# MODULE HANDBOOK

## Master of Science

## Artificial Intelligence (FI-MAAI-120)

**120 ECTS**

**Distance Learning**

INTERNATIONAL
UNIVERSITY OF
APPLIED SCIENCES

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2020-06-01

# 1. Semester

# 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 |
|---|---|---|---|
| see curriculum | Minimum 1 semester | WiSe/SoSe | English |

**Module Coordinator**

Prof. Dr. Ulrich Kerzel (Artificial Intelligence)

**Contributing Courses to Module**

- Artificial Intelligence (DLMAIAI01)

**Module Exam Type**

| Module Exam | Split Exam |
|---|---|
| Study Format: Distance Learning<br>Exam, 90 Minutes<br>Study Format: myStudies<br>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 IU International University of Applied Sciences (IU)** |
|---|---|
| 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 | 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**


- Russell, S. & Norvig, P. (2010). Artificial intelligence: a modern approach (3rd ed.). Upper Saddle River, NJ: Prentice Hall.
- Lucas, P.J.F & Van der Gaag, L. (1991). Principles of expert systems. Amsterdam: Addison Wesley (copyright returned to author).
- Clocksin, W.F. & Mellish, C.S. (2003). Programming in Prolog (4th ed.). Berlin: Springer-Verlag.
- Ward, J. (2015). The student's guide to cognitive neuroscience. (3rd ed.). New York, NY: Psychology Press.
- Frankish, K & Ramsey, W.M. (Eds.) (2012). The Cambridge handbook of cognitive science. Cambridge: Cambridge University Press.

### Study Format Distance Learning

| **Study Format** | **Course Type** |
|---|---|
| Distance Learning | Online Lecture |

| **Information about the examination** | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Exam, 90 Minutes |

| **Student Workload** | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 90 h | 0 h | 30 h | 30 h | 0 h | 150 h |

| **Instructional Methods** | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☐ Guideline |
| ☑ Shortcast | ☑ Live Tutorium/Course Feed |
| ☑ Audio | ☐ Reader |
| ☑ Exam Template | ☐ Slides |

### Study Format myStudies

| Study Format | Course Type |
|---|---|
| myStudies | Lecture |

| Information about the examination | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Exam, 90 Minutes |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 90 h | 0 h | 30 h | 30 h | 0 h | 150 h |

| Instructional Methods | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☐ Guideline |
| ☑ Shortcast | ☑ Live Tutorium/Course Feed |
| ☑ Audio | ☐ Reader |
| ☑ Exam Template | ☐ Slides |

# Advanced Mathematics

**Module Code: DLMDSAM**

| 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 |
|---|---|---|---|
| see curriculum | Minimum 1 semester | WiSe/SoSe | English |

**Module Coordinator**

Prof. Dr. Eric Guiffo Kaigom (Advanced Mathematics)

**Contributing Courses to Module**

- Advanced Mathematics (DLMDSAM01)

**Module Exam Type**

| Module Exam | Split Exam |
|---|---|
| Study Format: myStudies<br>Exam, 90 Minutes<br>Study Format: Distance Learning<br>Exam, 90 Minutes | |

**Weight of Module**

see curriculum

**Module Contents**

- Calculus
- Integral transformations
- Vector algebra
- Vector calculus
- Matrices and vector spaces
- Information theory

**Learning Outcomes**

**Advanced Mathematics**

On successful completion, students will be able to

- remember the fundamental rules of differentiation and integration.
- apply integration and differentiation techniques to vectors and vector fields.
- analyze matrix equations.
- understand the generalization of vectors to tensors.
- evaluate different metrics from information theoretical perspectives.

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

# Advanced Mathematics

**Course Code: DLMDSAM01**

| Study Level | Language of Instruction | Contact Hours | CP | Admission Requirements |
|---|---|---|---|---|
| MA | English | | 5 | none |

**Course Description**

Modern techniques to analyze data and derive predictions for future events are deeply rooted in mathematical techniques.The course builds a solid base to understand the concepts behind advanced algorithms used to process, analyze, and predict data and observations and enables students to follow future research, especially in the fields of data-intensive sciences.The course reviews differentiation and integration and then discusses partial differentiation, differentiation, vector algebra and vector calculus. Matrix calculation and vector spaces are fundamental to many modern data processing algorithms and are discussed in detail. Calculations based on Tensors are introduced.Common metrics are discussed from an informational, theoretical point of view.

**Course Outcomes**

On successful completion, students will be able to

- remember the fundamental rules of differentiation and integration.
- apply integration and differentiation techniques to vectors and vector fields.
- analyze matrix equations.
- understand the generalization of vectors to tensors.
- evaluate different metrics from information theoretical perspectives.

**Contents**

1. Calculus
   - 1.1 Differentiation & Integration
   - 1.2 Partial Differentiation & Integration
   - 1.3 Vector Analysis
   - 1.4 Calculus of Variations
2. Integral Transformations
   - 2.1 Convolution
   - 2.2 Fourier Transformation
3. Vector Algebra
   - 3.1 Scalars and Vectors
   - 3.2 Addition, Subtraction of Vectors
   - 3.3 Multiplication of Vectors, Vector Product, Scalar Product

4. Vector Calculus
   - 4.1 Integration of Vectors
   - 4.2 Differentiation of Vectors
   - 4.3 Scalar and Vector Fields
   - 4.4 Vector Operators

5. Matrices and Vector Spaces
   - 5.1 Basic Matrix Algebra
   - 5.2 Determinant, Trace, Transpose, Complex, and Hermitian Conjugates
   - 5.3 Eigenvectors and Eigenvalues
   - 5.4 Diagonalization
   - 5.5 Tensors

6. Information Theory
   - 6.1 MSE
   - 6.2 Gini Index
   - 6.3 Entropy, Shannon Entropy, Kulback Leibler Distance
   - 6.4 Cross Entropy

**Literature**

**Compulsory Reading**

**Further Reading**


- Riley, K. F., Hobson, M. P, & Bence, S. J. (2006). Mathematical methods for physics and engineering (2nd ed.). Cambridge University Press.
- Strang, G. (2016). Introduction to linear algebra. Wellesley-Cambridge Press .

### Study Format myStudies

| Study Format | Course Type |
|---|---|
| myStudies | Lecture |

| Information about the examination | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Exam, 90 Minutes |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 90 h | 0 h | 30 h | 30 h | 0 h | 150 h |

| Instructional Methods | |
|---|---|
| ☐ Learning Sprints® | ☑ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☐ Guideline |
| ☑ Shortcast | ☑ Live Tutorium/Course Feed |
| ☑ Audio | ☐ Reader |
| ☑ Exam Template | ☐ Slides |

### Study Format Distance Learning

| **Study Format** | **Course Type** |
|---|---|
| Distance Learning | Online Lecture |

| **Information about the examination** | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Exam, 90 Minutes |

| **Student Workload** | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 90 h | 0 h | 30 h | 30 h | 0 h | 150 h |

| **Instructional Methods** | |
|---|---|
| ☐ Learning Sprints® | ☑ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☐ Guideline |
| ☑ Shortcast | ☑ Live Tutorium/Course Feed |
| ☑ Audio | ☐ Reader |
| ☑ Exam Template | ☐ Slides |

# Use Case and Evaluation

**Module Code: DLMDSUCE**

| 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 |
|---|---|---|---|
| see curriculum | Minimum 1 semester | WiSe/SoSe | English |

**Module Coordinator**

Prof. Dr. Ulrich Kerzel (Use Case and Evaluation)

**Contributing Courses to Module**

- Use Case and Evaluation (DLMDSUCE01)

**Module Exam Type**

| Module Exam | Split Exam |
|---|---|
| Study Format: Distance Learning<br>Oral Assignment | |

**Weight of Module**

see curriculum

**Module Contents**

- Use case evaluation
- Model-centric evaluation
- Business-centric evaluation
- Monitoring
- Avoiding common fallacies
- Change management

**Learning Outcomes**

**Use Case and Evaluation**

On successful completion, students will be able to

- analyze use cases and their requirements regarding the project objectives.
- apply common metrics to evaluate predictions.
- evaluate key performance indicators to assess projects from a business perspective.
- create monitoring tools that can be used to constantly evaluate the status quo of a project.
- understand common fallacies and how to avoid them.

| **Links to other Modules within the Study Program** | **Links to other Study Programs of IU International University of Applied Sciences (IU)** |
|---|---|
| This module is similar to other modules in the fields of Data Science & Artificial Intelligence | All Master Programms in the IT & Technology fields |

# Use Case and Evaluation

**Course Code: DLMDSUCE01**

| Study Level | Language of Instruction | Contact Hours | CP | Admission Requirements |
|---|---|---|---|---|
| MA | English | | 5 | none |

**Course Description**

The evaluation and definition of use cases is the fundamental groundwork from which the projects can be defined. This does not only include the scope and technical requirements of a project but also how value can be derived from the project. A crucial aspect is the definition of what makes a project successful, both in terms of a technical evaluation as well as a business centric perspective and how the status quo can be monitored effectively during the progress of a project. The course also discusses how to avoid common fallacies and understand the implications of introducing data-driven decisions into traditional management structures.

**Course Outcomes**

On successful completion, students will be able to

- analyze use cases and their requirements regarding the project objectives.
- apply common metrics to evaluate predictions.
- evaluate key performance indicators to assess projects from a business perspective.
- create monitoring tools that can be used to constantly evaluate the status quo of a project.
- understand common fallacies and how to avoid them.

**Contents**

1. Use Case Evaluation
   - 1.1 Identification of Use Cases
   - 1.2 Specifying Use Case Requirements
   - 1.3 Data Sources and Data Handling Classification
2. Model-centric Evaluation
   - 2.1 Common Metrics for Regression and Classification
   - 2.2 Visual Aides
3. Business-centric Evaluation
   - 3.1 Cost Function and Optimal Point Estimators
   - 3.2 Evaluation Using KPIs
   - 3.3 A/B Test

4. Monitoring
   - 4.1 Visual Monitoring Using Dashboards
   - 4.2 Automated Reporting and Alerting

5. Avoiding Common Fallacies
   - 5.1 Cognitive Biases
   - 5.2 Statistical Effects
   - 5.3 Change Management: Transformation to a Data-driven Company

**Literature**

**Compulsory Reading**

**Further Reading**


- Few, S. (2013). Information dashboard design: Displaying data for at-a-glance monitoring (2nd ed.). Burlingame, CA: Analytics Press.
- Gilliland, M., Tashman, L., & Sglavo, U. (2016). Business forecasting: Practical problems and solutions. Hoboken, NJ: John Wiley & Sons.
- Hyndman, R. (2018). Forecasting: Principles and practices (2nd ed.). Melbourne: OTexts.
- Kahneman, D. (2012). Thinking, fast and slow. New York, NY: Penguin Books.
- Osterwalder, A., & Pigneur, Y. (2010). Business model generation. Hoboken, NJ: Wiley.
- Parmenter, D. (2015). Key performance indicators: Developing, implementing, and using winning KPIs. Hoboken, NJ: John Wiley & Sons.

### Study Format Distance Learning

| **Study Format** | **Course Type** |
|---|---|
| Distance Learning | Online Lecture |

| **Information about the examination** | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Oral Assignment |

| **Student Workload** | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 110 h | 0 h | 20 h | 20 h | 0 h | 150 h |

| **Instructional Methods** | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☑ Guideline |
| ☑ Shortcast | ☑ Live Tutorium/Course Feed |
| ☑ Audio | ☐ Reader |
| ☐ Exam Template | ☐ Slides |

DLMDSUCE01

# Seminar: AI and Society

**Module Code: DLMAISAIS**

| 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 |
|---|---|---|---|
| see curriculum | Minimum 1 semester | WiSe/SoSe | English |

**Module Coordinator**

Prof. Dr. Tim Schlippe (Seminar: AI and Society)

**Contributing Courses to Module**

- Seminar: AI and Society (DLMAISAIS01)

**Module Exam Type**

| Module Exam | Split Exam |
|---|---|
| Study Format: Distance Learning<br>Written Assessment: Research Essay | |

**Weight of Module**

see curriculum

**Module Contents**

In this module, students will reflect on current societal and political implications of artificial intelligence. To this end, pertinent topics will be introduced via articles that are then critically evaluated by the students in the form of a written essay.

**Learning Outcomes**

**Seminar: AI and Society**

On successful completion, students will be able to

- name selected current societal topics and issues in artificial intelligence.
- explain the influence and impact of artificial intelligence on societal, economic, and polital topics.
- transfer theoretically-acquired knowledge to real-world cases.
- treat in a scientific manner a select topic in the form of a written essay.
- critically question and discuss current societal and political issues arising from the recent advances in artificial intelligence methodology.
- develop own problem-solving skills and processes through reflection on the possible impact of their future occupation in the sector of artificial intelligence.

| **Links to other Modules within the Study Program** | **Links to other Study Programs of IU International University of Applied Sciences (IU)** |
|---|---|
| This module is similar to other modules in the fields of Data Science & Artificial Intelligence | All Master Programmes in the IT & Technology fields |

# Seminar: AI and Society

**Course Code: DLMAISAIS01**

| Study Level | Language of Instruction | Contact Hours | CP | Admission Requirements |
|---|---|---|---|---|
| MA | English | | 5 | none |

**Course Description**

In the current decade, impressive advances have been achieved in the field of artificial intelligence. Several cognitive tasks like object recognition in images and video, natural language processing, game strategy, and autonomous driving and robotics are now being performed by machines at unprecedented levels of ability. This course will examine some of societal, economic, and political implications of these developments.

**Course Outcomes**

On successful completion, students will be able to

- name selected current societal topics and issues in artificial intelligence.
- explain the influence and impact of artificial intelligence on societal, economic, and polital topics.
- transfer theoretically-acquired knowledge to real-world cases.
- treat in a scientific manner a select topic in the form of a written essay.
- critically question and discuss current societal and political issues arising from the recent advances in artificial intelligence methodology.
- develop own problem-solving skills and processes through reflection on the possible impact of their future occupation in the sector of artificial intelligence.

**Contents**

- The seminar covers current topics concerning the societal impact of artificial intelligence. Each participant must create a seminar paper on a topic assigned to him/her. A current list of topics is given in the Learning Management System.

**Literature**

**Compulsory Reading**

**Further Reading**


- Turabian, K. L. (2013). A manual for writers of research papers, theses, and dissertations. Chicago: University of Chicago Press.
- Swales, J. M., & Feak, C. R. (2012). Academic writing for graduate students, essential tasks and skills. Michigan: University of Michigan Press.
- Bailey, S. (2011). Academic writing for international students of business. New York, NY: Routledge

### Study Format Distance Learning

| Study Format | Course Type |
|---|---|
| Distance Learning | Seminar |

| Information about the examination | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** no<br>**Course Evaluation:** no |
| **Type of Exam** | Written Assessment: Research Essay |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 120 h | 0 h | 30 h | 0 h | 0 h | 150 h |

| Instructional Methods | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☐ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☑ Guideline |
| ☐ Shortcast | ☐ Live Tutorium/Course Feed |
| ☐ Audio | |
| ☐ Exam Template | |

# Advanced Statistics

**Module Code: DLMDSAS**

| 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 |
|---|---|---|---|
| see curriculum | Minimum<br>1 semester | WiSe/SoSe | English |

**Module Coordinator**

Prof. Dr. Paul Libbrecht (Advanced Statistics)

**Contributing Courses to Module**

- Advanced Statistics (DLMDSAS01)

**Module Exam Type**

| Module Exam | Split Exam |
|---|---|
| Study Format: myStudies<br>Advanced Workbook (passed / not passed)<br>Study Format: Distance Learning<br>Advanced Workbook (passed / not passed) | |

**Weight of Module**

see curriculum

**Module Contents**

- Introduction to statistics
- Important probability distributions and their applications
- Bayesian statistics
- Descriptive statistics
- Data visualization
- Parameter estimation
- Hypothesis tests

**Learning Outcomes**

**Advanced Statistics**

On successful completion, students will be able to

- understand the fundamental building blocks of statistics.
- analyze stochastic data in terms of the underlying probability distributions.
- utilize Bayesian statistics techniques.
- summarize the properties of observed data using descriptive statistics.
- apply data visualization techniques to design graphics that illustrate the behavior of observed data.
- evaluate model parameters using parameter estimation techniques.
- create hypothesis tests to discriminate between several model classes.

| **Links to other Modules within the Study Program** | **Links to other Study Programs of IU International University of Applied Sciences (IU)** |
|---|---|
| This module is similar to other modules in the field of Methods. | All Master Programmes in the Business & Management field. |

# Advanced Statistics

**Course Code: DLMDSAS01**

| Study Level | Language of Instruction | Contact Hours | CP | Admission Requirements |
|---|---|---|---|---|
| MA | English | | 5 | DLMDSAM01 |

**Course Description**

Nearly all processes in nature and technical or scientific scenarios are not deterministic but stochastic. Therefore, these processes must be described in terms of probabilities and probability density distributions.After defining and introducing the fundamental concepts of statistics, the course will cover important probability distributions and their prevalence in application scenarios; discuss descriptive techniques to summarize and visualize data effectively; and discuss the Bayesian approach to statistics.Estimating parameters is a key ingredient in optimizing data models, and the course will give a thorough overview of the most important techniques.Hypothesis testing is a crucial aspect in establishing the observation of new effects and determination of the significance of statistical effects. Special focus will be given to the correct interpretation of p-Values and the correct procedure for multiple hypothesis tests.

**Course Outcomes**

On successful completion, students will be able to

- understand the fundamental building blocks of statistics.
- analyze stochastic data in terms of the underlying probability distributions.
- utilize Bayesian statistics techniques.
- summarize the properties of observed data using descriptive statistics.
- apply data visualization techniques to design graphics that illustrate the behavior of observed data.
- evaluate model parameters using parameter estimation techniques.
- create hypothesis tests to discriminate between several model classes.

