MODULE HANDBOOK

Master of Science

Business Intelligence (FS-OI-MABUI-60)

60 ECTS

Distance Learning

INTERNATIONAL
UNIVERSITY OF
APPLIED SCIENCES

Contents

2022-09-01

1. Semester

Business Intelligence I

Module Code: DLMDSEBA1

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

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

Module Coordinator

Prof. Dr. Peter Poensgen (Business Intelligence I)

Contributing Courses to Module

- Business Intelligence I (DLMDSEBA01)

Module Exam Type

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

Weight of Module

see curriculum

Module Contents

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

Learning Outcomes

Business Intelligence I

On successful completion, students will be able to

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

Links to other Modules within the Study Program	**Links to other Study Programs of IU International University of Applied Sciences (IU)**
This module is similar to other modules in the fields of Computer Science & Software Development	All Master Programs in the IT & Technology fields

Business Intelligence I

Course Code: DLMDSEBA01

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

Course Description

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

Course Outcomes

On successful completion, students will be able to

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

Contents

1. Motivation and Introduction
   - 1.1 Motivation and historical development of the field
   - 1.2 Business intelligence as a framework
2. Data Provisioning
   - 2.1 Operative and dispositive systems
   - 2.2 The data warehouse concept
   - 2.3 Architecture variants
3. Data Warehouse
   - 3.1 The ETL-Process
   - 3.2 DWH and Data-Mart concepts
   - 3.3 ODS and meta-data

4. Modeling Multidimensional Dataspaces
   - 4.1 Data modeling
   - 4.2 OLAP-Cubes
   - 4.3 Physical storage concepts
   - 4.4 Star-Schema and Snowflake-Schema
   - 4.5 Historization

5. Analytical Systems
   - 5.1 Freeform data analysis and OLAP
   - 5.2 Reporting systems
   - 5.3 Model-based analytical systems
   - 5.4 Concept-oriented systems

6. Distribution and Access
   - 6.1 Information distribution
   - 6.2 Information access

7. Current and future business intelligence application areas
   - 7.1 Mobile BI
   - 7.2 Predictive and Prescriptive Analytics
   - 7.3 Artificial Intelligence

Literature

Compulsory Reading

Further Reading

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

Study Format Distance Learning

Study Format	**Course Type**
Distance Learning	Case Study

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **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

DLMDSEBA01

Relational and NoSQL Databases

Module Code: DLMBIRND

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

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

Module Coordinator

Prof. Dr. Peter Poensgen (Relational and NoSQL Databases)

Contributing Courses to Module

- Relational and NoSQL Databases (DLMBIRND01)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Advanced Workbook	

Weight of Module

see curriculum

Module Contents

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

Learning Outcomes

Relational and NoSQL Databases

On successful completion, students will be able to

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

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

Relational and NoSQL Databases

Course Code: DLMBIRND01

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

Course Description

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

Course Outcomes

On successful completion, students will be able to

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

Contents

4. NoSQL Concepts
   - 4.1 Schemaless Data and the ACID Principle
   - 4.2 Types of NoSQL Databases
   - 4.3 Row-Based and Column-Based Storage
   - 4.4 Updates and Appends
   - 4.5 Multi-Model Databases

5. Selected NoSQL Databases in Practice
   - 5.1 Redis
   - 5.2 MongoDB
   - 5.3 Cassandra
   - 5.4 HBase
   - 5.5 Neo4j

Literature

Compulsory Reading

Further Reading

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

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Advanced Workbook

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

Data Query Languages

Module Code: DLMDMDQL

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

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

Module Coordinator

Prof. Dr. Carsten Skerra (Data Query Languages)

Contributing Courses to Module

- Data Query Languages (DLMDMDQL01)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Advanced Workbook (passed / not passed)	

Weight of Module

see curriculum

Module Contents

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

Learning Outcomes

Data Query Languages

On successful completion, students will be able to

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

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

Data Query Languages

Course Code: DLMDMDQL01

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

Course Description

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

Course Outcomes

On successful completion, students will be able to

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

Contents

1. Introduction to Data Query Languages
   - 1.1 Definition of Data Query Languages
   - 1.2 Differentiation to other Languages
   - 1.3 Typical Examples of Data Query Languages
2. Data Management
   - 2.1 Data Life Cycle
   - 2.2 Types of Datasets (Structured, Semi-Structured and Unstructured Data)
   - 2.3 Role of Databases (SQL & NoSQL Databases)
3. Fundamentals of SQL
   - 3.1 Brief Overview
   - 3.2 Data Definition Language (DDL)
   - 3.3 Data Query Language (DQL)
   - 3.4 Data Manipulation Language (DML)

4. Advanced SQL
   - 4.1 Transaction Control Language (TCL)
   - 4.2 Data Control Language (DCL)
   - 4.3 Differences between various SQL Versions (MSSQL, PL/SQL, etc.)

