MODULE HANDBOOK

Master of Science

Master Software Engineering (FS-OI-EU-MASE-120)

120 CP

Distance Learning

INTERNATIONAL
UNIVERSITY OF
APPLIED SCIENCES

Classification: Consecutive

Contents

3. Semester

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1. Semester

Software Engineering: Software Processes

Module Code: DLMCSSESP

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. Damir Ismailovic (Software Engineering: Software Process)

Contributing Courses to Module

- Software Engineering: Software Process (DLMCSSESP01)

Module Exam Type

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

Weight of Module

see curriculum

Module Contents

- Software process modeling
- Basic software life cycles
- Agile and lean processes
- The Software Product Life Cycle
- Governance and management of software processes

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Learning Outcomes

Software Engineering: Software Process

On successful completion, students will be able to

- describe the role of software processes and lifecycle models in software engineering from initialization to the withdrawal of a software system.
- describe the notations used for software processes and discuss their relative advantages.
- discuss the differences and commonalities of plan-driven and agile approaches.
- select an appropriate process model for specific application cases and discuss their advantages and disadvantages.
- adapt (tailor-) selected process models to an individual situation.

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Links to other Modules within the Study Program

This module is similar to other modules in the field of Computer Science & Software Development.

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Links to other Study Programs of the University

All Master Programmes in the IT & Technology field.

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Software Engineering: Software Process

Course Code: DLMCSSESP01

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

Course Description

Software processes and life cycle models provide a structure for different software engineering tasks. The aim of this module is to provide an understanding of this structure and how to apply it across the entire plan-build-run life cycle. An important foundation for working with software processes is modeling using suitable notation. The different types of life cycles are discussed, including the plan-driven and the agile approaches as well as mixed forms (hybrid models). A special focus is put on the different environments for which these approaches are best suited. Beyond software development, this course also addresses the entire software life cycle, including the operations phase and the cooperation between the two phases, e.g., based on DevOps. Software processes are not just a topic on the level of the individual development group or project but a task for the entire organization; therefore, they should be integrated into overall IT governance and management efforts.

Course Outcomes

On successful completion, students will be able to

- describe the role of software processes and lifecycle models in software engineering from initialization to the withdrawal of a software system.
- describe the notations used for software processes and discuss their relative advantages.
- discuss the differences and commonalities of plan-driven and agile approaches.
- select an appropriate process model for specific application cases and discuss their advantages and disadvantages.
- adapt (tailor-) selected process models to an individual situation.

Contents

1. Foundations of Software Processes
   - 1.1 The Role of Software Processes and Life Cycle Models
   - 1.2 Historical Overview

2. Software Process Definition and Modelling
   - 2.1 Modelling Notations and Meta-Models
   - 2.2 Notations for Modelling the Interaction Between Processes
   - 2.3 Detailed-Level Notations

Literature
Compulsory Reading
Further Reading ▪ Boehm, B. (2006). A view of 20th and 21st century software engineering. ICSE '06: Proceedings of the 28th international conference on software engineering (pp. 12—29). Association for Computing Machinery. ▪ Boehm, B., & Turner, R. (2004). Balancing agility and discipline: A guide for the perplexed. Addison-Wesley Professional. ▪ Kneuper, R. (2018). Software processes and life cycle models: An introduction to modelling, using and managine Agile, plan-driven and hybrid processes. Springer. ▪ Meyer, B. (2014). Agile! The good, the hype and the ugly. Springer. ▪ Schwaber, K., & Sutherland, J. (2020). The scrum guide: The definitive guide to scrum: The rules of the game. Ken Schwaber and Jeff Sutherland.

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

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

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

Advanced Requirements Engineering

Module Code: DLMSEARE

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 Tobias Brückmann (Advanced Requirements Engineering)

Contributing Courses to Module

- Advanced Requirements Engineering (DLMSEARE01)

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

Module Contents

- Introduction and Overview of Requirements Engineering
- Fundamental Principles of Requirements Engineering
- Work Products and Documentation Practices
- Practices for Requirements Elaboration
- Process, Working Structure and Tool Support
- Management Practices for Requirements

Learning Outcomes	
Advanced Requirements Engineering On successful completion, students will be able to ▪ understand the overall goal of the requirements engineering discipline with its specific terminology and principles. ▪ apply the techniques and methods of Requirements Engineering in order to elicit, document, validate and manage high-quality requirements. ▪ evaluate requirements based on well-known quality criteria and stakeholder feedback. ▪ create comprehensive requirements documents using a well-defined structure.	
Links to other Modules within the Study Program This module is similar to other modules in the fields of Computer Science & Software Development.	**Links to other Study Programs of the University** All Master Programs in the IT & Technology fields.

Advanced Requirements Engineering

Course Code: DLMSEARE01

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

Course Description

This course is intended to equip students with a comprehensive and high-level understanding of requirements engineering. Rather than solely covering the foundational aspects of requirements engineering, which include techniques for elicitation, documentation, validation, and negotiation of requirements, the curriculum delves deeply into the diverse tools and methodologies utilized in requirements management and modeling. Furthermore, it teaches vital facets of the discipline, such as quality assurance measures and techniques for effectively managing conflicts in the realm of requirements engineering.

Course Outcomes

On successful completion, students will be able to

- understand the overall goal of the requirements engineering discipline with its specific terminology and principles.
- apply the techniques and methods of Requirements Engineering in order to elicit, document, validate and manage high-quality requirements.
- evaluate requirements based on well-known quality criteria and stakeholder feedback.
- create comprehensive requirements documents using a well-defined structure.

Contents

1. Introduction and Overview of Requirements Engineering
   - 1.1 Requirements Engineering: What, Why, Where and How?
   - 1.2 Role and Tasks of a Requirements Engineer

2. Fundamental Principles of Requirements Engineering
   - 2.1 Value Orientation and Stakeholders
   - 2.2 Shared Understanding and Context
   - 2.3 The P-A-L Triple and Validation
   - 2.4 Evolution and Innovation
   - 2.5 Systematic and Disciplined Work

3. Work Products and Documentation Practices
   - 3.1 Characteristics, Levels, and Aspects of Work Products

3.2 Text-Based Work Products
3.3 Model-Based Work Products
3.4 Requirements Documentation and Glossaries
3.5 Quality Criteria

4. Practices for Requirements Elaboration
4.1 Sources for Requirements
4.2 Elicitation of Requirements
4.3 Resolving Conflicts
4.4 Validation of Requirements

5. Process, Working Structure, and Tool Support
5.1 Influencing Factors
5.2 Process Facets
5.3 Process Configuration
5.4 Requirements Engineering Tools

6. Management Practices for Requirements
6.1 Life Cycle Management and Version Control
6.2 Configurations and Baselines
6.3 Attributes and Views
6.4 Traceability and Change Handling
6.5 Prioritization

Literature

Compulsory Reading

Further Reading

- Glinz, M., van Loenhoud, H., Staal, S. & Bühne, S. (2022). Handbook for the CPRE Foundation Level according to the IREB Standard (Version 1.1.0).
- IREB e.V. (2022). IREB Certified Professional for Requirements Engineering – Foundation Level – Syllabus (Version 3.1.0).
- Pohl, K. & Rupp, C. (2015). Requirements Engineering Fundamentals (2nd Edition). Rocky Nook Inc. Santa Barbara.

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

Software Architecture

Module Code: DLMSESA

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. Holger Klus (Software Architecture)

Contributing Courses to Module

- Software Architecture (DLMSESA01)

Module Exam Type

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

Weight of Module

see curriculum

Module Contents

- Basic Concepts of Software Architecture
- Understanding Architectural Requirements
- Software Architecture Design
- Software Architecture Documentation and Communication
- Software Architecture Evaluation
- Software Architecture Example

Learning Outcomes	
Software Architecture On successful completion, students will be able to ▪ understand the term and meaning of software architecture. ▪ know the tasks and responsibilities of the role software architect. ▪ apply design principles and architecture patterns. ▪ apply methods for the (agile) development of software architectures. ▪ apply methods and tools for the documentation of software architectures. ▪ able to apply methods for the validation of software architectures.	
Links to other Modules within the Study Program This module is similar to other modules in the fields of Computer Science & Software Development.	**Links to other Study Programs of the University** All Master Programs in the IT & Technology fields.

Software Architecture

Course Code: DLMSESA01

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

Course Description

Creating, documenting and validating architectures is a task attributed to the software architect role in software processes. To perform these tasks professionally requires a basic understanding of important terms, activities, methods and tools. This course, following established continuing education courses for architects, teaches the theoretical basics and the required methodological competence for a successful career as a software architect.

Course Outcomes

On successful completion, students will be able to

- understand the term and meaning of software architecture.
- know the tasks and responsibilities of the role software architect.
- apply design principles and architecture patterns.
- apply methods for the (agile) development of software architectures.
- apply methods and tools for the documentation of software architectures.
- able to apply methods for the validation of software architectures.

Contents

1. Basic Concepts of Software Architecture
   - 1.1 Definitions and Goals of Software Architecture
   - 1.2 Software Architecture in Software Engineering
   - 1.3 Role and Responsibilities of a Software Architect
   - 1.4 Types of IT Systems and Challenges of Distributed Systems
   - 1.5 Approaches und Techniques for Architecture Development

2. Understanding Architectural Requirements
   - 2.1 Design Principles
   - 2.2 Influencing Factors
   - 2.3 Quality Requirements
   - 2.4 Cross-Cutting Concepts

3. Software Architecture Design
   - 3.1 Solution Patterns

3.2 Dependency Management
3.3 Interface Design

4. Software Architecture Documentation and Communication
   4.1 Target Group and Quality Criteria
   4.2 Architectural Views
   4.3 Elements of Architecture Documentation
   4.4 Modelling Software Architecture
   4.5 Templates and Tools

5. Software Architecture Evaluation
   5.1 Quality Models and Standards
   5.2 Qualitative Analysis
   5.3 Quantitative Evaluation

6. Software Architecture Example
   6.1 Case Study
   6.2 Architectural Requirements
   6.3 Architecture Design
   6.4 Architecture Documentation
   6.5 Architecture Evaluation

Literature

Compulsory Reading

Further Reading

- Bass, L., Clements, P. & Kazman, R. (2021) Software Architecture in Practice (4th Edition). Addison Wesley.
- iSAQB e.V. (2023) Curriculum for Certified Professional for Software Architecture (CPSA) Foundation Level (2023.1-rev2-EN-20230321).
- Starke, G. & Lorz, A. (2023) Software Architecture Foundation: CPSA-F Exam Preparation (2nd Edition). Van Haren Publishing.
- Starke, G., Simons, M., Zörner, S. & Müller, R. (2019) arc42 by Example: Software architecture documentation in practice. Packt Publishing.

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

Secure Software Development

Module Code: DLMCSEEDSO1_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

Prof. Dr. Petra Beenken (Secure Software Development)

Contributing Courses to Module

- Secure Software Development (DLMCSEEDSO01_E)

Module Exam Type

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

Weight of Module

see curriculum

Module Contents

- Project Management
- Security by Design
- Privacy by Design
- Software Supply Chain Security
- Common Anti-Coding Patterns
- Testing and Auditing
- DevSecOps

Learning Outcomes	
Secure Software Development On successful completion, students will be able to ▪ design secure applications. ▪ understand what leads to software compromise. ▪ avoid common coding errors. ▪ manage the secure software lifecycle. ▪ employ a rigorous security testing regime. ▪ manage vulnerability disclosures.	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Computer Science & Software Development	All Master Programs in the IT & Technology field

Secure Software Development

Course Code: DLMCSEEDSO01_E

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

Course Description

Attacking vulnerabilities in insecure software is a leading attack vector for criminals and malicious state actors. Finding unknown, so-called zero-day vulnerabilities is a key weapon for professional criminals. So, it is of utmost importance to design and implement secure software. First we must understand common software weaknesses and then avoid these as early in the software development and lifecycle as possible through a security-by-design philosophy. We also must run and manage a security testing and vulnerability disclosure process. Providing and implementing timely patches is essential.

Course Outcomes

On successful completion, students will be able to

- design secure applications.
- understand what leads to software compromise.
- avoid common coding errors.
- manage the secure software lifecycle.
- employ a rigorous security testing regime.
- manage vulnerability disclosures.

Contents

1. Project Management
   - 1.1 Software Architecture
   - 1.2 Software Lifestyle
   - 1.3 The Development of the Architecture According to the Principles of an Agile Approach
   - 1.4 Infrastructure as Code
   - 1.5 Programming Language Consideration
2. Security by Design
   - 2.1 Advantages of Considering Security Early
   - 2.2 Security by Design and Security by Default
   - 2.3 Managing Vulnerability Disclosures
   - 2.4 Managing Patches/Updating
   - 2.5 Managing Pentesting and Bug Bounty Programs

3. Privacy by Design
    - 3.1 Encryption
    - 3.2 Differential Privacy
    - 3.3 Zero-Knowledge Proofs/Protocols

4. Software Supply Chain Security
    - 4.1 Package Security
    - 4.2 Container Security
    - 4.3 Programming Language Considerations

5. Common Anti-Coding Patterns
    - 5.1 Common Vulnerabilities and Exposures
    - 5.2 Classes of Bugs
    - 5.3 Sources of Bugs
    - 5.4 Severity of Bugs

6. Testing and Auditing
    - 6.1 Software Testing Pyramid
    - 6.2 Unit, Integration, System, and End-to-End (E2E) Testing
    - 6.3 Security Testing
    - 6.4 IT Support and Testing With the “Shifting Left” Methodology
    - 6.5 Security Code Auditing

7. DevSecOps
    - 7.1 DevOps
    - 7.2 Cloud Security
    - 7.3 Distributed Systems
    - 7.4 Ephemeral Processes
    - 7.5 Automation

Literature
Compulsory Reading
Further Reading ▪ Adkins, H. et al (2020): Building Secure and Reliable Systems. 1st edition, O'Reilly Media, Newton, MA. ▪ Common Weakness Enumeration, https://cwe.mitre.org/ ▪ Dwork, C. / Roth, A. (2014): The Algorithmic Foundations of Differential Privacy. In Foundations and Trends in Theoretical Computer Science Vol. 9, Nos. 3–4 (2014) 211–407. ▪ The Open Web Application Security Project, https://owasp.org/

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 ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Software Testing

Module Code: DLMSEST

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. Marian Benner-Wickner (Software Testing)

Contributing Courses to Module

- Software Testing (DLMSEST01)

Module Exam Type

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

Weight of Module

see curriculum

Module Contents

- Software Testing Foundations
- Static Testing
- Dynamic Testing
- Advanced Dynamic Testing
- Test Planning
- Test Management and Tools

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Learning Outcomes

Software Testing

On successful completion, students will be able to

- understand the purpose and essential principles of software testing.
- know the tasks and responsibilities of the role software tester.
- distinguish between different test levels and test types.
- apply methods and techniques for static and dynamic testing.
- understand concepts, methods and tools of test management and agile testing.

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Links to other Modules within the Study Program

This module is similar to other modules in the fields of Computer Science & Software Development.

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Links to other Study Programs of the University

All Master Programs in the IT & Technology fields.

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Software Testing

Course Code: DLMSEST01

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

Course Description

Delivering high quality software is challenging, especially given the highly complex and agile contexts in which software is produced and embedded today. Planning, coordinating, and executing software testing requires a comprehensive understanding of a variety of concepts. Following established professional trainings for software testers, this course teaches the theoretical basics and the necessary methodological competence for successful career as a software tester.

Course Outcomes

On successful completion, students will be able to

- understand the purpose and essential principles of software testing.
- know the tasks and responsibilities of the role software tester.
- distinguish between different test levels and test types.
- apply methods and techniques for static and dynamic testing.
- understand concepts, methods and tools of test management and agile testing.

Contents

1. Software Testing Foundations
   - 1.1 Terms and Goals of Testing
   - 1.2 Testing Principles
   - 1.3 Testing Activities and Roles
   - 1.4 Essential Skills and Good Practices
   - 1.5 Testing in the Software Development Lifecycle

2. Static Testing
   - 2.1 Basic Concepts of Static Testing
   - 2.2 Review Process: Roles and Responsibilities
   - 2.3 Types and Success Factors of Reviews
   - 2.4 Tools

3. Dynamic Testing
   - 3.1 Black-Box Test Techniques

Literature

Compulsory Reading

Further Reading

- Ammann, P. & Offutt, J. (2016) Introduction to Software Testing (2nd Edition). Cambridge University Press.
- Hambling, B., Morgan, P., Samaroo, A., Thompson, G. & Williams, P. (2019) Software Testing: An ISTQB-BCS Certified Tester Foundation guide (4th edition). BCS Learning & Development Ltd.
- International Software Testing Qualifications Board. (2023). Certified Tester Foundation Level Syllabus (v4.0).
- International Organization for Standardization. (2022). Software and systems engineering – Software testing – Part 1: General concepts (ISO Standard No. 29119-1:2021).

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
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests

Project: Applied Software Engineering

Module Code: DLMSEPASE

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLMCSEEDSO01_E or DLMSEARE01 or DLMSESA01 or DLMSEST01	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. Max Pumperla (Project: Applied Software Engineering)

Contributing Courses to Module

- Project: Applied Software Engineering (DLMSEPASE01)

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

Module Contents

Software engineering projects are structured with clearly defined roles and activities to produce customer-oriented software. In this course, students will participate in all relevant activities tied to their selected role. This process commences with an analysis of previous work outputs, which then leads to task planning and eventually to the creation and documentation of their individual software engineering products. Throughout this process, they gain insight into organizational dynamics of role adjacency and conflicts, and practical experience in creating role-specific documentation.

Learning Outcomes	
Project: Applied Software Engineering On successful completion, students will be able to ▪ analyze a given practical software engineering problem. ▪ identify an appropriate approach to solve the problem according to their individual software engineering role of choice (requirements engineer, software architect, software developer, tester, test manager, deployment, maintenance). ▪ solve the problem in an interdisciplinary manner by taking responsibility for the chosen role and carrying out its activities.	
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.

Project: Applied Software Engineering

Course Code: DLMSEPASE01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
MA	English		5	DLMCSEEDSO01_E or DLMSEARE01 or DLMSESA01 or DLMSEST01

Course Description

With the rising complexity of software systems and increasing frequent release cycles, software engineering has become a discipline that places high demands on the practical experience of each individual role involved. In this course, students can apply the concepts, methods or tools they've learned to practical use within a group setting. In doing so, they can better prepare themselves for the role they aim to fill in the software process within their future professions.