**Contents**

1. Introduction to Statistics
   - 1.1 Random Variables
   - 1.2 Kolmogorov Axioms
   - 1.3 Probability Distributions
   - 1.4 Decomposing probability distributions
   - 1.5 Expectation Values and Moments
   - 1.6 Central Limit Theorem
   - 1.7 Sufficient Statistics
   - 1.8 Problems of Dimensionality
   - 1.9 Component Analysis and Discriminants

2. Important Probability Distributions and their Applications
   - 2.1 Binomial Distribution
   - 2.2 Gauss or Normal Distribution
   - 2.3 Poisson and Gamma-Poisson Distribution
   - 2.4 Weibull Distribution

3. Bayesian Statistics
   - 3.1 Bayes' Rule
   - 3.2 Estimating the Prior, Benford's Law, Jeffry's Rule
   - 3.3 Conjugate Prior
   - 3.4 Bayesian & Frequentist Approach

4. Descriptive Statistics
   - 4.1 Mean, Median, Mode, Quantiles
   - 4.2 Variance, Skewness, Kurtosis

5. Data Visualization
   - 5.1 General Principles of Dataviz/Visual Communication
   - 5.2 1D, 2D Histograms
   - 5.3 Box Plot, Violin Plot
   - 5.4 Scatter Plot, Scatter Plot Matrix, Profile Plot
   - 5.5 Bar Chart

6. Parameter Estimation
   - 6.1 Maximum Likelihood
   - 6.2 Ordinary Least Squares
   - 6.3 Expectation Maximization (EM)
   - 6.4 Lasso and Ridge Regularization
   - 6.5 Propagation of Uncertainties

7. Hypothesis Test
   - 7.1 Error of 1st and 2nd Kind
   - 7.2 Multiple Hypothesis Tests
   - 7.3 p-Value

**Literature**

**Compulsory Reading**

**Further Reading**


- Bishop, C. (2007). Pattern recognition and machine learning (2nd ed.). Singapore: Springer.
- Bruce, P., & Bruce, A. (2017). Statistics for data scientists: 50 essential concepts. Sebastopol, CA: O'Reilley Publishing.
- Downey, A. (2013). Think Bayes. Sebastopol, CA: O'Reilley Publishing.
- Downey, A. (2014). Think stats. Sebastopol, CA: O'Reilley Publishing.
- McKay, D. (2003). Information theory, inference and learning algorithms. Cambridge: Cambridge University Press.
- Reinhart, A. (2015). Statistics done wrong. San Francisco, CA: No Starch Press.

### Study Format myStudies

| Study Format | Course Type |
|---|---|
| myStudies | Lecture |

| Information about the examination | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Advanced Workbook (passed / not passed) |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 110 h | 0 h | 20 h | 20 h | 0 h | 150 h |

| Instructional Methods | |
|---|---|
| ☐ Learning Sprints® | ☑ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☑ Guideline |
| ☑ Shortcast | ☑ Live Tutorium/Course Feed |
| ☐ Audio | ☐ Reader |
| ☐ Exam Template | ☐ Slides |

### Study Format Distance Learning

| **Study Format** | **Course Type** |
|---|---|
| Distance Learning | Online Lecture |

| **Information about the examination** | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Advanced Workbook (passed / not passed) |

| **Student Workload** | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 110 h | 0 h | 20 h | 20 h | 0 h | 150 h |

| **Instructional Methods** | |
|---|---|
| ☐ Learning Sprints® | ☑ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☑ Guideline |
| ☑ Shortcast | ☑ Live Tutorium/Course Feed |
| ☐ Audio | ☐ Reader |
| ☐ Exam Template | ☐ Slides |

# Project: AI Use Case

**Module Code: DLMAIPAIUC**

| Module Type | Admission Requirements | Study Level | CP | Student Workload |
|---|---|---|---|---|
| see curriculum | DLMDSAM, DLMDSUCE | MA | 5 | 150 h |

| Semester / Term | Duration | Regularly offered in | Language of Instruction |
|---|---|---|---|
| see curriculum | Minimum<br>1 semester | WiSe/SoSe | English |

**Module Coordinator**

Prof. Dr. Tim Schlippe (Project: AI Use Case)

**Contributing Courses to Module**

- Project: AI Use Case (DLMAIPAIUC01)

**Module Exam Type**

| Module Exam | Split Exam |
|---|---|
| Study Format: Distance Learning<br>Portfolio | |

**Weight of Module**

see curriculum

**Module Contents**

A current list of topics is given in the Learning Management System. This forms the basis of the course but can be amended or updated by the tutor.

**Learning Outcomes**

**Project: AI Use Case**

On successful completion, students will be able to

- apply the concepts covered in the preceding artificial intelligence (AI) courses to build a running AI model or system.
- explain the design choices made in the selection of the employed model and its implementation.
- transfer acquired theoretical knowledge to real-world case studies.
- translate the learned theories into the practice of AI system building.
- critically evaluate the resulting model's or system's performance.

| **Links to other Modules within the Study Program** | **Links to other Study Programs of IU International University of Applied Sciences (IU)** |
|---|---|
| This module is similar to other modules in the fields of Data Science & Artificial Intelligence | All Master Programmes in the IT & Technology fields |

# Project: AI Use Case

**Course Code: DLMAIPAIUC01**

| Study Level | Language of Instruction | Contact Hours | CP | Admission Requirements |
|---|---|---|---|---|
| MA | English | | 5 | DLMDSAM, DLMDSUCE |

**Course Description**

In the course “Project: AI Use Case”, students choose a project task in accord with their tutor from a variety of options. The goal is to prototypically implement an artificial intelligence model or system in a suitable development environment. The choice of approach, the system or software implemented, and the resulting performance on the task are to be reasoned about, explained, and documented in a project report. To this end, students make practical use of the methodological knowledge acquired in the previous courses by applying them to relevant real-world problems.

**Course Outcomes**

On successful completion, students will be able to

- apply the concepts covered in the preceding artificial intelligence (AI) courses to build a running AI model or system.
- explain the design choices made in the selection of the employed model and its implementation.
- transfer acquired theoretical knowledge to real-world case studies.
- translate the learned theories into the practice of AI system building.
- critically evaluate the resulting model’s or system’s performance.

**Contents**

- In this project course the students work on a practical implementation of an artificial intelligence use case of their choosing. All relevant artifacts like use case evaluation, chosen implementation method, code, and outcomes are to be documented in the form of a written project report.

**Literature**

**Compulsory Reading**

**Further Reading**


- Jackson, P. (1998). Introduction to expert systems (3rd ed.). Chicago, IL: Addison Wesley Longman.
- Nilsson, N. (2009). The quest for artificial intelligence. Cambridge: Cambridge University Press.
- Russel, S., & Norvig, P. (2009). Artificial intelligence: A modern approach (3rd ed.). Malaysia: Pearson.

### Study Format Distance Learning

| Study Format | Course Type |
|---|---|
| Distance Learning | Project |

| Information about the examination | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** no<br>**Course Evaluation:** no |
| **Type of Exam** | Portfolio |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 120 h | 0 h | 30 h | 0 h | 0 h | 150 h |

| Instructional Methods | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☐ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☑ Guideline |
| ☐ Shortcast | ☑ Live Tutorium/Course Feed |
| ☐ Audio | |
| ☐ Exam Template | |

# 2. Semester

# Programming with Python

**Module Code: DLMDSPWP**

| 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 |
|---|---|---|---|
| see curriculum | Minimum 1 semester | WiSe/SoSe | English |

**Module Coordinator**

Dr.-Ing. Reza Shahbazfar (Programming with Python)

**Contributing Courses to Module**

- Programming with Python (DLMDSPWP01)

**Module Exam Type**

| Module Exam | Split Exam |
|---|---|
| Study Format: myStudies<br>Written Assessment: Written Assignment<br>Study Format: Distance Learning<br>Written Assessment: Written Assignment | |

**Weight of Module**

see curriculum

**Module Contents**

- Introduction to the Python programming language
- Object-oriented concepts in Python
- Handling of exceptions and errors
- The Python library ecosystem
- Environments and package management
- Documentation and testing
- Version control

**Learning Outcomes**

**Programming with Python**

On successful completion, students will be able to

- remember basic Python syntax and programming concepts.
- understand object-oriented concepts in Python.
- analyze and apply different methods for error handling in Python.
- know common and important Python libraries and how to apply them to given programming tasks.
- understand concepts like environments and version control.

| **Links to other Modules within the Study Program** | **Links to other Study Programs of IU International University of Applied Sciences (IU)** |
|---|---|
| This module is similar to other modules in the field of Data Science & Artificial Intelligence. | All Master Programmes in the IT & Technology field. |

# Programming with Python

**Course Code: DLMDSPWP01**

| Study Level | Language of Instruction | Contact Hours | CP | Admission Requirements |
|---|---|---|---|---|
| MA | English | | 5 | none |

**Course Description**

Python is one of the most versatile and widely used scripting languages. Its clean and uncluttered syntax as well as its straightforward design greatly contribute to this success and make it an ideal language for programming education. Its application ranges from web development to scientific computing. Especially in the fields of data science and artificial intelligence, it is the most common programming language supported by all major data-handling and analytical frameworks. This course provides a thorough introduction to the language and its main features, as well as insights into the rationale and application of important adjacent concepts such as environments, testing, and version control.

**Course Outcomes**

On successful completion, students will be able to

- remember basic Python syntax and programming concepts.
- understand object-oriented concepts in Python.
- analyze and apply different methods for error handling in Python.
- know common and important Python libraries and how to apply them to given programming tasks.
- understand concepts like environments and version control.

**Contents**

1. Introduction to Python
   - 1.1 Data structures
   - 1.2 Functions
   - 1.3 Flow control
   - 1.4 Input / Output
   - 1.5 Modules & packages
2. Classes and inheritance
   - 2.1 Scopes and namespaces
   - 2.2 Classes and inheritance
   - 2.3 Iterators and generators

3. Errors and exceptions
   - 3.1 Syntax errors
   - 3.2 Handling and raising exceptions
   - 3.3 User-defined exceptions

4. Important libraries
   - 4.1 Standard Python library
   - 4.2 Scientific calculations
   - 4.3 Speeding up Python
   - 4.4 Visualization
   - 4.5 Accessing databases

5. Working with Python
   - 5.1 Virtual environments
   - 5.2 Managing packages
   - 5.3 Unit and integration testing
   - 5.4 Documenting code

6. Version control
   - 6.1 Introduction to version control
   - 6.2 Version control with GIT

**Literature**

**Compulsory Reading**

**Further Reading**


- Lutz, M. (2017). Learning python (5th ed.). O'Reilly.
- Mathes, E. (2019). Python crash course. (2nd ed.). No Starch Press.

### Study Format myStudies

| Study Format | Course Type |
|---|---|
| myStudies | Lecture |

| Information about the examination | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Written Assessment: Written Assignment |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 110 h | 0 h | 20 h | 20 h | 0 h | 150 h |

| Instructional Methods | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☑ Guideline |
| ☑ Shortcast | ☑ Live Tutorium/Course Feed |
| ☑ Audio | ☐ Reader |
| ☐ Exam Template | ☐ Slides |

### Study Format Distance Learning

| Study Format | Course Type |
|---|---|
| Distance Learning | Online Lecture |

| Information about the examination | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** no<br>**Course Evaluation:** no |
| **Type of Exam** | Written Assessment: Written Assignment |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 110 h | 0 h | 20 h | 20 h | 0 h | 150 h |

| Instructional Methods | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☑ Guideline |
| ☑ Shortcast | ☑ Live Tutorium/Course Feed |
| ☑ Audio | ☐ Reader |
| ☐ Exam Template | ☐ Slides |

# Machine Learning

**Module Code: DLMDSML**

| Module Type | Admission Requirements | Study Level | CP | Student Workload |
|---|---|---|---|---|
| see curriculum | DLMDSAM01, DLMDSPWP01 | MA | 5 | 150 h |

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

**Module Coordinator**

Prof. Dr. Thomas Zöller (Machine Learning)

**Contributing Courses to Module**

- Machine Learning (DLMDSML01)

**Module Exam Type**

| Module Exam | Split Exam |
|---|---|
| Study Format: Distance Learning<br>Exam | |

**Weight of Module**

see curriculum

**Module Contents**

- Supervised, unsupervised, and reinforcement learning approaches
- Regression and classification learning problems
- Estimation of functional dependencies via regression techniques
- Data clustering
- Support vector machines, large margin classification
- Decision tree learning

**Learning Outcomes**

**Machine Learning**

On successful completion, students will be able to

- know different machine learning model classes.
- comprehend the difference between supervised, unsupervised, and reinforcement learning methods.
- understand common machine learning models.
- analyze trade-offs in the application of different models.
- appropriately choose machine learning models according to a given task.

| **Links to other Modules within the Study Program** | **Links to other Study Programs of IU International University of Applied Sciences (IU)** |
|---|---|
| This module is similar to other modules in the fields of Data Science & Artificial Intelligence | All Master Programmes in the IT & Technology fields |

# Machine Learning

**Course Code: DLMDSML01**

| Study Level | Language of Instruction | Contact Hours | CP | Admission Requirements |
|---|---|---|---|---|
| MA | English | | 5 | DLMDSAM01, DLMDSPWP01 |

**Course Description**

Machine learning is a field of scientific study concerned with algorithmic techniques that enable machines to learn performance on a given task via the discovery of patterns or regularities in exemplary data. Consequently, its methods commonly draw upon a statistical basis in conjunction with the computational capabilities of modern computing hardware. This course aims to acquaint the student with the main branches of machine learning and provide a thorough introduction to the most widely used approaches and methods in this field.

**Course Outcomes**

On successful completion, students will be able to

- know different machine learning model classes.
- comprehend the difference between supervised, unsupervised, and reinforcement learning methods.
- understand common machine learning models.
- analyze trade-offs in the application of different models.
- appropriately choose machine learning models according to a given task.

**Contents**

1. Introduction to Machine Learning
   - 1.1 Regression & Classification
   - 1.2 Supervised & Unsupervised Learning
   - 1.3 Reinforcement Learning
2. Clustering
   - 2.1 Introduction to clustering
   - 2.2 K-Means
   - 2.3 Expectation Maximization
   - 2.4 DBScan
   - 2.5 Hierarchical Clustering

3. Regression
   - 3.1 Linear & Non-linear Regression
   - 3.2 Logistic Regression
   - 3.3 Quantile Regression
   - 3.4 Multivariate Regression
   - 3.5 Lasso & Ridge Regression

4. Support Vector Machines
   - 4.1 Introduction to Support Vector Machines
   - 4.2 SVM for Classification
   - 4.3 SVM for Regression

5. Decision Trees
   - 5.1 Introduction to Decision Trees
   - 5.2 Decision Trees for Classification
   - 5.3 Decision Trees for Regression

6. Genetic Algorithms
   - 6.1 Introduction to Genetic Algorithms
   - 6.2 Applications of Genetic Algorithms

**Literature**

**Compulsory Reading**

**Further Reading**


- Akerkar, R., & Sajja, P. S. (2016). Intelligent techniques for data science. Springer International Publishing.
- Hodeghatta, U. R., & Nayak, U. (2017). Business analytics using R- A practical approach. Apress Publishing.
- Lahoz-Beltra, R. (2016). SGA: Simple Genetic Algorithm (SGA) in Python.
- Runkler, T. A. (2012). Data analytics: Models and algorithms for intelligent data analysis. Springer Vieweg Press.
- Skiena, S. S (2017). The data science design manual. Springer International Publishing. Database: Springer eBook Package English Computer Science

### Study Format Distance Learning

| **Study Format** | **Course Type** |
|---|---|
| Distance Learning | Online Lecture |

| **Information about the examination** | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Exam |

| **Student Workload** | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 90 h | 0 h | 30 h | 30 h | 0 h | 150 h |

| **Instructional Methods** | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☐ Guideline |
| ☑ Shortcast | ☑ Live Tutorium/Course Feed |
| ☑ Audio | ☐ Reader |
| ☑ Exam Template | ☐ Slides |

DLMDSML01

# Deep Learning

**Module Code: DLMDSDL**

| Module Type | Admission Requirements | Study Level | CP | Student Workload |
|---|---|---|---|---|
| see curriculum | DLMDSAM01,<br>DLMDSPWP01,<br>DLMDSML01 | MA | 5 | 150 h |

| Semester / Term | Duration | Regularly offered in | Language of Instruction |
|---|---|---|---|
| see curriculum | Minimum<br>1 semester | WiSe/SoSe | English |

**Module Coordinator**

Prof. Dr. Thomas Zöller (Deep Learning)

**Contributing Courses to Module**

- Deep Learning (DLMDSDL01)

**Module Exam Type**

| Module Exam | Split Exam |
|---|---|
| Study Format: Distance Learning<br>Oral Assignment | |

**Weight of Module**

see curriculum

**Module Contents**

- Introduction to neural networks and deep earning
- Network architectures
- Neural network training
- Alternative training methods
- Further network architectures

**Learning Outcomes**

**Deep Learning**

On successful completion, students will be able to

- comprehend the fundamental building blocks of neural networks.
- understand concepts in deep learning.
- analyze the relevant deep learning architecture in a wide range of application scenarios.
- create deep learning models.
- utilize alternative methods to train deep learning models.

| **Links to other Modules within the Study Program** | **Links to other Study Programs of IU International University of Applied Sciences (IU)** |
|---|---|
| This module is similar to other modules in the fields of Data Science & Artificial Intelligence | All Master Programmes in the IT & Technology fields |

# Deep Learning

**Course Code: DLMDSDL01**

| Study Level | Language of Instruction | Contact Hours | CP | Admission Requirements |
|---|---|---|---|---|
| MA | English | | 5 | DLMDSAM01, DLMDSPWP01, DLMDSML01 |

**Course Description**

Neural networks and deep learning approaches have revolutionized the fields of data science and artificial intelligence in recent years, and applications built on these techniques have reached or surpassed human performance in many specialized applications.After a short review of the origins of neural networks and deep learning, this course will cover the most common neural network architectures and discuss in detail how neural networks are trained using dedicated data samples, avoiding common pitfalls such as overtraining.The course includes a detailed overview of alternative methods to train neural networks and further network architectures which are relevant in a wide range of specialized application scenarios.

**Course Outcomes**

On successful completion, students will be able to

- comprehend the fundamental building blocks of neural networks.
- understand concepts in deep learning.
- analyze the relevant deep learning architecture in a wide range of application scenarios.
- create deep learning models.
- utilize alternative methods to train deep learning models.

**Contents**

1. Introduction to Neural Network and Deep Learning
   - 1.1 The Biological Brain
   - 1.2 Perceptron and Multi-Layer Perceptrons
2. Network Architectures
   - 2.1 Feed-Forward Networks
   - 2.2 Convolutional Networks
   - 2.3 Recurrent Networks, Memory Cells and LSTMs
3. Neural Network Training
   - 3.1 Weight Initialization and Transfer Function
   - 3.2 Backpropagation and Gradient Descent
   - 3.3 Regularization and Overtraining

4. Alternative Training Methods
   - 4.1 Attention
   - 4.2 Feedback Alignment
   - 4.3 Synthetic Gradients
   - 4.4 Decoupled Network Interfaces

5. Further Network Architectures
   - 5.1 Generative Adversarial Networks
   - 5.2 Autoencoders
   - 5.3 Restricted Boltzmann Machines
   - 5.4 Capsule Networks
   - 5.5 Spiking Networks

**Literature**

**Compulsory Reading**

**Further Reading**


- Chollet, F. (2017). Deep learning with Python. Shelter Island, NY: Manning.
- Efron, B., & Hastie, T. (2016). Computer age statistical inference. Cambridge: Cambridge University Press.
- Geron, A. (2017). Hands-on machine learning with Scikit-Learn and TensorFlow. Boston, MA: O'Reilly Publishing.
- Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep learning. Boston, MA: MIT Press.
- Russel, S., & Norvig, P. (2010). Artificial intelligence – A modern approach (3rd ed.). Essex: Pearson.

