Master of Science (M.Sc.)
”Business Informatics“

University of Mannheim

– Module catalog –

Academic Year
HWS 2023/ FSS 2024

Content

Foreword

This document describes the courses that will be offered in academic year HWS 2023/ FSS 2024 for students studying M. Sc. Business Informatics (Examination Regulations for the Master's Program from 12th December 2017). You can find the Examination Regulations on the website of the Student Services (Studienbüros):

https://www.uni-mannheim.de/en/academics/during-your-studies/examinations/examination-regulations/

It is possible that additional courses will be made available during the course of the academic year. These will be published in an appendix available on the following web page:

https://www.wim.uni-mannheim.de/studium/studienorganisation/m-sc-business-informatics/

Part 1: M.Sc. Business Informatics

A. Overview

		ECTS
Fundamentals Computer Science	Three „Computer Science Fundamentals“ courses	**18**
Fundamentals Business Administration	Courses from the module catalog of the “Mannheim Master in Management”	**18 (at least)**
Specialization Courses	Specialization Courses	**36**
Projects and Seminars	Team Project, Scientific Research and Seminars	**18**
Master’s Thesis	Six-month-long written academic assignment	**30**
Total		**120**

Abbreviations:
HWS (Herbst-/Wintersemester): Course is offered in the respective Fall semester
FSS (Frühjahrs-/Sommersemester): Course is offered in the respective Spring semester
FSS/HWS: Course is offered both in Spring semester and Fall semester

Please note: the module descriptions of all IS courses can be found in the module catalog of the “Mannheim Master in Management” which can be found here:
https://www.bwl.uni-mannheim.de/studium/master/mmm/#c176637

General constraints:

See Examination Regulations on the website of the Student Services (Studienbüros):

https://www.uni-mannheim.de/en/academics/during-your-studies/examinations/examination-regulations/

B. Fundamentals

1. Overview

i. Fundamentals Computer Science

Module no.	Name of Module	Offered	Language	ECTS	Page
CS 404	Kryptographie I/ Cryptographie I	FSS	E	6	6
CS 408	Selected Topics in IT-Security	FSS	E	6	9
CS 500	Advanced Software Engineering	HWS	E	6	11
CS 530	Database Systems II	FSS	D	6	13
CS 550	Algorithmics	FSS/HWS	E	6	15
CS 560	Large-Scale Data Management	HWS	E	6	18
IE 500	Data Mining I	FSS/HWS	E	6	20
IE 560	Decision Support	HWS	E	6	22

ii. Fundamentals Business Administration

All 5XX and 6XX courses from the following areas:

- Accounting and Taxation (ACC, TAX)
- Banking, Finance and Insurance (FIN)
- Management (MAN)
- Marketing (MKT)
- Operations Management (OPM)

They are listed in the module catalog of the “Mannheim Master in Management”:
https://www.bwl.uni-mannheim.de/studium/master/mmm/#c176637

2. Detailed descriptions

i. Fundamentals Computer Science

CS 404	**Kryptographie I** ***Cryptographie I***
Form der Veranstaltung	Vorlesung mit begleitender Übung
Typ der Veranstaltung	Vertiefung Informatik
Modulniveau	Bachelor
ECTS	6
Arbeitsaufwand	Präsenzstudium: 56 h pro Semester (4 SWS)
	Eigenstudium: ca. 112 h pro Semester • davon Vor- und Nachbereitung der Veranstaltung und freies Selbststudium: 84 h pro Semester • davon Vorbereitung für die Prüfung, z.B. Prüfungs-/Seminarabschlussarbeits- und Präsentationsvorbereitung: 28 h pro Semester
Vorausgesetzte Kenntnisse	Es gibt keine formalen Voraussetzungen, aber folgende inhaltliche Vorkenntnisse werden empfohlen: Praktische Informatik I und II, Lineare Algebra, Algorithmen und Datenstrukturen, Analysis, Einführung in die Statistik
Lehrinhalte	In der Vorlesung erfolgt eine Einführung in die moderne Kryptographie, d.h. in die Theorie und der Praxis der Absicherung von digitalen Daten. Neben der Bereitstellung der für das Verständnis des Stoffs nötigen mathematischen, algorithmischen und informationstheoretischen Grundlagen werden vor allem die grundlegenden Konzepte und mehrere in der Praxis eingesetzte Verfahren vorgestellt. Behandelt Themen sind beispielsweise: • Grundbegriffe der Kryptographie • Blockchiffren, z.B. Data Encryption Standard (DES) und Advanced Encryption Standard (AES), und Stromchiffren • Verfahren zum sicheren Schlüsselaustausch, bspw. das Diffie-Hellman Protokoll • Public-Key Verschlüsselungsverfahren, bspw. RSA • Hashfunktionen