5. Data Query Languages for NoSQL Database and other Purposes
   - 5.1 Document Databases (N1QL/couchbase and MongoDB)
   - 5.2 Graph Databases (Cypher/Neo4j)
   - 5.3 GraphQL for APIs

6. Using Data Query Languages within Application Programming
   - 6.1 Special Aspects (Architecture, Connection Management, Coding and Testing)
   - 6.2 Examples (SQL in Python and SQL in Java)

Literature

Compulsory Reading

Further Reading

- Badia, A. (2020): SQL for Data Science: Data Cleaning, Wrangling and Analytics with Relational Databases. Springer, Cham, Switzerland.
- Hogan, A. (2020): The Web of Data. Springer, Cham, Switzerland.
- Meier , A./Kaufmann, M. (2019): SQL & NoSQL Databases: Models, Languages, Consistency Options and Architectures for Big Data Management. Springer, Wiesbaden, Germany.
- Molinaro, A./Graaf, R. de (2020): SQL cookbook: Query solutions and techniques for all SQL users. O'Reilly, Beijing.
- Wiese, L. (2015): Advanced Data Management: For SQL, NoSQL, Cloud and Distributed Databases. De Gruyter, Berlin.

Study Format Distance Learning

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

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **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: Business Intelligence

Module Code: DLMDSEBA2

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLMDSEBA01	MA	5	150 h

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

Module Coordinator

Prof. Dr. Peter Poensgen (Project: Business Intelligence)

Contributing Courses to Module

- Project: Business Intelligence (DLMDSEBA02)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Portfolio	

Weight of Module

see curriculum

Module Contents

Implementation of a business intelligence use case.

Learning Outcomes

Project: Business Intelligence

On successful completion, students will be able to

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

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

Project: Business Intelligence

Course Code: DLMDSEBA02

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

Course Description

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

Course Outcomes

On successful completion, students will be able to

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

Contents

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

Literature

Compulsory Reading

Further Reading

- Kimball, R. (2013). The data warehouse toolkit: The definitive guide to dimensional modeling (3rd ed.). Indianapolis, IN: Wiley.
- Linstedt, D., & Olschimke, M. (2015). Building a scalable data warehouse with Data Vault 2.0. Waltham, MA: Morgan Kaufmann.
- Provost, F. (2013). Data science for business: What you need to know about data mining and data-analytic thinking. Sebastopol, CA: O'Reilly.
- Sherman, R. (2014). Business intelligence guidebook: From data integration to analytics. Waltham, MA: Morgan Kaufmann.
- Turban, E., Sharda, R., Delen, D., & King, D. (2010). Business intelligence. A managerial approach (2nd ed.). Upper Saddle River, NJ: Prentice Hall.

Study Format Distance Learning

Study Format	**Course Type**
Distance Learning	Project

Information about the examination	
Examination Admission Requirements	**BOLK:** no **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 Warehousing Architecture Types

Module Code: DLMBIDWAT

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLMDSEBA01, DLMBIRND01	MA	5	150 h

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

Module Coordinator

Prof. Dr. Peter Poensgen (Data Warehousing Architecture Types)

Contributing Courses to Module

- Data Warehousing Architecture Types (DLMBIDWAT01)

Module Exam Type

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

Weight of Module

see curriculum

Module Contents

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

Learning Outcomes

Data Warehousing Architecture Types

On successful completion, students will be able to

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

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

Data Warehousing Architecture Types

Course Code: DLMBIDWAT01

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

Course Description

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

Course Outcomes

On successful completion, students will be able to

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

Contents

1. Introduction
   - 1.1 Big data: Structured, Semi-Structured and Unstructured Data Types
   - 1.2 Unstructured Big Data Challenges
   - 1.3 Characteristics of Data Warehouses
   - 1.4 RDBMS-Based Data Warehousing
   - 1.5 NoSQL-Based Data Warehousing
2. Data Warehouse Architecture
   - 2.1 Single-Layer Architecture
   - 2.2 Two-Layer Architecture
   - 2.3 Three-Layer Architecture