### Study Format Distance Learning

| **Study Format** | **Course Type** |
|---|---|
| Distance Learning | Online Lecture |

| **Information about the examination** | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Oral Assignment |

| **Student Workload** | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 110 h | 0 h | 20 h | 20 h | 0 h | 150 h |

| **Instructional Methods** | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☑ Guideline |
| ☑ Shortcast | ☑ Live Tutorium/Course Feed |
| ☑ Audio | ☐ Reader |
| ☐ Exam Template | ☐ Slides |

DLMDSDL01

# NLP and Computer Vision

**Module Code: DLMAINLPCV**

| Module Type | Admission Requirements | Study Level | CP | Student Workload |
|---|---|---|---|---|
| see curriculum | DLMDSAM, DLMDSPWP, DLMDSML | MA | 5 | 150 h |

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

**Module Coordinator**

Prof. Dr. Tim Schlippe (NLP and Computer Vision)

**Contributing Courses to Module**

- NLP and Computer Vision (DLMAINLPCV01)

**Module Exam Type**

| Module Exam | Split Exam |
|---|---|
| Study Format: Distance Learning<br>Oral Assignment | |

**Weight of Module**

see curriculum

**Module Contents**

- Important methods in computer vision and NLP
- Relevant applications in both domains
- Security and privacy implications of computer vision and NLP

**Learning Outcomes**

**NLP and Computer Vision**

On successful completion, students will be able to

- name important problems in natural language and image processing.
- recognize the common algorithms and methods to address said problems.
- understand common use-case scenarios in which NLP and computer vision techniques are applied.
- analyze the advantages and drawbacks of various NLP and computer vision algorithms.
- reflect on pertinent implications of NLP and computer vision technology with respect to privacy and security.

| **Links to other Modules within the Study Program** | **Links to other Study Programs of IU International University of Applied Sciences (IU)** |
|---|---|
| This module is similar to other modules in the fields of Data Science & Artificial Intelligence | All Master Programmes in the IT & Technology fields |

# NLP and Computer Vision

**Course Code: DLMAINLPCV01**

| Study Level | Language of Instruction | Contact Hours | CP | Admission Requirements |
|---|---|---|---|---|
| MA | English | | 5 | DLMDSAM, DLMDSPWP, DLMDSML |

**Course Description**

This course elucidates contemporary approaches to computer vision and natural language processing. In order to achieve this goal, two problem domains are introduced with a comprehensive overview on related topics and techniques. It is then demonstrated how related tasks arise in relevant application scenarios. Finally, an outlook on privacy and security aspects is provided in order to sensitize the students to pressing questions in this domain.

**Course Outcomes**

On successful completion, students will be able to

- name important problems in natural language and image processing.
- recognize the common algorithms and methods to address said problems.
- understand common use-case scenarios in which NLP and computer vision techniques are applied.
- analyze the advantages and drawbacks of various NLP and computer vision algorithms.
- reflect on pertinent implications of NLP and computer vision technology with respect to privacy and security.

**Contents**

1. Introduction to NLP
   - 1.1 What is NLP?
   - 1.2 Regular expressions, tokenization & stop-words
   - 1.3 Bag of Words and word vectors
   - 1.4 N-Grams: Grouping related words
   - 1.5 Word sense disambiguation
   - 1.6 NLP with Python
2. Applications of NLP
   - 2.1 Topic identification and text summary
   - 2.2 Sentiment analysis
   - 2.3 Named entity recognition
   - 2.4 Translation
   - 2.5 Chatbots

3. Introduction to Computer Vision
   - 3.1 What is computer vision?
   - 3.2 Pixels and filters
   - 3.3 Feature detection
   - 3.4 Distortion and calibration
   - 3.5 Multiple & stereo vision
   - 3.6 Computer vision with Python

4. Applications of Computer Vision
   - 4.1 Image classification, motion tracking
   - 4.2 Semantic segmentation
   - 4.3 Object identification & tracking
   - 4.4 Eigenfaces and facial recognition

5. Privacy and Security
   - 5.1 Adversarial image attacks
   - 5.2 Privacy of visual data & privacy preserving visual features
   - 5.3 Wearable and mobile camera privacy

**Literature**

**Compulsory Reading**

**Further Reading**


- Bird S., Klein, E., & Loper, E. (2009). Natural language processing with Python. O'Reilly.
- Fisher, R. B., Breckon, T. P., Dawson-Howe, K., Fitzgibbon, A. , Robertson, C. , Trucco, E., & Williams, C. K. I. (2014). Dictionary of computer vision and image processing. Wiley .

### Study Format Distance Learning

| **Study Format** | **Course Type** |
|---|---|
| Distance Learning | Online Lecture |

| **Information about the examination** | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Oral Assignment |

| **Student Workload** | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 110 h | 0 h | 20 h | 20 h | 0 h | 150 h |

| **Instructional Methods** | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☑ Guideline |
| ☑ Shortcast | ☑ Live Tutorium/Course Feed |
| ☑ Audio | ☐ Reader |
| ☐ Exam Template | ☐ Slides |

# UI/UX Expert

**Module Code: DLMAIEUIUX**

| Module Type | Admission Requirements | Study Level | CP | Student Workload |
|---|---|---|---|---|
| see curriculum | ▪ DLMAIEUIUX01<br>▪ none | MA | 10 | 300 h |

| Semester / Term | Duration | Regularly offered in | Language of Instruction |
|---|---|---|---|
| see curriculum | Minimum<br>1 semester | WiSe/SoSe | English |

**Module Coordinator**

Prof. Dr. Adelka Niels (User Interface and Experience) / Prof. Dr. Adelka Niels (Project: Human Computer Interaction)

**Contributing Courses to Module**

- User Interface and Experience (DLMAIEUIUX01)
- Project: Human Computer Interaction (DLMAIEUIUX02)

**Module Exam Type**

| Module Exam | Split Exam |
|---|---|
| | User Interface and Experience<br>• Study Format "Distance Learning": Exam, 90 Minutes<br>Project: Human Computer Interaction<br>• Study Format "Fernstudium": Portfolio |

**Weight of Module**

see curriculum

**Module Contents**

**User Interface and Experience**

- 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

**Project: Human Computer Interaction**

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**

**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.

**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 IU International University of Applied Sciences (IU)** |
|---|---|
| This module is similar to other modules in the fields of Data Science & Artificial Intelligence | All Master Programs in the IT & Technology fields |

# User Interface and Experience

**Course Code: DLMAIEUIUX01**

| Study Level | Language of Instruction | 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** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Exam, 90 Minutes |

| **Student Workload** | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 90 h | 0 h | 30 h | 30 h | 0 h | 150 h |

| **Instructional Methods** | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☐ Guideline |
| ☑ Shortcast | ☐ Live Tutorium/Course Feed |
| ☑ Audio | ☐ Reader |
| ☑ Exam Template | ☐ Slides |

# Project: Human Computer Interaction

**Course Code: DLMAIEUIUX02**

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

### Study Format Fernstudium

| Study Format | Course Type |
|---|---|
| Fernstudium | Project |

| Information about the examination | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** no<br>**Course Evaluation:** no |
| **Type of Exam** | Portfolio |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 120 h | 0 h | 30 h | 0 h | 0 h | 150 h |

| Instructional Methods | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☐ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☑ Guideline |
| ☐ Shortcast | ☑ Live Tutorium/Course Feed |
| ☐ Audio | |
| ☐ Exam Template | |

# Technical Project Lead

**Module Code: DLMDSETPL**

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

| Semester / Term | Duration | Regularly offered in | Language of Instruction |
|---|---|---|---|
| see curriculum | Minimaldauer:<br>1 Semester | WiSe/SoSe | English |

**Module Coordinator**

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

**Contributing Courses to Module**

- IT Project Management (DLMBITPAM01)
- Project: Technical Project Planning (DLMDSETPL01)

**Module Exam Type**

| Module Exam | Split Exam |
|---|---|
| | IT Project Management<br>• Study Format "Distance Learning": Exam<br>Project: Technical Project Planning<br>• Study Format "Distance Learning": Portfolio |

**Weight of Module**

see curriculum

**Module Contents**

**IT Project Management**

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

**Project: Technical Project Planning**

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

**Learning Outcomes**

**IT Project Management**

On successful completion, students will be able to

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

**Project: Technical Project Planning**

On successful completion, students will be able to

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

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

# IT Project Management

**Course Code: DLMBITPAM01**

| Study Level | Language of Instruction | Contact Hours | CP | Admission Requirements |
|---|---|---|---|---|
| MA | English | | 5 | none |

**Course Description**

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

**Course Outcomes**

On successful completion, students will be able to

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

**Contents**

1. Introduction: Characteristics of IT Projects
   - 1.1 Defining IT Projects
   - 1.2 Overview on Typical Roles and Phases of IT Projects
   - 1.3 Risks and Challenges of IT Projects
   - 1.4 Role of an IT Project Manager
2. Organizing the Work
   - 2.1 Project Breakdown Structure, Work Packages
   - 2.2 Prioritization
   - 2.3 Time Planning, Milestones, Gantt-Diagram
   - 2.4 Definition of Done

3. Cost Estimation and Controlling
   - 3.1 Challenges of Cost Estimation in IT Projects
   - 3.2 Estimation Techniques: 3-Point Estimation, Double Blind Expert Estimation, Function Points
   - 3.3 Cost Controlling Using Earned Value Analysis
   - 3.4 Risk Management

4. The Human Factor
   - 4.1 Vision Keeping
   - 4.2 Stakeholder Management
   - 4.3 Conflict Management

5. Organizing Small and Medium Projects
   - 5.1 Rational Unified Process (RUP)
   - 5.2 Agile Software Processes
   - 5.3 Scrum
   - 5.4 Plan-driven Project Management in Small Projects

6. Organizing Large Projects
   - 6.1 PMBOK Guide
   - 6.2 Prince2
   - 6.3 Multi Project Management
   - 6.4 Agile Software Processes in Large Projects
   - 6.5 Selection of the Appropriate Project Management Method

**Literature**

**Compulsory Reading**

**Further Reading**

- Stephens, R. (2015). Beginning software engineering. Chichester: John Wiley & Sons. (Database: ProQuest).
- Hans, R. T. (2013). Work breakdown structure: A tool for software project scope verification. Pretoria: Tshwane University of Technology.

### Study Format Distance Learning

| **Study Format** | **Course Type** |
|---|---|
| Distance Learning | Online Lecture |

| **Information about the examination** | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Exam |

| **Student Workload** | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 90 h | 0 h | 30 h | 30 h | 0 h | 150 h |

| **Instructional Methods** | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☐ Guideline |
| ☑ Shortcast | ☐ Live Tutorium/Course Feed |
| ☑ Audio | ☐ Reader |
| ☑ Exam Template | ☐ Slides |

# Project: Technical Project Planning

**Course Code: DLMDSETPL01**

| Study Level | Language of Instruction | Contact Hours | CP | Admission Requirements |
|---|---|---|---|---|
| MA | English | | 5 | DLMBITPAM01 |

**Course Description**

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

**Course Outcomes**

On successful completion, students will be able to

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

**Contents**

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

**Literature**

**Compulsory Reading**

**Further Reading**


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

### Study Format Distance Learning

| **Study Format** | **Course Type** |
|---|---|
| Distance Learning | Project |

| **Information about the examination** | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** no<br>**Course Evaluation:** no |
| **Type of Exam** | Portfolio |

| **Student Workload** | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 120 h | 0 h | 30 h | 0 h | 0 h | 150 h |

| **Instructional Methods** | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☐ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☑ Guideline |
| ☐ Shortcast | ☑ Live Tutorium/Course Feed |
| ☐ Audio | |
| ☐ Exam Template | |

DLMDSETPL01

# AI Specialist

**Module Code: DLMAIEAIS**

| Module Type | Admission Requirements | Study Level | CP | Student Workload |
|---|---|---|---|---|
| see curriculum | ▪ DDLMDSAM, DLMDSPWP, DLMDSML, DLMAINLPCV, DLMAIEAIS01<br>▪ DLMDSAM, DLMDSPWP, DLMDSML, DLMAINLPCV01 | MA | 10 | 300 h |

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

**Module Coordinator**

Prof. Dr. Tim Schlippe (Advanced NLP and Computer Vision) / Prof. Dr. Tim Schlippe (Project: NLP and Computer Vision)

**Contributing Courses to Module**

- Advanced NLP and Computer Vision (DLMAIEAIS01)
- Project: NLP and Computer Vision (DLMAIEAIS02)

**Module Exam Type**

| Module Exam | Split Exam |
|---|---|
| | Advanced NLP and Computer Vision<br>• Study Format "Distance Learning": Exam, 90 Minutes<br>Project: NLP and Computer Vision<br>• Study Format "Fernstudium": Portfolio |

**Weight of Module**
see curriculum

**Module Contents**

**Advanced NLP and Computer Vision**

- Machine translation and semantic text interpretation
- Recovery of scene geometry
- Semantic image and video analysis
- Object tracking

**Project: NLP and Computer Vision**

- Transfer and application of methodological computer vision and NLP knowledge
- Implementation of an NLP or computer vision software module

**Learning Outcomes**

**Advanced NLP and Computer Vision**

On successful completion, students will be able to

- name core aspects of advanced computer vision and NLP problems and techniques.
- summarize current approaches to problems in text and speech processing.
- recognize promising developments in scene understanding and semantic image analysis.
- remember challenges and solution strategies in single and multiple object tracking.

**Project: NLP and Computer Vision**

On successful completion, students will be able to

- apply knowledge of NLP and computer vision methods to practical problems.
- evaluate different methods, algorithms, and approaches to solving a given problem with respect to its set of constraints.
- recognize the benefits and drawbacks of design options and choices.
- build real-world computer vision or NLP applications.

**Links to other Modules within the Study Program**

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

**Links to other Study Programs of IU International University of Applied Sciences (IU)**

All Master Programmes in the IT & Technology fields

# Advanced NLP and Computer Vision

**Course Code: DLMAIEAIS01**

| Study Level | Language of Instruction | Contact Hours | CP | Admission Requirements |
|---|---|---|---|---|
| MA | English | | 5 | DLMDSAM, DLMDSPWP, DLMDSML, DLMAINLPCV01 |

**Course Description**

This course expands upon the material presented in the introductory NLP and Computer Vision course. With respect to the processing of text, it provides an overview of machine translation and information extraction. Moreover, it addresses signal processing aspects of NLP such as speech recognition and synthesis. Additionally, important concepts from the subject domain of computer vision such as the recovery of scene geometry, the semantic analysis of still and video imagery, and object tracking are discussed.

**Course Outcomes**

On successful completion, students will be able to

- name core aspects of advanced computer vision and NLP problems and techniques.
- summarize current approaches to problems in text and speech processing.
- recognize promising developments in scene understanding and semantic image analysis.
- remember challenges and solution strategies in single and multiple object tracking.

**Contents**

1. Text Processing
   - 1.1 Machine translation
   - 1.2 Information extraction
2. Speech Signal Processing
   - 2.1 Speech recognition
   - 2.2 Speech synthesis
3. Geometry Reconstruction
   - 3.1 3D reconstruction from 2D images/videos
   - 3.2 Change of perspective

4. Semantic Image Analysis
   - 4.1 Image retrieval
   - 4.2 Semantic segmentation / object detection
   - 4.3 Medical imaging analysis
   - 4.4 Copyright violation, counterfeit and forgery detection
   - 4.5 Face recognition and biometrics

5. Tracking
   - 5.1 Challenges in tracking
   - 5.2 Object representation
   - 5.3 Single vs. multiple object tracking

**Literature**

**Compulsory Reading**

**Further Reading**


- Bengfort, B., Bilbro, R., & Ojeda, T. (2018). Applied text analysis with Python: Enabling language aware data products with machine learning. O'Reilly.
- Clark, A., Fox, C., & Lappin, S. (Eds.). (2010). The handbook of computational linguistics and natural language processing. Wiley-Blackwell.
- Davies, E. R. (2017). Computer vision: Principles, algorithms, applications, learning (5th ed.). Academic Press.
- Fisher, R. B., Breckon, T. P., Dawson-Howe, K., Fitzgibbon, A., Robertson, C., Trucco, E., & Williams, C. K. I. (2016). Dictionary of computer vision and image processing (2nd ed.). Wiley.

### Study Format Distance Learning

| **Study Format** | **Course Type** |
|---|---|
| Distance Learning | Online Lecture |

| **Information about the examination** | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Exam, 90 Minutes |

| **Student Workload** | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 90 h | 0 h | 30 h | 30 h | 0 h | 150 h |

| **Instructional Methods** | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☐ Guideline |
| ☑ Shortcast | ☐ Live Tutorium/Course Feed |
| ☑ Audio | ☐ Reader |
| ☑ Exam Template | ☐ Slides |

# Project: NLP and Computer Vision

**Course Code: DLMAIEAIS02**

| Study Level | Language of Instruction | Contact Hours | CP | Admission Requirements |
|---|---|---|---|---|
| MA | English | | 5 | DDLMDSAM, DLMDSPWP, DLMDSML, DLMAINLPCV, DLMAIEAIS01 |

**Course Description**

This course is intended to give students an opportunity to apply their knowledge in NLP and computer vision to a real-world implementation task. To this end, an apposite solution for a given task and the accompanying set of constraints must be found. Methodological and algorithmic choices must be appropriately evaluated to find the best path forward. The found solution design is implemented as a running piece of software, furthering the students' programming skills.

**Course Outcomes**

On successful completion, students will be able to

- apply knowledge of NLP and computer vision methods to practical problems.
- evaluate different methods, algorithms, and approaches to solving a given problem with respect to its set of constraints.
- recognize the benefits and drawbacks of design options and choices.
- build real-world computer vision or NLP applications.