Course Outcomes

On successful completion, students will be able to

- analyze a given practical software engineering problem.
- identify an appropriate approach to solve the problem according to their individual software engineering role of choice (requirements engineer, software architect, software developer, tester, test manager, deployment, maintenance).
- solve the problem in an interdisciplinary manner by taking responsibility for the chosen role and carrying out its activities.

Contents

- In software engineering, projects are organized in terms of distinct roles (e.g., requirements engineer, software architect, software developer, software tester, test manager) and distinct activities (e.g., planning, analysis, implementation) in order to create software that fits the customer's needs. Depending on their chosen approach, either agile or plan-driven, students engage in all typical activities relevant for their chosen role. This often begins with the analysis of work products from the preceding roles, followed by planning tasks. Lastly students will produce their own software engineering work products and document them using established structures or templates. Through these responsibilities, they gain experience regarding organizational issues such as adjacent roles, and conflicting roles, as well as practical matters like creating role-specific documentation (e.g. requirements specification, software architecture documentation, test plan and documentation, deployment instructions).

Literature
Compulsory Reading
Further Reading ▪ Gruhn, V., & Striemer, R. (Eds.). (2018). The essence of software engineering. Cham: Springer Open. ▪ Sommerville, I. (2019). Engineering Software products. Pearson. ▪ Sommerville, I. (2015). Software Engineering. (10th Edition). Addison-Wesley.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Project

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

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

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

2. Semester

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 Study Format: Distance Learning Written Assessment: Written Assignment Study Format: myStudies Written Assessment: Written Assignment	**Split Exam**
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 This module is similar to other modules in the field of Methods	**Links to other Study Programs of the University** 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	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

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	**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

IT Project Management

Module Code: DLMCSITPM

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. Carsten Skerra (IT Project Management)

Contributing Courses to Module

- IT Project Management (DLMBITPAM01)

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

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

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

IT Governance and Compliance

Module Code: DLMBITGSM2

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. Radiah Rivu (IT Governance and Compliance)

Contributing Courses to Module

- IT Governance and Compliance (DLMBITGSM02)

Module Exam Type

Module Exam	Split Exam
<u>Study Format: myStudies</u> Exam, 90 Minutes <u>Study Format: Distance Learning</u> Exam, 90 Minutes	

Weight of Module

see curriculum

Module Contents

- Establishing IT governance and compliance
- COBIT framework
- IT governance frameworks
- Data protection and data security

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Learning Outcomes

IT Governance and Compliance

On successful completion, students will be able to

- explain IT governance and compliance both as tools to achieve organizational goals and to satisfy regulatory requirements.
- know the different IT governance frameworks given, in particular the industry standard model COBIT.
- set out the processes and policies for administering and managing IT systems for ensuring compliance with local and international regulatory requirements.
- understand that ensuring compliance with the IT governance framework can be a daunting task that requires constant collection, organization, monitoring, analysis and reporting on event logs to detect and manage control-related activity.
- recognize the IT governance and compliance monitoring tools for ensuring that controls for information systems are effectively implemented, monitored, and maintained.

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Links to other Modules within the Study Program

This module is similar to other modules in the field of Computer Science & Software Development.

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Links to other Study Programs of the University

All Master Programmes in the IT & Technology field.

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IT Governance and Compliance

Course Code: DLMBITGSM02

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

Course Description

IT governance and compliance are key elements within corporate governance, since most modern businesses rely heavily on IT infrastructure for their success. These elements detail the required leadership and organizational structures for maintaining and extending information technology in order to meet business strategies and objectives.

Course Outcomes

On successful completion, students will be able to

- explain IT governance and compliance both as tools to achieve organizational goals and to satisfy regulatory requirements.
- know the different IT governance frameworks given, in particular the industry standard model COBIT.
- set out the processes and policies for administering and managing IT systems for ensuring compliance with local and international regulatory requirements.
- understand that ensuring compliance with the IT governance framework can be a daunting task that requires constant collection, organization, monitoring, analysis and reporting on event logs to detect and manage control-related activity.
- recognize the IT governance and compliance monitoring tools for ensuring that controls for information systems are effectively implemented, monitored, and maintained.

Contents

1. About IT Governance
   - 1.1 Concept and Definitions
   - 1.2 The Value of IT in the Organization
   - 1.3 Current State and Perceptions
   - 1.4 Governance, Compliance and Risk Management in IT

2. Establishing IT Governance and Compliance
   - 2.1 Assessment
   - 2.2 IT Strategy
   - 2.3 Tactics
   - 2.4 Operations

2.5 Compliance
2.6 Performance

3. The COBIT Framework
3.1 Overview of COBIT
3.2 The COBIT Goals Cascade
3.3 The COBIT Process Reference Model
3.4 Deploying and Implementing COBIT

4. IT Governance Frameworks
4.1 Quality Management as a Foundation
4.2 ISO 9000 Family
4.3 Maturity Models
4.4 Relationship to Service and Architecture Frameworks (ITIL, TOGAF)
4.5 Relationship to IT Security Frameworks (ISO 27000 family)

5. Data Protection and IT Security
5.1 Data Protection
5.2 IT Security Management
5.3 IT Security Threats and Attack Scenarios
5.4 Countermeasures
5.5 Cryptography

Literature

Compulsory Reading

Further Reading

- Calder, A., & Watkins, S. G. (2020). IT governance [electronic resource]: an international guide to data security and ISO 27001/ISO 27002 (Seventh Edition). KoganPage.

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

Seminar: Sustainable Software Engineering

Module Code: DLMSESSSE

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. Marian Benner-Wickner (Seminar: Sustainable Software Engineering)

Contributing Courses to Module

- Seminar: Sustainable Software Engineering (DLMSESSSE01)

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

Module Contents

This module covers sustainable software engineering concepts, focusing on environmental and ecological impacts. Topics include sustainable coding practices, green hardware, lifecycle software assessment, e-waste management, and ethical issues. Students will analyze research literature and industry case studies, while discussing future opportunities and challenges in this field. The module content is understood to be distinct from sustainability in the pure technical sense, e.g. by focusing on technical debt.

Learning Outcomes	
Seminar: Sustainable Software Engineering On successful completion, students will be able to ▪ understand the impact of software on ecological indicators like the greenhouse gas footprint. ▪ understand how a specific role in software engineering can affect these measures. ▪ understand the need for corporate climate targets in software companies. ▪ know the importance of producing sustainable software in a sustainable way. ▪ independently research current efforts in sustainable software engineering and present the results in an appropriate, scientific manner.	
Links to other Modules within the Study Program This module is similar to other modules in the fields of Computer Science & Software Development.	**Links to other Study Programs of the University** All Master Programs in the IT & Technology fields.

Seminar: Sustainable Software Engineering

Course Code: DLMSESSSE01

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

Course Description

As software becomes an integral part of almost every aspect of daily life, it also has a significant impact on the environment: Because of the many data centers needed for resource-intensive calculations like AI appliances, IT generates huge amounts of greenhouse gas. In addition, the resources used to produce IT hardware, such as computer chips or smartphone batteries, are ecologically highly questionable. In order to meet internationally binding climate targets and prevent further damage to the environment, algorithms and data center operations must become more efficient. Based on state-of-the-art research in the field of sustainable software engineering, we will examine the approaches available to address these issues.

Course Outcomes

On successful completion, students will be able to

- understand the impact of software on ecological indicators like the greenhouse gas footprint.
- understand how a specific role in software engineering can affect these measures.
- understand the need for corporate climate targets in software companies.
- know the importance of producing sustainable software in a sustainable way.
- independently research current efforts in sustainable software engineering and present the results in an appropriate, scientific manner.

Contents

- This course on sustainable software engineering encompasses the concepts of software sustainability and its importance. It focuses mainly on environmental impacts, but also strives to highlight economic and social aspects. It delves into the practical application of sustainability principles in software development, including energy-efficient coding practices, use of green hardware, and cloud computing. A deep dive into lifecycle assessment of software, handling electronic waste, and the ethical implications is also part of this course. Students can explore research literature and case studies on sustainable software practices in industry. The course also discusses future challenges and opportunities in the field of sustainable software engineering.

Literature
Compulsory Reading
Further Reading ▪ Green Software Foundation. (2023). 2023 State of Green Software. ▪ Ibrahim, S. R. A., Yahaya, J., & Sallehudin, H. (2022). Green Software Process Based on Sustainability, Waste and Evaluation Theory Approach: The Conceptual Model. 2022 IEEE International Conference on Computing (ICOCO), Computing (ICOCO), 2022 IEEE International Conference On, 283–288. ▪ Kolaxis, I. (2022). 101 Green Software: A Practical Guide for Developers & Architects. ▪ Poth, A., Widok, A. H., Henschel, A., & Eißfeldt, D. (2022). Foster Sustainable Software Engineering (SSE) Awareness in Large Enterprises – a Cheat Sheet for Technical and Organizational Indicators (Vol. 1646). Springer International Publishing. ▪ Tanveer, B. (2021). Sustainable software engineering - have we neglected the software engineer’s perspective? 2021 36th IEEE/ACM International Conference on Automated Software Engineering Workshops (ASEW), Automated Software Engineering Workshops (ASEW), 2021 36th IEEE/ACM International Conference on, ASEW, 267–270.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Seminar

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

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

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

Embedded Systems Engineering

Module Code: DLMSEESE

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

Kamran Mahmood (Embedded Systems Engineering)

Contributing Courses to Module

- Embedded Systems Engineering (DLMSEESE01)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Exam	

Weight of Module

see curriculum

Module Contents

- Essential Basics, Software Design Architecture and Patterns for Embedded Systems
- Core and Support Engineering Processes for Embedded Systems Development
- Methods and Tools in Development, Production, and Service
- Norms and Standards Regarding Embedded Systems Engineering
- Application Areas of Embedded Systems

Learning Outcomes	
Embedded Systems Engineering On successful completion, students will be able to ▪ demonstrate a systematic understanding of the use cases and interrelationships of software, hardware and the concept of embedded systems. ▪ analyze the requirements of embedded systems and understand the implications regarding reliability, security and safety. ▪ analyze and critically evaluate concepts for development regarding core and support engineering processes to design embedded systems. ▪ demonstrate judgement about methods and tools in development, production and service (e.g. Matlab, Simulink).	
Links to other Modules within the Study Program This module is similar to other modules in the fields of Computer Science & Software Development.	**Links to other Study Programs of the University** All Master Programs in the IT & Technology fields.

Embedded Systems Engineering

Course Code: DLMSEESE01

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

Course Description

The Embedded Systems Engineering course covers the fundamental concepts in a wide range of relevant topics in control systems, embedded systems, and electronic systems development. This course will provide insights into the engineering processes and common standards for analyzing and designing embedded systems for various applications.The first part introduces the fundamentals of control systems (discrete, embedded, real-time, distributed, networked systems), such as their design and architecture and specific requirements regarding reliability and safety. Then, the monitoring and diagnosis of embedded systems hardware units are described in more detail to give a good overview of how they work internally. In addition, the main aspects of core and support engineering processes for developing electronic systems and software included from a low-level perspective to higher-level approaches. An overview of methods and tools in development, production and service (e.g. Matlab Simulink) is given as they play a key role in advanced applications at this level. This teaching brief concludes with norms and standards (ISO/IEC 250xx) and important application areas for modern embedded systems.

Course Outcomes

On successful completion, students will be able to

- demonstrate a systematic understanding of the use cases and interrelationships of software, hardware and the concept of embedded systems.
- analyze the requirements of embedded systems and understand the implications regarding reliability, security and safety.
- analyze and critically evaluate concepts for development regarding core and support engineering processes to design embedded systems.
- demonstrate judgement about methods and tools in development, production and service (e.g. Matlab, Simulink).

Contents

1. Introduction to Embedded Systems:
   - 1.1 Introduction to Software Engineering of Embedded and Real-Time Systems
   - 1.2 Application Domains and Embedded Systems Hardware/Software Co-Development
   - 1.3 Software Modeling for Embedded Systems – Aspects of Reliability, Safety & Security
   - 1.4 Methods and Tools for the Development of Software for Embedded Systems
   - 1.5 Agile Development for Embedded Systems

2. Essential Basics, Software Design Architecture and Patterns for Embedded Systems:
    - 2.1 Essential Basics (Open-Loop and Closed-Loop Control Systems, Discrete Systems, Embedded Systems, Real-Time Systems, Distributed and Networked Systems)
    - 2.2 Electrics/Electronics and Software Architecture
    - 2.3 Software Reuse by Design in Embedded Systems
    - 2.4 Software Performance Engineering for Embedded Systems
    - 2.5 System Reliability, Safety, Monitoring, and Diagnostics – Security by Design
3. Core and Support Engineering Processes for Embedded Systems Development:
    - 3.1 Embedded Software Programming and Implementation Guidelines (Basic Definitions, Notations, Process Models and Standards)
    - 3.2 Initial Core Processes (Human Factors and User Interface Design for Embedded Systems – Requirements Management)
    - 3.3 Design Core Processes (Design, Implementation, Coding, Test, Integration, Test)
    - 3.4 Verification and Validation Core Processes (Calibration, System and Acceptance Test)
    - 3.5 Subset of Support Processes (Configuration Management, Subcontractor Management)
4. Methods and Tools in Development, Production, and Service:
    - 4.1 Embedded Software Quality, Integration and Testing Techniques
    - 4.2 Multicore Software Development for Embedded Systems
    - 4.3 Safety-Critical Software Development
    - 4.4 Software Development Tools for Embedded Systems
5. Norms and Standards regarding Embedded Systems Engineering:
    - 5.1 Framework for Software Product Quality Requirements and Evaluation (ISO/IEC 25000)
    - 5.2 Software Maintenance Processes for the Long-Term Sustainability and Support of Embedded Systems (ISO 14764)
    - 5.3 Safety-Critical Embedded Systems (ISO 26262), When Functional Safety is Critical in Embedded Systems Development
    - 5.4 Information Security Management (ISO/IEC 27001), When Cyber Security is a Critical Concern in Embedded Systems
6. Outlook of Application Areas of Embedded Systems
    - 6.1 Embedded Systems Specialized in Machine Learning
    - 6.2 Embedded Software for Automotive Applications - Autonomous Driving
    - 6.3 Embedded Software for Networking Applications - Integrated Internet of Things (IIoT)
    - 6.4 Human Implants - Embedded Medical Devices

Literature
Compulsory Reading
Further Reading ▪ International Organization for Standardization. (2014). Systems and software engineering — Systems and software Quality Requirements and Evaluation (SQuaRE) — Planning and management (ISO Standard No. 25001:2014). https://www.iso.org/standard/64787.html ▪ International Organization for Standardization. (2018). Information security management systems (ISO Standard No. 27001:2018). https://www.iso.org/standard/27001 ▪ International Organization for Standardization. (2018). Road vehicles — Functional safety (ISO Standard No. 26262:2018). https://www.iso.org/standard/68383.html ▪ International Organization for Standardization. (2022). Software engineering — Software life cycle processes (ISO Standard No. 14764:2022). https://www.iso.org/standard/27001 ▪ Oshana, R. (2013). Software engineering for embedded systems: methods, practical techniques, and applications. Newnes/Elsevier. ▪ Schäuffele, J. & Zurawka, T. (2016). Automotive Software Engineering - Principles, Processes, Methods, and Tools (2nd Edition). SAE International.

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

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

Project: Embedded Systems

Module Code: DLMSEPES

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLMSEESE01	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
Kamran Mahmood (Project: Embedded Systems)

Contributing Courses to Module
▪ Project: Embedded Systems (DLMSEPES01)

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

Module Contents
In this course, students learn to apply embedded systems development concepts they have learned in previous modules to practical scenarios or projects. As project teams, the students work on a project independently chosen from a set of project suggestions. Students can also contribute their own project ideas.

Learning Outcomes

Project: Embedded Systems

On successful completion, students will be able to

- to identify and demonstrate appropriate practices in various roles in embedded systems and electronic systems development as system developers, testers, and technical project managers.
- to analyze, apply and critically evaluate concepts of requirements elicitation and specification development and extend these concepts through FMEA (Failure Modes, Effects and Criticality Analysis).
- to demonstrate judgement and critically evaluate the methods for validating simulations.
- to define and apply simulation processes for early validation of systems (keywords like software/ hardware in a loop and the use of Matlab).
- to elicit requirements, write specifications, apply verification methods, and use simulations to validate systems in a dedicated manner to an embedded system.

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.

Project: Embedded Systems

Course Code: DLMSEPES01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
MA	English		5	DLMSEESE01

Course Description
The students apply the knowledge gained in previous courses related to Embedded Systems Engineering in a practical example. The practical example (e.g. from the automotive, medical technology, or energy technology) is to be selected so that the reliability and safety aspects are in the foreground. The focus here is on the application of the additional processes for safeguarding during the specification, design and modelling, as well as the integration and testing of embedded systems. Finally, the selected practical example is validated in a simulation environment (e.g., Matlab Simulink).

Course Outcomes

On successful completion, students will be able to

- to identify and demonstrate appropriate practices in various roles in embedded systems and electronic systems development as system developers, testers, and technical project managers.
- to analyze, apply and critically evaluate concepts of requirements elicitation and specification development and extend these concepts through FMEA (Failure Modes, Effects and Criticality Analysis).
- to demonstrate judgement and critically evaluate the methods for validating simulations.
- to define and apply simulation processes for early validation of systems (keywords like software/ hardware in a loop and the use of Matlab).
- to elicit requirements, write specifications, apply verification methods, and use simulations to validate systems in a dedicated manner to an embedded system.

Contents

- Students in this course will acquire practical skills in system development, testing, and management. They will be able to elicit requirements, write specifications, apply verification methods, and use simulations to validate systems. In addition, they will comprehend the significance of validating simulations and be able to apply these methods. This will prepare them for various roles in embedded systems and electronic systems development.