Literature

Compulsory Reading

Further Reading

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

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **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

Seminar: Data Warehouse Approaches and Methodologies

Module Code: DLMBISDWAM

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLMDSEBA01, DLMBIDWAT01	MA	5	150 h

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

Module Coordinator

Prof. Dr. André Hollstein (Seminar: Data Warehouse Approaches and Methodologies)

Contributing Courses to Module

- Seminar: Data Warehouse Approaches and Methodologies (DLMBISDWAM01)

Module Exam Type

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

Weight of Module

see curriculum

Module Contents

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

Learning Outcomes

Seminar: Data Warehouse Approaches and Methodologies

On successful completion, students will be able to

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

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

Seminar: Data Warehouse Approaches and Methodologies

Course Code: DLMBISDWAM01

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

Course Description

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

Course Outcomes

On successful completion, students will be able to

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

Contents

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

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

Study Format Distance Learning

Study Format	**Course Type**
Distance Learning	Seminar

Information about the examination	
Examination Admission Requirements	**BOLK:** no **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	

DLMBISDWAM01

2. Semester

Advanced Research Methods

Module Code: DLMARM

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

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

Module Coordinator

Prof. Dr. Josephine Zhou-Brock (Advanced Research Methods)

Contributing Courses to Module

- Advanced Research Methods (DLMARM01)

Module Exam Type

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

Weight of Module

see curriculum

Module Contents

- Social science and research paradigms
- Case study research
- Specific topics of qualitative research
- Advanced issues of qualitative research conceptualization and data analysis
- Underlying assumptions of quantitative research: concepts and consequences
- Evaluation research

Learning Outcomes

Advanced Research Methods

On successful completion, students will be able to

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

Links to other Modules within the Study Program	**Links to other Study Programs of 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 fields

Advanced Research Methods

Course Code: DLMARM01

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

Course Description

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

Course Outcomes

On successful completion, students will be able to

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

Contents

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

2. Case Study Research
   - 2.1 Types of Case Study Research
   - 2.2 Maintaining Quality in Case Study Research
   - 2.3 Case Study Design
   - 2.4 Implementing Case Studies
   - 2.5 Analyzing Case Studies

3. Specific Topics of Qualitative Research
   - 3.1 Idea Generation
   - 3.2 Critical Incident Technique
   - 3.3 Understanding Communication: Discourse Analysis
   - 3.4 Perceiving Perception: Interpretive Phenomenological Analysis

4. Advanced Issues of Qualitative Research Conceptualizing and Data Analysis
   - 4.1 Measurement Theory
   - 4.2 Index and Scale Construction
   - 4.3 Types of Scale Construction
   - 4.4 The Problem of Nonresponse and Missing Data
   - 4.5 Implications of IT for Research Strategies

5. Underlying Assumptions of Quantitative Research: Concepts and Consequences
   - 5.1 Classical Test Theory
   - 5.2 Probabilistic Test Theory
   - 5.3 Advanced Topics of Test Theory

6. Evaluation Research
   - 6.1 What is Evaluation Research?
   - 6.2 Types of Evaluation Research
   - 6.3 Meta-Analysis
   - 6.4 Meta-Evaluation

Literature
Compulsory Reading
Further Reading ▪ Babbie, E. R. (2021). The practice of social research (15th ed.). Cengage Learning. ▪ Giles, D. C. (2002). Advanced research methods in psychology. Routledge. ▪ Saunders, M., Thornhill, A., & Lewis, P. (2009). Research methods for business students (5th ed.). Pearson.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **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 myStudies

Study Format	Course Type
myStudies	Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **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

DLMARM01

Applied Data Modeling and Reporting

Module Code: DLMBIEADMR

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	▪ None ▪ DLMDSEBA01, DLMBIDMR01	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. Peter Poensgen (Data Modeling and Reporting) / Prof. Dr. Peter Poensgen (Project: Data Modeling and Reporting)

Contributing Courses to Module

- Data Modeling and Reporting (DLMBIDMR01)
- Project: Data Modeling and Reporting (DLMBIPDMR01)

Module Exam Type

Module Exam	Split Exam
	Data Modeling and Reporting • Study Format "Distance Learning": Exam, 90 Minutes (100) Project: Data Modeling and Reporting • Study Format "Distance Learning": Written Assessment: Project Report