	• Message Authentication Codes
Lern- und Kompetenzziele	Fachkompetenz: Nach Abschluss des Moduls sind die Studierenden befähigt, die größten Risiken im elektronischen Datenverkehr, wie sie bspw. beim Online-Banking oder Einkauf über Online-Händler wie Amazon auftreten können, zu erkennen und zu vermeiden. (BK1, BK2, BK7)
	Methodenkompetenz: Die Studierenden können in konkreten Anwendungsfällen notwendige Sicherheitsziele erkennen und passende Methoden auswählen und einsetzen. Beispiele sind Verfahren zur Geheimhaltung von Daten (Verschlüsselungen), den Aufbau einer vertrauenswürdigen Verbindung (Schlüsselaustausch) und der sicheren Authentifikation (Zertifikate und digitale Signaturen). (BK5, BF4, BF5)
	Personale Kompetenz: Das analytische, konzentrierte und präzise Denken der Studierenden wird geschult. Durch die eigenständige Behandlung von Anwendungen, z.B. im Rahmen der Übungsaufgaben, wird ihr Abstraktionsvermögen weiterentwickelt und der Transfer des erlernten Stoffes auf verwandte Fragestellungen gefördert. (BKO2)
Medienformen	Anschrieb (Tafel, elektronisch), Folien, Handouts
Begleitende Literatur	• Christof Paar, Bart Preneel, Jan Pelzl: Understanding Cryptography: A Textbook for Students and Practitioners, Springer, 2009. • Douglas R. Stinson: Cryptography - Theory and Practice, Taylor & Francis, 2005. • Alan G. Konheim: Cryptography: A Primer, John Wiley & Sons, 1981.
Lehr- und Lernmethoden	Nacharbeit der Vorlesung und Studium der relevanten Literatur im Selbststudium, gemeinsames Durcharbeiten konkreter Beispiele während der Vorlesung, Lösen von Übungsaufgaben im Selbststudium und in der Übung in Kooperation mit den Kommilitonen.

Art der Prüfungsleistung	Schriftliche Prüfung
Prüfungsvorleistungen	-
Prüfungsdauer	90 Minuten
Sprache	Englisch
Angebotsturnus	Frühjahrssemester
Lehrende/r	Prof. Dr. Frederik Armknecht, Prof. Dr. Matthias Krause
Modulverantwortlicher	Prof. Dr. Frederik Armknecht, Prof. Dr. Matthias Krause
Dauer des Moduls	1 Semester
Weiterführende Module	-
Verwendbarkeit	B.Sc. Wirtschaftsinformatik, B.Sc. Wirtschaftsmathematik, M.Sc. Wirtschaftspädagogik, Lehramt Informatik, Beifach Angewandte Informatik. M.Sc. Wirtschaftsinformatik
Einordnung in Fachsemester	5./6. Fachsemester

CS 408	**Selected Topics in IT-Security**
Form of module	Inverted classroom with exercises
Type of module	Vertiefung Informatik
Level	Bachelor
ECTS	6
Workload	Hours per semester present: 56h (4 SWS) Self-study: 112h
Prerequisites	No formal prerequisites. However, knowledge with respect to the content of the following lectures are suggested: • Praktische Informatik I and II, programming
Aim of module	This course aims to increase the security awareness of students and offers them a basic understanding with respect to a variety of relevant IT-security topics. Possible topics are: • Security Goals • Crash course in Cryptography • Access Control • Authentication • Social Engineering • E-Mail Security • System Vulnerabilities • Malware • Hardware Security • Network Security • Web Security • Trust • Risk Assessment
Learning outcomes and qualification goals	Expertise: Students will acquire the knowledge to identify security threats and to select and use appropriate countermeasures. (MK2)
	Methodological competence: Successful participants will be able to understand, to select, apply and evaluate the most appropriate techniques for a variety of different privacy-sensitive scenarios. In particular they are able to realize possible risks in new scenarios and to transfer given solutions to these. (MK1)
	Personal competence: The analytic, concentrated, and precise thinking of the students is trained. By the independent treatment of applications, e.g. in the course of the exercises, their abstraction capacity is further developed and the transfer of the learned material to related questions is trained. (MF1, MKO3)

Media	Video recordings, annotated lecture slides
Literature	none
Methods	Reworking the lecture and studying the relevant literature in self-study. During the lecture: discussing questions and ideas and working together on concrete examples. Solving exercises in self-study and in practice in cooperation with fellow students.
Form of assessment	Written exam
Admission requirements for assessment	none
Duration of assessment	90 minutes
Language	English
Offering	FSS
Lecturer	Prof. Dr. Frederik Armknecht
Person in charge	Prof. Dr. Frederik Armknecht
Duration of module	1 Semester
Further modules	-
Range of application	B.Sc. Wirtschaftsinformatik, B.Sc. Medien- und Kommunikationswissenschaft, M.Sc. Wirtschaftspädagogik, Lehramt Informatik, Beifach Angewandte Informatik, M.Sc. Wirtschaftsinformatik