Literature
Compulsory Reading
Further Reading ▪ Elkholy, M. M., & El-Hay, E. A. (2020). Efficient dynamic performance of brushless DC motor using soft computing approaches. Neural Computing & Applications, 32(10), 6041–6054. ▪ Kharola, A., & Patil, P. (2017). Dynamic stabilization of one wheel mobile robot (OWMR): a soft-computing approach. Journal of Industrial & Production Engineering, 34(6), 477–485. ▪ Malzahn, J., Roozing, W., & Tsagarakis, N. (2019). The Compliant Joint Toolbox for MATLAB: An Introduction With Examples. IEEE Robotics & Automation Magazine, 26(3), 52–63. ▪ Oshana, R. (2013). Software engineering for embedded systems: methods, practical techniques, and applications. Newnes/Elsevier. ▪ Sumathi, S., Surekha, P., & Ashok Kumar, L. (2015). Solar PV and Wind Energy Conversion Systems : An Introduction to Theory, Modeling with MATLAB/SIMULINK, and the Role of Soft Computing Techniques.

Study Format Distance Learning

Study Format	**Course Type**
Distance Learning	Project

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

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

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

Networks and Distributed Systems

Module Code: DLMCSNDS

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
Uwe Behley (Networks and Distributed Systems)

Contributing Courses to Module
▪ Networks and Distributed Systems (DLMCSNDS01)

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

Module Contents

- Communication Networks
- Communication Protocols
- Distributed System Architectures
- Distributed Algorithms and Applications

Learning Outcomes	
Networks and Distributed Systems On successful completion, students will be able to ▪ explain the basic concepts of digital data transmission and computer networks. ▪ detail the ISO/OSI reference model and characterize aspects of its different layers. ▪ compare the ISO/OSI model to the TCP/IP protocol stack, its services, and its applications. ▪ elaborate on different approaches and architectures for distributed systems. ▪ describe the challenges and opportunities of distributed algorithms and applications. ▪ analyze different aspects of decentralized, mobile, and pervasive computing.	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Computer Science & Software Development.	All Bachelor Programmes in the IT & Technology field.

Networks and Distributed Systems

Course Code: DLMCSNDS01

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

Course Description

Isolated computer systems are becoming the exception, with modern systems typically connected to each other via networks. Through these networks, data is constantly exchanged via the internet using communication protocols. These allow modern computers to access data and functions from other computer systems, enabling distributed systems. In this distributed Systems algorithms and applications are partially mapped to different entities within the network to perform shared computing tasks. The knowledge transfer regarding the required technologies, architectures, and algorithms for doing so is the focus of this course.

Course Outcomes

On successful completion, students will be able to

- explain the basic concepts of digital data transmission and computer networks.
- detail the ISO/OSI reference model and characterize aspects of its different layers.
- compare the ISO/OSI model to the TCP/IP protocol stack, its services, and its applications.
- elaborate on different approaches and architectures for distributed systems.
- describe the challenges and opportunities of distributed algorithms and applications.
- analyze different aspects of decentralized, mobile, and pervasive computing.

Contents

1. Computer Networks
   - 1.1 Basic Concepts of Digital Data Transmission
   - 1.2 Network Topologies and Interconnections
   - 1.3 Basics of Communication Engineering and Coding Theory
   - 1.4 The Physical Layer: Transmission Methods and Media

2. Communication Protocols
   - 2.1 The ISO/OSI Reference Model
   - 2.2 The Data Link Layer: Standards and Technologies
   - 2.3 The Network Layer: Addressing and Routing
   - 2.4 The Transport Layer: Reliability and Flow Control

3. The Internet Protocol Suite

Literature

Compulsory Reading

Further Reading

- Comer, D. E. (2015). Computer networks and internets (global ed., 6th ed.). Pearson Education.
- Comer, D. E. (2018). The internet book: Everything you need to know about computer networking and how the internet works (5th ed.). CRC Press.
- Kurose, J., & Keith R. (2017). Computer networking: A top-down approach, global edition (7th ed.). Pearson Education.
- Tanenbaum, A. S., & Wetherall, D. J. (2011). Computer networks: New international edition (5th ed.). Pearson Education.
- Van Steen, M., & Tanenbaum, A. S. (2017). Distributed systems (3rd ed.). CreateSpace Independent Publishing Platform.

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	

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	**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 ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Container Orchestration

Module Code: DLMDCCCO

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. Tianxiang Lu (Container Orchestration)

Contributing Courses to Module

- Container Orchestration (DLMDCCCO01)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Exam or Written Assessment: Case Study, 90 Minutes	

Weight of Module

see curriculum

Module Contents

- Introduction to Containers
- Container Composition And Services
- Container Registries
- Container Orchestration
- Kubernetes
- Orchestration in Production

Learning Outcomes	
Container Orchestration On successful completion, students will be able to ▪ transfer acquired theoretical knowledge to real-world case studies. ▪ apply the concepts covered in the preceding container orchestration course to build a running system. ▪ explain the design choices made in the selection of the deployed components and its implementation. ▪ translate the learned theories into the practice of orchestration. ▪ critically evaluate the resulting system’s performance.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Computer Science & Software Development	**Links to other Study Programs of the University** All Master Programs in the IT & Technology field(s)

Container Orchestration

Course Code: DLMDCCCO01

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

Course Description

Containers have become very popular in the last ten years. In many scenarios, they have completely replaced the software installation as it is much simpler, avoids dependencies and leads to much fewer issues for the software supplier. At the same time, service-oriented architectures have grown. Often, each container provides just one service of a whole service bouquet. As the services depend on each other, they must be orchestrated, which happens on container level. The standard for container orchestration is the open-source software Kubernetes, which was originally created by Google.

Course Outcomes

On successful completion, students will be able to

- transfer acquired theoretical knowledge to real-world case studies.
- apply the concepts covered in the preceding container orchestration course to build a running system.
- explain the design choices made in the selection of the deployed components and its implementation.
- translate the learned theories into the practice of orchestration.
- critically evaluate the resulting system’s performance.

Contents

1. Introduction to Containers
   - 1.1 Software Installation Before Containers
   - 1.2 Need For a Standard Environment
   - 1.3 Containers vs. Virtual Machines
   - 1.4 Container Images

2. Container Composition and Services
   - 2.1 Service-Oriented Architectures
   - 2.2 Separation of Concerns
   - 2.3 Communication Between Containers
   - 2.4 Software-Defined Network
   - 2.5 Example with Docker-Compose

Literature
Compulsory Reading
Further Reading ▪ Dobies, J. & Wood, J. (2020). Kubernetes Operators: Automating the Container Orchestration Platform. O'Reilly. ▪ Saito, H., Lee, H-C. C. & Hsu, K-J. C. (2018). Kubernetes Cookbook: Practical Solutions to Container Orchestration (2nd ed.). Packt Publishing ▪ Sayfan, G. (2018) Mastering Kubernetes: Level up Your Container Orchestration Skills with Kubernetes to Build, Run, Secure, and Observe Large-Scale Distributed Apps (3rd ed.). Packt Publishing ▪ Schenker, G. N. (2020). Learn Docker - Fundamentals of Docker 19. x: Build, Test, Ship, and Run Containers with Docker and Kubernetes. (2nd ed.). Packt Publishing

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

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

Data Engineering

Module Code: DLMDSEDE1

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 (Data Engineering)

Contributing Courses to Module
▪ Data Engineering (DLMDSEDE01)

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

Module Contents

- Principles of Data Engineering
- Paradigms for Data Processing at Scale
- Overview on Data Governance, Security, and Protection
- Common Cloud Platforms
- DataOps Approach

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

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

Project: Data Engineering

Module Code: DLMDSEDE2

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLMDSEDE01	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. Max Pumperla (Project: Data Engineering)

Contributing Courses to Module

- Project: Data Engineering (DLMDSEDE02)

Module Exam Type	
Module Exam <u>Study Format: Distance Learning</u> Portfolio <u>Study Format: myStudies</u> *Type of examination*	**Split Exam**
Weight of Module see curriculum	

Module Contents

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

Learning Outcomes	
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 Programs in the IT & Technology field

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

Process Management with Scrum

Module Code: DLMPREEPMS1

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	Minimaldauer: 1 Semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Nebojsa Radojevic (Process Management with Scrum)

Contributing Courses to Module
▪ Process Management with Scrum (DLMPREEPMS01)

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

Module Contents

- Scrum Origin, Basic Idea and Fields of Application
- Scrum Roles
- Product Backlog and Sprint Planning
- Executing the Scrum Process
- Helpful Tools
- Implementation and Scaling of Scrum

Learning Outcomes	
Process Management with Scrum On successful completion, students will be able to ▪ understand and explain the contents of the agile manifest. ▪ understand Scrum as a framework for developing, delivering, and sustaining products in a complex environment. ▪ describe each of the roles within a Scrum team and explain each item and each step within the Scrum process. ▪ handle the refinement process of the product backlog and discuss the interaction within the team and to the outside world during and after a sprint. ▪ understand the concept of user stories and apply the method to simple cases. ▪ understand and describe possibilities for the scaling of Scrum.	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other moduls in the field of Project Management	All Master Programs in the Business & Management field

Process Management with Scrum

Course Code: DLMPREEPMS01

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

Course Description

Within the broad field of project management, Scrum falls into the category of agile methods. As such, Scrum is more of a process management framework than a project management method. In this course the Scrum framework will be described and discussed in detail. The Agile Manifesto will be introduced, and the basic idea of iterative and incremental development will be discussed, leading up to the methodology of Scrum. A thorough review will be done on the different roles within the Scrum team. The terms product backlog, refinement and increment are defined and explained. As core feature of Scrum, the execution of sprints and daily scrums will be detailed. For the practical application of Scrum, the handling of requirements and creation of user stories will be introduced. The student also gets to know the little tools for communication and task-tracking used within development teams. Furthermore, the student will learn when and how a Scrum process should be implemented and what kind of benefits and risks can be expected from it.

Course Outcomes

On successful completion, students will be able to

- understand and explain the contents of the agile manifest.
- understand Scrum as a framework for developing, delivering, and sustaining products in a complex environment.
- describe each of the roles within a Scrum team and explain each item and each step within the Scrum process.
- handle the refinement process of the product backlog and discuss the interaction within the team and to the outside world during and after a sprint.
- understand the concept of user stories and apply the method to simple cases.
- understand and describe possibilities for the scaling of Scrum.

Contents

1. Scrum Origin, Basic Idea and Fields of Application
   - 1.1 The Birth of Scrum – How and Why it All Began
   - 1.2 The Agile Manifesto and a Change in Perspective
   - 1.3 The Approach of Iterative and Incremental Development
   - 1.4 Defining Fields for Scrum and Fields for Not Scrum

2. Scrum Roles

Literature
Compulsory Reading
Further Reading ▪ Highsmith, J. (2002). Agile software development ecosystems. Addison-Wesley Professional. ▪ Schwaber, K. (2004). Agile project management with Scrum. Microsoft 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: 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	

Project: Corporate Project with Scrum

Module Code: DLMPREEPMS2

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLMPREEPMS01	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. Nebojsa Radojevic (Project: Corporate Project with Scrum)

Contributing Courses to Module
▪ Project: Corporate Project with Scrum (DLMPREEPMS02)

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

Module Contents
After studying the methods of Scrum and learning about the systematic development approach, this course offers the opportunity to transfer the learned contents to practice. Choosing a real project or task within an organization, the method can be experienced and compared to the theoretical concept.

Learning Outcomes	
Project: Corporate Project with Scrum On successful completion, students will be able to ▪ understand Scrum and its roles within the context of a corporate organization. ▪ explain the elements and processes of Scrum in detail and out of practical experience. ▪ create user stories, refine the product backlog and select items for a sprint. ▪ collaborate in the daily scrum and apply the little tools within the development team. ▪ discuss critically the benefits and limitations of the Scrum framework.	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other moduls in the field of Project Management	All Master Programs in the Business & Management field

Project: Corporate Project with Scrum

Course Code: DLMPREEPMS02

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
MA	English		5	DLMPREEPMS01

Course Description

The course „Project: Corporate Project with Scrum" is building on the basic knowledge of the Scrum Framework acquired in the previous course. The theoretical foundations of Scrum can be applied within a real company environment. The student experiences the advantages of agile work and can reflect on the Scrum roles in practice. The student is also confronted with the hurdles that arise in applying the methodology in a real situation and can experiment with own approaches to solutions.

Course Outcomes

On successful completion, students will be able to

- understand Scrum and its roles within the context of a corporate organization.
- explain the elements and processes of Scrum in detail and out of practical experience.
- create user stories, refine the product backlog and select items for a sprint.
- collaborate in the daily scrum and apply the little tools within the development team.
- discuss critically the benefits and limitations of the Scrum framework.

Contents

- The course „Project: Corporate Project with Scrum" is building on the basic knowledge of the Scrum Framework acquired in the previous course and on the general knowledge of management know-how and classical project management acquired during the previous semesters. Based on a real task to be resolved within an organization (commercial enterprise, public administration, or the like), the students can gain practical experience working with agile methods utilizing the Scrum Framework.
- The students will reflect critically on the similarities and differences they observed and, if applicable, also compare the experienced agile methods with classical methods of project management. To meet scientific criteria, a literature search and a thorough comparison of the scientific and methodological foundation to the practical aspects experienced in the project is strongly encouraged and supported. The business aspect (costs, gain, time, quality, strategic relevance, etc.) of the project should be recognized and analyzed based on scientific methods. The students will demonstrate their ability to combine specialist knowledge and transfer of this knowledge to a specific project in a professional environment. They will also critically reflect on the experienced own work with Scrum, as well as on the theoretical concept of the Scrum Framework itself.

Literature
Compulsory Reading
Further Reading ▪ Anon. (2001): Manifesto for Agile Software Development. (URL: https://agilemanifesto.org [Retrieved: 20.03.20201]). ▪ Ockerman, S./ Reindl, S. (2019): Mastering Professional Scrum: Coaches' Notes for Busting Myths, Solving Challenges, and Growing Agility. Addison Wesley Longman, Boston. ▪ Rubin, K. S. (2013): Essential Scrum: A Practical Guide to the Most Popular Agile Process. Addison-Wesley Professional, Boston. ▪ Schwaber, K. / Sutherland, J. V. (2012): Software in 30 days: How Agile Managers Beat the Odds, Delight their Customers and Leave Competitors in the Dust. Wiley, New Jersey. ▪ Sutherland, J. (2015): Scrum: The art of Doing Twice the Work in Half the Time. Random House UK, London. ▪ Verheyen, G. (2019): Scrum: A Pocket Guide: a Smart Travel Companion. 2nd edition, Van Haren Publishing, VW 's-Hertogenbosch.

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	**Exam Preparation**
☑ Slides	☑ Guideline

Product Development

Module Code: DLMBPDDT1

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. Dorian Mora (Product Development)

Contributing Courses to Module

- Product Development (DLMBPDDT01)

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

- Production planning techniques
- Design tasks
- Product development approaches
- Digital product development and organizational aspects

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Learning Outcomes

Product Development

On successful completion, students will be able to

- know the basic definitions and principles of (new) product development.
- understand the key skills in product development.
- discuss, differentiate, and select appropriate product development approaches with respect to a given scenario.
- work with digital product development tools and techniques like CAD, PDM and PLM at a basic level.
- develop own solutions and approaches to academic and practical questions.
- discuss, evaluate, and adapt different digital product development techniques and tools.

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Links to other Modules within the Study Program

This module is similar to other modules in the field of Design

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Links to other Study Programs of the University

All Master Programs in the Design, Architecture& Construction field

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Product Development

Course Code: DLMBPDDT01

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

Course Description

This course aims to provide basic work and problem-solving methods for the successful development of products. It introduces the definition of key design tasks and various alternative product development approaches such as flow-based, lean product development, and design thinking. Finally, the students will become familiar with the use of computer-aided design (CAD) tools and how they integrate into modern product development approaches.

Course Outcomes

On successful completion, students will be able to

- know the basic definitions and principles of (new) product development.
- understand the key skills in product development.
- discuss, differentiate, and select appropriate product development approaches with respect to a given scenario.
- work with digital product development tools and techniques like CAD, PDM and PLM at a basic level.
- develop own solutions and approaches to academic and practical questions.
- discuss, evaluate, and adapt different digital product development techniques and tools.

Contents

1. Introduction
   - 1.1 Basic Definitions
   - 1.2 The Product Development Process
   - 1.3 Indicators and Metrics
   - 1.4 Product Development Models
   - 1.5 Current Trends in Product Development

2. The Product Development Process
   - 2.1 Planning
   - 2.2 Concept Development
   - 2.3 Design
   - 2.4 Testing and Refinement
   - 2.5 Production and Ramp-up

3. Product Development Approaches
    - 3.1 Lean Product Development
    - 3.2 Design Thinking
    - 3.3 Human-Centered Design
    - 3.4 User Experience Strategy
    - 3.5 Open Innovation

4. Digital Tools
    - 4.1 Computer-Aided Design
    - 4.2 Computer-Aided Quality
    - 4.3 Product Data Management
    - 4.4 Product Lifecycle Management

5. Organizational Perspective
    - 5.1 Incremental, Platform, and Breakthrough Development
    - 5.2 Building Teams
    - 5.3 Political Issues in Organizations
    - 5.4 Distributed New Product Development

Literature

Compulsory Reading

Further Reading

- Kahn, K. B., Kay, S. E., Slotegraaf, R. J., & Uban, S. (Eds.). (2012). The PDMA handbook of new productdevelopment (3rd ed.). Hoboken, NJ: John Wiley & Sons. (Database: ProQuest).
- Ottosson, S. (2018). Developing and managing innovation in a fast changing and complex world:Benefiting from dynamic principles. Cham: Springer. (Database: ProQuest).
- Ulrich, K. T., & Eppinger, S. D. (2016). Product design and development (6th ed.). New York, NY:McGraw Hill.

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	**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	

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	

Design Thinking

Module Code: DLMBPDDT2

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	Minimaldauer: 1 Semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Dorian Mora (Design Thinking)

Contributing Courses to Module

- Design Thinking (DLMBPDDT02)

Module Exam Type

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

Weight of Module

see curriculum

Module Contents

This course will put students in the mindset of Design Thinking. Students will be introduced to phases and distinct methods for inspiration, as well as the ideation and implementation of products. A current list of topics is located in the Learning Management System.

Learning Outcomes	
Design Thinking On successful completion, students will be able to ▪ comprehend, critically reflect on, and adopt the Design Thinking mindset. ▪ understand the inspiration, ideation, and implementation phases. ▪ evaluate and identify appropriate methods from the toolbox of human-centered design for given design tasks and challenges.	
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 Design	All Master Programs in the Design, Architecture & Construction field

Design Thinking

Course Code: DLMBPDDT02

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

Course Description
In this course, students will receive a hands-on introduction to human-centered design via the Design Thinking method. Beyond conveying the individual basic principles, the procedures in Design Thinking are examined in detail. In order to fully understand Design Thinking in terms of important aspects in practice, selected methods for the individual process steps are presented in theory and application. Students will learn to improve their design process by reflecting on and adapting their activities.