Weight of Module

see curriculum

Module Contents

Data Modeling and Reporting

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

Project: Data Modeling and Reporting

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

Learning Outcomes

Data Modeling and Reporting

On successful completion, students will be able to

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

Project: Data Modeling and Reporting

On successful completion, students will be able to

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

Links to other Modules within the Study Program	Links to other Study Programs of 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

Data Modeling and Reporting

Course Code: DLMBIDMR01

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

Course Description

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

Course Outcomes

On successful completion, students will be able to

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

Contents

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

2. Data Modeling Life Cycle
   - 2.1 Understand the Business
   - 2.2 Acquire and Explore Data
   - 2.3 Model and Validate
   - 2.4 Build and Deploy
   - 2.5 Test, Release and Document

3. Data Model Types
   - 3.1 Hierarchical Model
   - 3.2 Relational Model
   - 3.3 Network Model
   - 3.4 Object-Oriented Model
   - 3.5 Entity-Relationship Model

4. Data Extraction Using SQL
   - 4.1 Basic Concepts
   - 4.2 Querying and Filtering
   - 4.3 Aggregate Functions
   - 4.4 Sorting and Grouping Results
   - 4.5 Querying Multiple Tables

5. NoSQL Data Extraction
   - 5.1 Motives and Characteristics
   - 5.2 Key-Value Stores
   - 5.3 Document Stores
   - 5.4 Column Family Stores
   - 5.5 Graph Databases

6. Data Reporting
   - 6.1 Reporting Tools
   - 6.2 Layout and Format
   - 6.3 Automated Data Reporting
   - 6.4 SQL Reporting

7. Online Transactional Processing
   - 7.1 Transactional Data
   - 7.2 Key Selection Criteria
   - 7.3 Capability Matrix
   - 7.4 Technology Choices

8. Online Analytical Processing
   - 8.1 OLAP Cubes Structure
   - 8.2 Basic Analytical Operations
   - 8.3 Types of OLAP Systems
   - 8.4 Multidimensional Processing
   - 8.5 Hybrid Processin

Literature

Compulsory Reading

Further Reading

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

Study Format Distance Learning

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

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **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: Data Modeling and Reporting

Course Code: DLMBIPDMR01

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

Course Description

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

Course Outcomes

On successful completion, students will be able to

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

Contents

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

Literature

Compulsory Reading

Further Reading

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

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Project

Information about the examination	
Examination Admission Requirements	**BOLK:** no **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	
☐ Exam Template	

Storage and Data Provisioning in Data Warehouse Systems

Module Code: DLMBIESDPDWS

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	▪ DLMBIETLT01, DLMDSEBA01, DLMDMDQL01 ▪ DLMDSEBA01, DLMDMDQL01	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. Peter Poensgen (Extract, Transform and Load Technologies) / Prof. Dr. Peter Poensgen (Project: Extract, Transform and Load Technologies)

Contributing Courses to Module

- Extract, Transform and Load Technologies (DLMBIETLT01)
- Project: Extract, Transform and Load Technologies (DLMBIESDPDWS01)

Module Exam Type

Module Exam	Split Exam
	Extract, Transform and Load Technologies • Study Format "Distance Learning": Written Assessment: Case Study Project: Extract, Transform and Load Technologies • Study Format "Distance Learning": Written Assessment: Project Report

Weight of Module
see curriculum

Module Contents

Extract, Transform and Load Technologies

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

Project: Extract, Transform and Load Technologies

In this course, students learn to apply the Extract, Transform and Load (ETL) methods and technologies, they learned in previous module, in a practical project.

Learning Outcomes

Extract, Transform and Load Technologies

On successful completion, students will be able to

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

Project: Extract, Transform and Load Technologies

On successful completion, students will be able to

- practice and deepen the learned ETL knowledge.
- implement methods for moving data from different sources into a data warehouse.
- design a common data repository and associated ETL process for a data warehouse.
- evaluate the results of the ETL process.
- demonstrate the effective use of technical skills through documentation.
- present the main techniques of ETL and all related procedures.