**Contents**

- In this course, students will put the knowledge acquired in the preceding course, Advanced NLP and Computer Vision, into practice through the implementation of an NLP or computer vision project of their choosing.

| Literature |
| --- |
| **Compulsory Reading** |
| **Further Reading**<br>▪ Bengfort, B., & Ojeda, T. (2018). Applied text analysis with Python : Enabling language aware data products with machine learning. Sebastopol, CA: O'Reilly.<br>▪ Clark, A., Fox, C., & Lappin, S. (Eds.). (2010). Handbook of computational linguistics and natural language processing . Malden, MA: Wiley-Blackwell.<br>▪ Davies, E. R. (2017). Computer vision: Principles, algorithms, applications, learning (5th ed.). Cambridge, MA: Academic Press.<br>▪ Fisher, R. B., Breckon, T. P., Dawson-Howe, K., Fitzgibbon, A., Robertson, C., Trucco, E., Williams, C. K. I. (2016). Dictionary of computer vision and image processing. Chichester: John Wiley & Sons Ltd.<br>▪ Jurafsky, D., & Martin, J. H. (2008). Speech and language processing . Boston, MA: Prentice Hall.<br>▪ Szelski, R. (2011). Computer vision: Algorithms and applications (2 nd ed.). Wiesbaden: Springer VS. |

### Study Format Fernstudium

| Study Format | Course Type |
|---|---|
| Fernstudium | Project |

| Information about the examination | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** no<br>**Course Evaluation:** no |
| **Type of Exam** | Portfolio |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 120 h | 0 h | 30 h | 0 h | 0 h | 150 h |

| Instructional Methods | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☐ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☑ Guideline |
| ☐ Shortcast | ☑ Live Tutorium/Course Feed |
| ☐ Audio | |
| ☐ Exam Template | |

# Data Engineer

**Module Code: DLMDSEDE**

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

| Semester / Term | Duration | Regularly offered in | Language of Instruction |
|---|---|---|---|
| see curriculum | Minimum<br>1 semester | WiSe/SoSe | English |

**Module Coordinator**

Prof. Dr. Christian Müller-Kett (Data Engineering) / Prof. Dr. Christian Müller-Kett (Project: Data Engineering)

**Contributing Courses to Module**

- Data Engineering (DLMDSEDE01)
- Project: Data Engineering (DLMDSEDE02)

**Module Exam Type**

| Module Exam | Split Exam |
|---|---|
| | Data Engineering<br>• Study Format "Distance Learning": Oral Assignment<br>Project: Data Engineering<br>• Study Format "Fernstudium": Portfolio |

**Weight of Module**

see curriculum

**Module Contents**

**Data Engineering**

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

**Project: Data Engineering**

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

**Learning Outcomes**

**Data Engineering**

On successful completion, students will be able to

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

**Project: Data Engineering**

On successful completion, students will be able to

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

| **Links to other Modules within the Study Program** | **Links to other Study Programs of IU International University of Applied Sciences (IU)** |
|---|---|
| This module is similar to other modules in the field of Data Science & Artificial Intelligence. | All Master Programmes in the IT & Technology field. |

# Data Engineering

**Course Code: DLMDSEDE01**

| Study Level | Language of Instruction | 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** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Oral Assignment |

| **Student Workload** | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 110 h | 0 h | 20 h | 20 h | 0 h | 150 h |

| **Instructional Methods** | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☑ Guideline |
| ☑ Shortcast | ☐ Live Tutorium/Course Feed |
| ☑ Audio | ☐ Reader |
| ☐ Exam Template | ☐ Slides |

# Project: Data Engineering

**Course Code: DLMDSEDE02**

| Study Level | Language of Instruction | 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**<br>▪ Kleppmann, M. (2017). Designing data intensive applications: The big ideas behind reliable, scalable, and maintainable systems. Sebastopol, CA: O'Reilly.<br>▪ Farcic, V. (2016). The DevOps 2.0 toolkit: Automating the continuous deployment pipeline with containerized microservices. Scotts Valley, CA: CreateSpace Independent Publishing Platform.<br>▪ White, T. (2015). Hadoop: The definitive guide: Storage and analysis at Internet scale. Sebastopol, CA: O'Reilley.<br>▪ Karau, H., Konwinski, A., Wendell, P., & Zaharia, M. (2015). Learning Spark: Lightning fast data analysis. Sebastopol, CA: O'Reilley.<br>▪ 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 Fernstudium

| Study Format | Course Type |
|---|---|
| Fernstudium | Project |

| Information about the examination | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** no<br>**Course Evaluation:** no |
| **Type of Exam** | Portfolio |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 120 h | 0 h | 30 h | 0 h | 0 h | 150 h |

| Instructional Methods | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☐ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☑ Guideline |
| ☐ Shortcast | ☑ Live Tutorium/Course Feed |
| ☐ Audio | |
| ☐ Exam Template | |

# 3. Semester

# Inference and Causality

**Module Code: DLMAIIAC**

| Module Type | Admission Requirements | Study Level | CP | Student Workload |
|---|---|---|---|---|
| see curriculum | DLMDSAM, DLMDSAS, DLMDSPWP | MA | 5 | 150 h |

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

**Module Coordinator**

Prof. Dr. Ulrich Kerzel (Inference and Causality)

**Contributing Courses to Module**

- Inference and Causality (DLMAIIAC01)

**Module Exam Type**

| Module Exam | Split Exam |
|---|---|
| Study Format: Distance Learning<br>Advanced Workbook (passed / not passed) | |

**Weight of Module**

see curriculum

**Module Contents**

- Statistical inference
- Introduction to causality
- Interventions
- Do-calculus
- Fallacies

**Learning Outcomes**

**Inference and Causality**

On successful completion, students will be able to

- examine data in terms of statistical inference.
- create probabilistic models.
- understand the building blocks of causal inference.
- analyze interventions in statistical systems.
- follow the rules of do-calculus.
- evaluate common fallacies in causal analysis.

| **Links to other Modules within the Study Program** | **Links to other Study Programs of IU International University of Applied Sciences (IU)** |
|---|---|
| This module is similar to other modules in the fields of Data Science & Artificial Intelligence | All Master Programmes in the IT & Technology fields |

# Inference and Causality

**Course Code: DLMAIIAC01**

| Study Level | Language of Instruction | Contact Hours | CP | Admission Requirements |
|---|---|---|---|---|
| MA | English | | 5 | DLMDSAM, DLMDSAS, DLMDSPWP |

**Course Description**

Statistical inference and causal analysis are crucial tools for analyzing and understanding data on a fundamental level. This course starts with an introduction to Bayesian inference and Bayesian networks which use probabilities to describe statistical problems and introduce probabilistic modelling which allows the specification of Bayesian statistical models in code. This course introduces the concepts of causality, how causality relates to correlation between variables, and discusses the fundamental building blocks of causal analysis. The effect of interventions (i.e., when the experimenter actively changes the setup from which the data are taken) are also discussed. This course then introduces the rules of do-calculus, which allow interventions to be described formally.Finally, the course discusses a wide range of typical fallacies which arise in the context of causal analysis.

**Course Outcomes**

On successful completion, students will be able to

- examine data in terms of statistical inference.
- create probabilistic models.
- understand the building blocks of causal inference.
- analyze interventions in statistical systems.
- follow the rules of do-calculus.
- evaluate common fallacies in causal analysis.

**Contents**

1. Statistical Inference
   - 1.1 Bayesian inference
   - 1.2 Bayesian networks
   - 1.3 Probabilistic modelling
2. Introduction to Causality
   - 2.1 Correlation vs causation
   - 2.2 Granger causality
   - 2.3 Directed Acyclic Graphs (DAG)
   - 2.4 Elements of causal graphs: collider, chain, fork
   - 2.5 D – separation

3. Interventions
   - 3.1 Seeing vs doing
   - 3.2 Conditional independence
   - 3.3 Confounders & counterfactuals
   - 3.4 Causal inference vs randomized controlled trials

4. Do-calculus
   - 4.1 Front- & backdoor criterion
   - 4.2 Three rules of do-calculus

5. Fallacies
   - 5.1 Mediation fallacy
   - 5.2 Collider bias
   - 5.3 Simpson's & Berkson's Paradox
   - 5.4 Imputing missing values: causal vs data-driven view

**Literature**

**Compulsory Reading**

**Further Reading**


- Berzuini, C., Dawid, P., & Bernardinelli, L. (2012). Causality: Statistical perspectives and applications. Wiley.
- Hernan, M. A., & Robins, J. M. (2020). Causal inference: What if. CRC Press.
- Pearl, J. (2013). Causality: Models, reasoning and inference (2nd ed.). Cambridge University Press.
- Pearl, J., & Mackenzie, D. (2018). The book of why: The new science of cause and effect. Basic Books.
- Pearl, J., Glymour, M., & Jewell, N. P. (2016). Causal inference in statistics: A primer. Wiley.
- Wakefield, J. (2013). Bayesian and frequentist regression methods. Springer.

### Study Format Distance Learning

| **Study Format** | **Course Type** |
|---|---|
| Distance Learning | Online Lecture |

| **Information about the examination** | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Advanced Workbook (passed / not passed) |

| **Student Workload** | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 110 h | 0 h | 20 h | 20 h | 0 h | 150 h |

| **Instructional Methods** | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☑ Guideline |
| ☑ Shortcast | ☑ Live Tutorium/Course Feed |
| ☑ Audio | ☐ Reader |
| ☐ Exam Template | ☐ Slides |

# Reinforcement Learning

**Module Code: DLMAIRIL**

| Module Type | Admission Requirements | Study Level | CP | Student Workload |
|---|---|---|---|---|
| see curriculum | DLMDSAM, DLMDSPWP, DLMDSML, DLMDSDL | MA | 5 | 150 h |

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

**Module Coordinator**

Prof. Dr. Ulrich Kerzel (Reinforcement Learning)

**Contributing Courses to Module**

- Reinforcement Learning (DLMAIRIL01)

**Module Exam Type**

| Module Exam | Split Exam |
|---|---|
| Study Format: Distance Learning<br>Written Assessment: Written Assignment | |

**Weight of Module**

see curriculum

**Module Contents**

- Introduction to reinforcement learning
- Markov chains
- Bandit
- Q-Learning
- Reinforcement learning approaches

**Learning Outcomes**

**Reinforcement Learning**

On successful completion, students will be able to

- understand the concepts of reinforcement learning.
- analyze Markov decision processes.
- evaluate value functions, actions and policies.
- apply Q-Learning methods to reinforcement learning problems.
- summarize model-free and model-based approaches.
- evaluate the tradeoff between exploitation and exploration.

| **Links to other Modules within the Study Program** | **Links to other Study Programs of IU International University of Applied Sciences (IU)** |
|---|---|
| This module is similar to other modules in the fields of Data Science & Artificial Intelligence | All Master Programmes in the IT & Technology fields |

# Reinforcement Learning

**Course Code: DLMAIRIL01**

| Study Level | Language of Instruction | Contact Hours | CP | Admission Requirements |
|---|---|---|---|---|
| MA | English | | 5 | DLMDSAM, DLMDSPWP, DLMDSML, DLMDSDL |

**Course Description**

Reinforcement learning allows computers to derive problem-solving strategies without being explicitly programmed for the specific task, similar to the way humans and animals learn.After introducing the concepts of reinforcement learning, the course discusses the properties of Markov chains and single- and multi-armed bandits in detail. Special attention is given to the understanding of value functions and discounted value functions.The course connects reinforcement learning with neural networks and deep learning and discusses how Q-Learning approaches can be used to utilize deep learning methods in reinforcement learning problems, including extensions such as double Q-Learning, hierarchical learning, and actor-critic learning.Finally, the course discusses reinforcement learning approaches such as model-free and model-based learning and the tradeoff between exploration and exploitation.

**Course Outcomes**

On successful completion, students will be able to

- understand the concepts of reinforcement learning.
- analyze Markov decision processes.
- evaluate value functions, actions and policies.
- apply Q-Learning methods to reinforcement learning problems.
- summarize model-free and model-based approaches.
- evaluate the tradeoff between exploitation and exploration.

**Contents**

1. Introduction to Reinforcement Learning
   - 1.1 Understanding Reinforcement Learning
   - 1.2 Components of Reinforcement Learning Systems

2. Markov Chains
   - 2.1 Markov Decision Process & Markov Property
   - 2.2 Value Functions and Discounted Value Functions
   - 2.3 General Utility Function
   - 2.4 Actions & Policy
   - 2.5 Bellman's Equation
   - 2.6 Value Iteration
   - 2.7 Markov Chain Monte Carlo (MCMC)

3. Bandit
   - 3.1 Single-Arm Bandit
   - 3.2 Multi-Arm Bandit

4. Q-Learning
   - 4.1 Time-difference Learning
   - 4.2 Reinforcement Learning with Neural Networks & Deep Q Learning
   - 4.3 Experience Replay
   - 4.4 Double Q-Learning
   - 4.5 Delayed Sparse Rewards
   - 4.6 Hierarchical Learning
   - 4.7 Value- vs Policy-Based Learning
   - 4.8 Actor Critic Learning

5. Reinforcement Learning Approaches
   - 5.1 Model-Free Learning
   - 5.2 Model-Based Learning
   - 5.3 Exploration vs Exploitation

**Literature**

**Compulsory Reading**

**Further Reading**

- Bertsekas, D. P. (2019). Reinforcement learning and optimal control. Athena Scientific
- Sutton, R. S., & Barto, A. G. (1998). Reinforcement learning: An introduction. MIT Press.

### Study Format Distance Learning

| **Study Format** | **Course Type** |
|---|---|
| Distance Learning | Online Lecture |

| **Information about the examination** | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Written Assessment: Written Assignment |

| **Student Workload** | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 110 h | 0 h | 20 h | 20 h | 0 h | 150 h |

| **Instructional Methods** | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☑ Guideline |
| ☑ Shortcast | ☑ Live Tutorium/Course Feed |
| ☑ Audio | ☐ Reader |
| ☑ Exam Template | ☐ Slides |

DLMAIRIL01

# Software Engineering for Data Intensive Sciences

**Module Code: DLMDSSEDIS**

| Module Type | Admission Requirements | Study Level | CP | Student Workload |
|---|---|---|---|---|
| see curriculum | DLMDSPWP | MA | 5 | 150 h |

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

**Module Coordinator**

Prof. Dr. Max Pumperla (Software Engineering for Data Intensive Sciences)

**Contributing Courses to Module**

- Software Engineering for Data Intensive Sciences (DLMDSSEDIS01)

**Module Exam Type**

| Module Exam | Split Exam |
|---|---|
| Study Format: Distance Learning<br>Oral Assignment | |

**Weight of Module**

see curriculum

**Module Contents**

- Agile project management
- DevOps
- Software development
- API
- From model to production

**Learning Outcomes**

**Software Engineering for Data Intensive Sciences**

On successful completion, students will be able to

- understand the agile approaches Scrum and Kanban.
- explain how DevOps brings software development and operations together into one team.
- write high-quality code using relevant software development techniques.
- evaluate the requirements for APIs.
- create APIs for software applications.
- identify the challenges of bringing a model into production.

| Links to other Modules within the Study Program | Links to other Study Programs of IU International University of Applied Sciences (IU) |
|---|---|
| This module is similar to other modules in the fields of Data Science & Artificial Intelligence | All Master Programmes in the IT & Technology fields |

# Software Engineering for Data Intensive Sciences

**Course Code: DLMDSSEDIS01**

| Study Level | Language of Instruction | Contact Hours | CP | Admission Requirements |
|---|---|---|---|---|
| MA | English | | 5 | DLMDSPWP |

**Course Description**

Building a successful data-based product requires a significant amount of high-quality code which needs to run in a professional production environment. This course starts by introducing the agile approaches Scrum and Kanban and then discusses the shift from more traditional software development approaches to the DevOps culture.Special focus is given to the discussion and understanding of techniques and approaches for producing high-quality code such as unit and integration testing, test-driven development, pair programing, and continuous delivery and integration.Since many software artefacts are accessed via APIs, this course introduces concepts of API design and paradigms.Finally, this course addresses the challenges of bringing code into a production environment, building a scalable environment, and using cloud-cased approaches.

**Course Outcomes**

On successful completion, students will be able to

- understand the agile approaches Scrum and Kanban.
- explain how DevOps brings software development and operations together into one team.
- write high-quality code using relevant software development techniques.
- evaluate the requirements for APIs.
- create APIs for software applications.
- identify the challenges of bringing a model into production.

**Contents**

1. Agile Project Management
   - 1.1 Introduction to SCRUM
   - 1.2 Introduction to Kanban
2. DevOps
   - 2.1 Traditional lifecycle management
   - 2.2 Bringing development and operations together
   - 2.3 Impact of team structure
   - 2.4 Building a DevOps infrastructure

3. Software Development
   - 3.1 Unit & integration test, performance monitoring
   - 3.2 Test-driven development & pair programing
   - 3.3 Continuous delivery & integration
   - 3.4 Overview of relevant tools

4. API
   - 4.1 API design
   - 4.2 API paradigms

5. From Model to Production
   - 5.1 Building a scalable environment
   - 5.2 Model versioning and persistence
   - 5.3 Cloud-based approaches

**Literature**

**Compulsory Reading**

**Further Reading**


- Farcic, V. (2016). The DevOps 2.0 toolkit: Automating the continuous deployment pipeline with containerized microservices. CreateSpace Independent Publishing Platform.
- Hunt, A., & Thomas, D. (1999). The pragmatic programmer: From journeyman to master. Addison Wesley.
- Kelleher, A. & Kelleher, A. (2019). Machine learning in production: Developing and optimizing data science workflows and applications. Addison-Wesley.
- Kerzner, H. (2017). Project Management - A Systems Approach to Planning, Scheduling, and Controlling (12th ed., pp. 74—75). John Wiley & Sons.
- Martin, R. C. (2008). Clean code. Prentice Hall.

### Study Format Distance Learning

| Study Format | Course Type |
|---|---|
| Distance Learning | Online Lecture |

| Information about the examination | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Oral Assignment |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 110 h | 0 h | 20 h | 20 h | 0 h | 150 h |

| Instructional Methods | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☑ Guideline |
| ☑ Shortcast | ☐ Live Tutorium/Course Feed |
| ☐ Audio | ☐ Reader |
| ☐ Exam Template | ☐ Slides |

DLMDSSEDIS01

# Management

**Module Code: DLMMANE**

| Module Type | Admission Requirements | Study Level | CP | Student Workload |
|---|---|---|---|---|
| see curriculum | None | MBA | 10 | 300 h |

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

**Module Coordinator**

Prof. Dr. Georg Berkel (Leadership) / Prof. Dr. Josephine Zhou-Brock (Strategic Management)

**Contributing Courses to Module**

- Leadership (DLMBLSE01)
- Strategic Management (DLMBSME01)

**Module Exam Type**

| Module Exam | Split Exam |
|---|---|
| | Leadership<br>• Study Format "myStudies": Exam, 90 Minutes<br>• Study Format "Distance Learning": Exam, 90 Minutes<br>Strategic Management<br>• Study Format "myStudies": Exam, 90 Minutes<br>• Study Format "Distance Learning": Exam, 90 Minutes |

**Weight of Module**

see curriculum

**Module Contents**

**Leadership**

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

**Strategic Management**

- Foundations of professional leadership
- Leadership and motivation in the corporation
- Leadership and corporate culture
- Leadership and change management

**Learning Outcomes**

**Leadership**

On successful completion, students will be able to

- recognize underlying beliefs and attitudes towards leadership and compare the influence of various theories of leadership on the identification and development of leaders.
- recognize the impact of cultural environments on leadership, and understand the challenges and opportunities of cross-cultural management.
- outline the influence of social roles on leaders and employees, and assess the influence of roles types on the interactions between leaders and those they are leading.
- ,as a leader, support employees by drawing on empirical evidence to effectively meet the expectations of employees.
- recognize the roles and conflicting interests inherent to leadership positions and develop strategies to address locomotion and cohesion.
- discriminate between effective and non-effective methods for managing staff and organizational activities, and apply those techniques and tools in practice to maximize the satisfaction and effectiveness of staff.
- perform the various responsibilities delegated to a leader such as communicate with employees, lead planning activities, delegate tasks, and plan and lead controlling activities.
- create a plan to support employees through the process of change within an organization.
- assess personal leadership style using a variety of measures and evaluate leadership activities relative to transactional and transformational leadership styles.