Course Outcomes

On successful completion, students will be able to

- comprehend, critically reflect on, and adopt the Design Thinking mindset.
- understand the inspiration, ideation, and implementation phases.
- evaluate and identify appropriate methods from the toolbox of human-centered design for given design tasks and challenges.

Contents

- The course covers current topics and trends in Design Thinking, illustrating some methods and techniques as well as case studies. Each participant must create a project report on a chosen project, where he/she describes the application of the Design Thinking approach to a real product development scenario.

Literature
Compulsory Reading
Further Reading ▪ IDEO.org. (2015). The Field Guide to Human-Centered Design. A step-by-step guide that will get you solving prob-lems like a designer. Retrieved from http://www.designkit.org/resources/1 ▪ Pressman, Andy (2019): Design Thinking. A Guide to Creative Problem Solving for Everyone, New York : Routledge. ▪ Lockwood, T., & Papke, E. (n.d.). Innovation by design : how any organization can leverage design thinking to pro-duce change, drive new ideas, and deliver meaningful solutions. ▪ Lewrick, M., Link, P., Leifer, L. J., & Langensand, N. (2018). The design thinking playbook : mindful digital transfor-mation of teams, products, services, businesses and ecosystems. John Wiley & Sons.

Study Format myStudies

Study Format	Course Type
myStudies	Project

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

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	**Exam Preparation**
☑ Slides	☑ Guideline

Quality Management and Sustainability

Module Code: DLMEMQMS

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. Adrienne Steffen (Quality Management and Sustainability)

Contributing Courses to Module
▪ Quality Management and Sustainability (DLMEMQMS01)

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

Module Contents

- Introduction to quality management
- Processes and problem solving
- Quality techniques
- Standards, auditing, and certification
- Total Quality Management (TQM)
- Introduction to sustainability in engineering
- Sustainability in the business context
- Incorporating sustainability in project management

Learning Outcomes

Quality Management and Sustainability

On successful completion, students will be able to

- analyze the purpose and objectives of operational quality management (QM).
- demonstrate the core task of management and recognize the effectiveness and efficiency of QM systems in the execution of business processes.
- choose and apply the basic concepts of quality and process management.
- model the structure of the QM system and its components.
- appraise the structure of standardization series of standards including the process of requirements for auditing and certification of QM systems.
- relate sustainability to other success factors in engineering and justify its practice.
- distinguish the peculiarities of sustainability in engineering management by interpreting relevant positives and challenges.
- assess the triple bottom line and/or other frameworks for sustainability to design innovative business models.
- combine sustainability norms and practices into engineering project management generating added value for all stakeholders.

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 Quality and Sustainability Management	All Master Programs in the Transport & Logistics field

Quality Management and Sustainability

Course Code: DLMEMQMS01

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

Course Description

The lecture starts with basic concepts of quality, quality management (QM), quality management system, and customer satisfaction. Afterwards the course deals with the most important operational processes and the quality characteristics of products and services. Quality techniques are the subject of the third section. Requirements for a QM system according to standardization procedures are explained and the procedure for certification and auditing is explained. Other QM models, e.g., the EFQ or TQM, are discussed.The second part of the lecture is dedicated to sustainability for primarily engineering companies followed by noteworthy examples from the domain. A further focus exists on the triple bottom line approach, its obligations, and opportunities. Finally, a detailed analysis of how to incorporate sustainability in engineering project management considering its impact and challenges while factoring in project management practices and standards.

Course Outcomes

On successful completion, students will be able to

- analyze the purpose and objectives of operational quality management (QM).
- demonstrate the core task of management and recognize the effectiveness and efficiency of QM systems in the execution of business processes.
- choose and apply the basic concepts of quality and process management.
- model the structure of the QM system and its components.
- appraise the structure of standardization series of standards including the process of requirements for auditing and certification of QM systems.
- relate sustainability to other success factors in engineering and justify its practice.
- distinguish the peculiarities of sustainability in engineering management by interpreting relevant positives and challenges.
- assess the triple bottom line and/or other frameworks for sustainability to design innovative business models.
- combine sustainability norms and practices into engineering project management generating added value for all stakeholders.

Contents

1. Introduction to quality management
   - 1.1 Classification and meaning
   - 1.2 Managing quality

1.3 Definition and characteristics of quality
1.4 Requirements
1.5 Customer satisfaction

2. Processes and problem solving
   2.1 Processes and process management
   2.2 Process measurement
   2.3 Problem-solving techniques

3. Quality techniques
   3.1 Elementary quality tools (error collection list, flow chart, histogram, Pareto chart, correlation analysis, cause-and-effect diagram, quality control chart)
   3.2 Management tools (affinity diagram, relations diagram, tree diagram, matrix diagram, portfolio diagram, problem decision plan)
   3.3 Other quality techniques (FMEA, QFD, and House of Quality, Design of Experiments, Poka Yoke)

4. Standards, auditing, and certification
   4.1 Standardized quality management systems
   4.2 Auditing and certification

5. Total Quality Management (TQM)
   5.1 TQM as a management approach
   5.2 Principles of TQM
   5.3 TQM in engineering

6. Introduction to sustainability in engineering
   6.1 Defining sustainability in engineering
   6.2 Examples of sustainability in engineering

7. Sustainability in the business context
   7.1 The triple bottom line
   7.2 Obligations and opportunities

8. Incorporating sustainability in project management
   8.1 The impact of sustainability in project management
   8.2 The challenges
   8.3 The practices and standards of project management

Literature
Compulsory Reading
Further Reading ▪ Brzozowska, A., Pabian, A., & Pabian, B. (2021). Sustainability in project management: A functionalapproach. CRC Press. ▪ Foster, S. T. (2017). Managing quality: Integrating the supply chain (Global ed.). Pearson EducationLimited. ▪ Luthra, S., Garg, D., Aggarwal, A., & Mangla, S. K. (2021). Total quality management (TQM): Principles,methods, and applications. CRC 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	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	

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	**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	

Cyber Security and Data Protection

Module Code: DLMCSITSDP

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. Ralf Kneuper (Cyber Security and Data Protection)

Contributing Courses to Module
▪ Cyber Security and Data Protection (DLMCSITSDP01)

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

Module Contents

- Data protection and privacy
- Cyber security building blocks
- Cyber security management
- Cryptography concepts
- Cryptography applications

Learning Outcomes	
Cyber Security and Data Protection On successful completion, students will be able to ▪ explain the core concepts of cyber security, data protection, and cryptography including their differences and relationships. ▪ compare the approaches to data protection within in different legal systems. ▪ apply data protection concepts to data science and other application scenarios. ▪ analyze application scenarios to identify the adequate cyber security management measures that should be implemented. ▪ explain the different approaches to data protection in different cultures.	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Computer Science & Software Development	All Master Programmes in the IT & Technology field

Cyber Security and Data Protection

Course Code: DLMCSITSDP01

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

Course Description

With the increasing digitization and networking of IT systems, the need for safeguarding systems and the data processed by these systems has grown. The aim of this module is to provide an understanding of security measures needed, cyber security including cryptography, and data protection. While the need for cyber security is similar around the world, different cultures have different expectations regarding data protection and privacy. Nevertheless, personal data are often processed outside the country where the affected individuals live. Hence, the cultural aspects of data protection need to be taken into account wherever the data are processed. This course provides an overview of the main cyber security measures in different application scenarios, as well as their integration into an Information Security Management System, with particular focus on the relevant ISO/IEC 270xx family of standards. Cryptography provides an important tool set for cyber security and is used in many different application scenarios such as secure Internet protocols and block chain.

Course Outcomes

On successful completion, students will be able to

- explain the core concepts of cyber security, data protection, and cryptography including their differences and relationships.
- compare the approaches to data protection within in different legal systems.
- apply data protection concepts to data science and other application scenarios.
- analyze application scenarios to identify the adequate cyber security management measures that should be implemented.
- explain the different approaches to data protection in different cultures.

Contents

1. Foundations of Data Protection and Cyber Security
   - 1.1 Terminology and Risk Management
   - 1.2 Core Concepts of Cyber Security
   - 1.3 Core Concepts of Data Protection and Privacy
   - 1.4 Core Concepts of Cryptography
   - 1.5 Legal Aspects

2. Data Protection

2.1 Basic Concepts of Data Protection (ISO/IEC 29100, Privacy by Design)
2.2 Data Protection in Europe: the GDPR
2.3 Data Protection in the USA
2.4 Data Protection in Asia

3. Applying Data Protection
3.1 Anonymity and Pseudonyms (k-Anonymity, i-Diversity, Differential Privacy)
3.2 Data Protection in Data Science and Big Data
3.3 User Tracking in Online Marketing
3.4 Cloud Computing

4. Building Blocks of Cyber Security
4.1 Authentication, Access Management and Control
4.2 Cyber Security in Networks
4.3 Developing Secure IT Systems (OWASP, etc.)

5. Cyber Security Management
5.1 Security Policy
5.2 Security and Risk Analysis
5.3 The ISO 270xx Series
5.4 IT Security and IT Governance
5.5 Example: Cyber Security for Credit Cards (PCI DSS)

6. Cryptography
6.1 Symmetric Cryptography
6.2 Asymmetric Cryptography
6.3 Hash Functions
6.4 Secure Data Exchange (Diffie-Hellman, Perfect Forward Secrecy, etc.)

7. Cryptographic Applications
7.1 Digital Signatures
7.2 Electronic Money
7.3 Secure Internet Protocols (TLS, IPSec, etc.)
7.4 Block Chain

Literature
Compulsory Reading
Further Reading ▪ Amoroso, E., & Amoroso, M. (2017). From CIA to APT: An introduction to cyber security. Independently published. ▪ National Institute of Standards and Technology. (2018). Framework for improving critical infrastructure cybersecurity. ▪ Paar, C., & Pelzl, J. (2011). Understanding cryptography: A textbook for students and practitioners. Springer. ▪ Walker, B. (2019). Cyber security comprehensive beginners guide to learn the basics and effective methods of cyber security. Independently published.

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	**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

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

Cyber Risk Assessment and Management

Module Code: DLMCSECRAM_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

Prof. Dr. Carsten Skerra (Cyber Risk Assessment and Management)

Contributing Courses to Module

- Cyber Risk Assessment and Management (DLMCSECRAM01_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

- Organizational IT Risk Management
- Measuring the Cyber Threat
- Threat Modeling
- Standardization and Compliance
- Risk Assessment
- The Cyber-Resilient Organization

Learning Outcomes	
Cyber Risk Assessment and Management On successful completion, students will be able to ▪ understand the process of attack modeling. ▪ associate a cost with attack outcomes. ▪ understand black swan events. ▪ evaluate the impact that legislation has on risks and costs. ▪ understand how an organization needs to make decisions based on risk.	
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

Cyber Risk Assessment and Management

Course Code: DLMCSECRAM01_E

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

Course Description

Decisions on making changes or not should be informed by the risk of that action or inaction. This is dictated by the cost a potentially successful attack would have. But how to model attacks and associate costs with them? We will explore the discipline of attack modeling and risk evaluation in this course.

Course Outcomes

On successful completion, students will be able to

- understand the process of attack modeling.
- associate a cost with attack outcomes.
- understand black swan events.
- evaluate the impact that legislation has on risks and costs.
- understand how an organization needs to make decisions based on risk.

Contents

1. Organizational IT Risk Management
   - 1.1 Business Need of Risk Management
   - 1.2 Anatomy of a Data Exfiltration Attack
   - 1.3 Cyber Catastrophes
   - 1.4 Cyber Risk
2. Measuring the Cyber Threat
   - 2.1 Measurement and Management
   - 2.2 Cyber Threat Metrics
   - 2.3 Measuring the Threat for an Organization
   - 2.4 The Likelihood of Major Cyber Attacks
   - 2.5 Black Swan Events
3. Threat Modeling
   - 3.1 Attack Tree Methodology
   - 3.2 STRIDE
   - 3.3 DREAD

3.4 LINDDUN

4. Standardization and Compliance
   - 4.1 NIST Risk Management Framework
   - 4.2 ISO 27005
   - 4.3 BSI 100-3

5. Risk Assessment
   - 5.1 Methodologies
   - 5.2 Factoring in Black Swan Events
   - 5.3 Continuous Reevaluation

6. The Cyber-Resilient Organization
   - 6.1 Changing Approaches to Risk Management
   - 6.2 Incident Response and Crisis Management
   - 6.3 Resilience Engineering, Security Solutions and Finances
   - 6.4 Cyber Insurance

Literature

Compulsory Reading

Further Reading

- Antonucci, D. (2017). The cyber risk handbook: Creating and measuring effective cybersecurity capabilities. Wiley.
- Refsdal, A., Solhaug, B., & Stolen, K. (2015). Cyber-risk management. 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	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 ☑ Video ☑ Audio ☑ Slides	☑ 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	**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 ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Mobile Software Engineering I

Module Code: DLMIWMB1_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	Minimaldauer: 1 Semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Marian Benner-Wickner (Mobile Software Engineering I)

Contributing Courses to Module
▪ Mobile Software Engineering I (DLMIWMB01_E)

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

Module Contents

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

Learning Outcomes	
Mobile Software Engineering I On successful completion, students will be able to ▪ identify the differences and peculiarities of software development for mobile systems and explain them. ▪ differentiate various activities, roles and risks in the development, operation and maintenance of mobile software systems. ▪ explain and distinguish the architecture and technical features of the Android platform. ▪ independently create mobile software systems to solve specific problems for the Android platform.	
Links to other Modules within the Study Program This module is similar to other modules in the fields of Computer Science & Software Development.	**Links to other Study Programs of the University** All Master Programs in the IT & Technology field.

Mobile Software Engineering I

Course Code: DLMIWMB01_E

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

Course Description

Using the mobile platform "Android" as an example, the course teaches how the programming of mobile applications (Apps) differs from the development of browser-based information systems, which technologies and programming concepts are typically used, and what typical challenges there are in app development for business applications.

Course Outcomes

On successful completion, students will be able to

- identify the differences and peculiarities of software development for mobile systems and explain them.
- differentiate various activities, roles and risks in the development, operation and maintenance of mobile software systems.
- explain and distinguish the architecture and technical features of the Android platform.
- independently create mobile software systems to solve specific problems for the Android platform.

Contents

1. Basics of Mobile Software Development
   - 1.1 Special Features of Mobile Devices
   - 1.2 Special Features of Mobile Software Development
   - 1.3 Classification of Mobile Devices
   - 1.4 The Android Platform

2. Android System Architecture
   - 2.1 The Android System
   - 2.2 Security
   - 2.3 Communication with Networks

3. Development Environment
   - 3.1 Android Studio
   - 3.2 First App and Emulator Test
   - 3.3 Application Deployment

Literature

Compulsory Reading

Further Reading

- Allen, G. (2021). Android for Absolute Beginners: Getting Started with Mobile Apps Development Using the Android Java SDK. Apress.
- Google Inc. (2022a). Android Developer Guides [available on internet].
- Hagos, T. (2020). Learn Android Studio 4 : Efficient Java-Based Android Apps Development. 2nd ed. Apress.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Case Study

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

Mobile Software Engineering II

Module Code: DLMIWMB2_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	Minimaldauer: 1 Semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Marian Benner-Wickner (Mobile Software Engineering II)

Contributing Courses to Module
▪ Mobile Software Engineering II (DLMIWMB02_E)

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

Module Contents
Design, implementation and documentation of small, mobile applications based on a specific task.

Learning Outcomes	
Mobile Software Engineering II On successful completion, students will be able to ▪ independently design and prototype a small mobile application to solve a targeted task. ▪ recognize typical problems and challenges in the practical implementation od small mobile applications. ▪ document the design and implementation of self-developed small, mobile applications.	
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 field.

Mobile Software Engineering II

Course Code: DLMIWMB02_E

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

Course Description

In this course, students independently create a mobile application and document its design and implementation.

Course Outcomes

On successful completion, students will be able to

- independently design and prototype a small mobile application to solve a targeted task.
- recognize typical problems and challenges in the practical implementation od small mobile applications.
- document the design and implementation of self-developed small, mobile applications.

Contents

- Design, implementation and documentation of small, mobile applications based on a specific task. Possible topics are for example:
    - A radio app to improve the exchange between listeners and the station in general, but especially between listeners and radio hosts.
    - An app that allows a group of board game fans to better organize their regular evening game date.
    - An app that thesis supervisors can use to improve their supervision processes.

Literature

Compulsory Reading

Further Reading

- Allen, G. (2021). Android for absolute beginners getting started with mobile apps development using the Android Java SDK. Apress.
- Google Inc. (ed.) (2022a). Android Developer Guide [available on internet].
- Google Inc. (ed.) (2022b). Android Studio [available on internet].
- Hagos, T. (2020). Learn Android Studio 4 : Efficient Java-Based Android Apps Development: 2nd ed. Apress.

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	**Exam Preparation**
☑ Slides	☑ Guideline

Leveraging Data Sources & Data Mining

Module Code: DLMDMEDM1

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	Minimaldauer: 1 Semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Frank Passing (Leveraging Data Sources & Data Mining)

Contributing Courses to Module

- Leveraging Data Sources & Data Mining (DLMDMEDM01)

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

Module Contents

- 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

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.	
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	**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
☑ Creative Lab	☑ Reader	☑ Online Tests
	☑ Video	
	☑ Audio	
	☑ Slides	

Project: Leveraging Data Sources & Data Mining

Module Code: DLMDMEDM2

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLMDMEDM01	MA	5	

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

Module Coordinator

Prof. Dr. Frank Passing (Project: Leveraging Data Sources & Data Mining)

Contributing Courses to Module

- Project: Leveraging Data Sources & Data Mining (DLMDMEDM02)

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

Module Contents

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	
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.

