): What's Your Digital Business Model?: Six Questions to Help You Build the Next-Generation Enterprise: Harvard Business Review.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam or Written Assessment: Case Study, 90 Minutes

Student Workload					
Self Study 100 h	**Contact Hours** 0 h	**Tutorial/Tutorial Support** 25 h	**Self Test** 25 h	**Independent Study** 0 h	**Hours Total** 150 h

Instructional Methods

Tutorial Support	Learning Material	Exam Preparation
☑ Course Feed	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests ☑ Guideline

IT Project and Change Management

Course Code: DLMIPC01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
MA	English		5	None

Course Description

In this course, students learn about the term change management and its connection with IT projects. They will also learn about success factors and how communication management can be used to support change processes in a targeted manner. Furthermore, they will learn what change management means in the context of IT service management and how IT projects and IT architectures can be specifically designed regarding continuous adaptation.

Course Outcomes

On successful completion, students will be able to

- explain the term change management and how change management and IT projects are related to each other.
- explain success factors in change management and demonstrate how targeted communication management can be done.
- explain the term change management in the context of IT service management and explain how change management can be organized in a structured manner there.
- assess how IT projects and IT architectures can be prepared for continuous change and with which concrete management techniques the ability to change is made possible.

Contents

1. Change Management
    1.1 Introduction and Examples
    1.2 Definition: Change Management
    1.3 Relationships between Change and IT Project Management
    1.4 Areas of Influence of IT Projects on Companies

2. Supporting Methods for Change Management
    2.1 Introduction
    2.2 Rapid Protoytping
    2.3 Agility and Change
    2.4 Complexity and Change
    2.5 The Process Logic of the Tetralemma and Change
    2.6 Knowledge Management and Change

Literature
Compulsory Reading
Further Reading
▪ Bridges, W./Bridges, S. (2009): Managing Transitions. Making the Most of Change. 3. Auflage, Da Capo, Cambridge (MA). ▪ Hiatt, J./Creasey, T. (2012): Change Management. The People Side of Change. 2. Auflage, Prosci, Fort Collins (CO). ▪ Project Management Institute (Hrsg.) (2013): A Guide to the Project Management Body of Knowledge (PMBOK Guide). 5. Auflage, Project Management Institute, Newtown (PA).

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

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

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	Learning Material	Exam Preparation
☑ Course Feed	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Technical Project Lead

Module Code: DLMDSETPL

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	- DLMBITPAM01 - none	MA	10	300 h

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

Module Coordinator
Prof. Dr. Carsten Skerra (IT Project Management) / Prof. Dr. Dorian Mora (Project: Technical Project Planning)

Contributing Courses to Module
- IT Project Management (DLMBITPAM01)   - Project: Technical Project Planning (DLMDSETPL01)

Module Exam Type	
Module Exam	**Split Exam**
	<u>IT Project Management</u> • Study Format "myStudies": Exam, 90 Minutes • Study Format "Distance Learning": Exam, 90 Minutes <u>Project: Technical Project Planning</u> • Study Format "Distance Learning": Portfolio • Study Format "myStudies": *Type of examination*
Weight of Module see curriculum	

Module Contents

IT Project Management

- Organizing the work
- Cost estimation and controlling
- The human factor
- Organizing small, medium, and large projects

Project: Technical Project Planning

In this course, students learn to apply the project management concepts they learned in previous modules in a real-world project.

Learning Outcomes

IT Project Management

On successful completion, students will be able to

- critically reflect the status of knowledge on IT project management.
- set up different IT project management formats (small, medium and large projects) and know the methods for managing these different IT projects professionally.
- develop an IT management proposal as the fundament of a professional IT project management concept.
- understand and integrate different IT management project plans (e.g., time plan, cost plan, resources plan, risk plan) and use those plans in an integrative IT project planning and controlling scheme.
- organize and to lead an IT project team and its core and/or extended team members.

Project: Technical Project Planning

On successful completion, students will be able to

- apply the concepts of project management to real-world tasks and problems.
- translate the learned theories into the practice of project management.
- analyze a real-world problem and define and implement a project to resolve it.
- appraise the results of a project performed and identify what worked well and what did not.
- explain the work they perform, give its scientific background, and produce adequate documentation.