CS 500	**Advanced Software Engineering**
Form of module	Lectures and accompanying tutorials
Type of module	Computer Science Fundamental
Level	Master
ECTS	6
Workload	Hours per semester present: 56 h (4 SWS)
	Self-study: 112 h per semester • 28h: pre and post lecture studying and revision • 56h: tutorial exercises • 28h: directed independent study (reading papers, books etc.)
Prerequisites	-
Aim of module	The course deals with the model-based specification of software systems and components as well as their verification, validation, and quality assurance. The emphasis is on view-based specification methods that use multiple views, expressed in multiple languages, to describe orthogonal aspects of software systems/components. Key examples include structural views represented using class diagrams, operational views expressed using constraint languages and behavioral views expressed using state diagrams. An important focus of the course is the use of these views to define tests and extra-functional properties.
Learning outcomes and qualification goals	Expertise: After taking the course, students will be familiar with the latest state-of-the-art techniques for specifying the externally visible properties of a software system/component – that is, for describing a software system/component as a "black box", and for verifying them. (MK1, MK2)
	Methodological competence: Participants will know how to use the expertise acquired during the course to describe the requirements that a system/component has to satisfy and to define tests to check whether a system/component fulfils these requirements. (MF1, MF3)
	Personal competence:

	With the acquired skills and know-how, students will be able to play a key role in projects involving the development of systems, components, and software applications. (MKO3)
Media	Printed Lecture Notes, Presentations, Tool Demonstrations
Literature	• C. Atkinson et. al., Component-Based Product Line Engineering with the UML, Addison-Wesley, 2001. • Paul Ammann & Jeff Offutt., "Introduction to Software Testing", Cambridge University Press, January 2008.
Methods	Lectures, tutorials, independent study
Form of assessment	Written examination
Admission requirements for assessment	-
Duration of assessment	90 minutes
Language	English
Offering	Fall semester
Lecturer	Prof. Dr. Colin Atkinson
Person in charge	Prof. Dr. Colin Atkinson
Duration of module	1 Semester
Further modules	-
Range of application	M.Sc. Wirtschaftsinformatik, M.Sc. Wirtschaftspädagogik, Lehramt Informatik
Semester	1./ 2. semester

CS 530	**Datenbanksysteme II** *Database Systems II (DBSII)*
Form der Veranstaltung	Vorlesung mit Übung
Typ der Veranstaltung	Vertiefung
Modulniveau	Master
ECTS	6
Arbeitsaufwand	Präsenzstudium: 4SWS
	Eigenstudium: 56h pro Semester • davon Vor- und Nachbereitung der Veranstaltung und freies Selbststudium: 28h pro Semester • davon Vorbereitung für die Prüfung: 28 h pro Semester
Vorausgesetzte Kenntnisse	PI2, Algorithmen und Datenstrukturen, DBSI, C, C++
Lehrinhalte	Implementierung von Hauptspeicherdatenbanksystemen
Lern- und Kompetenzziele	Fachkompetenz: • effiziente C/C++ Programme entwickeln • physische Algebra • Implementierung von Indexstrukturen (MK1, MK3)
	Methodenkompetenz: • Analyse komplexer Algorithmen (MF1)
	Personale Kompetenz: • Praezises Analysieren (MKO1, MKO3)
Medienformen	Präsentationen mit Tafelanschrieb
Begleitende Literatur	Skript
Lehr- und Lernmethoden	Vorlesung (2 SWS)
Art der Prüfungsleistung	Schriftliche Prüfung
Prüfungsvorleistung	-
Prüfungsdauer	90 Minuten (schriftliche Prüfung)
Sprache	Deutsch
Angebotsturnus	FSS (nicht im FSS 2024)

Lehrende/r	Moerkotte
Modulverantwortlicher	Moerkotte
Dauer des Moduls	1 Semester
Weiterführende Module	-
Verwendbarkeit	M.Sc. Wirtschaftsinformatik
Einordnung in Fachsemester	1./2./3. Fachsemester

CS 550	**Algorithmics**
Form of module	Lecture with tutorials
Type of module	Fundamental in Computer Science
Level	Master
ECTS	6
Workload	Attendance: 56 h per semester (4 h per week)
	Self-study: 112 h per semester • 28 h per semester for preparation and reworking of lectures/tutorials • 84 h per semester for the preparation of the exams
Prerequisites	Practical Informatics I, Algorithms and Data Structures, Linear Algebra, Statistics
Aim of module	The lecture deals with the design and the analysis of algorithms for various practically relevant computational problems and with methods for analyzing the complexity of certain problems. In particular, we will learn methods of formalizing discrete optimization problems and designing algorithms for them on the basis of analyzing the structure of these problems. Moreover, we will learn techniques for proving the correctness and estimating the running time of these algorithms. In the second part of the lecture, we will deal with the theory of NP-completeness with gives evidence that certain highly relevant problems do not have efficient algorithms. During the lecture we will derive algorithms and complexity-theoretic results for the following computational problems: • shortest path problems and shortest round tour problems • linear optimization problems • flow problem • matching problems • satisfiability problems • discret linear optimization problems
Learning outcomes and qualification goals	Professional expertise: The students know efficient algorithms and the most important complexity-theoretic results for a number of