**Strategic Management**

On successful completion, students will be able to

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

| **Links to other Modules within the Study Program** | **Links to other Study Programs of IU International University of Applied Sciences (IU)** |
|---|---|
| This module is similar to other modules in the fields of Business Administration & Management | All Master Programmes in the Business & Management fields |

# Leadership

**Course Code: DLMBLSE01**

| Study Level | Language of Instruction | Contact Hours | CP | Admission Requirements |
|---|---|---|---|---|
| MBA | English | | 5 | None |

**Course Description**

In today's knowledge-based society, employees are a firm's most valuable resource. A key responsibility of leadership is to develop the knowledge, expertise, and skills of employees. Good leadership is crucial for the continued success of a firm in the face of increasingly competitive markets. This course presents the necessary competencies of the leader in a modern, knowledge-based organization. Central questions raised by modern leadership theory are presented and discussed. In doing so, the course focuses on requirements and instruments of professional leadership, aspects of situational leadership, and leadership communication and interactions, both in the context of strategic management and change processes. The methodological and conceptual foundations of leadership are presented to students, along with empirical examples and best-practice principles, with the intent for students to master the challenges of enhancing the firm's most valuable asset—its employees—via professional and contemporary leadership practices.

**Course Outcomes**

On successful completion, students will be able to

- recognize underlying beliefs and attitudes towards leadership and compare the influence of various theories of leadership on the identification and development of leaders.
- recognize the impact of cultural environments on leadership, and understand the challenges and opportunities of cross-cultural management.
- outline the influence of social roles on leaders and employees, and assess the influence of roles types on the interactions between leaders and those they are leading.
- ,as a leader, support employees by drawing on empirical evidence to effectively meet the expectations of employees.
- recognize the roles and conflicting interests inherent to leadership positions and develop strategies to address locomotion and cohesion.
- discriminate between effective and non-effective methods for managing staff and organizational activities, and apply those techniques and tools in practice to maximize the satisfaction and effectiveness of staff.
- perform the various responsibilities delegated to a leader such as communicate with employees, lead planning activities, delegate tasks, and plan and lead controlling activities.
- create a plan to support employees through the process of change within an organization.
- assess personal leadership style using a variety of measures and evaluate leadership activities relative to transactional and transformational leadership styles.

**Contents**

1. An Overview of Leadership
   - 1.1 Leadership and Personality: Trait Theories
   - 1.2 Leadership as a Skill: Attribute and Behavior Theories
   - 1.3 Positive Reinforcement: Behavioral Theories
   - 1.4 Leadership Dependent on the Situation: Situational Approaches
   - 1.5 Situational and Contingency Theories
   - 1.6 Theory of Functional Leadership Behavior
   - 1.7 Integrated Psychological Theory
   - 1.8 Transactional and Transformative Leadership
   - 1.9 Leadership as an Emotionally Charged Process
   - 1.10 Neo-Emergent Theory

2. Leadership as a Social Role
   - 2.1 Roles and Groups
   - 2.2 Role Types
   - 2.3 Formal Conditions for Social Roles – Corporate Context Determining Roles in Organizations
   - 2.4 The Individual and The Group – Conforming and Deviating Behavior
   - 2.5 The Problems of Formalized Role Understanding and Self-Concept

3. Leadership from the Employee's Perspective
   - 3.1 General Expectations for Managers
   - 3.2 Truthfulness and Authenticity
   - 3.3 Handling Conflicts Competently
   - 3.4 Conflicts in Groups
   - 3.5 Conflict Resolution Pattern According to Matzat
   - 3.6 Enthusiasm
   - 3.7 Ability to Cope with Pressure
   - 3.8 Assertiveness
   - 3.9 Empathy
   - 3.10 Expertise

4. Leadership from the Manager's Perspective
   - 4.1 Self-Concept as a Manager
   - 4.2 Locomotion and Cohesion
   - 4.3 Individual Problems and Learning Dimensions of Management Behavior
   - 4.4 The Concept of Human Nature and Its Influence on Management Behavior: Theories from Maslow, McGregor, and Herzberg
   - 4.5 Ambiguity Tolerance

5. Management Tools
   - 5.1 Management Tools - Definition
   - 5.2 Organizational Management Tools
   - 5.3 Personnel Management Tools

6. Managerial Functions
   - 6.1 Responsibilities of a Manager
   - 6.2 Communication
   - 6.3 Foundations of Interpersonal Communication
   - 6.4 Planning
   - 6.5 Setting Objectives
   - 6.6 Delegating
   - 6.7 Controlling
   - 6.8 Creating a Feedback Culture

7. Organizational Change
   - 7.1 Knowledge
   - 7.2 Cultural Value Change and Subjectification
   - 7.3 Globalization
   - 7.4 Technological Progress
   - 7.5 Change Management – Leadership in Times of Change

8. Successful Employee Management
   - 8.1 Measuring Leadership Style and Leadership Behavior
   - 8.2 Measuring Transactional and Transformational Leadership with the Multifactor Leadership Questionnaire (MLQ)
   - 8.3 Correlation of Leadership Behavior with Subjective and Objective Success Criteria
   - 8.4 Validation of Leadership Success Using Situational Factors
   - 8.5 Leadership Principles Guiding Leadership Behavior

**Literature**

**Compulsory Reading**

**Further Reading**


- Gneezy, U., & Rustichini, A. (2000). Pay enough or don't pay at all. The Quarterly Journal of Economics,115(3), 791–810. (Database: EBSCO).
- Goleman, D., Boyatzis, R., & McKee, A. (2004). Primal leadership: Learning to lead with emotionalintelligence. Boston, MA: Harvard Business School Press.
- Hechter, M., & Opp, K.-D. (2001). Social norms. New York, NY: Russell Sage Foundation.
- Herzberg, F., Mausner, B., & Bloch Synderman, B. (1993). The motivation to work. New Brunswick:Transaction Publishers. (Database: EBSCO).
- Kouzes, J. M., & Posner, B. Z. (1999). Encouraging the heart: A leader's guide to rewarding and recognizingothers. San Francisco, CA: Jossey-Bass. (Database: CIANDO).
- Maslow, A. (1954). Motivation and personality. New York, NY: Harper & Row.
- Norton, R. W. (1975). Measurement of ambiguity tolerance. Journal of Personality Assessment, 39(6), 607–619. (Database: EBSCO).
- Trilling, L. (1972). Sincerity and authenticity. Cambridge, MA: Harvard University Press. (Database: EBSCO).

### Study Format myStudies

| Study Format | Course Type |
|---|---|
| myStudies | Lecture |

| Information about the examination | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Exam, 90 Minutes |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 90 h | 0 h | 30 h | 30 h | 0 h | 150 h |

| Instructional Methods | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☑ Vodcast | ☐ Guideline |
| ☐ Shortcast | ☑ Live Tutorium/Course Feed |
| ☑ Audio | |
| ☑ Exam Template | |

### Study Format Distance Learning

| **Study Format** | **Course Type** |
|---|---|
| Distance Learning | Online Lecture |

| **Information about the examination** | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Exam, 90 Minutes |

| **Student Workload** | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 90 h | 0 h | 30 h | 30 h | 0 h | 150 h |

| **Instructional Methods** | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☑ Vodcast | ☐ Guideline |
| ☐ Shortcast | ☑ Live Tutorium/Course Feed |
| ☑ Audio | |
| ☑ Exam Template | |

# Strategic Management

**Course Code: DLMBSME01**

| Study Level | Language of Instruction | Contact Hours | CP | Admission Requirements |
|---|---|---|---|---|
| MBA | English | | 5 | None |

**Course Description**

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

**Course Outcomes**

On successful completion, students will be able to

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

**Contents**

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

2. The Strategic Environment
   - 2.1 Where Are We in the Market Place? The Macro Environment
   - 2.2 Where Are We in the Market Place? The Micro Environment
   - 2.3 Analysis, Strategic Capabilities, and the Five Forces Model

3. The Position in the Market
   - 3.1 Why Do We Exist?
   - 3.2 What is Our Position in the Market?
   - 3.3 What Information Does the Company Need?
   - 3.4 What Capabilities Does the Company Have?
   - 3.5 What Capabilities Do Others Have?

4. What Strategic Options Are Available to the Strategic Business Unit (SBU)?
   - 4.1 What Strategic Options Does the SBU Have?
   - 4.2 Interactive Strategies
   - 4.3 Product Life Cycle

5. What Strategic Options Are Available to the Corporation?
   - 5.1 Areas to Consider When Formulating a Strategy
   - 5.2 Strategic Options
   - 5.3 Outsourcing
   - 5.4 Product Portfolio Analysis Using the BCG Matrix
   - 5.5 Product Portfolio Analysis Using the GE-McKinsey Matrix

6. What International Strategies Are Available?
   - 6.1 Why Do Companies Go International?
   - 6.2 What Factors Contribute to the Decision About Which Country to Invest In?
   - 6.3 How Can a Company Invest Internationally?

7. Do-It-Yourself, Buy, or Ally?
   - 7.1 Do-It-Yourself
   - 7.2 Mergers and Acquisitions (M&As)
   - 7.3 Strategic Alliances
   - 7.4 How to Decide Whether to Buy, Alley, or Do-It-Yourself?

8. How to Evaluate Strategies?
   - 8.1 How to Evaluate Strategy?
   - 8.2 Implementing Strategy

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

### Study Format myStudies

| Study Format | Course Type |
|---|---|
| myStudies | Lecture |

| Information about the examination | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Exam, 90 Minutes |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 90 h | 0 h | 30 h | 30 h | 0 h | 150 h |

| Instructional Methods | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☐ Guideline |
| ☑ Shortcast | ☑ Live Tutorium/Course Feed |
| ☑ Audio | ☐ Reader |
| ☑ Exam Template | ☐ Slides |

### Study Format Distance Learning

| Study Format | Course Type |
|---|---|
| Distance Learning | Online Lecture |

| Information about the examination | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Exam, 90 Minutes |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 90 h | 0 h | 30 h | 30 h | 0 h | 150 h |

| Instructional Methods | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☐ Guideline |
| ☑ Shortcast | ☑ Live Tutorium/Course Feed |
| ☑ Audio | ☐ Reader |
| ☑ Exam Template | ☐ Slides |

# Sales, Pricing and Brand Management

**Module Code: DLMBSPBE**

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

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

**Module Coordinator**

Caterina Fox (Global Brand Management) / Caterina Fox (Sales and Pricing)

**Contributing Courses to Module**

- Global Brand Management (DLMBSPBE01)
- Sales and Pricing (DLMBSPBE02)

**Module Exam Type**

| Module Exam | Split Exam |
|---|---|
| | Global Brand Management<br>• Study Format "Distance Learning": Exam, 90 Minutes<br>Sales and Pricing<br>• Study Format "Distance Learning": Exam, 90 Minutes |

**Weight of Module**

see curriculum

**Module Contents**

**Global Brand Management**

- For most companies, a major opportunity to grow their business involves looking for possibilities outside their native country. However, taking brands beyond national boundaries presents a new set of branding issues as the global marketplace is constantly changing. At the same time, various forms of regionalization are taking place, adding another layer of complexity to managing a brand portfolio. Arguably, products, pricing and distribution are increasingly becoming commodities and the new competitive arena is brand value, creating long-term, profitable brand relationships. Ultimately, strong brands will transcend industries and provide an organization with one of its most valuable assets. This course ultimately aims to introduce students to the differentiation of products and services in a world of alternatives and the benefits/disadvantages of providing customers with the power of choice.

Establishing and maintaining a competitive customer interface is one of the major challenges for every company to assure successful revenue- and profit-management. The course will allow students to understanding the optimization levers of the customer interface. This includes advanced methods of market- and customer segmentation, channel management including the design, setup and optimization of a customer oriented sales organization (e.g. key account management), practices for sales-force-effectiveness, sales optimization levers, e.g. for customer penetration, and methods for price-differentiation and -realization. The course incorporates case-studies and practice related data and for each optimization lever, students are introduced to a comprehensive tool-box approach. The tool box for each lever contains the required theory, a set of basic analyses and the application of best-practice examples and metrics.

**Sales and Pricing**

**Learning Outcomes**

**Global Brand Management**

On successful completion, students will be able to

- analyze brands, brand components and brand management.
- examine how brands are positioned and re-positioned in regional, national and international markets and explore the concept of shared- and co-operative branding.
- promote the importance of brand valuation and measurement techniques within their company.
- form and apply tactics to address brand falsification and protection as well as to develop strategies to manage a brand crisis.
- analyze the main challenges facing international brands, and be able to measure their brand equity
- understand the factors that contribute to increasing or losing consumer-based brand equity.
- analyze a company's current brand strategy and propose viable alternatives as well as make informed decisions with greater probability of success.

**Sales and Pricing**

On successful completion, students will be able to

- identify the key-success factors for modern sales organizations.
- describe the relationship between segmentation and the design of an appropriate sales organization.
- execute respective analyses and apply improvement levers.
- demonstrate the use of the tool-boxes for the respective optimization levers.
- identify major characteristics of a high-performance sales organization.
- conduct decisive analyses to assess the strength and weaknesses of a sales organization and identify respective optimization levers.
- implement the required organizational and process-related improvement levers.
- measure the performance of a sales-organization using established methods, KPIs and metrics.
- apply fundamental concepts of international pricing.

| **Links to other Modules within the Study Program** | **Links to other Study Programs of IU International University of Applied Sciences (IU)** |
|---|---|
| This module is similar to other modules in the field(s) of Marketing & Sales | All Master Programmes in the Marketing field(s) |

# Global Brand Management

**Course Code: DLMBSPBE01**

| Study Level | Language of Instruction | Contact Hours | CP | Admission Requirements |
|---|---|---|---|---|
| MA | English | | 5 | none |

**Course Description**

For most companies, a major opportunity to grow their business involves looking for possibilities outside their native country. However, taking brands beyond national boundaries presents a new set of branding issues as the global marketplace is constantly changing. At the same time, various forms of regionalization are taking place, adding another layer of complexity to managing a brand portfolio. Arguably, products, pricing and distribution are increasingly becoming commodities and the new competitive arena is brand value, creating long-term, profitable brand relationships. Ultimately, strong brands will transcend industries and provide an organization with one of its most valuable assets. This course ultimately aims to introduce students to the differentiation of products and services in a world of alternatives and the benefits/disadvantages of providing customers with the power of choice.

**Course Outcomes**

On successful completion, students will be able to

- analyze brands, brand components and brand management.
- examine how brands are positioned and re-positioned in regional, national and international markets and explore the concept of shared- and co-operative branding.
- promote the importance of brand valuation and measurement techniques within their company.
- form and apply tactics to address brand falsification and protection as well as to develop strategies to manage a brand crisis.
- analyze the main challenges facing international brands, and be able to measure their brand equity
- understand the factors that contribute to increasing or losing consumer-based brand equity.
- analyze a company's current brand strategy and propose viable alternatives as well as make informed decisions with greater probability of success.

**Contents**

1. Introduction to Global Brand Management
   - 1.1 Brand, Brand Equity, and Brand Value
   - 1.2 Brand Management and Brand Leadership
   - 1.3 Integrating Marketing Activities

2. Culture and Branding
   - 2.1 What is Culture?
   - 2.2 Culture and Consumer Behavior
   - 2.3 The Global-Local Dilemma of Branding

3. Creating Global Brands
   - 3.1 Brand Positioning
   - 3.2 Designing and Implementing Stages of Branding Strategies
   - 3.3 Choosing Brand Elements to Build Brand Equity
   - 3.4 Designing Marketing Programs to Build Brand Equity

4. Managing Global Brands
   - 4.1 Branding Strategy
   - 4.2 Brand Hierarchy
   - 4.3 Business-to-Business (B2B) Brand Management Strategies

5. Growing and Sustaining Brand Equity
   - 5.1 Extending the Brand
   - 5.2 Brand Alliances
   - 5.3 Green and Cause Marketing

6. Measuring Global Brand Equity and Performance
   - 6.1 Brand Equity Measurement Systems
   - 6.2 Measuring Sources of Brand Equity
   - 6.3 Measuring Outcomes of Brand Equity

7. Brand Analysis and Strategy Across Multiple Markets: A Managerial Approach
   - 7.1 Internal Analysis
   - 7.2 External Analysis
   - 7.3 Global Brand Management Scenarios

8. Managing a Brand Crisis
   - 8.1 Revitalizing a Brand
   - 8.2 Brand Falsification
   - 8.3 Brand Protection Strategies
   - 8.4 Brand Crises

| Literature |
| --- |
| **Compulsory Reading** |
| **Further Reading**<br>▪ Aaker, D. A. (1991). Managing brand equity. New York, NY: Free Press.<br>▪ de Mooij, M. (2014). Global marketing and advertising: Understanding cultural paradoxes (4th ed.). Thousand Oaks, CA: Sage.<br>▪ Kapferer, J. N. (2012). The new strategic brand management: Advanced insights and strategic thinking (5th ed.). London: Kogan Page.<br>▪ Keller, K. L., Aperia, T., & Georgson, M. (2013). Strategic brand management: A European perspective (2nd ed.). Upper Saddle River, NJ: Prentice Hall. (Database: MyiLibrary). |

### Study Format Distance Learning

| Study Format | Course Type |
|---|---|
| Distance Learning | Online Lecture |

| Information about the examination | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Exam, 90 Minutes |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 90 h | 0 h | 30 h | 30 h | 0 h | 150 h |

| Instructional Methods | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☑ Vodcast | ☐ Guideline |
| ☐ Shortcast | ☐ Live Tutorium/Course Feed |
| ☑ Audio | ☐ Reader |
| ☑ Exam Template | ☐ Slides |

# Sales and Pricing

**Course Code: DLMBSPBE02**

| Study Level | Language of Instruction | Contact Hours | CP | Admission Requirements |
|---|---|---|---|---|
| MA | English | | 5 | DLMBSPBE01 |

**Course Description**

Establishing and maintaining a competitive customer interface is one of the major challenges for every company to assure successful revenue- and profit-management.The course will allow students to understanding the optimization levers of the customer interface. This includes advanced methods of market- and customer segmentation, channel management including the design, setup and optimization of a customer oriented sales organization (e.g. key account management), practices for sales-force-effectiveness, sales optimization levers, e.g. for customer penetration, and methods for price-differentiation and -realization.The course incorporates case-studies and practice related data and for each optimization lever, students are introduced to a comprehensive tool-box approach. The tool box for each lever contains the required theory, a set of basic analyses and the application of best-practice examples and metrics.