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	**Exam Preparation**
☑ Slides	☑ Guideline

User Interface and Experience

Module Code: DLMAIEUIUX1

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. Adelka Niels (User Interface and Experience)

Contributing Courses to Module

- User Interface and Experience (DLMAIEUIUX01)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Exam, 90 Minutes Study Format: myStudies *Type of examination*	

Weight of Module

see curriculum

Module Contents

- ROI of UX design
- Role and mindset of UX design in IT projects
- The UX design process
- UX psychology: How the human mind works
- User research
- UX design basics

Learning Outcomes	
User Interface and Experience On successful completion, students will be able to ▪ Understand what design is about and the crucial aspects of good design ▪ understand and define the role of the UI/UX designer within a project. ▪ explain the UX design process and the user-centered mindset. ▪ advocate the importance of UX design for IT projects. ▪ describe the basic methods of user research, user testing, and user-centered design.	
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 fields

User Interface and Experience

Course Code: DLMAIEUIUX01

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

Course Description

UX design is crucial to the development of new IT services and applications and enhances the quality of the outcome. Applying UX design techniques can significantly and positively change the software development process, and good UX design is the result of effective teamwork. Within this course the students will understand the mindset, basic techniques, and impact of UX design on IT projects. They will learn how the UX design process works and the role of the UX designer within IT projects. They will also gain skills in the type of collaboration that produces the best results. Using their basic knowledge about good design, the students will know when it is appropriate that they make small changes to UIs themselves and when it is time to consult a designer.

Course Outcomes

On successful completion, students will be able to

- Understand what design is about and the crucial aspects of good design
- understand and define the role of the UI/UX designer within a project.
- explain the UX design process and the user-centered mindset.
- advocate the importance of UX design for IT projects.
- describe the basic methods of user research, user testing, and user-centered design.

Contents

1. ROI of UX design
   - 1.1 Efficacy
   - 1.2 Efficiency
   - 1.3 The impact of design on use errors
2. Role and Mindset of UX design in IT projects
   - 2.1 The role of UX design: the UX designer
   - 2.2 The UX mindset: putting the user first
3. The UX design Process
   - 3.1 In a waterfall process environment
   - 3.2 In an agile process environment
4. UX Psychology: How the Human Mind Works

	4.1	Perceptual psychology
	4.2	Information processing
	4.3	Decision-making
	4.4	Situation awareness
	4.5	Errors
5.	User Research	
	5.1	The benefit of user research
	5.2	Basic research techniques
	5.3	User testing
6.	UX design Basics	
	6.1	Interaction design
	6.2	Information architecture
	6.3	Screen design
	6.4	Graphic design
	6.5	Rules of good design

Literature

Compulsory Reading

Further Reading

- Cooper, A., Reimann, R., Cronin, D., & Noessel, C. (2014). About face: The essentials of interaction design (5th ed.). Wiley.
- Johnson, J. (2010). Designing with the mind in mind. Elsevier.
- Preece, J., Sharp, H., & Rogers, Y. (2015). Interaction design: Beyond human-computer interaction (5th ed.). Wiley.
- Unger, R., & Chandler, C. (2012). A project guide to UX design: For user experience designers in the field or in the making. New Riders Pub.

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

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**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods

Project: Human Computer Interaction

Module Code: DLMAIEUIUX2

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLMAIEUIUX01	MA	5	150 h

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

Module Coordinator

Prof. Dr. Adelka Niels (Project: Human Computer Interaction)

Contributing Courses to Module

- Project: Human Computer Interaction (DLMAIEUIUX02)

Module Exam Type

Module Exam	Split Exam
Study Format: myStudies *Type of examination* Study Format: Distance Learning Portfolio	

Weight of Module

see curriculum

Module Contents

In this course the students will gain practical experience in user experience design. They will conduct user testing for a given user interface and work on developing improvements. The work process and the results will become part of a portfolio.

Learning Outcomes	
Project: Human Computer Interaction On successful completion, students will be able to ▪ evaluate the usability of a user interface. ▪ conduct user testing. ▪ understand the practical implications of putting users first. ▪ make small changes in existing user interfaces and recognize the situations in which a user experience designer should be consulted.	
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: Human Computer Interaction

Course Code: DLMAIEUIUX02

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
MA	English		5	DLMAIEUIUX01

Course Description

In this course the students will gain practical experience in user experience design. They will set up and conduct a user testing for a given user interface and develop improvements. The work process and the results will become part of a portfolio.

Course Outcomes

On successful completion, students will be able to

- evaluate the usability of a user interface.
- conduct user testing.
- understand the practical implications of putting users first.
- make small changes in existing user interfaces and recognize the situations in which a user experience designer should be consulted.

Contents

- User experience design focusses on the needs of users. Within this portfolio project the students put into practice basic techniques which lead to good user-centered design. They learn how to test the user experience and usability of an application by conducting user tests, and they also learn how to develop and test ideas for improvement. Students will finish this course having gained practical experience working within the mindset of putting users first.

Literature
Compulsory Reading
Further Reading ▪ Barnum, C. (2010): Usability Testing Essentials: Ready, Set...Test!, Morgan Kaufmann, Burlington, USA ▪ Cooper, A., Reimann, R., Cronin, D., & Noessel, C. (2014). About face: The essentials of interaction design. New York, NY: Wiley. ▪ Johnson, J. (2010). Designing with the mind in mind. Burlington, MA: Elsevier. ▪ Preece, J., Sharp, H., & Rogers, Y. (2015). Interaction design: Beyond human-computer interaction. New York, NY: Wiley. ▪ Microsoft Windows Dev Center. (2018). Guidelines. [Web page]. Retrieved from https://docs.microsoft.com/en-us/windows/desktop/uxguide/guidelines ▪ Unger, R., & Chandler, C. (2012). A project guide to UX design. Berkeley, CA: New Riders.

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

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

Artificial Intelligence

Module Code: DLMAIAI

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. Claudia Heß (Artificial Intelligence)

Contributing Courses to Module

- Artificial Intelligence (DLMAIAI01)

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

- History of AI
- AI application areas
- Expert systems
- Neuroscience
- Modern AI systems

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

3.2 Cognitive Processes

4. Modern AI Systems
   4.1 Recent Developments in Hard- and Software
   4.2 Narrow vs General AI
   4.3 NLP and Computer Vision

5. AI Application Areas
   5.1 Autonomous Vehicles & Mobility
   5.2 Personalized Medicine
   5.3 FinTech
   5.4 Retail & Industry

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	**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	

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	**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 ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Project: AI Excellence with Creative Prompting Techniques

Module Code: DLMPAIECPT1

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	Minimaldauer: 1 Semester	WiSe/SoSe	English

Module Coordinator
N.N. (Project: AI Excellence with Creative Prompting Techniques)

Contributing Courses to Module
▪ Project: AI Excellence with Creative Prompting Techniques (DLMPAIECPT01)

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

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

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

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

3. Semester

Embedded Systems Engineering

Module Code: DLMSEESE

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

Kamran Mahmood (Embedded Systems Engineering)

Contributing Courses to Module

- Embedded Systems Engineering (DLMSEESE01)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Exam	

Weight of Module

see curriculum

Module Contents

- Essential Basics, Software Design Architecture and Patterns for Embedded Systems
- Core and Support Engineering Processes for Embedded Systems Development
- Methods and Tools in Development, Production, and Service
- Norms and Standards Regarding Embedded Systems Engineering
- Application Areas of Embedded Systems

Learning Outcomes	
Embedded Systems Engineering On successful completion, students will be able to ▪ demonstrate a systematic understanding of the use cases and interrelationships of software, hardware and the concept of embedded systems. ▪ analyze the requirements of embedded systems and understand the implications regarding reliability, security and safety. ▪ analyze and critically evaluate concepts for development regarding core and support engineering processes to design embedded systems. ▪ demonstrate judgement about methods and tools in development, production and service (e.g. Matlab, Simulink).	
Links to other Modules within the Study Program This module is similar to other modules in the fields of Computer Science & Software Development.	**Links to other Study Programs of the University** All Master Programs in the IT & Technology fields.

Embedded Systems Engineering

Course Code: DLMSEESE01

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

Course Description

The Embedded Systems Engineering course covers the fundamental concepts in a wide range of relevant topics in control systems, embedded systems, and electronic systems development. This course will provide insights into the engineering processes and common standards for analyzing and designing embedded systems for various applications.The first part introduces the fundamentals of control systems (discrete, embedded, real-time, distributed, networked systems), such as their design and architecture and specific requirements regarding reliability and safety. Then, the monitoring and diagnosis of embedded systems hardware units are described in more detail to give a good overview of how they work internally. In addition, the main aspects of core and support engineering processes for developing electronic systems and software included from a low-level perspective to higher-level approaches. An overview of methods and tools in development, production and service (e.g. Matlab Simulink) is given as they play a key role in advanced applications at this level. This teaching brief concludes with norms and standards (ISO/IEC 250xx) and important application areas for modern embedded systems.

Course Outcomes

On successful completion, students will be able to

- demonstrate a systematic understanding of the use cases and interrelationships of software, hardware and the concept of embedded systems.
- analyze the requirements of embedded systems and understand the implications regarding reliability, security and safety.
- analyze and critically evaluate concepts for development regarding core and support engineering processes to design embedded systems.
- demonstrate judgement about methods and tools in development, production and service (e.g. Matlab, Simulink).

Contents

1. Introduction to Embedded Systems:
    - 1.1 Introduction to Software Engineering of Embedded and Real-Time Systems
    - 1.2 Application Domains and Embedded Systems Hardware/Software Co-Development
    - 1.3 Software Modeling for Embedded Systems – Aspects of Reliability, Safety & Security
    - 1.4 Methods and Tools for the Development of Software for Embedded Systems
    - 1.5 Agile Development for Embedded Systems

2. Essential Basics, Software Design Architecture and Patterns for Embedded Systems:
   - 2.1 Essential Basics (Open-Loop and Closed-Loop Control Systems, Discrete Systems, Embedded Systems, Real-Time Systems, Distributed and Networked Systems)
   - 2.2 Electrics/Electronics and Software Architecture
   - 2.3 Software Reuse by Design in Embedded Systems
   - 2.4 Software Performance Engineering for Embedded Systems
   - 2.5 System Reliability, Safety, Monitoring, and Diagnostics – Security by Design

3. Core and Support Engineering Processes for Embedded Systems Development:
   - 3.1 Embedded Software Programming and Implementation Guidelines (Basic Definitions, Notations, Process Models and Standards)
   - 3.2 Initial Core Processes (Human Factors and User Interface Design for Embedded Systems – Requirements Management)
   - 3.3 Design Core Processes (Design, Implementation, Coding, Test, Integration, Test)
   - 3.4 Verification and Validation Core Processes (Calibration, System and Acceptance Test)
   - 3.5 Subset of Support Processes (Configuration Management, Subcontractor Management)

4. Methods and Tools in Development, Production, and Service:
   - 4.1 Embedded Software Quality, Integration and Testing Techniques
   - 4.2 Multicore Software Development for Embedded Systems
   - 4.3 Safety-Critical Software Development
   - 4.4 Software Development Tools for Embedded Systems

5. Norms and Standards regarding Embedded Systems Engineering:
   - 5.1 Framework for Software Product Quality Requirements and Evaluation (ISO/IEC 25000)
   - 5.2 Software Maintenance Processes for the Long-Term Sustainability and Support of Embedded Systems (ISO 14764)
   - 5.3 Safety-Critical Embedded Systems (ISO 26262), When Functional Safety is Critical in Embedded Systems Development
   - 5.4 Information Security Management (ISO/IEC 27001), When Cyber Security is a Critical Concern in Embedded Systems

6. Outlook of Application Areas of Embedded Systems
   - 6.1 Embedded Systems Specialized in Machine Learning
   - 6.2 Embedded Software for Automotive Applications - Autonomous Driving
   - 6.3 Embedded Software for Networking Applications - Integrated Internet of Things (IIoT)
   - 6.4 Human Implants - Embedded Medical Devices

Literature
Compulsory Reading
Further Reading ▪ International Organization for Standardization. (2014). Systems and software engineering — Systems and software Quality Requirements and Evaluation (SQuaRE) — Planning and management (ISO Standard No. 25001:2014). https://www.iso.org/standard/64787.html ▪ International Organization for Standardization. (2018). Information security management systems (ISO Standard No. 27001:2018). https://www.iso.org/standard/27001 ▪ International Organization for Standardization. (2018). Road vehicles — Functional safety (ISO Standard No. 26262:2018). https://www.iso.org/standard/68383.html ▪ International Organization for Standardization. (2022). Software engineering — Software life cycle processes (ISO Standard No. 14764:2022). https://www.iso.org/standard/27001 ▪ Oshana, R. (2013). Software engineering for embedded systems: methods, practical techniques, and applications. Newnes/Elsevier. ▪ Schäuffele, J. & Zurawka, T. (2016). Automotive Software Engineering - Principles, Processes, Methods, and Tools (2nd Edition). SAE International.

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

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

Project: Embedded Systems

Module Code: DLMSEPES

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLMSEESE01	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
Kamran Mahmood (Project: Embedded Systems)

Contributing Courses to Module
▪ Project: Embedded Systems (DLMSEPES01)

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

Module Contents
In this course, students learn to apply embedded systems development concepts they have learned in previous modules to practical scenarios or projects. As project teams, the students work on a project independently chosen from a set of project suggestions. Students can also contribute their own project ideas.

Learning Outcomes	
Project: Embedded Systems On successful completion, students will be able to ▪ to identify and demonstrate appropriate practices in various roles in embedded systems and electronic systems development as system developers, testers, and technical project managers. ▪ to analyze, apply and critically evaluate concepts of requirements elicitation and specification development and extend these concepts through FMEA (Failure Modes, Effects and Criticality Analysis). ▪ to demonstrate judgement and critically evaluate the methods for validating simulations. ▪ to define and apply simulation processes for early validation of systems (keywords like software/ hardware in a loop and the use of Matlab). ▪ to elicit requirements, write specifications, apply verification methods, and use simulations to validate systems in a dedicated manner to an embedded system.	
Links to other Modules within the Study Program This module is similar to other modules in the fields of Computer Science & Software Development.	**Links to other Study Programs of the University** All Master Programs in the IT & Technology fields.

Project: Embedded Systems

Course Code: DLMSEPES01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
MA	English		5	DLMSEESE01

Course Description

The students apply the knowledge gained in previous courses related to Embedded Systems Engineering in a practical example. The practical example (e.g. from the automotive, medical technology, or energy technology) is to be selected so that the reliability and safety aspects are in the foreground. The focus here is on the application of the additional processes for safeguarding during the specification, design and modelling, as well as the integration and testing of embedded systems. Finally, the selected practical example is validated in a simulation environment (e.g., Matlab Simulink).

Course Outcomes

On successful completion, students will be able to

- to identify and demonstrate appropriate practices in various roles in embedded systems and electronic systems development as system developers, testers, and technical project managers.
- to analyze, apply and critically evaluate concepts of requirements elicitation and specification development and extend these concepts through FMEA (Failure Modes, Effects and Criticality Analysis).
- to demonstrate judgement and critically evaluate the methods for validating simulations.
- to define and apply simulation processes for early validation of systems (keywords like software/ hardware in a loop and the use of Matlab).
- to elicit requirements, write specifications, apply verification methods, and use simulations to validate systems in a dedicated manner to an embedded system.

Contents

- Students in this course will acquire practical skills in system development, testing, and management. They will be able to elicit requirements, write specifications, apply verification methods, and use simulations to validate systems. In addition, they will comprehend the significance of validating simulations and be able to apply these methods. This will prepare them for various roles in embedded systems and electronic systems development.

Literature
Compulsory Reading
Further Reading ▪ Elkholy, M. M., & El-Hay, E. A. (2020). Efficient dynamic performance of brushless DC motor using soft computing approaches. Neural Computing & Applications, 32(10), 6041–6054. ▪ Kharola, A., & Patil, P. (2017). Dynamic stabilization of one wheel mobile robot (OWMR): a soft-computing approach. Journal of Industrial & Production Engineering, 34(6), 477–485. ▪ Malzahn, J., Roozing, W., & Tsagarakis, N. (2019). The Compliant Joint Toolbox for MATLAB: An Introduction With Examples. IEEE Robotics & Automation Magazine, 26(3), 52–63. ▪ Oshana, R. (2013). Software engineering for embedded systems: methods, practical techniques, and applications. Newnes/Elsevier. ▪ Sumathi, S., Surekha, P., & Ashok Kumar, L. (2015). Solar PV and Wind Energy Conversion Systems : An Introduction to Theory, Modeling with MATLAB/SIMULINK, and the Role of Soft Computing Techniques.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Project

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

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

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

Networks and Distributed Systems

Module Code: DLMCSNDS

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

Uwe Behley (Networks and Distributed Systems)

Contributing Courses to Module

- Networks and Distributed Systems (DLMCSNDS01)

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

- Communication Networks
- Communication Protocols
- Distributed System Architectures
- Distributed Algorithms and Applications

Learning Outcomes	
Networks and Distributed Systems On successful completion, students will be able to ▪ explain the basic concepts of digital data transmission and computer networks. ▪ detail the ISO/OSI reference model and characterize aspects of its different layers. ▪ compare the ISO/OSI model to the TCP/IP protocol stack, its services, and its applications. ▪ elaborate on different approaches and architectures for distributed systems. ▪ describe the challenges and opportunities of distributed algorithms and applications. ▪ analyze different aspects of decentralized, mobile, and pervasive computing.	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Computer Science & Software Development.	All Bachelor Programmes in the IT & Technology field.

Networks and Distributed Systems

Course Code: DLMCSNDS01

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

Course Description

Isolated computer systems are becoming the exception, with modern systems typically connected to each other via networks. Through these networks, data is constantly exchanged via the internet using communication protocols. These allow modern computers to access data and functions from other computer systems, enabling distributed systems. In this distributed Systems algorithms and applications are partially mapped to different entities within the network to perform shared computing tasks. The knowledge transfer regarding the required technologies, architectures, and algorithms for doing so is the focus of this course.

Course Outcomes

On successful completion, students will be able to

- explain the basic concepts of digital data transmission and computer networks.
- detail the ISO/OSI reference model and characterize aspects of its different layers.
- compare the ISO/OSI model to the TCP/IP protocol stack, its services, and its applications.
- elaborate on different approaches and architectures for distributed systems.
- describe the challenges and opportunities of distributed algorithms and applications.
- analyze different aspects of decentralized, mobile, and pervasive computing.