	computational problems which are highly relevant in practice. (MK1, MK2)
	Methodological competence: The students learn to formalize informally specified computational problems, to analyse their structure with the goal to design efficient algorithms, to prove the correctness and to analyse the running time of given algorithms. Moreover, they learn to prove the NP-completeness of certain problems. (MF1, MF3)
	Personal competence: Training of analytical, focussed, and precise thinking. Further development of abstraction abilities and the ability to transfer theoretical knowledge for solving practical problems, especially in the field of operations research. Increasing the sensitivity for the complexity and the efficient solvability of computational problems, especially through dealing with the theory of NP-completeness. (MF1, MKO3)
Media	Writing with chalk at the blackboard, slides, and electronic media
Literature	• Cormen, Leiserson, Rivest, Stein: Introduction to Algorithms, 3rd edition • Shimon Even: Graph Algorithms • Lovasz, Plummer: Matching Theory • Handbooks on Operations Research and Management Science Volume 7 (Editors: Ball, Magnati, Monma, Nemhauser) • J. Toran: Das Erfüllbarkeitsproblem SAT, Lehmann Media, 2012
Methods	Reworking of lectures and tutorials, self-studies with literature, solving exercises at home and in cooperation with other students at the tutorials
Form of assessment	Written examination
Admission requirements for assessment	-
Duration of assessment	90 Minutes
Language	English

Offering	Fall semester / Spring semester
Lecturer	Prof. Dr. Matthias Krause
Person in charge	Prof. Dr. Matthias Krause
Duration of module	1 semester
Further modules	CS 651 – Cryptography II
Range of application	M.Sc. Wirtschaftsinformatik, M.Sc. Mannheim Master in Data Science, M.Sc. Wirtschaftsmathematik, M.Sc. Wirtschaftspädagogik, Lehramt Informatik, M.Sc. Mathematik
Semester	1./ 2. semester

CS 560	**Large-Scale Data Management**
Form of module	Lecture with exercises
Type of module	Computer Science Fundamental
Level	Master
ECTS	6
Workload	In presence: 56 h (4 SWS)
	Exercises and self-study: 98 h
Prerequisites	Very good knowledge of database systems, good knowledge of algorithms and data structures as well as Java programming
Aim of module	This course introduces the fundamental concepts and computational paradigms of large-scale data management and Big Data. This includes methods for storing, updating, querying, and analyzing large dataset as well as for data-intensive computing. The course covers concept, algorithms, and system issues; accompanying exercises provide hands-on experience. Topics include: • Parallel and distributed databases • Big data platforms • NoSQL, NewSQL and polystore systems
Learning outcomes and qualification goals	Expertise: Students will acquire knowledge about methods and systems for managing large datasets and data-intensive computing. (MK1, MK2)
	Methodological competence: • Be able to judge, select, and use traditional or non-traditional data management systems for a given data management task • Be able to solve computational problems involving large datasets (MF1)
	Personal competence: • Study independently • Presentation and writing skills (MKO3)
Media	Slide set, black board, exercise sheets, datasets, software

Literature	• T. Öszu, P. Valduriez *Principles of Distributed Database Systems* Springer, 4th ed., 2020 • H. Garcia-Molina, J. D. Ullman, J. Widom *Database Systems: The Complete Book* Prentice Hall, 2nd ed., 2008 • More in lecture notes
Methods	Lecture, weekly exercise, experimentation with different systems
Form of assessment	Written examination
Duration of assessment	90 minutes
Language	English
Offering	Fall semester
Lecturer	Prof. Dr. Rainer Gemulla
Person in charge	Prof. Dr. Rainer Gemulla
Duration of module	1 semester
Further modules	-
Range of application	M.Sc. Wirtschaftsinformatik, M.Sc. Mannheim Master in Data Science, Lehramt Informatik
Semester	1st / 2nd semester

IE 500	**Data Mining I**
Form of module	Lecture with exercises and project
Type of module	Business Informatics Fundamental
Level	Master
ECTS	6
Workload	Hours per semester: 56 h (4 SWS)
	Self-study per semester: 98 h • 70 h: pre and post lecture studying and revision • 28 h: examination preparation
Prerequisites	Foundations of Statistics, Practical Informatics I
Aim of module	The course provides an introduction to advanced data analysis techniques as a basis for analyzing business data and providing input for decision support systems. The course will cover the following topics: • Goals and Principles of Data Mining • Data Representation and Preprocessing • Clustering • Classification • Regression • Association Analysis • Text Mining • Systems and Applications (e. g. Retail, Finance, Web Analysis)
Learning outcomes and qualification goals	Expertise: Students will acquire basic knowledge of the techniques, opportunities, and applications of data mining. (MK1, MF1)
	Methodological competence: • Successful participants will be able to identify opportunities for applying data mining in an enterprise environment, select and apply appropriate techniques, and interpret the results. • project organization skills (MK2, MF3, MF4, MKO1)
	Personal competence:

	• team work skills • presentation skills (MKO2, MF2)
Media	slide set, exercise sheets, data sets for the exercises
Literature	• Pang-Ning Tan, Michael Steinback, Vipin Kumar: Introduction to Data Mining, Pearson. • Vijay Kotu, Bala Deshpande: Predictive Analytics and Data Mining: Concepts and Practice with RapidMiner. Morgan Kaufmann
Methods	The course consists of a lecture together with accompanying practical exercises as well as student team projects. In the exercises the participants will gather initial expertise in applying state of the art data mining tools on realistic data sets. The team projects take place in the last third of the term. Within the projects, students realize more sophisticated data mining projects of personal choice and report about the results of their projects in the form of a written report as well as an oral presentation.
Form of assessment	Written examination (75%), project report (20%), oral project presentation (5%)
Admission requirements for assessment	-
Duration of assessment	60 minutes (written examination)
Language	English
Offering	Fall semester / Spring semester
Lecturer	Prof. Dr. Heiko Paulheim; Prof. Dr. Christian Bizer
Person in charge	Prof. Dr. Heiko Paulheim; Prof. Dr. Christian Bizer
Duration of module	1 Semester
Further modules	IE 672 – Data Mining II, IE 671 – Web Mining, IS 661 – Text Analytics, IE 675b – Machine Learning
Range of application	M.Sc. Wirtschaftsinformatik, M.Sc. Mannheim Master in Data Science, Lehramt Informatik
Semester	1st/2nd semester

IE 560	**Decision Support**
Form of module	Inverted classroom
Type of module	Business Informatics Fundamental
Level	Master
ECTS	6
Workload	Hours per semester: 42 h (1+2 SWS)
	Self-study per semester: 138 h • 89 h: pre- and post lecture studying and revision • 49 h: exam preparation
Prerequisites	Basic Probability Theory, Basic Knowledge of Propositional and First-Order Logic
Aim of module	The course provides an introduction to decision support techniques as a basis for the design of decision support systems. The course will cover the following topics: • Decision Theory • Decision- and Business Rules • Probabilistic Graphical Models • Game Theory and Mechanism Design • Decision Processes and Reinforcement Learning
Learning outcomes and qualification goals	Expertise: Students will acquire basic knowledge of the techniques, opportunities, and applications of decision theory. (MK1, MF1)
	Methodological competence: Successful participants will be able to identify opportunities for decision support in an enterprise environment, select and apply appropriate techniques, and interpret the results. (MK2, MF3, MF4, MKO1)
	Personal competence: -
Media	Lecture videos, slide set, exercise sheets, software tools
Literature	• S. Russel and P. Norvig: AI a modern Approach (3rd Edition), 2010 (selected sections)
Methods	The course consists of a lecture accompanied by practical homework and case studies. In the lecture, the students'

	basic concepts and methods of decision theory will be explained both in theory and using concrete examples. The students will practice and test their knowledge acquired in the lecture in homework assignments. Within the case studies, students model real world decision problems and try to solve them optimally using methods from the lecture.
Form of assessment	Written exam
Admission requirements for assessment	-
Duration of assessment	Written examina: 90 minutes
Language	English
Offering	Fall semester
Lecturer	Prof. Dr. Heiner Stuckenschmidt
Person in charge	Prof. Dr. Heiner Stuckenschmidt
Duration of module	1 Semester
Further modules	-
Range of application	M.Sc. Wirtschaftsinformatik, M.Sc. Mannheim Master in Data Science,
Semester	1st/2nd semester

ii. *Fundamentals Business Administration*

All 5XX and 6XX courses from the following areas:

- Accounting and Taxation (ACC, TAX)
- Banking, Finance and Insurance (FIN)
- Management (MAN)
- Marketing (MKT)
- Operations Management (OPM)

They are listed in the module catalog of the “Mannheim Master in Management”:
https://www.bwl.uni-mannheim.de/studium/master/mmm/#c176637

C. Specialization Courses

1. Overview

i. CS-Courses

ii. IE-Courses

iii. IS-Courses

Module no.	Name of Module	Offered	Language	ECTS	Page
IS 512	IT Management in the Digital Age	MMM*	E	6	MMM*
IS 513	Applied IT Management in the Digital Age	MMM*	E	6	MMM*
IS 515	Process Management & Analytics	MMM*	E	6	MMM*
IS 540	Management of Enterprise Systems	MMM*	E	6	MMM*
IS 541	Methods and Theories in Information Systems (ManTIS)	MMM*	E	6	MMM*
IS 556	Public Blockchains	MMM*	E	6	MMM*
IS 607	Digital Innovation	MMM*	E	6	MMM*
IS 613	Applied Project in Design Thinking and Lean Software Development	MMM*	E	6	MMM*
IS 614	Corporate Knowledge Management	MMM*	E	6	MMM*
IS 615	Design Thinking and Lean Development in Enterprise Software Development	MMM*	E	6	MMM*
IS 616	Large Scale Data Analysis and Visualization	MMM*	E	6	MMM*
IS 622**	Network Science	MMM*	E	6	MMM*
IS 629	Agile Software Product Management and Design	MMM*	E	6	MMM*
IS 661	Text Analytics	MMM*	E	6	MMM*