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

IT Project Management

Course Code: DLMBITPAM01

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

Course Description

The purpose of this course is to introduce students to the concepts involved in IT project management. This is achieved through the development of an understanding of the fundamental tenets of project management enhancing the students' ability to apply their knowledge, skills and competencies in analyzing and solving IT project management problems. A special focus is put on the specifics of IT project organization, cost management and the human factor within IT projects.

Course Outcomes

On successful completion, students will be able to

- critically reflect the status of knowledge on IT project management.
- set up different IT project management formats (small, medium and large projects) and know the methods for managing these different IT projects professionally.
- develop an IT management proposal as the fundament of a professional IT project management concept.
- understand and integrate different IT management project plans (e.g., time plan, cost plan, resources plan, risk plan) and use those plans in an integrative IT project planning and controlling scheme.
- organize and to lead an IT project team and its core and/or extended team members.

Contents

1. Introduction: Characteristics of IT Projects
    1.1 Defining IT Projects
    1.2 Overview on Typical Roles and Phases of IT Projects
    1.3 Risks and Challenges of IT Projects
    1.4 Role of an IT Project Manager

2. Organizing the Work
    2.1 Project Breakdown Structure, Work Packages
    2.2 Prioritization
    2.3 Time Planning, Milestones, Gantt-Diagram
    2.4 Definition of Done

3. Cost Estimation and Controlling

Literature
Compulsory Reading
Further Reading
▪   Stephens, R. (2015). Beginning software engineering. Wrox, a Wiley Brand.

Study Format myStudies

Study Format	Course Type
myStudies	Lecture

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	
Learning Material ☑ Course Book	**Exam Preparation** ☑ Online Tests

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

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

Project: Technical Project Planning

Course Code: DLMDSETPL01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
MA	English		5	DLMBITPAM01

Course Description

The focus of this course is to apply the project management knowledge gained previously in a practical portfolio project and reflect on the results. Students engage in this portfolio project and document the results, reflecting on the project management concepts they apply and the influence of these concepts on the success of the project.

Course Outcomes

On successful completion, students will be able to

- apply the concepts of project management to real-world tasks and problems.
- translate the learned theories into the practice of project management.
- analyze a real-world problem and define and implement a project to resolve it.
- appraise the results of a project performed and identify what worked well and what did not.
- explain the work they perform, give its scientific background, and produce adequate documentation.

Contents

- In this course, students perform and document a portfolio project in which they apply the project management topics covered in previous modules.

Literature

Compulsory Reading

Further Reading

- Hinde, D. (2012). PRINCE2 Study Guide. West Sussex: John Wiley & Sons.
- Kneuper, R. (2018). Software processes and lifecycle models. Cham: Springer Nature Switzerland.
- Phillips, J. (2010). IT project management: On track from start to finish (3rd ed.). New York, NY: McGraw-Hill.
- Project Management Institute. (2013). A guide to the project management body of knowledge: PMBOK guide.
- Schwaber, K. (2004). Agile project management with Scrum. Redmond, WA: Microsoft Press.

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	☑ Slides	☑ Guideline

Study Format myStudies

Study Format	Course Type
myStudies	

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

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

AI and Mastering AI Prompting

Module Code: DLMEAIMAIP

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

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

Module Coordinator

Prof. Dr. Claudia Heß (Artificial Intelligence) / N.N. (Project: AI Excellence with Creative Prompting Techniques)

Contributing Courses to Module

- Artificial Intelligence (DLMAIAI01)
- Project: AI Excellence with Creative Prompting Techniques (DLMPAIECPT01)

Module Exam Type	
Module Exam	**Split Exam** Artificial Intelligence • Study Format "Distance Learning": Exam, 90 Minutes • Study Format "myStudies": Exam, 90 Minutes Project: AI Excellence with Creative Prompting Techniques • Study Format "Distance Learning": Written Assessment: Project Report
Weight of Module see curriculum	

Module Contents

Artificial Intelligence

- History of AI
- Expert Systems
- Neuroscience
- Modern AI Systems
- AI Application Areas

Project: AI Excellence with Creative Prompting Techniques

In this module, students delve into the world of generative AI applications, creating AI-generated content such as text, images, and videos. They learn to design, analyze, and evaluate different prompting techniques in these systems and apply them within their respective fields of study.