Contents

1. Computer Networks
   - 1.1 Basic Concepts of Digital Data Transmission
   - 1.2 Network Topologies and Interconnections
   - 1.3 Basics of Communication Engineering and Coding Theory
   - 1.4 The Physical Layer: Transmission Methods and Media
2. Communication Protocols
   - 2.1 The ISO/OSI Reference Model
   - 2.2 The Data Link Layer: Standards and Technologies
   - 2.3 The Network Layer: Addressing and Routing
   - 2.4 The Transport Layer: Reliability and Flow Control
3. The Internet Protocol Suite

Literature

Compulsory Reading

Further Reading

- Comer, D. E. (2015). Computer networks and internets (global ed., 6th ed.). Pearson Education.
- Comer, D. E. (2018). The internet book: Everything you need to know about computer networking and how the internet works (5th ed.). CRC Press.
- Kurose, J., & Keith R. (2017). Computer networking: A top-down approach, global edition (7th ed.). Pearson Education.
- Tanenbaum, A. S., & Wetherall, D. J. (2011). Computer networks: New international edition (5th ed.). Pearson Education.
- Van Steen, M., & Tanenbaum, A. S. (2017). Distributed systems (3rd ed.). CreateSpace Independent Publishing Platform.

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 ☑ Video ☑ Audio ☑ Slides	☑ 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	**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 ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Container Orchestration

Module Code: DLMDCCCO

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. Tianxiang Lu (Container Orchestration)

Contributing Courses to Module
▪ Container Orchestration (DLMDCCCO01)

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

Module Contents

- Introduction to Containers
- Container Composition And Services
- Container Registries
- Container Orchestration
- Kubernetes
- Orchestration in Production

Learning Outcomes	
Container Orchestration On successful completion, students will be able to ▪ transfer acquired theoretical knowledge to real-world case studies. ▪ apply the concepts covered in the preceding container orchestration course to build a running system. ▪ explain the design choices made in the selection of the deployed components and its implementation. ▪ translate the learned theories into the practice of orchestration. ▪ critically evaluate the resulting system's performance.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Computer Science & Software Development	**Links to other Study Programs of the University** All Master Programs in the IT & Technology field(s)

Container Orchestration

Course Code: DLMDCCCO01

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

Course Description

Containers have become very popular in the last ten years. In many scenarios, they have completely replaced the software installation as it is much simpler, avoids dependencies and leads to much fewer issues for the software supplier. At the same time, service-oriented architectures have grown. Often, each container provides just one service of a whole service bouquet. As the services depend on each other, they must be orchestrated, which happens on container level. The standard for container orchestration is the open-source software Kubernetes, which was originally created by Google.

Course Outcomes

On successful completion, students will be able to

- transfer acquired theoretical knowledge to real-world case studies.
- apply the concepts covered in the preceding container orchestration course to build a running system.
- explain the design choices made in the selection of the deployed components and its implementation.
- translate the learned theories into the practice of orchestration.
- critically evaluate the resulting system’s performance.

Contents

1. Introduction to Containers
   - 1.1 Software Installation Before Containers
   - 1.2 Need For a Standard Environment
   - 1.3 Containers vs. Virtual Machines
   - 1.4 Container Images

2. Container Composition and Services
   - 2.1 Service-Oriented Architectures
   - 2.2 Separation of Concerns
   - 2.3 Communication Between Containers
   - 2.4 Software-Defined Network
   - 2.5 Example with Docker-Compose

Literature
Compulsory Reading
Further Reading ▪ Dobies, J. & Wood, J. (2020). Kubernetes Operators: Automating the Container Orchestration Platform. O'Reilly. ▪ Saito, H., Lee, H-C. C. & Hsu, K-J. C. (2018). Kubernetes Cookbook: Practical Solutions to Container Orchestration (2nd ed.). Packt Publishing ▪ Sayfan, G. (2018) Mastering Kubernetes: Level up Your Container Orchestration Skills with Kubernetes to Build, Run, Secure, and Observe Large-Scale Distributed Apps (3rd ed.). Packt Publishing ▪ Schenker, G. N. (2020). Learn Docker - Fundamentals of Docker 19. x: Build, Test, Ship, and Run Containers with Docker and Kubernetes. (2nd ed.). Packt Publishing

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

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

Data Engineering

Module Code: DLMDSEDE1

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 (Data Engineering)

Contributing Courses to Module

- Data Engineering (DLMDSEDE01)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Oral Assignment Study Format: myStudies *Type of examination*	

Weight of Module

see curriculum

Module Contents

- Principles of Data Engineering
- Paradigms for Data Processing at Scale
- Overview on Data Governance, Security, and Protection
- Common Cloud Platforms
- DataOps Approach

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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.

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Links to other Modules within the Study Program

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

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Links to other Study Programs of the University

All Master Programs in the IT & Technology field

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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	**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	

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**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods

Project: Data Engineering

Module Code: DLMDSEDE2

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLMDSEDE01	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. Max Pumperla (Project: Data Engineering)

Contributing Courses to Module

- Project: Data Engineering (DLMDSEDE02)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Portfolio Study Format: myStudies *Type of examination*	

Weight of Module

see curriculum

Module Contents

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

Learning Outcomes	
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 Programs in the IT & Technology field

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

Process Management with Scrum

Module Code: DLMPREEPMS1

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	Minimaldauer: 1 Semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Nebojsa Radojevic (Process Management with Scrum)

Contributing Courses to Module
▪ Process Management with Scrum (DLMPREEPMS01)

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

Module Contents

- Scrum Origin, Basic Idea and Fields of Application
- Scrum Roles
- Product Backlog and Sprint Planning
- Executing the Scrum Process
- Helpful Tools
- Implementation and Scaling of Scrum

Learning Outcomes	
Process Management with Scrum On successful completion, students will be able to ▪ understand and explain the contents of the agile manifest. ▪ understand Scrum as a framework for developing, delivering, and sustaining products in a complex environment. ▪ describe each of the roles within a Scrum team and explain each item and each step within the Scrum process. ▪ handle the refinement process of the product backlog and discuss the interaction within the team and to the outside world during and after a sprint. ▪ understand the concept of user stories and apply the method to simple cases. ▪ understand and describe possibilities for the scaling of Scrum.	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other moduls in the field of Project Management	All Master Programs in the Business & Management field

Process Management with Scrum

Course Code: DLMPREEPMS01

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

Course Description

Within the broad field of project management, Scrum falls into the category of agile methods. As such, Scrum is more of a process management framework than a project management method. In this course the Scrum framework will be described and discussed in detail. The Agile Manifesto will be introduced, and the basic idea of iterative and incremental development will be discussed, leading up to the methodology of Scrum. A thorough review will be done on the different roles within the Scrum team. The terms product backlog, refinement and increment are defined and explained. As core feature of Scrum, the execution of sprints and daily scrums will be detailed. For the practical application of Scrum, the handling of requirements and creation of user stories will be introduced. The student also gets to know the little tools for communication and task-tracking used within development teams. Furthermore, the student will learn when and how a Scrum process should be implemented and what kind of benefits and risks can be expected from it.

Course Outcomes

On successful completion, students will be able to

- understand and explain the contents of the agile manifest.
- understand Scrum as a framework for developing, delivering, and sustaining products in a complex environment.
- describe each of the roles within a Scrum team and explain each item and each step within the Scrum process.
- handle the refinement process of the product backlog and discuss the interaction within the team and to the outside world during and after a sprint.
- understand the concept of user stories and apply the method to simple cases.
- understand and describe possibilities for the scaling of Scrum.

Contents

1. Scrum Origin, Basic Idea and Fields of Application
   - 1.1 The Birth of Scrum – How and Why it All Began
   - 1.2 The Agile Manifesto and a Change in Perspective
   - 1.3 The Approach of Iterative and Incremental Development
   - 1.4 Defining Fields for Scrum and Fields for Not Scrum

2. Scrum Roles

2.1 The Development Team
2.2 The Product Owner
2.3 The Scrum Master
2.4 The Customer Involvement
2.5 The Organization

3. Product Backlog and Sprint Planning
   3.1 Principles of a Product Backlog
   3.2 Refinement Process
   3.3 Definition of Ready
   3.4 Determining Capacity
   3.5 Selecting Items and Defining the Sprint Goal

4. Executing the Scrum Process
   4.1 The Scrum Process
   4.2 Sprint Cycle
   4.3 Daily Scrum
   4.4 Sprint Review
   4.5 Sprint Retrospective

5. Helpful Tools
   5.1 Requirements and User Stories
   5.2 Planning Poker
   5.3 Communication Tools (e. g. Task Board)
   5.4 Tracking Tools (e. g. Burn-down Chart)
   5.5 Available Software Tools

6. Implementation and Scaling of Scrum
   6.1 Implementation of Scrum in a Company
   6.2 Chances, Risks, and Limitations of Scrum
   6.3 Scrum of Scrums
   6.4 The Nexus Framework for Scaling Scrum
   6.5 Other Approaches

Literature
Compulsory Reading
Further Reading ▪ Highsmith, J. (2002). Agile software development ecosystems. Addison-Wesley Professional. ▪ Schwaber, K. (2004). Agile project management with Scrum. Microsoft 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: 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	

Project: Corporate Project with Scrum

Module Code: DLMPREEPMS2

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLMPREEPMS01	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. Nebojsa Radojevic (Project: Corporate Project with Scrum)

Contributing Courses to Module
▪ Project: Corporate Project with Scrum (DLMPREEPMS02)

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

Module Contents
After studying the methods of Scrum and learning about the systematic development approach, this course offers the opportunity to transfer the learned contents to practice. Choosing a real project or task within an organization, the method can be experienced and compared to the theoretical concept.

Learning Outcomes	
Project: Corporate Project with Scrum On successful completion, students will be able to ▪ understand Scrum and its roles within the context of a corporate organization. ▪ explain the elements and processes of Scrum in detail and out of practical experience. ▪ create user stories, refine the product backlog and select items for a sprint. ▪ collaborate in the daily scrum and apply the little tools within the development team. ▪ discuss critically the benefits and limitations of the Scrum framework.	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other moduls in the field of Project Management	All Master Programs in the Business & Management field

Project: Corporate Project with Scrum

Course Code: DLMPREEPMS02

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
MA	English		5	DLMPREEPMS01

Course Description

The course „Project: Corporate Project with Scrum" is building on the basic knowledge of the Scrum Framework acquired in the previous course. The theoretical foundations of Scrum can be applied within a real company environment. The student experiences the advantages of agile work and can reflect on the Scrum roles in practice. The student is also confronted with the hurdles that arise in applying the methodology in a real situation and can experiment with own approaches to solutions.

Course Outcomes

On successful completion, students will be able to

- understand Scrum and its roles within the context of a corporate organization.
- explain the elements and processes of Scrum in detail and out of practical experience.
- create user stories, refine the product backlog and select items for a sprint.
- collaborate in the daily scrum and apply the little tools within the development team.
- discuss critically the benefits and limitations of the Scrum framework.

Contents

- The course „Project: Corporate Project with Scrum" is building on the basic knowledge of the Scrum Framework acquired in the previous course and on the general knowledge of management know-how and classical project management acquired during the previous semesters. Based on a real task to be resolved within an organization (commercial enterprise, public administration, or the like), the students can gain practical experience working with agile methods utilizing the Scrum Framework.
- The students will reflect critically on the similarities and differences they observed and, if applicable, also compare the experienced agile methods with classical methods of project management. To meet scientific criteria, a literature search and a thorough comparison of the scientific and methodological foundation to the practical aspects experienced in the project is strongly encouraged and supported. The business aspect (costs, gain, time, quality, strategic relevance, etc.) of the project should be recognized and analyzed based on scientific methods. The students will demonstrate their ability to combine specialist knowledge and transfer of this knowledge to a specific project in a professional environment. They will also critically reflect on the experienced own work with Scrum, as well as on the theoretical concept of the Scrum Framework itself.

Literature
Compulsory Reading
Further Reading ▪ Anon. (2001): Manifesto for Agile Software Development. (URL: https://agilemanifesto.org [Retrieved: 20.03.20201]). ▪ Ockerman, S./ Reindl, S. (2019): Mastering Professional Scrum: Coaches' Notes for Busting Myths, Solving Challenges, and Growing Agility. Addison Wesley Longman, Boston. ▪ Rubin, K. S. (2013): Essential Scrum: A Practical Guide to the Most Popular Agile Process. Addison-Wesley Professional, Boston. ▪ Schwaber, K. / Sutherland, J. V. (2012): Software in 30 days: How Agile Managers Beat the Odds, Delight their Customers and Leave Competitors in the Dust. Wiley, New Jersey. ▪ Sutherland, J. (2015): Scrum: The art of Doing Twice the Work in Half the Time. Random House UK, London. ▪ Verheyen, G. (2019): Scrum: A Pocket Guide: a Smart Travel Companion. 2nd edition, Van Haren Publishing, VW 's-Hertogenbosch.

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	**Exam Preparation**
☑ Slides	☑ Guideline

Product Development

Module Code: DLMBPDDT1

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. Dorian Mora (Product Development)

Contributing Courses to Module

- Product Development (DLMBPDDT01)

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

- Production planning techniques
- Design tasks
- Product development approaches
- Digital product development and organizational aspects

Learning Outcomes	
Product Development On successful completion, students will be able to ▪ know the basic definitions and principles of (new) product development. ▪ understand the key skills in product development. ▪ discuss, differentiate, and select appropriate product development approaches with respect to a given scenario. ▪ work with digital product development tools and techniques like CAD, PDM and PLM at a basic level. ▪ develop own solutions and approaches to academic and practical questions. ▪ discuss, evaluate, and adapt different digital product development techniques and tools.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Design	**Links to other Study Programs of the University** All Master Programs in the Design, Architecture& Construction field

Product Development

Course Code: DLMBPDDT01

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

Course Description

This course aims to provide basic work and problem-solving methods for the successful development of products. It introduces the definition of key design tasks and various alternative product development approaches such as flow-based, lean product development, and design thinking. Finally, the students will become familiar with the use of computer-aided design (CAD) tools and how they integrate into modern product development approaches.

Course Outcomes

On successful completion, students will be able to

- know the basic definitions and principles of (new) product development.
- understand the key skills in product development.
- discuss, differentiate, and select appropriate product development approaches with respect to a given scenario.
- work with digital product development tools and techniques like CAD, PDM and PLM at a basic level.
- develop own solutions and approaches to academic and practical questions.
- discuss, evaluate, and adapt different digital product development techniques and tools.

Contents

1. Introduction
   - 1.1 Basic Definitions
   - 1.2 The Product Development Process
   - 1.3 Indicators and Metrics
   - 1.4 Product Development Models
   - 1.5 Current Trends in Product Development

2. The Product Development Process
   - 2.1 Planning
   - 2.2 Concept Development
   - 2.3 Design
   - 2.4 Testing and Refinement
   - 2.5 Production and Ramp-up

3. Product Development Approaches
    3.1 Lean Product Development
    3.2 Design Thinking
    3.3 Human-Centered Design
    3.4 User Experience Strategy
    3.5 Open Innovation

4. Digital Tools
    4.1 Computer-Aided Design
    4.2 Computer-Aided Quality
    4.3 Product Data Management
    4.4 Product Lifecycle Management

5. Organizational Perspective
    5.1 Incremental, Platform, and Breakthrough Development
    5.2 Building Teams
    5.3 Political Issues in Organizations
    5.4 Distributed New Product Development

Literature

Compulsory Reading

Further Reading

- Kahn, K. B., Kay, S. E., Slotegraaf, R. J., & Uban, S. (Eds.). (2012). The PDMA handbook of new productdevelopment (3rd ed.). Hoboken, NJ: John Wiley & Sons. (Database: ProQuest).
- Ottosson, S. (2018). Developing and managing innovation in a fast changing and complex world:Benefiting from dynamic principles. Cham: Springer. (Database: ProQuest).
- Ulrich, K. T., & Eppinger, S. D. (2016). Product design and development (6th ed.). New York, NY:McGraw Hill.

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	**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	

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	

Design Thinking

Module Code: DLMBPDDT2

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	Minimaldauer: 1 Semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Dorian Mora (Design Thinking)

Contributing Courses to Module

- Design Thinking (DLMBPDDT02)

Module Exam Type

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

Weight of Module

see curriculum

Module Contents

This course will put students in the mindset of Design Thinking. Students will be introduced to phases and distinct methods for inspiration, as well as the ideation and implementation of products. A current list of topics is located in the Learning Management System.

Learning Outcomes	
Design Thinking On successful completion, students will be able to ▪ comprehend, critically reflect on, and adopt the Design Thinking mindset. ▪ understand the inspiration, ideation, and implementation phases. ▪ evaluate and identify appropriate methods from the toolbox of human-centered design for given design tasks and challenges.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Design	**Links to other Study Programs of the University** All Master Programs in the Design, Architecture & Construction field

Design Thinking

Course Code: DLMBPDDT02

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

Course Description

In this course, students will receive a hands-on introduction to human-centered design via the Design Thinking method. Beyond conveying the individual basic principles, the procedures in Design Thinking are examined in detail. In order to fully understand Design Thinking in terms of important aspects in practice, selected methods for the individual process steps are presented in theory and application. Students will learn to improve their design process by reflecting on and adapting their activities.

Course Outcomes

On successful completion, students will be able to

- comprehend, critically reflect on, and adopt the Design Thinking mindset.
- understand the inspiration, ideation, and implementation phases.
- evaluate and identify appropriate methods from the toolbox of human-centered design for given design tasks and challenges.

Contents

- The course covers current topics and trends in Design Thinking, illustrating some methods and techniques as well as case studies. Each participant must create a project report on a chosen project, where he/she describes the application of the Design Thinking approach to a real product development scenario.

Literature
Compulsory Reading
Further Reading ▪ IDEO.org. (2015). The Field Guide to Human-Centered Design. A step-by-step guide that will get you solving prob-lems like a designer. Retrieved from http://www.designkit.org/resources/1 ▪ Pressman, Andy (2019): Design Thinking. A Guide to Creative Problem Solving for Everyone, New York : Routledge. ▪ Lockwood, T., & Papke, E. (n.d.). Innovation by design : how any organization can leverage design thinking to pro-duce change, drive new ideas, and deliver meaningful solutions. ▪ Lewrick, M., Link, P., Leifer, L. J., & Langensand, N. (2018). The design thinking playbook : mindful digital transfor-mation of teams, products, services, businesses and ecosystems. John Wiley & Sons.