* For a detailed description please use the module catalog of the „Mannheim Master in Management“:
https://www.bwl.uni-mannheim.de/en/programs/master/mmm/module-catalogs-2011-2020/
** Prerequisite: No completed exam in IE 676

iv. International Courses & other Specialization Courses

Module no.	Name of Module	Offered	Language	ECTS	Page
BI 656	International Course	-	-	max. 18	71
MAB 519	Reinforcement Learning	Spring	E	9	M.Sc. Wima und M.Sc. Mathematik*

*For a detailed description, please see the module catalog of the respective following degree programs M.Sc. Wima and M.Sc. Mathematik:
https://www.wim.uni-mannheim.de/studium/studienorganisation/m-sc-wirtschaftsmathematik/#c109976

2. Detailed descriptions

i. CS-Courses

CS 600	**Model Driven Development**
Form of module	Lectures with accompanying tutorials
Type of module	Specialization course
Level	Master
ECTS	6
Workload	Hours per semester present at university: 56 h (4 SWS)
	Self-study: 112 h semester • 28 h: pre and post lecture studying and revision • 56 h: tutorial exercises • 28 h: directed independent study (reading papers, books etc.)
Prerequisites	Advanced Software Engineering
Aim of module	The course focuses on the principles, practices and tools involved in advanced model-driven development. This includes established modelling standard languages (e. g. UML, ATL, OCL) and modelling infrastructures (e. g. MOF, EMF, etc.) as well as leading edge, state-of-the-art modelling technologies (e. g. LML, PLM . . .). Key topics addressed include: • Multi-level modeling • Meta-modeling • Ontology engineering versus model engineering • Model transformations • Domain specific language definition and use • Model creation and evolution best practices • Model-driven software development • Model checking and ontology validation
Learning outcomes and qualification goals	Expertise: Students will be familiar with the accepted best practices and technologies used in mainstream model-driven development as well as state-of-the-art modeling technologies emerging from research institutions. (MK1, MK2)

	Methodological competence: Students will know how to apply modeling technologies in real-world projects. (MF1, MF3)
	Personal competence: Students will have the capability to analyse, understand and model complex systems. (MKO1)
Media	Printed Lecture Notes, Presentations, Tool Demonstrations
Literature	Jos B. Warmer and Anneke G. Kleppe, The Object Constraint Language: Getting Your Models Ready for MDA, Addison-Wesley Object Technology Series, 2003
Methods	Lectures, tutorials, independent study
Form of assessment	Written examination
Admission requirements for assessment	-
Duration of assessment	90 minutes
Language	English
Offering	Fall semester
Lecturer	Prof. Dr. Colin Atkinson
Person in charge	Prof. Dr. Colin Atkinson
Duration of module	1 semester
Further modules	-
Range of application	M.Sc. Wirtschaftsinformatik, M.Sc. Mannheim Master in Data Science, Lehramt Informatik
Semester	1st/2nd/3rd semester

CS 651	**Cryptography II**
Form of module	Inverted classroom
Type of module	Specialization course
Level	Master
ECTS	6
Workload Prerequisites	Hours per semester present: 56h (4 SWS) Self-study: 112h
	Even though the lecture deepens and continues topics discussed in *"CS 404 Cryptography I"*, it is not a prerequisite to have attended this lecture. The lecture "*Cryptography II"* can be studied without any prior knowledge on cryptography – all necessary basics are shortly recapitulated.
Aim of module	The goal of this lecture is to present and discuss important scientific concepts from modern cryptography. This includes: • Security Definitions: How can the security of cryptographic schemes formally defined? • Proofs of Security: How can the security of cryptographic schemes be proven (based on precise assumptions)? • Cryptanalysis: What are the established techniques to analyze cryptographic mechanisms? • Elliptic Curves • Zero-Knowledge Proofs
Learning outcomes and qualification goals	Expertise: With the help of current techniques and theories of modern cryptography, the students can assess the security of cryptographic processes and assess security statements accordingly. Furthermore, they can identify security goals and use appropriate techniques that could not be dealt with in "*CS 404 Cryptography I*". (MK2)
	Methodological competence: The students can select and use suitable methods for the security analysis of cryptographic processes. This includes, for example, the choice of the appropriate security model, proof of security based on clearly specified assumptions and the analysis of given procedures. In particular, the students can understand and assess the security arguments for existing procedures and to transfer them to new ones. Furthermore, they can use techniques and protocols to achieve security goals that were not yet possible with the methods discussed in *"CS 404 Cryptography I"*. (MK1)