**Course Outcomes**

On successful completion, students will be able to

- identify the key-success factors for modern sales organizations.
- describe the relationship between segmentation and the design of an appropriate sales organization.
- execute respective analyses and apply improvement levers.
- demonstrate the use of the tool-boxes for the respective optimization levers.
- identify major characteristics of a high-performance sales organization.
- conduct decisive analyses to assess the strength and weaknesses of a sales organization and identify respective optimization levers.
- implement the required organizational and process-related improvement levers.
- measure the performance of a sales-organization using established methods, KPIs and metrics.
- apply fundamental concepts of international pricing.

**Contents**

1. Segmentation
   - 1.1 Customer Segmentation
   - 1.2 Selection of Market Segments for Market Entry
   - 1.3 Development of Market Segments

2. Channel Management
   - 2.1 Distribution System as a Function of the Products Sold
   - 2.2 Selection of Distribution Partners
   - 2.3 Professionalization and Mobilization of Distribution Partners
   - 2.4 Control of Distribution Partners

3. Sales Force Effectiveness
   - 3.1 Sales Strategy
   - 3.2 Sales Process
   - 3.3 Sales Organization
   - 3.4 Sales Information and Management Systems
   - 3.5 Sales Controlling

4. Sales Optimization Levers
   - 4.1 Key Account Management
   - 4.2 Proactive Sales
   - 4.3 Value-Based Selling
   - 4.4 Online Sales Tools

5. Fundamentals of International Pricing
   - 5.1 Pricing Strategies
   - 5.2 Pricing for Market Segments
   - 5.3 Transaction Pricing and Managing the Price Waterfall
   - 5.4 Price Differentiation and Standardization in an International Context

6. Special Topics in International Pricing
   - 6.1 Gray Markets
   - 6.2 Transfer Pricing
   - 6.3 Price Wars
   - 6.4 Innovative Pricing Methods
   - 6.5 Risks in International Business

| Literature |
| --- |
| **Compulsory Reading** |
| **Further Reading**<br>▪ Dibb, S., & Simkin, L. (2010). The market segmentation workbook: Target marketing for marketing managers. Boston, MA: Cengage Learning.<br>▪ Kotler, P., Keller, K., Brady, M., Goodman, M., & Hansen, T. (2016). Marketing management (3rd ed.) (pp. 331–420). Harlow: Pearson Education. (Database: Myilibrary).<br>▪ Nagle, T. T., Zale, J., & Hogan, J. (2016). The strategy and tactics of pricing (5th ed.). Abingdon: Routledge. (Database: EBSCO).<br>▪ Zoltners, A. A., Sinha, P., & Zoltners, G. A. (2001). The complete guide to accelerating sales force performance: How to get more sales from your sales force. New York, NY: Amacom. (Database: EBSCO). |

### Study Format Distance Learning

| Study Format | Course Type |
|---|---|
| Distance Learning | Online Lecture |

| Information about the examination | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Exam, 90 Minutes |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 90 h | 0 h | 30 h | 30 h | 0 h | 150 h |

| Instructional Methods | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☑ Vodcast | ☐ Guideline |
| ☐ Shortcast | ☐ Live Tutorium/Course Feed |
| ☑ Audio | ☐ Reader |
| ☑ Exam Template | ☐ Slides |

DLMBSPBE02

# Consumer Behavior and Research

**Module Code: DLMBCBR**

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

| Semester / Term | Duration | Regularly offered in | Language of Instruction |
|---|---|---|---|
| see curriculum | Minimaldauer:<br>1 Semester | WiSe/SoSe | English |

**Module Coordinator**

Caterina Fox (International Consumer Behavior) / Caterina Fox (Applied Marketing Research)

**Contributing Courses to Module**

- International Consumer Behavior (DLMBCBR01)
- Applied Marketing Research (DLMBCBR02)

**Module Exam Type**

| Module Exam | Split Exam |
|---|---|
| | International Consumer Behavior<br>• Study Format "Distance Learning": Exam, 90 Minutes<br>Applied Marketing Research<br>• Study Format "Distance Learning": Exam, 90 Minutes |

**Weight of Module**

see curriculum

**Module Contents**

**International Consumer Behavior**

- Consumer Behavior
- The Consumer Decision-Making Process
- Internal Influences on Consumer Behavior
- External Influences on Consumer Behavior
- International Consumer Behavior
- International Marketing Strategy and Consumer Behavior

**Applied Marketing Research**

- The Role of Marketing Research in Managerial Decision-Making
- Problem Definition and the Marketing Research Process
- Secondary Data and Qualitative Research
- Survey Research and the Concept of Measurement
- Observational Research
- Sampling Issues, Data Processing, and Fundamental Data Analysis
- Communicating the Research Results

**Learning Outcomes**

**International Consumer Behavior**

On successful completion, students will be able to

- outline the purchase decision-making process undertaken by the consumer.
- describe the internal and external influences on the consumer decision-making processes.
- identify the different research methods available to companies to collect relevant data regarding their consumers and their behavior
- develop a plan to generate required market research data regarding consumer behavior and decision-making.
- be able to generate, analyze, interpret and report relevant data regarding consumers.
- present the key concepts characterizing international consumer behavior and discuss their impact on global marketing strategies.

**Applied Marketing Research**

On successful completion, students will be able to

- recognize and promote the importance of marketing research methodologies in supporting key marketing management decisions.
- identify some of the challenges of marketing research in an international environment.
- identify appropriate analysis tools for a given marketing related problem on a strategic and operational level.
- identify errors made in the research process.
- Outline the stages of the marketing research process.
- identify ethics problems in a marketing research situation and propose an ethically sound approach.
- propose a research design to study a particular research question.
- compare and contrast different research methods.
- recommend good practice for a variety of research techniques.
- Design questionnaires with sound measurement properties.
- interpret results of advanced marketing research efforts.
- transfer the gained insights into their future international work environment.

| **Links to other Modules within the Study Program** | **Links to other Study Programs of IU International University of Applied Sciences (IU)** |
|---|---|
| This module is similar to other modules in the field(s) Marketing & Sales | All Master Programmes in the Marketing field(s) |

# International Consumer Behavior

**Course Code: DLMBCBR01**

| Study Level | Language of Instruction | Contact Hours | CP | Admission Requirements |
|---|---|---|---|---|
| MA | English | | 5 | none |

**Course Description**

In a global economy characterized by greater competition, companies operating internationally need comprehensive market-driven strategies to survive in the market place. The course provides students with the relevant concepts for understanding the international environment of the company with focus on the demand side/the consumer. Students learn how differences in culture, economic systems, and political environments impact consumers' behavior in terms of decision-making in the fields of acquisition, consumption, and disposal of products, services, experiences, and ideas.

**Course Outcomes**

On successful completion, students will be able to

- outline the purchase decision-making process undertaken by the consumer.
- describe the internal and external influences on the consumer decision-making processes.
- identify the different research methods available to companies to collect relevant data regarding their consumers and their behavior
- develop a plan to generate required market research data regarding consumer behavior and decision-making.
- be able to generate, analyze, interpret and report relevant data regarding consumers.
- present the key concepts characterizing international consumer behavior and discuss their impact on global marketing strategies.

**Contents**

1. Consumer Behavior
   - 1.1 Consumer Behavior and International Marketing
   - 1.2 Consumer Decision-Making in the Marketplace
2. The Consumer Decision-Making Process
   - 2.1 The Pre-Purchase Stage
   - 2.2 The Purchase Stage
   - 2.3 The Post-Purchase Stage

3. Internal Influences on Consumer Behavior
   - 3.1 Motives and Motivation
   - 3.2 Perception
   - 3.3 Attitude

4. External Influences on Consumer Behavior
   - 4.1 Culture
   - 4.2 Subculture
   - 4.3 Groups and Families

5. International Consumer Behavior
   - 5.1 Cultural Dimensions
   - 5.2 The Influence of Social Media on Consumer Decision-Making

6. International Marketing Strategy and Consumer Behavior
   - 6.1 International Market Segmentation and Product Positioning
   - 6.2 Consumer Behavior and Product Strategy
   - 6.3 Consumer Behavior and Communication Strategy
   - 6.4 Consumer Behavior and Pricing Strategy
   - 6.5 Consumer Behavior and Distribution Strategy

**Literature**

**Compulsory Reading**

**Further Reading**


- Schiffman, L. G., & Kanuk, L. L. (2014). Consumer behavior. Frenchs Forest.: Pearson Education Australia.
- Solomon, M. (2016). Consumer behavior: Buying, having, and being (12th ed.). New York City, NY: Pearson.

### Study Format Distance Learning

| Study Format | Course Type |
|---|---|
| Distance Learning | Online Lecture |

| Information about the examination | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Exam, 90 Minutes |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 90 h | 0 h | 30 h | 30 h | 0 h | 150 h |

| Instructional Methods | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☐ Guideline |
| ☑ Shortcast | ☐ Live Tutorium/Course Feed |
| ☑ Audio | |
| ☑ Exam Template | |

# Applied Marketing Research

**Course Code: DLMBCBR02**

| Study Level | Language of Instruction | Contact Hours | CP | Admission Requirements |
|---|---|---|---|---|
| MA | English | | 5 | DLMBCBR01 |

**Course Description**

In a global economy characterized by greater competition, companies operating internationally need comprehensive market-driven strategies in order to survive in the market place. The course allows students to explore marketing research, the information-gathering arm of marketing practice. The topic is viewed primarily from the perspective of a consumer of marketing research, i.e. a busy manager who needs information to guide decision making. Given their role in decision-making regarding marketing and sourcing marketing research, it is helpful for managers to understand how producers of research approach the process. This background will help you as a manager to become a better-informed consumer of research who is able to participate in research design, evaluate the quality of marketing information that crosses your desk, and conduct marketing research projects yourself when appropriate.

**Course Outcomes**

On successful completion, students will be able to

- recognize and promote the importance of marketing research methodologies in supporting key marketing management decisions.
- identify some of the challenges of marketing research in an international environment.
- identify appropriate analysis tools for a given marketing related problem on a strategic and operational level.
- identify errors made in the research process.
- Outline the stages of the marketing research process.
- identify ethics problems in a marketing research situation and propose an ethically sound approach.
- propose a research design to study a particular research question.
- compare and contrast different research methods.
- recommend good practice for a variety of research techniques.
- Design questionnaires with sound measurement properties.
- interpret results of advanced marketing research efforts.
- transfer the gained insights into their future international work environment.

**Contents**

1. The Role of Marketing Research in Managerial Decision-Making
   - 1.1 The Importance of Marketing Research in Decision-Making
   - 1.2 The Institutions Involved in Marketing Research
   - 1.3 Common Challenges in Conducting Marketing Research

2. Problem Definition and the Marketing Research Process
   2.1 From Problem Recognition to Research Objectives: Step One
   2.2 From Research Design to Follow-Up: Steps Two to Six
   2.3 Forward and Backward Linkages in the Marketing Research Process

3. Secondary Data and Qualitative Research
   3.1 Advantages and Limitations of Secondary Data
   3.2 Definition and Types of Qualitative Research
   3.3 Limitations of Qualitative Research

4. Survey Research and the Concept of Measurement
   4.1 Survey Errors and Their Impact on Research Outcomes
   4.2 Measurement Scales
   4.3 Questionnaire Design

5. Observational Research
   5.1 Observational Research Defined
   5.2 Approaches to Observational Research
   5.3 Advantages and Limitations of Observational Research

6. Sampling Issues, Data Processing, and Fundamental Data Analysis
   6.1 Sampling Methods and Types of Samples
   6.2 Data Processing Issues
   6.3 Fundamental Data Analysis

7. Communicating the Research Results
   7.1 The Major Steps in Communicating the Results
   7.2 Organization of the Research Report
   7.3 The Marketing Research Presentation

| Literature |
| --- |
| **Compulsory Reading** |
| **Further Reading**<br>▪ Aaker, D. A., Kumar, V., Leone, R., & Day, G. S. (2012). Marketing research (11th ed.). Hoboken, NJ: John Wiley & Sons.<br>▪ Grover, R., & Vriens, M. (2006). The handbook of marketing research: Uses, misuses, and future advances. Thousand Oaks, CA: Sage Publications.<br>▪ Iacobucci, D., & Churchill, G. A. (2015). Marketing research: Methodological foundations (11th ed.). Mason, OH: South-Western Thomson Learning.<br>▪ Malhotra, N. K., Birks, D. F., & Wills, P. A. (2012). Marketing research: An applied approach (4th ed.). Harlow: Pearson. |

### Study Format Distance Learning

| Study Format | Course Type |
|---|---|
| Distance Learning | Online Lecture |

| Information about the examination | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Exam, 90 Minutes |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 90 h | 0 h | 30 h | 30 h | 0 h | 150 h |

| Instructional Methods | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☐ Guideline |
| ☑ Shortcast | ☐ Live Tutorium/Course Feed |
| ☑ Audio | |
| ☑ Exam Template | |

# Corporate Finance

**Module Code: DLMBCF**

| Module Type | Admission Requirements | Study Level | CP | Student Workload |
|---|---|---|---|---|
| see curriculum | None | MBA MA | 10 | 300 h |

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

**Module Coordinator**

Prof. Dr. Stéphane Timmer (Corporate Finance) / Prof. Dr. Andreas Simon (Advanced Corporate Finance)

**Contributing Courses to Module**

- Corporate Finance (DLMINRE01)
- Advanced Corporate Finance (DLMBCFIE01)

**Module Exam Type**

| Module Exam | Split Exam |
|---|---|
| | Corporate Finance<br>• Study Format "Distance Learning": Exam, 90 Minutes<br>• Study Format "myStudies": Exam, 90 Minutes<br>Advanced Corporate Finance<br>• Study Format "Distance Learning": Exam |

**Weight of Module**

see curriculum

**Module Contents**

**Corporate Finance**

- Portfolio and capital market theory and analysis
- Financing types, capital structure, and capital budgeting
- Company valuation procedures
- Acquisitions, corporate control and governance
- Finance planning
- Financing decisions and issuing securities
- Dividend policy and capital structure
- Debt financing and leasing
- Options and futures
- Takeovers, corporate control, and governance
- Solved and unsolved issues and the future of finance

**Advanced Corporate Finance**

**Learning Outcomes**

**Corporate Finance**

On successful completion, students will be able to

- know the key components of corporate finance.
- use financial mathematical methods.
- apply the previously learned methods by using selected data sets and case studies.
- understand the capital structures of a corporation as well as their need to make investment and funding decisions.
- apply the common methods of business valuation and understand the basics of mergers & acquisitions.

**Advanced Corporate Finance**

On successful completion, students will be able to

- identify methods of issuing corporate debt and equity securities, and understand the role of financial intermediaries.
- discuss dividend policy and corporate capital structure in perfect markets vis-à-vis imperfect markets.
- utilize a range of tools for valuing different kinds of debt.
- describe various financing options and their different forms of application in the context of corporate finance.
- discuss mergers and takeovers and the role of different parties involved in the transaction process.

| Links to other Modules within the Study Program | Links to other Study Programs of IU International University of Applied Sciences (IU) |
|---|---|
| This module is similar to other modules in the fields of Finance & Tax Accounting | All Master Programmes in the Business & Management fields |

# Corporate Finance

**Course Code: DLMINRE01**

| Study Level | Language of Instruction | Contact Hours | CP | Admission Requirements |
|---|---|---|---|---|
| MBA | English | | 5 | None |

**Course Description**

How is funding provided to a corporate activity? How much loan capital and/or own capital does one need? Which projects are worth investing in? What is the actual value of a company? What instruments are available to measure the value of a company and assess financial markets? How can one ensure an optimal balance between the competing goals of liquidity, safety, yield, and growth?This course offers answers to these and other complex questions on the topic of financing and investing. The introduction deals with portfolio selection and capital market theory. With this theoretical foundation, various financing types and capital structures are then explained in detail. Well-known corporate assessment procedures, such as the discounted cash flow method, are presented, as are different calculations that can be used to inform decision making. A critical element of the course is the topic of mergers and acquisitions. Case studies are included to illustrate which parties are typically involved in a merger or acquisition and what criteria is used to determine the success of such a venture. The course concludes with the topic of finance planning.

**Course Outcomes**

On successful completion, students will be able to

- know the key components of corporate finance.
- use financial mathematical methods.
- apply the previously learned methods by using selected data sets and case studies.
- understand the capital structures of a corporation as well as their need to make investment and funding decisions.
- apply the common methods of business valuation and understand the basics of mergers & acquisitions.

**Contents**

1. Portfolio and Capital Market Theory
   - 1.1 Capital Markets and Informational Efficiency
   - 1.2 Portfolio Theory
   - 1.3 CAPM
2. Stock and Portfolio Analysis
   - 2.1 Measures of Risk and Performance
   - 2.2 Stock Analysis

3. Optimal Capital Structure
   - 3.1 Capital Structure Based on the Traditional Theorem
   - 3.2 Capital Structure According to Modigliani/Miller
   - 3.3 Neo-Institutional Capital Structure Model

4. Types of Financing
   - 4.1 Internal and External Financing
   - 4.2 Debt Financing
   - 4.3 Equity Financing
   - 4.4 Additional Financing Options

5. Capital Budgeting
   - 5.1 Fundamental Concepts
   - 5.2 Static Capital Budgeting Methods
   - 5.3 Dynamic Investment Calculation Methods

6. Business Valuation
   - 6.1 Purpose and Methods of Business Valuation
   - 6.2 Individual Valuation Methods
   - 6.3 Total Valuation Methods
   - 6.4 Weighted Average Cost of Capital (WACC)

7. Corporate Control and M&A
   - 7.1 The Market for Corporate Control: Mergers and Acquisitions
   - 7.2 Motivations for M&A Transactions
   - 7.3 Phases of M&A Transactions

8. Specific Forms of M&A, Private Equity, Due Diligence, and IPOs
   - 8.1 Due Diligence
   - 8.2 Friendly and Hostile Takeovers, LBOs, MBOs, and MBIs, and IPOs
   - 8.3 Private Equity & Venture Capital Companies

9. Corporate Governance
   - 9.1 Internal and External Corporate Governance
   - 9.2 Example of Legal Basis: Sarbanes Oxley Act (SOX)
   - 9.3 Effect on the Company Performance and the Significance of Ownership Structures
   - 9.4 Additional Financing Options

10. Financial Planning
    - 10.1 Principles of Financial Planning
    - 10.2 Cash Budgeting
    - 10.3 Projected Financial Statements and Ratios

**Literature**

**Compulsory Reading**

**Further Reading**


- Brealey, R., Myers, S. C., & Allen, F. (2016). Principles of corporate finance (12th ed.). New York, NY: McGraw-Hill Education.
- Brealey, R. A., Myers, S. C., & Marcus, A. J. (2015). Fundamentals of corporate finance (8th ed.). New York, NY: McGraw-Hill Education.
- Brigham, E. F., & Daves, P. R. (2016). Intermediate financial management (12th ed.). Boston, MA: Cengage.
- Copeland, T. E., Weston, J. F., & Shastri, K. (2014). Financial theory and corporate policy (Pearson New International ed.). Harlow: Pearson Education.
- Damodaran, A. (2014). Applied corporate finance (4th ed.). Hoboken, NJ: Wiley & Sons.