Study Format myStudies

Study Format	Course Type
myStudies	Project

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

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	**Exam Preparation**
☑ Slides	☑ Guideline

Quality Management and Sustainability

Module Code: DLMEMQMS

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. Adrienne Steffen (Quality Management and Sustainability)

Contributing Courses to Module
▪ Quality Management and Sustainability (DLMEMQMS01)

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

Module Contents

- Introduction to quality management
- Processes and problem solving
- Quality techniques
- Standards, auditing, and certification
- Total Quality Management (TQM)
- Introduction to sustainability in engineering
- Sustainability in the business context
- Incorporating sustainability in project management

Learning Outcomes

Quality Management and Sustainability

On successful completion, students will be able to

- analyze the purpose and objectives of operational quality management (QM).
- demonstrate the core task of management and recognize the effectiveness and efficiency of QM systems in the execution of business processes.
- choose and apply the basic concepts of quality and process management.
- model the structure of the QM system and its components.
- appraise the structure of standardization series of standards including the process of requirements for auditing and certification of QM systems.
- relate sustainability to other success factors in engineering and justify its practice.
- distinguish the peculiarities of sustainability in engineering management by interpreting relevant positives and challenges.
- assess the triple bottom line and/or other frameworks for sustainability to design innovative business models.
- combine sustainability norms and practices into engineering project management generating added value for all stakeholders.

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 Quality and Sustainability Management	All Master Programs in the Transport & Logistics field

Quality Management and Sustainability

Course Code: DLMEMQMS01

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

Course Description

The lecture starts with basic concepts of quality, quality management (QM), quality management system, and customer satisfaction. Afterwards the course deals with the most important operational processes and the quality characteristics of products and services. Quality techniques are the subject of the third section. Requirements for a QM system according to standardization procedures are explained and the procedure for certification and auditing is explained. Other QM models, e.g., the EFQ or TQM, are discussed.The second part of the lecture is dedicated to sustainability for primarily engineering companies followed by noteworthy examples from the domain. A further focus exists on the triple bottom line approach, its obligations, and opportunities. Finally, a detailed analysis of how to incorporate sustainability in engineering project management considering its impact and challenges while factoring in project management practices and standards.

Course Outcomes

On successful completion, students will be able to

- analyze the purpose and objectives of operational quality management (QM).
- demonstrate the core task of management and recognize the effectiveness and efficiency of QM systems in the execution of business processes.
- choose and apply the basic concepts of quality and process management.
- model the structure of the QM system and its components.
- appraise the structure of standardization series of standards including the process of requirements for auditing and certification of QM systems.
- relate sustainability to other success factors in engineering and justify its practice.
- distinguish the peculiarities of sustainability in engineering management by interpreting relevant positives and challenges.
- assess the triple bottom line and/or other frameworks for sustainability to design innovative business models.
- combine sustainability norms and practices into engineering project management generating added value for all stakeholders.

Contents

1. Introduction to quality management
   - 1.1 Classification and meaning
   - 1.2 Managing quality

Literature
Compulsory Reading
Further Reading ▪ Brzozowska, A., Pabian, A., & Pabian, B. (2021). Sustainability in project management: A functionalapproach. CRC Press. ▪ Foster, S. T. (2017). Managing quality: Integrating the supply chain (Global ed.). Pearson EducationLimited. ▪ Luthra, S., Garg, D., Aggarwal, A., & Mangla, S. K. (2021). Total quality management (TQM): Principles,methods, and applications. CRC 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	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	

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

Cyber Security and Data Protection

Module Code: DLMCSITSDP

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. Ralf Kneuper (Cyber Security and Data Protection)

Contributing Courses to Module

- Cyber Security and Data Protection (DLMCSITSDP01)

Module Exam Type

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

Weight of Module

see curriculum

Module Contents

- Data protection and privacy
- Cyber security building blocks
- Cyber security management
- Cryptography concepts
- Cryptography applications

Learning Outcomes	
Cyber Security and Data Protection On successful completion, students will be able to ▪ explain the core concepts of cyber security, data protection, and cryptography including their differences and relationships. ▪ compare the approaches to data protection within in different legal systems. ▪ apply data protection concepts to data science and other application scenarios. ▪ analyze application scenarios to identify the adequate cyber security management measures that should be implemented. ▪ explain the different approaches to data protection in different cultures.	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Computer Science & Software Development	All Master Programmes in the IT & Technology field

Cyber Security and Data Protection

Course Code: DLMCSITSDP01

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

Course Description

With the increasing digitization and networking of IT systems, the need for safeguarding systems and the data processed by these systems has grown. The aim of this module is to provide an understanding of security measures needed, cyber security including cryptography, and data protection. While the need for cyber security is similar around the world, different cultures have different expectations regarding data protection and privacy. Nevertheless, personal data are often processed outside the country where the affected individuals live. Hence, the cultural aspects of data protection need to be taken into account wherever the data are processed. This course provides an overview of the main cyber security measures in different application scenarios, as well as their integration into an Information Security Management System, with particular focus on the relevant ISO/IEC 270xx family of standards. Cryptography provides an important tool set for cyber security and is used in many different application scenarios such as secure Internet protocols and block chain.

Course Outcomes

On successful completion, students will be able to

- explain the core concepts of cyber security, data protection, and cryptography including their differences and relationships.
- compare the approaches to data protection within in different legal systems.
- apply data protection concepts to data science and other application scenarios.
- analyze application scenarios to identify the adequate cyber security management measures that should be implemented.
- explain the different approaches to data protection in different cultures.

Contents

1. Foundations of Data Protection and Cyber Security
   - 1.1 Terminology and Risk Management
   - 1.2 Core Concepts of Cyber Security
   - 1.3 Core Concepts of Data Protection and Privacy
   - 1.4 Core Concepts of Cryptography
   - 1.5 Legal Aspects

2. Data Protection

2.1 Basic Concepts of Data Protection (ISO/IEC 29100, Privacy by Design)
2.2 Data Protection in Europe: the GDPR
2.3 Data Protection in the USA
2.4 Data Protection in Asia

3. Applying Data Protection
3.1 Anonymity and Pseudonyms (k-Anonymity, i-Diversity, Differential Privacy)
3.2 Data Protection in Data Science and Big Data
3.3 User Tracking in Online Marketing
3.4 Cloud Computing

4. Building Blocks of Cyber Security
4.1 Authentication, Access Management and Control
4.2 Cyber Security in Networks
4.3 Developing Secure IT Systems (OWASP, etc.)

5. Cyber Security Management
5.1 Security Policy
5.2 Security and Risk Analysis
5.3 The ISO 270xx Series
5.4 IT Security and IT Governance
5.5 Example: Cyber Security for Credit Cards (PCI DSS)

6. Cryptography
6.1 Symmetric Cryptography
6.2 Asymmetric Cryptography
6.3 Hash Functions
6.4 Secure Data Exchange (Diffie-Hellman, Perfect Forward Secrecy, etc.)

7. Cryptographic Applications
7.1 Digital Signatures
7.2 Electronic Money
7.3 Secure Internet Protocols (TLS, IPSec, etc.)
7.4 Block Chain

Literature
Compulsory Reading
Further Reading ▪ Amoroso, E., & Amoroso, M. (2017). From CIA to APT: An introduction to cyber security. Independently published. ▪ National Institute of Standards and Technology. (2018). Framework for improving critical infrastructure cybersecurity. ▪ Paar, C., & Pelzl, J. (2011). Understanding cryptography: A textbook for students and practitioners. Springer. ▪ Walker, B. (2019). Cyber security comprehensive beginners guide to learn the basics and effective methods of cyber security. Independently published.

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	**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

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

Cyber Risk Assessment and Management

Module Code: DLMCSECRAM_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

Prof. Dr. Carsten Skerra (Cyber Risk Assessment and Management)

Contributing Courses to Module

- Cyber Risk Assessment and Management (DLMCSECRAM01_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

- Organizational IT Risk Management
- Measuring the Cyber Threat
- Threat Modeling
- Standardization and Compliance
- Risk Assessment
- The Cyber-Resilient Organization

Learning Outcomes	
Cyber Risk Assessment and Management On successful completion, students will be able to ▪ understand the process of attack modeling. ▪ associate a cost with attack outcomes. ▪ understand black swan events. ▪ evaluate the impact that legislation has on risks and costs. ▪ understand how an organization needs to make decisions based on risk.	
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

Cyber Risk Assessment and Management

Course Code: DLMCSECRAM01_E

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

Course Description

Decisions on making changes or not should be informed by the risk of that action or inaction. This is dictated by the cost a potentially successful attack would have. But how to model attacks and associate costs with them? We will explore the discipline of attack modeling and risk evaluation in this course.

Course Outcomes

On successful completion, students will be able to

- understand the process of attack modeling.
- associate a cost with attack outcomes.
- understand black swan events.
- evaluate the impact that legislation has on risks and costs.
- understand how an organization needs to make decisions based on risk.

Contents

1. Organizational IT Risk Management
   - 1.1 Business Need of Risk Management
   - 1.2 Anatomy of a Data Exfiltration Attack
   - 1.3 Cyber Catastrophes
   - 1.4 Cyber Risk

2. Measuring the Cyber Threat
   - 2.1 Measurement and Management
   - 2.2 Cyber Threat Metrics
   - 2.3 Measuring the Threat for an Organization
   - 2.4 The Likelihood of Major Cyber Attacks
   - 2.5 Black Swan Events

3. Threat Modeling
   - 3.1 Attack Tree Methodology
   - 3.2 STRIDE
   - 3.3 DREAD

Literature

Compulsory Reading

Further Reading

- Antonucci, D. (2017). The cyber risk handbook: Creating and measuring effective cybersecurity capabilities. Wiley.
- Refsdal, A., Solhaug, B., & Stolen, K. (2015). Cyber-risk management. 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	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 ☑ Video ☑ Audio ☑ Slides	☑ 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	**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	

Mobile Software Engineering I

Module Code: DLMIWMB1_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	Minimaldauer: 1 Semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Marian Benner-Wickner (Mobile Software Engineering I)

Contributing Courses to Module

- Mobile Software Engineering I (DLMIWMB01_E)

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

Module Contents

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

Learning Outcomes	
Mobile Software Engineering I On successful completion, students will be able to ▪ identify the differences and peculiarities of software development for mobile systems and explain them. ▪ differentiate various activities, roles and risks in the development, operation and maintenance of mobile software systems. ▪ explain and distinguish the architecture and technical features of the Android platform. ▪ independently create mobile software systems to solve specific problems for the Android platform.	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the fields of Computer Science & Software Development.	All Master Programs in the IT & Technology field.

Mobile Software Engineering I

Course Code: DLMIWMB01_E

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

Course Description

Using the mobile platform "Android" as an example, the course teaches how the programming of mobile applications (Apps) differs from the development of browser-based information systems, which technologies and programming concepts are typically used, and what typical challenges there are in app development for business applications.

Course Outcomes

On successful completion, students will be able to

- identify the differences and peculiarities of software development for mobile systems and explain them.
- differentiate various activities, roles and risks in the development, operation and maintenance of mobile software systems.
- explain and distinguish the architecture and technical features of the Android platform.
- independently create mobile software systems to solve specific problems for the Android platform.

Contents

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

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

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

6. Advanced Techniques
   - 6.1 Threading
   - 6.2 Application Memory

Literature

Compulsory Reading

Further Reading

- Allen, G. (2021). Android for Absolute Beginners: Getting Started with Mobile Apps Development Using the Android Java SDK. Apress.
- Google Inc. (2022a). Android Developer Guides [available on internet].
- Hagos, T. (2020). Learn Android Studio 4 : Efficient Java-Based Android Apps Development. 2nd ed. Apress.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Case Study

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

Mobile Software Engineering II

Module Code: DLMIWMB2_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	Minimaldauer: 1 Semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Marian Benner-Wickner (Mobile Software Engineering II)

Contributing Courses to Module

- Mobile Software Engineering II (DLMIWMB02_E)

Module Exam Type

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

Weight of Module

see curriculum

Module Contents

Design, implementation and documentation of small, mobile applications based on a specific task.

Learning Outcomes	
Mobile Software Engineering II On successful completion, students will be able to ▪ independently design and prototype a small mobile application to solve a targeted task. ▪ recognize typical problems and challenges in the practical implementation od small mobile applications. ▪ document the design and implementation of self-developed small, mobile applications.	
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 field.

Mobile Software Engineering II

Course Code: DLMIWMB02_E

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

Course Description

In this course, students independently create a mobile application and document its design and implementation.

Course Outcomes

On successful completion, students will be able to

- independently design and prototype a small mobile application to solve a targeted task.
- recognize typical problems and challenges in the practical implementation od small mobile applications.
- document the design and implementation of self-developed small, mobile applications.

Contents

- Design, implementation and documentation of small, mobile applications based on a specific task. Possible topics are for example:
  - A radio app to improve the exchange between listeners and the station in general, but especially between listeners and radio hosts.
  - An app that allows a group of board game fans to better organize their regular evening game date.
  - An app that thesis supervisors can use to improve their supervision processes.

Literature

Compulsory Reading

Further Reading

- Allen, G. (2021). Android for absolute beginners getting started with mobile apps development using the Android Java SDK. Apress.
- Google Inc. (ed.) (2022a). Android Developer Guide [available on internet].
- Google Inc. (ed.) (2022b). Android Studio [available on internet].
- Hagos, T. (2020). Learn Android Studio 4 : Efficient Java-Based Android Apps Development: 2nd ed. Apress.

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	**Exam Preparation**
☑ Slides	☑ Guideline

Leveraging Data Sources & Data Mining

Module Code: DLMDMEDM1

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	Minimaldauer: 1 Semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Frank Passing (Leveraging Data Sources & Data Mining)

Contributing Courses to Module

- Leveraging Data Sources & Data Mining (DLMDMEDM01)

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

Module Contents

- 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

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.	
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

3. Data Retrieval Strategies
   - 3.1 Query Driven
   - 3.2 Mining Data Streams
   - 3.3 Large-Scale Data Mining
   - 3.4 Process Mining
   - 3.5 Information Extraction

4. Types of Data Sources
   - 4.1 APIs, Flat files and Unusual formats
   - 4.2 Relational Databases
   - 4.3 Non-relational Databases
   - 4.4 Streaming Data
   - 4.5 Open Data Sources

5. Data Mining Techniques
   - 5.1 Statistical Methods
   - 5.2 Machine Learning
   - 5.3 Data Warehousing
   - 5.4 Event Processing
   - 5.5 Real-time Processing

6. Web Mining
   - 6.1 Information Retrieval
   - 6.2 Web Content Mining
   - 6.3 Web Structure and Usage Mining
   - 6.4 Web Search and Spamdexing
   - 6.5 Access and Mine the Data Lake

7. Data Economy
   - 7.1 Data Producers and Aggregators
   - 7.2 Data Monetization
   - 7.3 Internet of Things
   - 7.4 Data Mining in Industry 4.0
   - 7.5 Big Data

8. Legal Regulations and Usage Policies
   - 8.1 General Data Protection Regulation
   - 8.2 Personal Information

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	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
☑ Creative Lab	☑ Reader	☑ Online Tests
	☑ Video	
	☑ Audio	
	☑ Slides	

Project: Leveraging Data Sources & Data Mining

Module Code: DLMDMEDM2

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLMDMEDM01	MA	5	

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

Module Coordinator

Prof. Dr. Frank Passing (Project: Leveraging Data Sources & Data Mining)

Contributing Courses to Module

- Project: Leveraging Data Sources & Data Mining (DLMDMEDM02)

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

Module Contents

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	
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.

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	**Exam Preparation**
☑ Slides	☑ Guideline

User Interface and Experience

Module Code: DLMAIEUIUX1

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. Adelka Niels (User Interface and Experience)

Contributing Courses to Module

- User Interface and Experience (DLMAIEUIUX01)

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

Module Contents

- ROI of UX design
- Role and mindset of UX design in IT projects
- The UX design process
- UX psychology: How the human mind works
- User research
- UX design basics

Learning Outcomes	
User Interface and Experience On successful completion, students will be able to ▪ Understand what design is about and the crucial aspects of good design ▪ understand and define the role of the UI/UX designer within a project. ▪ explain the UX design process and the user-centered mindset. ▪ advocate the importance of UX design for IT projects. ▪ describe the basic methods of user research, user testing, and user-centered design.	
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 fields

User Interface and Experience

Course Code: DLMAIEUIUX01

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

Course Description

UX design is crucial to the development of new IT services and applications and enhances the quality of the outcome. Applying UX design techniques can significantly and positively change the software development process, and good UX design is the result of effective teamwork. Within this course the students will understand the mindset, basic techniques, and impact of UX design on IT projects. They will learn how the UX design process works and the role of the UX designer within IT projects. They will also gain skills in the type of collaboration that produces the best results. Using their basic knowledge about good design, the students will know when it is appropriate that they make small changes to UIs themselves and when it is time to consult a designer.

Course Outcomes

On successful completion, students will be able to

- Understand what design is about and the crucial aspects of good design
- understand and define the role of the UI/UX designer within a project.
- explain the UX design process and the user-centered mindset.
- advocate the importance of UX design for IT projects.
- describe the basic methods of user research, user testing, and user-centered design.

Contents

1. ROI of UX design
   - 1.1 Efficacy
   - 1.2 Efficiency
   - 1.3 The impact of design on use errors
2. Role and Mindset of UX design in IT projects
   - 2.1 The role of UX design: the UX designer
   - 2.2 The UX mindset: putting the user first
3. The UX design Process
   - 3.1 In a waterfall process environment
   - 3.2 In an agile process environment
4. UX Psychology: How the Human Mind Works

4.1 Perceptual psychology
4.2 Information processing
4.3 Decision-making
4.4 Situation awareness
4.5 Errors

5. User Research
5.1 The benefit of user research
5.2 Basic research techniques
5.3 User testing

6. UX design Basics
6.1 Interaction design
6.2 Information architecture
6.3 Screen design
6.4 Graphic design
6.5 Rules of good design

Literature

Compulsory Reading

Further Reading

- Cooper, A., Reimann, R., Cronin, D., & Noessel, C. (2014). About face: The essentials of interaction design (5th ed.). Wiley.
- Johnson, J. (2010). Designing with the mind in mind. Elsevier.
- Preece, J., Sharp, H., & Rogers, Y. (2015). Interaction design: Beyond human-computer interaction (5th ed.). Wiley.
- Unger, R., & Chandler, C. (2012). A project guide to UX design: For user experience designers in the field or in the making. New Riders Pub.