	Personal competence: The analytic, concentrated, and precise thinking of the students is trained. By the independent treatment of applications, e.g. in the course of the exercises, their abstraction capacity is further developed and the transfer of the learned material to related questions is trained. (MF1, MKO3)
Media	Video recordings, annotated lecture slides
Literature	Jonathan Katz, Yehuda Lindell: Introduction to Modern Cryptography: Principles and Protocols, Chapman and Hall/CRC, 2007.
Methods	Reworking the lecture and studying the relevant literature in self-study. During the lecture: discussing questions and ideas and working together on concrete examples. Solving exercises in self-study and in practice in cooperation with fellow students.
Form of assessment	Oral exam
Admission requirements for assessment	none
Duration of assessment	30 minutes
Language	English
Offering	HWS
Lecturer	Prof. Dr. Frederik Armknecht
Person in charge	Prof. Dr. Frederik Armknecht
Duration of module	One term
Further modules	none
Range of application	M.Sc. Mannheim Master in Data Science, M.Sc. Wirtschaftsinformatik, Lehramt Informatik, M.Sc. Mathematik
Semester	1st/2nd/3rd semester

CS 652	**Data Security and Privacy**
Form of module	Inverted classroom with exercises
Type of module	Specialization course
Level	Master
ECTS	6
Workload	Hours per semester present: 56h (4 SWS)
	Self-study: 112h
Prerequisites	There are no formal prerequisites but knowledge in cryptography or IT-security is recommended, e.g., by attending the lectures “Kryptographie I” or “Selected Topics in IT-Security”
Aim of module	Nowadays, users are more and more revealing data to the outside – either willingly as in the context of data mining or possibly unconsciously as in the case of the Internet of Things. The aim of the module is to raise awareness, in particular with respect to privacy violations. This is done by showing various security threats, e.g., traces left on the Internet such as the use of cookies or browser fingerprinting. In particular, the topic of privacy preservation will be covered. This includes discussing different approaches for defining the meaning of privacy but also possible countermeasures such as anonymization of data or the use of dedicated encryption schemes.
Learning outcomes and qualification goals	Expertise: Students will acquire the knowledge to identify security and privacy threats and to select and use appropriate countermeasures. (MK2)
	Methodological competence: Successful participants will be able to understand, to select, apply and evaluate the most appropriate techniques for a variety of different privacy-sensitive scenarios. In particular they are able to realize possible risks in new scenarios and to transfer given solutions to these. (MK1)

	Personal competence: The analytic, concentrated, and precise thinking of the students is trained. By the independent treatment of applications, e.g. in the course of the exercises, their abstraction capacity is further developed and the transfer of the learned material to related questions is trained. (MF1, MKO3)
Media	Video recordings, annotated lecture slides
Literature	Will be announced in the lecture
Methods	Reworking the lecture and studying the relevant literature in self-study. During the lecture: discussing questions and ideas and working together on concrete examples. Solving exercises in self-study and in practice in cooperation with fellow students.
Form of assessment	Written exam
Admission requirements for assessment	-
Duration of assessment	90 minutes
Language	English
Offering	FSS
Lecturer	Prof. Dr. Frederik Armknecht
Person in charge	Prof. Dr. Frederik Armknecht
Duration of module	1 semester
Further modules	-
Range of application	M.Sc. Mannheim Master in Data Science, M.Sc. Wirtschaftsinformatik, Lehramt Informatik, M.Sc. Mathematik
Semester	1st/2nd/3rd semester

CS 655	**Cryptography**
Form of Module	Lecture with Exercise
Type of Module	Specialization Course
Level	Master
ECTS	6
Workload	Hours per semester present: 56 (4 SWS)
	Self-study: 98h (70h lectures/exercises, 28h exam preparation
Prerequisites	Basis skills in linear algebra, probability theory, algorithms, and data structures
Aim of Module	• Basic concepts of cryptography • Mathematical Background • Basics of Information Theory • Block Ciphers (DES, AES, etc.) • Stream Ciphers • Secure Key Exchange Protocols (Diffie-Hellman protocol, etc.) • Public Key encryption (RSA) • Cryptographic Hash Functions • Signature Systems and Message Authentication Codes
Learning Outcomes and qualification goals	Expertise: After the course the students are able to identify security risks in various modern scenarios of data traffic like online banking, wireless communication, online trade ... (MK1)
	Methodological competence: The students are able to formulate and formalize security goals for various use cases and to choose and to apply appropriate methods to reach these goals. Examples here are to provide data security data encryption, to establish trusted electronical data encryption, to establish trusted electronical communication channels, or to apply methods for secure authentication (MF1)