### Study Format Distance Learning

| Study Format | Course Type |
|---|---|
| Distance Learning | Online Lecture |

| Information about the examination | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Exam, 90 Minutes |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 90 h | 0 h | 30 h | 30 h | 0 h | 150 h |

| Instructional Methods | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☐ Guideline |
| ☑ Shortcast | ☐ Live Tutorium/Course Feed |
| ☑ Audio | ☐ Reader |
| ☑ Exam Template | ☐ Slides |

### Study Format myStudies

| Study Format | Course Type |
|---|---|
| myStudies | Lecture |

| Information about the examination | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Exam, 90 Minutes |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 90 h | 0 h | 30 h | 30 h | 0 h | 150 h |

| Instructional Methods | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☐ Guideline |
| ☑ Shortcast | ☐ Live Tutorium/Course Feed |
| ☑ Audio | ☐ Reader |
| ☑ Exam Template | ☐ Slides |

# Advanced Corporate Finance

**Course Code: DLMBCFIE01**

| Study Level | Language of Instruction | Contact Hours | CP | Admission Requirements |
|---|---|---|---|---|
| MA | English | | 5 | none |

**Course Description**

The last decade has seen fundamental changes in financial markets and financial instruments. Both the theory and practice of corporate finance have been moving ahead with uncommon speed. Participants will be guided through the main areas of modern financial theory, including the pricing of assets and derivatives, corporate financial policy, and corporate control. The course emphasizes the modern fundamentals of the theory of finance and brings the theory to life with contemporary examples.

**Course Outcomes**

On successful completion, students will be able to

- identify methods of issuing corporate debt and equity securities, and understand the role of financial intermediaries.
- discuss dividend policy and corporate capital structure in perfect markets vis-à-vis imperfect markets.
- utilize a range of tools for valuing different kinds of debt.
- describe various financing options and their different forms of application in the context of corporate finance.
- discuss mergers and takeovers and the role of different parties involved in the transaction process.

**Contents**

1. Financing Decisions and Issuing Securities
   - 1.1 Types of Corporate Financing
   - 1.2 Corporations and Issuing Shares
   - 1.3 Corporations and Issuing Debt Securities
2. Dividend Policy and Capital Structure
   - 2.1 What's Your Dividend Policy?
   - 2.2 What's Your Debt Policy?
   - 2.3 Weighted Average Cost of Capital (WACC)
   - 2.4 Corporate and Personal Taxes
   - 2.5 Capital Structure and Related Theories

3. Debt Financing and Leasing
   - 3.1 Debt Valuation
   - 3.2 Rating Debt
   - 3.3 Different Kinds of Debt and Hybrid Securities
   - 3.4 Leasing as a Form of Corporate Finance

4. Options and Futures
   - 4.1 Derivative Financial Instruments, Options and Futures
   - 4.2 Valuing Options, the Binomial Model, the Black-Scholes Formula
   - 4.3 Real Options

5. Takeovers, Corporate Control, and Governance
   - 5.1 Mergers and Acquisitions
   - 5.2 LBOs, Management Buyouts, and Going Private
   - 5.3 Private Equity and the Venture Capitalist
   - 5.4 Empirical Testing of Takeover Success
   - 5.5 Corporate Governance and Corporate Control

6. Unsolved Issues and the Future of Finance
   - 6.1 What Do We Know and What Do We Not Know About Finance?
   - 6.2 The Future of Finance

**Literature**

**Compulsory Reading**

**Further Reading**


- Brealey, R., Myers, S. C., & Allen, F. (2016). Principles of corporate finance (12th ed.). New York, NY: McGraw-Hill Education.
- Vernimmen, P., Quiry, P., Dallocchio, M., Le Fur, Y., & Salvi, A. (2014). Corporate finance: Theory and practice (4th ed.). Hoboken, NJ: John Wiley & Sons. (Database: EBSCO).

### Study Format Distance Learning

| Study Format | Course Type |
|---|---|
| Distance Learning | Online Lecture |

| Information about the examination | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Exam |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 90 h | 0 h | 30 h | 30 h | 0 h | 150 h |

| Instructional Methods | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☐ Guideline |
| ☑ Shortcast | ☐ Live Tutorium/Course Feed |
| ☑ Audio | ☐ Reader |
| ☑ Exam Template | ☐ Slides |

DLMBCFIE01

# Innovate and Change

**Module Code: DLMDSEIAC-01**

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

| Semester / Term | Duration | Regularly offered in | Language of Instruction |
|---|---|---|---|
| see curriculum | Minimum<br>1 semester | WiSe/SoSe | English |

**Module Coordinator**

Prof. Dr. René Schmidpeter (Change Management) / Prof. Dr. Georg Berkel (Innovation and Entrepreneurship)

**Contributing Courses to Module**

- Change Management (DLMBCM01)
- Innovation and Entrepreneurship (DLMBIE01-01)

**Module Exam Type**

| Module Exam | Split Exam |
|---|---|
| | Change Management<br>• Study Format "Distance Learning": Written Assessment: Case Study<br>Innovation and Entrepreneurship<br>• Study Format "myStudies": Exam, 90 Minutes<br>• Study Format "Distance Learning": Exam, 90 Minutes |

**Weight of Module**

see curriculum

**Module Contents**

**Change Management**

- The context and meaning of change
- The change process
- Perspectives for understanding change
- Implementing change

**Innovation and Entrepreneurship**

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

**Learning Outcomes**

**Change Management**

On successful completion, students will be able to

- recognize common features of organizational change and anticipate some of the standard difficulties encountered when an organization engages in change processes.
- explain the importance of organizational change.
- develop a conceptual framework for planned and improvised organizational change, and differentiate between anticipated, emergent, and opportunity-based change.
- utilize and redesign formal organizational structures to facilitate change processes.
- recognize the role of informal organizational structures and identify key stakeholders to promote change processes.
- analyze the social networks that exist within an organization, map independencies and motives/interests, and plan how to distribute information and redesign work flows.
- differentiate between groups of stakeholders and identify the most suitable strategy to adopt with each group.
- recognize the role of the change leader as a political broker and build social capital through informal methods.
- utilize stories and symbols when communicating with others in an organization to maximize leverage as a cultural change leader.
- draw on empirical evidence to plan and implement change processes in an organization.

**Innovation and Entrepreneurship**

On successful completion, students will be able to

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

| Links to other Modules within the Study Program | Links to other Study Programs of IU International University of Applied Sciences (IU) |
| --- | --- |
| This module is similar to other modules in the fields of Business Administration & Management | All Master Programmes in the Business & Management fields |

# Change Management

**Course Code: DLMBCM01**

| Study Level | Language of Instruction | Contact Hours | CP | Admission Requirements |
|---|---|---|---|---|
| MA | English | | 5 | none |

**Course Description**

We live in a world characterized by constant change. This affects not only individuals but also organizations. Even successful organizations need to constantly reinvent themselves in order to remain successful. This course presents a discussion of change in relation to the complexities of organizational life, with an emphasis on applying theory to actual practice. Organizational change is an international phenomenon and the course includes many international case examples. With a focus on organizational change as opposed to personal change and/or entrepreneurship, this course has a distinctly different focus from the related modules "Leadership" and "Innovation and Entrepreneurship." The first part of the course considers the nature of change and different change models. The second part focuses on how different perspectives complement one another and can be used to better understand, analyze, and diagnose change processes. The course deals with issues of structure, culture, and politics. In the later part of the course, the implementation of change is considered in detail. Given that many change processes fail, this part is an important learning component to complement an in-depth understanding of change.

**Course Outcomes**

On successful completion, students will be able to

- recognize common features of organizational change and anticipate some of the standard difficulties encountered when an organization engages in change processes.
- explain the importance of organizational change.
- develop a conceptual framework for planned and improvised organizational change, and differentiate between anticipated, emergent, and opportunity-based change.
- utilize and redesign formal organizational structures to facilitate change processes.
- recognize the role of informal organizational structures and identify key stakeholders to promote change processes.
- analyze the social networks that exist within an organization, map independencies and motives/interests, and plan how to distribute information and redesign work flows.
- differentiate between groups of stakeholders and identify the most suitable strategy to adopt with each group.
- recognize the role of the change leader as a political broker and build social capital through informal methods.
- utilize stories and symbols when communicating with others in an organization to maximize leverage as a cultural change leader.
- draw on empirical evidence to plan and implement change processes in an organization.

**Contents**

1. Organizational Change
   - 1.1 What is Organizational Change About?
   - 1.2 Organizational Change is Ubiquitous
   - 1.3 Change is Difficult

2. Change Management
   - 2.1 The Context of Organizational Change
   - 2.2 Planned Versus Improvisational Change Management
   - 2.3 The Congruence Model of Change

3. Designing Structure
   - 3.1 Formal Structure in Organizations
   - 3.2 Grouping
   - 3.3 Linking
   - 3.4 The Change Leader as an Architect

4. Social Networks
   - 4.1 What are Social Networks?
   - 4.2 Key Terms of Social Network Analysis
   - 4.3 Unique Characteristics of Social Networks
   - 4.4 Social Networks and Organizational Change

5. Politics
   - 5.1 Organizations as Political Arena
   - 5.2 Politics and Change
   - 5.3 The Importance of a Political Perspective on Change

6. Sense-Making
   - 6.1 Organizational Culture
   - 6.2 Sense-Making in Organizations
   - 6.3 The Change Leader as Shaman

7. Change Implementation
   - 7.1 How to Implement Change Successfully
   - 7.2 Four Perspectives on Change

| Literature |
| --- |
| **Compulsory Reading** |
| **Further Reading**<br>▪ Bolman, L. G., & Deal, T. E. (2013). Reframing organizations: Artistry, choice, and leadership (5th ed.). San Francisco, CA: Jossey-Bass.Cameron, K. S., & Quinn, R. E. (2011). Diagnosing and changing organizational culture: Based on the competing values framework (3rd ed.). San Francisco, CA: Jossey-Bass.Pentland, A. (2014). Social physics: How good ideas spread – The lessons from a new science. New York, NY: Penguin Press.McChrystal, S., Collins, T., Silverman, D., & Fussell, C. (2015). Team of teams: New rules of engagement for a complex world. New York, NY: Penguin Press.Worren, N. A. M. (2012). Organisation design: Re-defining complex systems. Harlow: Pearson. |

### Study Format Distance Learning

| Study Format | Course Type |
|---|---|
| Distance Learning | Case Study |

| Information about the examination | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Written Assessment: Case Study |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 110 h | 0 h | 20 h | 20 h | 0 h | 150 h |

| Instructional Methods | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☑ Guideline |
| ☑ Shortcast | ☐ Live Tutorium/Course Feed |
| ☑ Audio | ☐ Reader |
| ☐ Exam Template | ☐ Slides |

# Innovation and Entrepreneurship

**Course Code: DLMBIE01-01**

| Study Level | Language of Instruction | Contact Hours | CP | Admission Requirements |
|---|---|---|---|---|
| MBA | English | | 5 | None |

**Course Description**

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

**Course Outcomes**

On successful completion, students will be able to

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

**Contents**

1. Entrepreneurship
   - 1.1 Entrepreneurship and entrepreneur
   - 1.2 Enterprise related theories of entrepreneurship
   - 1.3 The economic significance of entrepreneurship
2. Company formation strategy
   - 2.1 Different contexts in which companies are founded
   - 2.2 The Entrepreneur
   - 2.3 Business models and strategies
3. Innovation and innovation management
   - 3.1 Innovation
   - 3.2 Innovation management
   - 3.3 Protection of intellectual property
   - 3.4 Case study: BMW Empathic Design
4. Legal form in international comparison
   - 4.1 Germany
   - 4.2 International comparison: USA

5. Financing entrepreneurial activity I: Sources of finance
   - 5.1 Incubators, accelerators and crowdfunding
   - 5.2 Business angels
   - 5.3 Private equity and corporate venture capital
   - 5.4 Public start-up support

6. Financing entrepreneurial activity II: Financing processes
   - 6.1 The investor view: Deal sourcing and deal screening
   - 6.2 The entrepreneurial view: Negotiations with investors
   - 6.3 The evaluation of business start-ups

7. The business plan
   - 7.1 Purpose and objectives of the business plan
   - 7.2 Expectations regarding the business plan
   - 7.3 Structure and content of the business plan
   - 7.4 Guidelines for creating a business plan

8. Digital business models and artificial intelligence
   - 8.1 e-Business
   - 8.2 Artificial intelligence
   - 8.3 The Globotics Evolution

9. Cooperative strategy: Alliances and joint ventures
   - 9.1 Cooperative strategy
   - 9.2 The right “fit”
   - 9.3 The right “form”

10. Family-owned company
    - 10.1 Definitions
    - 10.2 Economic significance
    - 10.3 Strengths and weaknesses

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

### Study Format myStudies

| Study Format | Course Type |
|---|---|
| myStudies | Lecture |

| Information about the examination | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Exam, 90 Minutes |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 90 h | 0 h | 30 h | 30 h | 0 h | 150 h |

| Instructional Methods | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☐ Guideline |
| ☑ Shortcast | ☑ Live Tutorium/Course Feed |
| ☑ Audio | ☐ Reader |
| ☑ Exam Template | ☐ Slides |

### Study Format Distance Learning

| Study Format | Course Type |
|---|---|
| Distance Learning | Online Lecture |

| Information about the examination | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Exam, 90 Minutes |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 90 h | 0 h | 30 h | 30 h | 0 h | 150 h |

| Instructional Methods | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☐ Guideline |
| ☑ Shortcast | ☑ Live Tutorium/Course Feed |
| ☑ Audio | ☐ Reader |
| ☑ Exam Template | ☐ Slides |

# Advanced Robotics 4.0

**Module Code: DLMAIEAR**

| Module Type | Admission Requirements | Study Level | CP | Student Workload |
|---|---|---|---|---|
| see curriculum | DLMAIEAR01 | MA | 10 | 300 h |

| Semester / Term | Duration | Regularly offered in | Language of Instruction |
|---|---|---|---|
| see curriculum | Minimaldauer:<br>1 Semester | WiSe/SoSe | English |

**Module Coordinator**

Prof. Dr. Leonardo Riccardi (Industrial and Mobile Robots ) / Prof. Dr. Leonardo Riccardi (Project: Collaborative Robotics )

**Contributing Courses to Module**

- Industrial and Mobile Robots (DLMAIEAR01)
- Project: Collaborative Robotics (DLMAIEAR02)

**Module Exam Type**

| Module Exam | Split Exam |
|---|---|
| | Industrial and Mobile Robots<br>• Study Format "Distance Learning": Exam, 90 Minutes<br>Project: Collaborative Robotics<br>• Study Format "Distance Learning": Written Assessment: Project Report |

**Weight of Module**

see curriculum

**Module Contents**

**Industrial and Mobile Robots**

- Architectural components of mobile and industrial robots
- Mathematical description
- Design of interactions and control

**Project: Collaborative Robotics**

- Human-robot interaction
- Safety operation
- Human-friendly robot design

A current list of topics is located in the Learning Management System.

**Learning Outcomes**

**Industrial and Mobile Robots**

On successful completion, students will be able to

- identify the main challenges of robotics in the era of Industry 4.0.
- understand the working principles of industrial and mobile robots.
- model a robotic system and design a motion control algorithm.
- use software platforms to command the execution of tasks and retrieve the execution status.

**Project: Collaborative Robotics**

On successful completion, students will be able to

- classify interactions between robots and humans.
- identify safety and risk scenarios.
- understand the principles of human-friendly robot design.
- apply algorithms for safe interaction.

| Links to other Modules within the Study Program | Links to other Study Programs of IU International University of Applied Sciences (IU) |
|---|---|

# Industrial and Mobile Robots

**Course Code: DLMAIEAR01**

| Study Level | Language of Instruction | Contact Hours | CP | Admission Requirements |
|---|---|---|---|---|
| MA | English | | 5 | none |

**Course Description**

The focus of this course is the theoretical foundation of mobile and industrial robotics. First, the basic concepts, architectural components (e.g., actuators and sensors), and challenges related to mobile and industrial robotics in the era of Industry 4.0 are presented. Next, the mathematical aspects concerning robot kinematics and trajectory planning are considered. These are necessary in order to define the operative task that a robot (mobile or industrial) must execute. The dynamics of a robotic system provides a mathematical model of the robot which can be exploited for simulation, design, and to control the task execution. There are various control architectures and approaches for robotic systems. This course focuses on the centralized and de-centralized architectures, as well as simple control design (e.g., proportional-integral-derivative control approaches).Finally, this course introduces the main software platforms and architectures used to control and exchange data with robots in a multi-agent environment, for instance, a manufacturing facility where many robots execute different tasks or must cooperate. The main patterns of such architectures and their uses are discussed. The adoption of model-based sensing/perception and control approaches yields intelligent systems which interact with the environment. This course concludes with an overview of behavior-based robotics, where robots are able to dynamically react to and learn from the real world.

**Course Outcomes**

On successful completion, students will be able to

- identify the main challenges of robotics in the era of Industry 4.0.
- understand the working principles of industrial and mobile robots.
- model a robotic system and design a motion control algorithm.
- use software platforms to command the execution of tasks and retrieve the execution status.

**Contents**

1. Introduction
    - 1.1 Robots and manufacturing
    - 1.2 Industrial robots
    - 1.3 Mobile robots
    - 1.4 Actuators for robotics
    - 1.5 Trends in robotics

2. Kinematics
   - 2.1 Position and orientation of a rigid body
   - 2.2 Joint kinematics
   - 2.3 Forward kinematics
   - 2.4 Inverse kinematics
   - 2.5 Differential kinematics
   - 2.6 Kinematics of mobile robots

3. Trajectory Planning
   - 3.1 Basic concepts
   - 3.2 Trajectories in the joints space
   - 3.3 Trajectories in the workspace
   - 3.4 Trajectory planning for mobile robots

4. Sensing and Perception
   - 4.1 Position
   - 4.2 Velocity
   - 4.3 Force
   - 4.4 Distance
   - 4.5 Visual

5. Fundamentals of Robot Dynamics
   - 5.1 Rigid body dynamics
   - 5.2 Lagrange formulation
   - 5.3 Newton formulation
   - 5.4 Direct and inverse dynamics
   - 5.5 Dynamics of mobile robots

6. Control of Robots
   - 6.1 Basic concepts
   - 6.2 Decentralized motion control
   - 6.3 Centralized motion control
   - 6.4 Force control

7. Architecture of Robotic Systems
   - 7.1 Architectural components
   - 7.2 Open Robot Control Software (OROCOS)
   - 7.3 Yet Another Robotic System Platform (YARP)
   - 7.4 Robot Operating System (ROS)
   - 7.5 Behavior-based robotics

**Literature**

**Compulsory Reading**

**Further Reading**


- Ben-Ari, M., & Mondada, F. (2017). Elements of robotics. Springer International Publishing.
- Siciliano, B., Sciavicco, L., Villani, L., & Oriolo, G. (2009). Robotics. Springer.
- Siciliano, B., & Khatib, O. (Eds.). (2016). Springer handbook of robotics (2nd ed.). Springer.