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

Extract, Transform and Load Technologies

Course Code: DLMBIETLT01

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

Course Description

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

Course Outcomes

On successful completion, students will be able to

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

Contents

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

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

3. ETL-based Frameworks for NoSQL Warehousing
   - 3.1 Data Extraction
   - 3.2 Transformation Rules
   - 3.3 Data Quality
   - 3.4 Loading Szenarios
   - 3.5 ETL vs. ELT

4. ETL-Tools
   - 4.1 Power BI
   - 4.2 MS Integration Services

5. Practical Implementation Scenarios of ETL
   - 5.1 Example ETL Flow
   - 5.2 Package Control Flow

6. ETL Testing
   - 6.1 Production Validation Testing
   - 6.2 Source-to-Target Count Testing
   - 6.3 Data Integration Testing

Literature

Compulsory Reading

Further Reading

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

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Case Study

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **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

Project: Extract, Transform and Load Technologies

Course Code: DLMBIESDPDWS01

Study Level	Language of Instruction	Contact Hours	CP	Admission Requirements
MA	English		5	DLMBIETLT01, DLMDSEBA01, DLMDMDQL01

Course Description

The focus of this course is to apply previously acquired "Extract, Transform and Load (ETL)" knowledge to a project implementation and reflect on the results. The students will carry out the project based on a given set of requirements and document the results.

Course Outcomes

On successful completion, students will be able to

- practice and deepen the learned ETL knowledge.
- implement methods for moving data from different sources into a data warehouse.
- design a common data repository and associated ETL process for a data warehouse.
- evaluate the results of the ETL process.
- demonstrate the effective use of technical skills through documentation.
- present the main techniques of ETL and all related procedures.

Contents

- In this course, students perform and document a hands-on project using the Extract, Transform and Load (ETL) methods using the topics covered in the previous course based on a given set of requirements.

Literature
Compulsory Reading
Further Reading ▪ Ciampa , Brian. (2014): The Data Warehouse Workshop: Providing Practical Experience to the Aspiring ETL Developer. CreateSpace Independent Publishing. ▪ Guru99. (2021): ETL (Extract, Transform, and Load) Process in Data Warehouse. (URL: https://www.guru99.com/etl-extract-load-process.html) ▪ Kimball, Ralph / Caserta , Joe. (2007): The Data Warehouse ETL Toolkit, Practical Techniques for Extracting, Cleaning, Conforming, and Delivering Data. John Wiley & Sons, Inc. ▪ Panoply. (2021): 3 Ways to Build An ETL Process with Examples. (URL: https://panoply.io/data-warehouse-guide/3-ways-to-build-an-etl-process/) ▪ Singh , Jaiteg. (2011): Understanding ETL and Data Warehousing: Issues, Challenges and Importance. Role of ETL routines in Quality Data Warehouse Solutions. Lambert.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Project

Information about the examination	
Examination Admission Requirements	**BOLK:** no **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	
☐ Exam Template	

DLMBIESDPDWS01

Big Data Engineering

Module Code: DLMBIEBDE

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	▪ none ▪ DLMDSBDT01	MA	10	300 h

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

Module Coordinator

Prof. Dr. Max Pumperla (Big Data Technologies) / Prof. Dr. Thomas Zöller (Project: Big Data Technologies)

Contributing Courses to Module

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

Module Exam Type

Module Exam	Split Exam
	Big Data Technologies • Study Format "myStudies": Oral Assignment • Study Format "Distance Learning": Oral Assignment Project: Big Data Technologies • Study Format "Distance Learning": Written Assessment: Project Report

Weight of Module

see curriculum

Module Contents

Big Data Technologies

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

Project: Big Data Technologies

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

Learning Outcomes

Big Data Technologies

On successful completion, students will be able to

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

Project: Big Data Technologies

On successful completion, students will be able to

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

Links to other Modules within the Study Program	Links to other Study Programs of 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

Big Data Technologies

Course Code: DLMDSBDT01

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

Course Description

Data are often considered the “new oil”, the raw material from which value is created. To harness the power of data, the data need to be stored and processed on a technical level. This course introduces the four “Vs” of data, as well as typical data sources and types. This course then discusses how data are stored in databases. Particular focus is given to database structures and different types of databases, e.g., relational, noSQL, NewSQL, and time-series.Beyond classical and modern databases, this course covers a wide range of storage frameworks such as distributed filesystems, streaming, and query frameworks. This is complemented by a detailed discussion of data storage formats ranging from classical approaches such as CSV and HDF5 to more modern approaches like Apache Arrow and Parquet.Finally, this course gives an overview of distributed computing environments based on local clusters, cloud computing facilities, and container-based approaches.