Learning Outcomes

Artificial Intelligence

On successful completion, students will be able to

- remember the historical developments in the field of artificial intelligence.
- analyze the different application areas of artificial intelligence.
- comprehend expert systems.
- apply Prolog to simple expert systems.
- comprehend the brain and cognitive processes from a neuro-scientific point of view.
- understand modern developments in artificial intelligence.

Project: AI Excellence with Creative Prompting Techniques

On successful completion, students will be able to

- comprehend and implement various prompting techniques in generative AI applications.
- analyze, assess, and combine different prompt techniques for various expected AI outputs.
- implement ethical considerations into the design and execution of various generative AI applications.
- design, implement, and refine effective prompts and their combinations for real-world scenarios through various hands-on exercises.
- showcase creative and innovative thinking and reasoning in the application of advanced prompting techniques to solve multidimensional problems in their specialized area of study.

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 Master Programs in the IT & Technology field

Artificial Intelligence

Course Code: DLMAIAI01

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

Course Description

The quest for artificial intelligence 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 the development and use of expert systems in early AI systems.In order to understand cognitive processes, the course will give a brief overview of the biological brain and (human) cognitive processes and then focus on the development of modern AI systems fueled by recent developments in hard- and software. Particular focus will be given to discussion of the development of "narrow AI" systems for specific use cases vs. the creation of general artificial intelligence.The course will give an overview of a wide range of potential application areas in artificial intelligence, including industry sectors such as autonomous driving and mobility, medicine, finance, retail, and manufacturing.

Course Outcomes

On successful completion, students will be able to

- remember the historical developments in the field of artificial intelligence.
- analyze the different application areas of artificial intelligence.
- comprehend expert systems.
- apply Prolog to simple expert systems.
- comprehend the brain and cognitive processes from a neuro-scientific point of view.
- understand modern developments in artificial intelligence.

Contents

1. History of AI
    1.1 Historical Developments
    1.2 AI Winter
    1.3 Notable Advances in AI

2. Expert Systems
    2.1 Overview Over Expert Systems
    2.2 Introduction to Prolog

3. Neuroscience
    3.1 The (Human) Brain

Literature

Compulsory Reading

Further Reading

- Chowdhary, K. R. (2020). Fundamentals of Artificial Intelligence. Springer India.
- Russell, S. & Norvig, P. (2022). Artificial intelligence. A modern approach (4th ed.). Pearson Education.
- Ward, J. (2020). The student's guide to cognitive neuroscience. (4th ed.). Taylor & Francis Group.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

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

Study Format myStudies

Study Format	Course Type
myStudies	Lecture

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

Project: AI Excellence with Creative Prompting Techniques

Course Code: DLMPAIECPT01

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

Course Description

In this course, students explore the exciting world of prompting in various generative AI applications. They involve themselves in hands-on exercises that combine various prompting techniques to create new AI-generated content, including text, images, and videos. Through these exercises, students learn how to effectively use, analyze, combine, and assess these systems within their specialized fields of study.

Course Outcomes

On successful completion, students will be able to

- comprehend and implement various prompting techniques in generative AI applications.
- analyze, assess, and combine different prompt techniques for various expected AI outputs.
- implement ethical considerations into the design and execution of various generative AI applications.
- design, implement, and refine effective prompts and their combinations for real-world scenarios through various hands-on exercises.
- showcase creative and innovative thinking and reasoning in the application of advanced prompting techniques to solve multidimensional problems in their specialized area of study.

Contents

- In this course, students engage in a practical application of a generative AI use case by choosing from the options provided in the extensive supplementary guide. The course presents practical examples as study materials and exercises with both individual and combined prompting techniques for open-source text, image, and video generation use cases. The exercises are crafted to inspire and lead students in executing their distinct generative AI use case work and provide guidance on describing the use case and selecting a mixture of prompting techniques. Additionally, students are led to critically evaluate the design, implementation, and the outcomes 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
- Epstein, Z., Hertzmann, A., Herman, L., Mahari, R., Frank, M. R., Groh, M., Schroeder, H., Smith, A., Akten, M., Fjeld, J., Farid, H., Leach, N., Pentland, A. S., & Russakovsky, O. (2023). Art and the science of generative AI: A deeper dive. arXiv. https://arxiv.org/pdf/2306.04141.pdf
- Gozalo-Brizuela, R., & Garrido-Merchán, E. C. (2023). A survey of generative AI applications. arXiv. https://arxiv.org/pdf/2306.02781.pdf
- 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 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 120 h	**Contact Hours** 0 h	**Tutorial/Tutorial Support** 30 h	**Self Test** 0 h	**Independent Study** 0 h	**Hours Total** 150 h