### Study Format Distance Learning

| Study Format | Course Type |
|---|---|
| Distance Learning | Online Lecture |

| Information about the examination | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Exam, 90 Minutes |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 90 h | 0 h | 30 h | 30 h | 0 h | 150 h |

| Instructional Methods | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☐ Guideline |
| ☑ Shortcast | ☐ Live Tutorium/Course Feed |
| ☑ Audio | ☐ Reader |
| ☑ Exam Template | ☐ Slides |

# Project: Collaborative Robotics

**Course Code: DLMAIEAR02**

| Study Level | Language of Instruction | Contact Hours | CP | Admission Requirements |
|---|---|---|---|---|
| MA | English | | 5 | DLMAIEAR01 |

**Course Description**

A collaborative robot is a robot which is used in collaborative operation, where humans and robots share the same workspace. This course focuses on the basic concepts of collaborative robotics, such as classification of human-robot interaction, definition of safe interaction, soft robotics and human-friendly robot design, and algorithms to guarantee such a safe interaction. The students will receive a hands-on introduction to the topic, with the goal of being able to autonomously design, simulate and test collaborative robotic systems.

**Course Outcomes**

On successful completion, students will be able to

- classify interactions between robots and humans.
- identify safety and risk scenarios.
- understand the principles of human-friendly robot design.
- apply algorithms for safe interaction.

**Contents**

- Each participant must create a project report on a topic related to collaborative robotics, focusing on design and/or implementation aspects.

**Literature**

**Compulsory Reading**

**Further Reading**


- Ben-Ari, M., & Mondada, F. (2018). Elements of robotics. Cham: Springer.
- Corke, P. (2017). Robotics, vision and control (2nd ed.). Berlin, Heidelberg: Springer.
- Mihelj, M., Bajd, T., Ude, A., Lenarčič, J., Stanovnik, A., Munih, M., ... Šlajpah, S. (2019). Robotics (2nd ed.). Cham: Springer.
- Siciliano, B., & Khatib, O. (Eds.). (2016). Springer handbook of robotics (2nd ed.). Berlin, Heidelberg: Springer.
- Teixeira, J. V. S., Reis, A. M., Mendes, F. B., & Vergara, L. G. L. (2019). Collaborative Robots. In P. Arezes (Ed.), Occupational and environmental safety and health. Studies in systems, decision and control (pp. 791-796). Cham: Springer.

### Study Format Distance Learning

| Study Format | Course Type |
|---|---|
| Distance Learning | Project |

| Information about the examination | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** no<br>**Course Evaluation:** no |
| **Type of Exam** | Written Assessment: Project Report |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 120 h | 0 h | 30 h | 0 h | 0 h | 150 h |

| Instructional Methods | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☐ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☑ Guideline |
| ☐ Shortcast | ☐ Live Tutorium/Course Feed |
| ☐ Audio | ☐ Reader |
| ☐ Exam Template | ☐ Slides |

# Applied Autonomous Driving

**Module Code: DLMDSEAAD**

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

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

**Module Coordinator**

Dr. Benjamin Lehmann (Architectures of Self-Driving Vehicles) / Dr. Benjamin Lehmann (Case Study: Localization, Motion Planning and Sensor Fusion)

**Contributing Courses to Module**

- Architectures of Self-Driving Vehicles (DLMDSEAAD01)
- Case Study: Localization, Motion Planning and Sensor Fusion (DLMDSEAAD02)

**Module Exam Type**

| Module Exam | Split Exam |
|---|---|
| | Architectures of Self-Driving Vehicles<br>• Study Format "Distance Learning": Exam, 90 Minutes<br>Case Study: Localization, Motion Planning and Sensor Fusion<br>• Study Format "Distance Learning": Written Assessment: Case Study |

**Weight of Module**

see curriculum

**Module Contents**

**Architectures of Self-Driving Vehicles**

- Architectural patterns of a self-driving car
- Perception and motion control
- Social impact of autonomous vehicles

**Case Study: Localization, Motion Planning and Sensor Fusion**

- Algorithms for localization and navigation
- Sensor fusion methods for localization and objects tracking
- Motion planning algorithms

**Learning Outcomes**

**Architectures of Self-Driving Vehicles**

On successful completion, students will be able to

- explain and recognize the main components of a self-driving car.
- distinguish the sensor solutions for a self-driving car and adopt the best one for a given scenario.
- model and implement a simple motion control system.
- manage the main communication protocols to retrieve valuable information.
- reflect on the social impact of self-driving cars.

**Case Study: Localization, Motion Planning and Sensor Fusion**

On successful completion, students will be able to

- distinguish the methods used for localization, motion planning, and sensor fusion.
- apply the methods to autonomous vehicles.
- understand the main issues related to the adoption of autonomous vehicles in real-world scenarios.

| **Links to other Modules within the Study Program** | **Links to other Study Programs of IU International University of Applied Sciences (IU)** |
|---|---|
| This module is similar to other modules in the field of Engineering | All Master Programmes in the IT & Technology fields |

# Architectures of Self-Driving Vehicles

**Course Code: DLMDSEAAD01**

| Study Level | Language of Instruction | Contact Hours | CP | Admission Requirements |
|---|---|---|---|---|
| MA | English | | 5 | none |

**Course Description**

This course gives an overview of the main architectural aspects of a self-driving car. After introducing the hardware and software platforms, the course presents the sensor solutions necessary to provide environment perception for autonomous vehicles. Such perception yields the information used for motion control, including braking and steering. The fundamental concepts for the realization and implementation of motion control are presented, together with related safety issues (e.g., motion control under false information). The way in which a self-driving car exchanges information with the outside world is also discussed, and the main technologies and protocols are introduced. The last part of the course elaborates on the social impact of self-driving cars: ethics, mobility, and design.

**Course Outcomes**

On successful completion, students will be able to

- explain and recognize the main components of a self-driving car.
- distinguish the sensor solutions for a self-driving car and adopt the best one for a given scenario.
- model and implement a simple motion control system.
- manage the main communication protocols to retrieve valuable information.
- reflect on the social impact of self-driving cars.

**Contents**

1. Introduction
    - 1.1 Basic concepts and key technologies
    - 1.2 Hardware overview
    - 1.3 Software overview
    - 1.4 State of the art and open challenges
    - 1.5 Trends

2. Environment Perception
   - 2.1 Basic concepts
   - 2.2 GPS
   - 2.3 Inertial sensors
   - 2.4 Lidar and Radar
   - 2.5 Cameras

3. Moving, Braking, Steering
   - 3.1 Fundamentals
   - 3.2 Dynamics of a mobile vehicle
   - 3.3 Braking technologies
   - 3.4 Lateral and longitudinal control
   - 3.5 Safety issues

4. Communication
   - 4.1 Car2X communication
   - 4.2 Protocols
   - 4.3 Safety issues

5. Social Impact
   - 5.1 Ethics for autonomous vehicles
   - 5.2 New mobility
   - 5.3 Autonomous vehicles and design

**Literature**

**Compulsory Reading**

**Further Reading**


- Heinrichs, D. (2016). Autonomous driving and urban land use. In M. Maurer, J. Gerdes, B. Lenz, H. Winner (Eds.) Autonomous driving (pp. 213—231). Springer.
- Mueck, M., & Karls, I. (2018). Networking vehicles to everything: Evolving automotive solutions. Walter de Gruyter GmbH & Co KG.
- Schaub, A. (2018). Robust perception from optical sensors for reactive behaviors in autonomous robotic vehicles. Springer.
- Sjafrie, H. (2019). Introduction to self-driving vehicle technology. CRC Press.

### Study Format Distance Learning

| **Study Format** | **Course Type** |
|---|---|
| Distance Learning | Online Lecture |

| **Information about the examination** | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Exam, 90 Minutes |

| **Student Workload** | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 90 h | 0 h | 30 h | 30 h | 0 h | 150 h |

| **Instructional Methods** | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☐ Guideline |
| ☑ Shortcast | ☑ Live Tutorium/Course Feed |
| ☑ Audio | ☐ Reader |
| ☑ Exam Template | ☐ Slides |

# Case Study: Localization, Motion Planning and Sensor Fusion

**Course Code: DLMDSEAAD02**

| Study Level | Language of Instruction | Contact Hours | CP | Admission Requirements |
|---|---|---|---|---|
| MA | English | | 5 | none |

**Course Description**

This course provides the fundamental concepts and methods of localization, motion planning, and sensor fusion for mobile robotics and self-driving cars. Mobile robots and autonomous vehicles rely on the ability to perceive the environment and react to its dynamic changes.The first part of the course focuses on the representation of motion and navigation based on odometry, which is affected by errors due to information uncertainty. A possible solution is offered by localization methods which use odometry and complementary information, such as a GPS signal, to improve the estimation of the position of the autonomous vehicles within a reference frame. In this way, the vehicle is able to move towards a goal.The problems with detecting dynamic change in the environment is addressed in the last part of the course, where the methods of sensor fusion are introduced. Thanks to the fusion of multiple data sources, information can be extracted, e.g., an approaching object or a change in a situation can be revealed. The autonomous vehicle must be able to track the object and react to its movement to avoid human hazard and damage. The determination of the best trajectory to follow is addressed in the final part of the course.The course gives a hands-on overview of the main methods for localization, motion planning, and sensor fusion. The students must apply the concepts and methods to case studies involving a self-driving vehicle in two main scenarios: “on the road” and in a manufacturing facility.

**Course Outcomes**

On successful completion, students will be able to

- distinguish the methods used for localization, motion planning, and sensor fusion.
- apply the methods to autonomous vehicles.
- understand the main issues related to the adoption of autonomous vehicles in real-world scenarios.

**Contents**

1. Motion and Odometry
   - 1.1 Basic principles
   - 1.2 Motion models
   - 1.3 Navigation by odometry
   - 1.4 Holonomic and non-holonomic motion
   - 1.5 Errors

2. Local Navigation
   - 2.1 Basic concepts
   - 2.2 Path finding
   - 2.3 Obstacle avoidance

3. Localization
   - 3.1 Basic concepts
   - 3.2 Triangulation
   - 3.3 GPS
   - 3.4 Probabilistic localization
   - 3.5 Uncertainty of motion

4. Sensor Fusion
   - 4.1 Sensors
   - 4.2 Elaborating data from sensors
   - 4.3 Kalman filter
   - 4.4 Extended Kalman filter
   - 4.5 Tracking objects

5. Motion Planning
   - 5.1 Path planning
   - 5.2 Motion prediction
   - 5.3 Trajectory generation

**Literature**

**Compulsory Reading**

**Further Reading**


- Mitchell, H. B. (2007). Multi-sensor data fusion: An introduction. Springer.
- Siciliano, B., & Khatib, O. (Eds.). (2016). Springer handbook of robotics. Springer.
- Thrun, S. (2002). Probabilistic robotics. Communications of the ACM, 45(3), 52—57.

### Study Format Distance Learning

| Study Format | Course Type |
|---|---|
| Distance Learning | Case Study |

| Information about the examination | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** yes<br>**Course Evaluation:** no |
| **Type of Exam** | Written Assessment: Case Study |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 110 h | 0 h | 20 h | 20 h | 0 h | 150 h |

| Instructional Methods | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☑ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☑ Guideline |
| ☑ Shortcast | ☑ Live Tutorium/Course Feed |
| ☑ Audio | ☐ Reader |
| ☐ Exam Template | ☐ Slides |

# Seminar: Current Topics in AI

**Module Code: DLMAISCTAI**

| 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 |
|---|---|---|---|
| see curriculum | Minimum<br>1 semester | WiSe/SoSe | English |

**Module Coordinator**

Prof. Dr. Tim Schlippe (Seminar: Current Topics in AI)

**Contributing Courses to Module**

- Seminar: Current Topics in AI (DLMAISCTAI01)

**Module Exam Type**

| Module Exam | Split Exam |
|---|---|
| Study Format: Distance Learning<br>Written Assessment: Research Essay | |

**Weight of Module**

see curriculum

**Module Contents**

In this module, students will reflect on current developments in AI. To this end, pertinent topics will be introduced via articles that are then critically evaluated by the students in the form of a written essay.

**Learning Outcomes**

**Seminar: Current Topics in AI**

On successful completion, students will be able to

- discuss current research trends and topics in AI.
- compose a theoretical essay exploring a selected topic in AI.
- expound upon apposite assumptions and design choices pertaining to the topic of choice.
- link the chosen topic to analogous approaches.
- identify and delineate potential uses for the chosen topic's concepts.

| Links to other Modules within the Study Program | Links to other Study Programs of IU International University of Applied Sciences (IU) |
|---|---|
| This module is similar to other modules in the fields of Data Science & Artificial Intelligence | All Master Programmes in the IT & Technology fields |

# Seminar: Current Topics in AI

**Course Code: DLMAISCTAI01**

| Study Level | Language of Instruction | Contact Hours | CP | Admission Requirements |
|---|---|---|---|---|
| MA | English | | 5 | none |

**Course Description**

The topic of artificial Intelligence (AI) has been addressed in computer science and cognitive science research since the 1950s; however, the meaning associated with the term has changed considerably over time. Having once been predominantly associated with logical calculus, reasoning, and planning, AI is now primarily interpreted in the context of deep networks of computational units. Despite these changes in approach, the important characteristic of AI continues to be the understanding and reproduction of cognitive abilities and functions by machines. This seminar strives to elucidate current research trends in AI. The students learn to independently analyze selected topics and case studies and link them with well-known concepts, as well as critically question and discuss them.

**Course Outcomes**

On successful completion, students will be able to

- discuss current research trends and topics in AI.
- compose a theoretical essay exploring a selected topic in AI.
- expound upon apposite assumptions and design choices pertaining to the topic of choice.
- link the chosen topic to analogous approaches.
- identify and delineate potential uses for the chosen topic's concepts.

**Contents**

- The seminar covers current topics in artificial intelligence. Each participant must write a seminar paper on a topic assigned to him/her.

**Literature**

**Compulsory Reading**

**Further Reading**


- Turabian, K. L. (2013). A manual for writers of research papers, theses, and dissertations. Chicago: University of Chicago Press.
- Swales, J. M., & Feak, C. R. (2012). Academic writing for graduate students, essential tasks and skills. Michigan: University of Michigan Press.
- Bailey, S. (2011). Academic writing for international students of business. New York, NY: Routledge

### Study Format Distance Learning

| Study Format | Course Type |
|---|---|
| Distance Learning | Seminar |

| Information about the examination | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** no<br>**Course Evaluation:** no |
| **Type of Exam** | Written Assessment: Research Essay |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 120 h | 0 h | 30 h | 0 h | 0 h | 150 h |

| Instructional Methods | |
|---|---|
| ☐ Learning Sprints® | ☐ Review Book |
| ☐ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☑ Guideline |
| ☐ Shortcast | ☐ Live Tutorium/Course Feed |
| ☐ Audio | |
| ☐ Exam Template | |

# 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 |
|---|---|---|---|
| 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<br>• Study Format "Distance Learning": Written Assessment: Master Thesis (90)<br>• Study Format "myStudies": Written Assessment: Master Thesis (90)<br>Colloquium<br>• Study Format "Distance Learning": Presentation: Colloquium (10)<br>• Study Format "myStudies": Presentation: Colloquium (10) |

**Weight of Module**

see curriculum

**Module Contents**

**Master Thesis**

- Master's thesis

**Colloquium**

- Colloquium on the Master's thesis

**Learning Outcomes**

**Master Thesis**

On successful completion, students will be able to

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

**Colloquium**

On successful completion, students will be able to

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

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

# Master Thesis

**Course Code: MMTHE01**

| Study Level | Language of Instruction | 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**<br>▪ Bui, Y. N. (2013). How to Write a Master's Thesis (2nd ed.). SAGE Publications, Incorporated.<br>▪ Turabian, K. L. (2013). A Manual for Writers of Research Papers, theses, and dissertations (8th ed.). University of Chicago Press.<br>▪ Further subject specific literature |

### Study Format Distance Learning

| Study Format | Course Type |
|---|---|
| Distance Learning | Thesis |

| Information about the examination | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** no<br>**Course Evaluation:** no |
| **Type of Exam** | Written Assessment: Master Thesis |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 810 h | 0 h | 0 h | 0 h | 0 h | 810 h |

| Instructional Methods | |
|---|---|
| ☐ Learning Sprints® | ☑ Review Book |
| ☐ Course Book | ☐ Creative Lab |
| ☐ Vodcast | ☑ Guideline |
| ☐ Shortcast | ☐ Live Tutorium/Course Feed |
| ☐ Audio | |
| ☐ Exam Template | |

### Study Format myStudies

| Study Format | Course Type |
|---|---|
| myStudies | Thesis |

| Information about the examination | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** no<br>**Course Evaluation:** no |
| **Type of Exam** | Written Assessment: Master Thesis |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 810 h | 0 h | 0 h | 0 h | 0 h | 810 h |

**Instructional Methods**

- ☐ Learning Sprints®
- ☐ Course Book
- ☐ Vodcast
- ☐ Shortcast
- ☐ Audio
- ☐ Exam Template
- ☑ Review Book
- ☐ Creative Lab
- ☑ Guideline
- ☐ Live Tutorium/Course Feed

# Colloquium

**Course Code: MMTHE02**

| Study Level | Language of Instruction | 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** | **BOLK:** no<br>**Course Evaluation:** no |
| **Type of Exam** | Presentation: Colloquium |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 90 h | 0 h | 0 h | 0 h | 0 h | 90 h |

**Instructional Methods**

- ☐ Learning Sprints®
- ☐ Course Book
- ☐ Vodcast
- ☐ Shortcast
- ☐ Audio
- ☐ Exam Template
- ☐ Review Book
- ☐ Creative Lab
- ☐ Guideline
- ☐ Live Tutorium/Course Feed

### Study Format myStudies

| Study Format | Course Type |
|---|---|
| myStudies | Thesis Defense |

| Information about the examination | |
|---|---|
| **Examination Admission Requirements** | **BOLK:** no<br>**Course Evaluation:** no |
| **Type of Exam** | Presentation: Colloquium |

| Student Workload | | | | | |
|---|---|---|---|---|---|
| **Self Study** | **Presence** | **Tutorial** | **Self Test** | **Practical Experience** | **Hours Total** |
| 90 h | 0 h | 0 h | 0 h | 0 h | 90 h |

**Instructional Methods**

- ☐ Learning Sprints®
- ☐ Course Book
- ☐ Vodcast
- ☐ Shortcast
- ☐ Audio
- ☐ Exam Template
- ☐ Review Book
- ☐ Creative Lab
- ☐ Guideline
- ☐ Live Tutorium/Course Feed