Course Outcomes

On successful completion, students will be able to

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

Contents

1. Data Types and Data Sources
   - 1.1 The 4Vs of data: volume, velocity, variety, veracity
   - 1.2 Data sources
   - 1.3 Data types

2. Databases
   - 2.1 Database structures
   - 2.2 Introduction to SQL
   - 2.3 Relational databases
   - 2.4 nonSQL, NewSQL databases
   - 2.5 Timeseries DB

3. Modern data storage frameworks
   - 3.1 Distributed Filesystems
   - 3.2 Streaming frameworks
   - 3.3 Query frameworks

4. Data formats
   - 4.1 Traditional data exchange formats
   - 4.2 Apache Arrow
   - 4.3 Apache Parquet

5. Distributed Computing
   - 5.1 Cluster-based approaches
   - 5.2 Containers
   - 5.3 Cloud-based approaches

Literature

Compulsory Reading

Further Reading

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

Study Format myStudies

Study Format	Course Type
myStudies	Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **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

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **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
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Project: Big Data Technologies

Course Code: DLMBIEBDE01

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

Course Description

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

Course Outcomes

On successful completion, students will be able to

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

Contents

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

Literature

Compulsory Reading

Further Reading

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

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Project

Information about the examination	
Examination Admission Requirements	**BOLK:** no **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®
- ☐ Course Book
- ☐ Vodcast
- ☐ Shortcast
- ☐ Audio
- ☐ Exam Template
- ☐ Review Book
- ☐ Creative Lab
- ☑ Guideline
- ☐ Live Tutorium/Course Feed

Master Thesis

Module Code: DLMMTHES

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	See current study and exam regulations (SPO)	MA	15	450 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 (DLMMTHES01)
- Colloquium (DLMMTHES02)

Module Exam Type

Module Exam	Split Exam
	Master Thesis • Study Format "Distance Learning": Written Assessment: Master Thesis (90) • Study Format "myStudies": Written Assessment: Master Thesis (90) Colloquium • Study Format "myStudies": Presentation: Colloquium (10) • Study Format "Distance Learning": Presentation: Colloquium (10)

Weight of Module

see curriculum

Module Contents

Master Thesis

- Written Master Thesis

Colloquium

- Thesis Defense

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)
All modules in the master program	All Master Programmes

Master Thesis

Course Code: DLMMTHES01

Study Level	Language of Instruction	Contact Hours	CP	Admission Requirements
MA	English		13.5	See current study and exam regulations (SPO)

Course Description

The aim and purpose of the Master's thesis is to successfully apply the subject-specific and methodological competencies acquired during the course of study in the form of an academic dissertation with a thematic reference to the major field of study. The content of the Master's thesis can be a practical-empirical or theoretical-scientific problem. Students should prove that they can independently analyse a selected problem with scientific methods, critically evaluate it and work out proposed solutions under the subject-methodological guidance of an academic supervisor. The topic to be chosen by the student from the respective field of study should not only prove the acquired scientific competences, but should also deepen and round off the academic knowledge of the student in order to optimally align his professional abilities and skills with the needs of the future field of activity.

Course Outcomes

On successful completion, students will be able to

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

Contents

- Within the framework of the Master's thesis, the problem as well as the scientific research goal must be clearly emphasized. The work must reflect the current state of knowledge of the topic to be examined by means of an appropriate literature analysis. The student must prove his ability to use the acquired knowledge theoretically and/or empirically in the form of an independent and problem-solution-oriented application.

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

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Thesis

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

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
405 h	0 h	0 h	0 h	0 h	405 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

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

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
405 h	0 h	0 h	0 h	0 h	405 h

Instructional Methods

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

Colloquium

Course Code: DLMMTHES02

Study Level	Language of Instruction	Contact Hours	CP	Admission Requirements
MA	English		1.5	See current study and exam regulations (SPO)

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 myStudies

Study Format	Course Type
myStudies	Thesis Defense

Information about the examination	
Examination Admission Requirements	**BOLK:** no **Course Evaluation:** no
Type of Exam	Presentation: Colloquium

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
45 h	0 h	0 h	0 h	0 h	45 h

Instructional Methods

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

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Thesis Defense

Information about the examination	
Examination Admission Requirements	**BOLK:** no **Course Evaluation:** no
Type of Exam	Presentation: Colloquium

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
45 h	0 h	0 h	0 h	0 h	45 h

Instructional Methods

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