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

4. Semester

Master Thesis

Module Code: MMTHE

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	MA	30	900 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) (Master Thesis) / Degree Program Advisor (SGL) (Colloquium)

Contributing Courses to Module

- Master Thesis (MMTHE01)
- Colloquium (MMTHE02)

Module Exam Type

Module Exam	Split Exam
	Master Thesis • Study Format "Distance Learning": Master Thesis (90) • Study Format "myStudies": Master Thesis (90) **Colloquium** • Study Format "Distance Learning": Colloquium (10) • Study Format "myStudies": Colloquium (10)
Weight of Module see curriculum	

Module Contents
Master Thesis
▪ Master's thesis
Colloquium
▪ Colloquium on the Master's thesis

Learning Outcomes
Master 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.
▪ analyse selected tasks with scientific methods, critically evaluate them and develop appropriate solutions under the guidance of an academic supervisor.
▪ record and analyse existing (research) literature appropriate to the topic of the Master'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 under consideration of academic presentation and communication techniques.
▪ reflect on the scientific and methodological approach chosen in the Master's thesis.
▪ actively answer subject-related questions from subject experts (experts of the Master's thesis).

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field(s) of Methods.	All Master Programmes in the Business & Management field(s).

Master Thesis

Course Code: MMTHE01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
MA	English		27	none

Course Description

The aim and purpose of the Master'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 Master's thesis can be a practical-empirical or theoretical-scientific problem. Students should prove that they can independently analyse 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 to be chosen by the student from the respective field of study should not only prove the acquired scientific competences, but should also deepen and round off the academic knowledge of the student in order to optimally align his professional abilities and skills with the needs of the future field of activity.

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.
- analyse selected tasks with scientific methods, critically evaluate them and develop appropriate solutions under the guidance of an academic supervisor.
- record and analyse existing (research) literature appropriate to the topic of the Master's thesis.
- prepare a detailed written elaboration in compliance with scientific methods.

Contents

- Within the framework of the Master'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 his 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 • Bui, Y. N. (2013). How to Write a Master's Thesis (2nd ed.). SAGE Publications, Incorporated. • Turabian, K. L. (2013). A Manual for Writers of Research Papers, theses, and dissertations (8th ed.). University of Chicago Press. • Further subject specific literature

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Thesis

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

Student Workload					
Self Study 810 h	**Contact Hours** 0 h	**Tutorial/Tutorial Support** 0 h	**Self Test** 0 h	**Independent Study** 0 h	**Hours Total** 810 h

Instructional Methods

Study Format myStudies

Study Format	Course Type
myStudies	Thesis

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

Student Workload					
Self Study 810 h	**Contact Hours** 0 h	**Tutorial/Tutorial Support** 0 h	**Self Test** 0 h	**Independent Study** 0 h	**Hours Total** 810 h

Instructional Methods

Colloquium

Course Code: MMTHE02

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
MA	English		3	none

Course Description

The colloquium will take place after submission of the Master's thesis. This is done at the invitation of the experts. During the colloquium, the students must prove that they have fully 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, and the answering of questions by the experts.

Course Outcomes

On successful completion, students will be able to

- present a problem from their field of study under consideration of academic presentation and communication techniques.
- reflect on the scientific and methodological approach chosen in the Master's thesis.
- actively answer subject-related questions from subject experts (experts of the Master's thesis).

Contents

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

Literature

Compulsory Reading

Further Reading

- Renz, K.-C. (2016): The 1 x 1 of the presentation. For school, study and work. 2nd edition, Springer Gabler, Wiesbaden.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Thesis Defense

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

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

Instructional Methods
Learning Material ☑ Slides

Study Format myStudies

Study Format	Course Type
myStudies	Thesis Defense

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

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

Instructional Methods
Learning Material ☑ Slides