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
- ☑ Course Book
- ☑ Video
- ☑ Audio
- ☑ Slides

Exam Preparation
- ☑ Practice Exam
- ☑ Online Tests

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**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods

Artificial Intelligence

Module Code: DLMAIAI

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. Claudia Heß (Artificial Intelligence)

Contributing Courses to Module

- Artificial Intelligence (DLMAIAI01)

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

- History of AI
- AI application areas
- Expert systems
- Neuroscience
- Modern AI systems

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

3.2 Cognitive Processes

4. Modern AI Systems
   4.1 Recent Developments in Hard- and Software
   4.2 Narrow vs General AI
   4.3 NLP and Computer Vision

5. AI Application Areas
   5.1 Autonomous Vehicles & Mobility
   5.2 Personalized Medicine
   5.3 FinTech
   5.4 Retail & Industry

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	**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 ☑ Video ☑ Audio ☑ Slides	☑ 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	**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 ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Project: AI Excellence with Creative Prompting Techniques

Module Code: DLMPAIECPT1

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	Minimaldauer: 1 Semester	WiSe/SoSe	English

Module Coordinator

N.N. (Project: AI Excellence with Creative Prompting Techniques)

Contributing Courses to Module

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

Module Exam Type

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

Weight of Module

see curriculum

Module Contents

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
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

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

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

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

Project: Human Computer Interaction

Module Code: DLMAIEUIUX2

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLMAIEUIUX01	MA	5	150 h

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

Module Coordinator

Prof. Dr. Adelka Niels (Project: Human Computer Interaction)

Contributing Courses to Module

- Project: Human Computer Interaction (DLMAIEUIUX02)

Module Exam Type

Module Exam	Split Exam
Study Format: myStudies *Type of examination* Study Format: Distance Learning Portfolio	

Weight of Module

see curriculum

Module Contents

In this course the students will gain practical experience in user experience design. They will conduct user testing for a given user interface and work on developing improvements. The work process and the results will become part of a portfolio.

Learning Outcomes	
Project: Human Computer Interaction On successful completion, students will be able to ▪ evaluate the usability of a user interface. ▪ conduct user testing. ▪ understand the practical implications of putting users first. ▪ make small changes in existing user interfaces and recognize the situations in which a user experience designer should be consulted.	
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: Human Computer Interaction

Course Code: DLMAIEUIUX02

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
MA	English		5	DLMAIEUIUX01

Course Description

In this course the students will gain practical experience in user experience design. They will set up and conduct a user testing for a given user interface and develop improvements. The work process and the results will become part of a portfolio.

Course Outcomes

On successful completion, students will be able to

- evaluate the usability of a user interface.
- conduct user testing.
- understand the practical implications of putting users first.
- make small changes in existing user interfaces and recognize the situations in which a user experience designer should be consulted.

Contents

- User experience design focusses on the needs of users. Within this portfolio project the students put into practice basic techniques which lead to good user-centered design. They learn how to test the user experience and usability of an application by conducting user tests, and they also learn how to develop and test ideas for improvement. Students will finish this course having gained practical experience working within the mindset of putting users first.

Literature
Compulsory Reading
Further Reading ▪ Barnum, C. (2010): Usability Testing Essentials: Ready, Set...Test!, Morgan Kaufmann, Burlington, USA ▪ Cooper, A., Reimann, R., Cronin, D., & Noessel, C. (2014). About face: The essentials of interaction design. New York, NY: Wiley. ▪ Johnson, J. (2010). Designing with the mind in mind. Burlington, MA: Elsevier. ▪ Preece, J., Sharp, H., & Rogers, Y. (2015). Interaction design: Beyond human-computer interaction. New York, NY: Wiley. ▪ Microsoft Windows Dev Center. (2018). Guidelines. [Web page]. Retrieved from https://docs.microsoft.com/en-us/windows/desktop/uxguide/guidelines ▪ Unger, R., & Chandler, C. (2012). A project guide to UX design. Berkeley, CA: New Riders.

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

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

Management of IT Services and Architecture

Module Code: MWIT2-01_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

Prof. Dr. Andrew Adjah Sai (Management of IT Services and Architecture)

Contributing Courses to Module

- Management of IT Services and Architecture (MWIT02-01_E)

Module Exam Type

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

Weight of Module

see curriculum

Module Contents

- Basics of IT Service Management and Terminology
- IT Infrastructure Library (ITIL)
- IT Outsourcing
- IT Architecture Management
- IT Application Portfolio Management
- Structural Organization of IT and Architecture Governance

Learning Outcomes	
Management of IT Services and Architecture On successful completion, students will be able to ▪ name, explain and distinguish the basic principles of IT strategy, IT governance and IT architecture management. ▪ explain and differentiate between the typical activities of IT architecture management, their interrelationships and their dependencies. ▪ explain the fundamentals and challenges of IT service management. ▪ describe the motivation and structure of the IT Infrastructure Library (ITIL), explain the main elements and locate specific activities in the service lifecycle.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Computer Science & Software Development	**Links to other Study Programs of the University** All Master Programs in the IT & Technology field

Management of IT Services and Architecture

Course Code: MWIT02-01_E

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

Course Description

IT service management is an approach to align and understand a company's IT as a service provider and supporter of operational and business processes. Here, the focus is on quality management and handling of daily operations. In addition to specific IT projects, e.g., the development of an IT system or the introduction of standard software, strategic management must be used for the organization-wide IT infrastructure. The task of IT architecture management is the strategic alignment of the IT infrastructure with the organization's business and IT strategy. This course provides concepts, methods, procedures and models for the tasks within the scope of IT architecture management.

Course Outcomes

On successful completion, students will be able to

- name, explain and distinguish the basic principles of IT strategy, IT governance and IT architecture management.
- explain and differentiate between the typical activities of IT architecture management, their interrelationships and their dependencies.
- explain the fundamentals and challenges of IT service management.
- describe the motivation and structure of the IT Infrastructure Library (ITIL), explain the main elements and locate specific activities in the service lifecycle.

Contents

1. IT Service Management Basics and Terms
   - 1.1 IT Services
   - 1.2 IT Service Management
   - 1.3 ITSM Frameworks
2. ITIL 4 - Basics and Four Dimensions
   - 2.1 Stakeholders, Services and Service Management
   - 2.2 Value Contribution of IT
   - 2.3 Four Dimensions Model
3. ITIL 4 - Service Value System
   - 3.1 Basics and Overview

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

Study Format 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	

DevOps

Module Code: DLMDCCDO

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

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

Module Coordinator

Prof. Dr. Tianxiang Lu (DevOps)

Contributing Courses to Module

- DevOps (DLMDCCDO01)

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

Module Contents

- Building and Testing
- Releases and Deployment
- Security and Maintenance
- Monitoring and Logging

Learning Outcomes	
DevOps On successful completion, students will be able to ▪ define DevOps and related disciplines. ▪ plan the building and testing process for software. ▪ perform software releases and deployments. ▪ implement the security of applications. ▪ understand the need for monitoring and logging.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Computer Science & Software Development	**Links to other Study Programs of the University** All Master Programs in the IT & Technology field(s)

DevOps

Course Code: DLMDCCDO01

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

Course Description

Software development and software maintenance used to be two different disciplines. Due to the growing complexity, interfaces, and interactions between the components, these have been combined in DevOps. DevOps engineers have a profound knowledge of software development and know how to operate the software. This course reflects the full spectrum of software DevOps starting from requirements, detailing build processes and collaboration, taking a deeper look into testing and deployment, focusing on software security until eventually finishing with monitoring and logging to ensure solid operations

Course Outcomes

On successful completion, students will be able to

- define DevOps and related disciplines.
- plan the building and testing process for software.
- perform software releases and deployments.
- implement the security of applications.
- understand the need for monitoring and logging.

Contents

1. Introduction to DevOps
   - 1.1 Term Definition
   - 1.2 Historical Development
   - 1.3 Software Getting More Complex
   - 1.4 Challenges in Deployment and Operations
   - 1.5 Security

2. Building Software
   - 2.1 Requirements
   - 2.2 Co-Development in Teams
   - 2.3 Configuration management with Git
   - 2.4 Solving Conflicts
   - 2.5 Continuous Builds

3. Testing Software
   - 3.1 Module Tests
   - 3.2 Integration Tests
   - 3.3 Measuring Coverage
   - 3.4 Test Automation
   - 3.5 Integrating Tests in Continuous Build
   - 3.6 User Acceptance Testing

4. Software Releases and Deployments
   - 4.1 Working With the Trunk
   - 4.2 Working With Branches
   - 4.3 Planning a Release
   - 4.4 Manual Deployment
   - 4.5 Automatic Deployment

5. Software Security
   - 5.1 Importance of Security
   - 5.2 Types of Security
   - 5.3 Security Testing
   - 5.4 Detecting Security Incidents
   - 5.5 Reacting to Security incidents

6. Monitoring and Logging
   - 6.1 Definition Monitoring
   - 6.2 Definition Logging
   - 6.3 Aggregating information
   - 6.4 Extracting KPIs
   - 6.5 Management Systems (Like Nagios)

Literature
Compulsory Reading
Further Reading ▪ Farcic, V. (2016). The DevOps 2.0 Toolkit. Packt Publishing. ▪ Forsgren, N., Kim, G., & Humble, J. (2018). Accelerate: the Science behind DevOps: building and scaling high performing technology organizations (First edition). IT Revolution Press. ▪ Gift, N., Behrman, K., Deza, A., & Gheorghiu, G. (2019). Python for DevOps: learn ruthlessly effective automation (First edition). O'Reilly. ▪ Kim, G., Willis, J., Debois, P., Allspaw, J., & Humble, J. (2016). The DevOps handbook: how to create world-class agility, reliability, and security in technology organizations (First edition). IT Revolution Press.

Study Format Distance Learning

Study Format Distance Learning	**Course Type** 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 ☑ Slides	**Exam Preparation** ☑ Online Tests ☑ Guideline

Conversation Management and Communication Techniques

Module Code: DLMWPGUK_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

Prof. Dr. Caroline Trautwein (Conversation Management and Communication Techniques)

Contributing Courses to Module

- Conversation Management and Communication Techniques (DLMWPGUK01_E)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Oral Assignment	

Weight of Module

see curriculum

Module Contents

- Forms of Communication
- Means of Communication Techniques of Communication
- Communication with Specific Groups Conversation Management
- Means in Conversation
- Dealing with Difficult Conversation Situations

Learning Outcomes	
Conversation Management and Communication Techniques On successful completion, students will be able to ▪ place the importance of the areas of communication techniques and interviewing in the overall context of business psychology, ▪ identify goals and forms of communication and interviewing in the context of business psychology, ▪ use and apply means, methods and instruments of communication and conversation in the context of business psychology, ▪ identify and understand purposeful communication and conversation management techniques against the backdrop of difficult and deadlocked situations, ▪ explain and develop appropriate measures of communication and conversation, ▪ discuss and uncover problems of communication and conversation and suggest alternative 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 field of Social Work	All Master Programs in the Social Sciences field

Conversation Management and Communication Techniques

Course Code: DLMWPGUK01_E

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

Course Description

Good communication skills are the key to professional success. To achieve professional goals, you have to be convincing in conversations. Only those who really understand their conversation partners and are also understood by them, will achieve a good result more quickly. To achieve this, it is essential to be prepared, especially for difficult conversations, and to have a toolbox of different conversation techniques at your disposal, so that can be used in a targeted manner to make constructive communication possible. In addition to certain means of communication, this also requires special techniques and methods. Knowledge and understanding of the psychological and human aspects of the use of communication techniques and the conduct of discussions are an important basis for the success of discussions in the context of business psychology.
The course also addresses difficult and critical discussion situations as well as communication with specific target groups. Students learn about different communication styles, communication techniques as well as the phases of conducting discussions in order to specifically prepare for and conduct discussions with other team members as well as external partners. You will learn how to better adapt to your conversation partners and act accordingly in order to achieve good results for both sides.

Course Outcomes

On successful completion, students will be able to

- place the importance of the areas of communication techniques and interviewing in the overall context of business psychology,
- identify goals and forms of communication and interviewing in the context of business psychology,
- use and apply means, methods and instruments of communication and conversation in the context of business psychology,
- identify and understand purposeful communication and conversation management techniques against the backdrop of difficult and deadlocked situations,
- explain and develop appropriate measures of communication and conversation,
- discuss and uncover problems of communication and conversation and suggest alternative approaches.

Contents

- 6.4 Employing Influence
- 6.5 Planning and Structuring Conversations
- 6.6 Problem-solving in groups

7. Difficult Conversations
   - 7.1 Conveying Difficult Content
   - 7.2 Difficult Interaction Partners
   - 7.3 Conflicts
   - 7.4 Feedback Rules

8. Public Communication
   - 8.1 Types
   - 8.2 Rhetorics
   - 8.3 Preparing
   - 8.4 Delivering
   - 8.5 The influence of social media

Literature

Compulsory Reading

Further Reading

- Adler, R. B., Rodman, G. R., & du Pré, A. (2017). Understanding human communication (13thed.). Oxford University Press.
- Communication in the real world: An introduction to communication studies. (2016). University of Minnesota Libraries Publishing.
- Hargie, O. (2017). Skilled interpersonal communication: Research, theory and practice (6thed.). 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	Oral Assignment

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

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

Project: Software Process Management

Module Code: DLMSEPSPM

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLMCSSESP01	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. Damir Ismailovic (Project: Software Process Management)

Contributing Courses to Module

- Project: Software Process Management (DLMSEPSPM01)

Module Exam Type

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

Weight of Module

see curriculum

Module Contents

In this module, students learn to understand context parameters for software processes, and how to design and tailor software process elements accordingly. They will acquire profound knowledge about how to make and justify design decisions based on these parameters, create clear and effective documentation, and apply dynamic software process management through all stages, adapting as project requirements and parameters change.

Learning Outcomes	
Project: Software Process Management On successful completion, students will be able to ▪ understand and delimit context parameters for software processes. ▪ know elements and degrees of freedom for the design of a SW process. ▪ analyze dependencies between context parameters and SE process elements (which process model/role/activity/artifact etc. for which context?). ▪ justify which design decision was made with reference to the context parameters. ▪ document software process in a comprehensible way. ▪ apply software process management from process design via process introduction to process adaptation, process assessment and process improvement and process evaluation.	
Links to other Modules within the Study Program This module is similar to other modules in the fields of Computer Science & Software Development.	**Links to other Study Programs of the University** All Master Programs in the IT & Technology fields.

Project: Software Process Management

Course Code: DLMSEPSPM01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
MA	English		5	DLMCSSESP01

Course Description

In this project, students should be provided the opportunity to design their own software process for a (fictitious or real) specific company context of their own choosing. For this purpose, a few scenarios with specific context parameters will be given, to which the students can then tailor an appropriate software engineering process. Possible characteristics are, amongst others: agile vs. waterfall, customizing of standard software vs. individual programming, make-or-buy, internal vs. external development, internal vs. external operation, embedded software vs. frontend application, cloud native vs. everything on premise, critical infrastructure vs. consumer apps, software house vs. IT department.

Course Outcomes

On successful completion, students will be able to

- understand and delimit context parameters for software processes.
- know elements and degrees of freedom for the design of a SW process.
- analyze dependencies between context parameters and SE process elements (which process model/role/activity/artifact etc. for which context?).
- justify which design decision was made with reference to the context parameters.
- document software process in a comprehensible way.
- apply software process management from process design via process introduction to process adaptation, process assessment and process improvement and process evaluation.

Contents

- During this course, students delve into the comprehension and delimitation of context parameters for designing software processes. This provides them with the necessary context to understand how different organizational settings, project scopes, and technical requirements can impact the process. They explore the elements that make up a software process and the degrees of freedom for process design. Students learn how to navigate between different approaches, roles, activities, and artifacts to consider during process design and how to tailor these elements based on the contextual needs. Design decisions within the software process are discussed, focusing on how these decisions are influenced and justified by the context parameters. This enables students to make informed decisions and justify these in the light of the constraints and conditions imposed by the parameters. The course instructs students on how to comprehensibly document the software process. It also covers how to apply software process management from introduction through adaptation, assessment, improvement, and evaluation. This holistic approach encourages students to conceptualize the software process not as a static framework but as a dynamic construct that evolves based on the progress of the project and changing parameters.

Literature

Compulsory Reading

Further Reading

- Gruhn, V., & Striemer, R. (Eds.). (2018). The essence of software engineering. Cham: Springer Open.
- Jacobson, I., Lawson, H., Ng, P., McMahon, P., & Goedicke, M. (2019). The Essentials of Modern Software Engineering : Free the Practices From the Method Prisons! ACM Books.
- Kneuper, R. (2018). Software processes and lifecycle models. Cham: Springer Nature Switzerland.
- Sommerville, I. (2019). Engineering Software products. Pearson.
- Sommerville, I. (2015). Software Engineering. (10th Edition). Addison- Wesley.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Project

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

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

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

Internship: Master Software Engineering

Module Code: DLMSEISE

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	MA	20	600 h

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

Module Coordinator
N.N. (Internship: Master Software Engineering)

Contributing Courses to Module
▪ Internship: Master Software Engineering (DLMSEISE01)

Module Exam Type	
Module Exam <u>Study Format: Distance Learning</u> Internship Reflection Paper (passed / not passed)	**Split Exam**
Weight of Module see curriculum	

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

Learning Outcomes	
Internship: Master Software Engineering On successful completion, students will be able to ▪ to transfer theoretical knowledge to practical problems. ▪ depending on the tasks undertaken, to independently address and manage practical challenges; to reflect on their success. ▪ to better assess the scope, significance, and limitations of theoretical concepts in light of practical demands.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Methods.	**Links to other Study Programs of the University** All Master Programs in the Business field.

Internship: Master Software Engineering

Course Code: DLMSEISE01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
MA	English		20	none

Course Description

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

Course Outcomes

On successful completion, students will be able to

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

Contents

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

Literature

Compulsory Reading

Further Reading

- Within the subject relation, the literature of each module in the program is relevant.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Practical work

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

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
0 h	0 h	0 h	0 h	600 h	600 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 This module is similar to other modules in the field(s) of Methods.	**Links to other Study Programs of the University** 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	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
810 h	0 h	0 h	0 h	0 h	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	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
810 h	0 h	0 h	0 h	0 h	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	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	0 h	0 h	0 h	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	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	0 h	0 h	0 h	90 h

Instructional Methods
Learning Material ☑ Slides