	Personal competence: The course trains abstract thinking and the ability to formally model application scenarios. By solving exercises independently, the transfer of the learned material to related questions is promoted.
Media	Exercise sheets and lecture slides available online, blackboard
Literature	• Christof Paar, Bart Preneel, Jan Pelzl: Understanding Cryptography: A Terxtbook for Students and Practitioners, Springer 2009 • Douglas R. Stinson: Cryptography - Theory and Practice, Taylor & Francis, 2005 • Alan G. Konheim: Cryptography: A Primer, John Wiley & Sons, 1981
Methods	Lecture, exercises every two weeks, book studies
Form of assessment	Written or oral examination (TBA)
Admission requirements for assessment	-
Duration of assessment	TBA
Language	English
Offering	FSS
Person in Charge	Prof. Dr. Matthias Krause
Duration of Module	1 Semester
Further Modules	Cryptography II
Range of Application	M.Sc Business Informatics, M.Sc Data Science, Lehramt Informatik, B.Sc. Wirtschaftsmathematik
Semester	1st/2nd/3rd Semester

CS 660	**Compiler Construction**
Form of module	Lecture with Exercise
Type of module	Specialization Course
Level	Master
ECTS	6
Workload	Hours per semester present: 56h (4 SWS)
	Self-study: 112h
Prerequisites	Basic skills in C/C++ are advantageous but the course will include a crash course in C++
Aim of module	• Lexing, Parsing • Semantic Analysis, Type Checking • Program Analysis & Optimizations • SSA • LLVM
Learning outcomes and qualification goals	Expertise: Know basic concepts of compiler design & implementation. (MK1, MK2, MF1, MF3)
	Methodological competence: Students will be able to design and implement a compiler from scratch. (MF1, MF2, MF3)
	Personal competence: • Learn how to read software documentation and a language specification. • Learn how to cope with a huge software stack. • Teamwork skills. (MK01, MK02)
Media	Lecture slides, exercise sheets, project assignments, software, software documentation
Literature	• Aho, Alfred Vaino; Lam, Monica Sin-Ling; Sethi, Ravi; Ullman, Jeffrey David (2006). *Compilers: Principles, Techniques, and Tools.* ISBN 0-321-48681-1.

	• Helmut Seidl, Reinhard Wilhelm, Sebastian Hack: *Compiler Design - Analysis and Transformation.* Springer 2012, ISBN 978-3-642-17547-3. • Andrew W. Appel, Jens Palsberg: *Modern Compiler Implementation in Java, 2nd edition*. Cambridge University Press 2002, ISBN 0-521-82060-X.
Methods	• Lecture • Weekly Exercise • Implementation of a compiler that translates a subset of C into executable code via LLVM in groups of 2-3 students.
Form of assessment	• Written exam (50%) • Software, code & documentation + oral presentation of the programming project (50%) You need to pass both the exam and the project in order to pass the whole course.
Admission requirements for assessment	-
Duration of assessment	• 90 minutes written exam • 30 minutes oral project presentation
Language	English
Offering	Fall Semester
Lecturer	Juniorprofessor Dr. Roland Leißa
Person in charge	Juniorprofessor Dr. Roland Leißa
Duration of module	1 Semester
Further modules	-
Range of application	M. Sc. Wirtschaftsinformatik, M.Sc. Mannheim Master in Data Science, Lehramt Informatik
Semester	1st/2nd/3rd semester

CS 661	**Parallel Programming**
Form of module	Lecture with Exercise
Type of module	Specialization Course
Level	Master
ECTS	6
Workload	Hours per semester present: 56h (4 SWS)
	Self-study: 112h
Prerequisites	Good programming skills.
Aim of module	In this course we will talk about various forms of paralleilsm: • multi-threading • SIMD vectorization • GPUs • distributed systems In order to target these hardware architectures, we will also discuss several programming languages/systems such as: • Java • C/C++ • OpenCL/CUDA • assembly language • OpenMP • MPI
Learning outcomes and qualification goals	Expertise: • Know various forms of parallelism. (MK1, MK2, MF1, MF3)
	Methodological competence: • Students will be able to use various forms of parallelism in software projects. (MF1, MF2, MF3)
	Personal competence: • Learn how to read software documentation. • Teamwork skills. (MK01, MK02)
Media	Lecture slides, exercise sheets, project assignments, software, software documentation

Literature	Schmidt, Bertil; Gonzalez-Dominguez, Jorge; Hundt, Christian; Schlarb, Moritz (2017). Parallel Programming: Concepts and Practice. ISBN-13: 978-0128498903. ISBN-10: 0128498900.
Methods	• Lecture • Weekly Exercise
Form of assessment	Written examination (90 minutes)
Admission requirements for assessment	≥ 50% points in homework assignments in groups of 2-3 students
Duration of assessment	90 minutes written exam
Language	English
Offering	Spring Semester
Lecturer	Junior Professor Dr. Roland Leißa
Person in charge	Junior Professor Dr. Roland Leißa
Duration of module	1 semester
Further modules	-
Range of application	M. Sc. Wirtschaftsinformatik, M.Sc. Mannheim Master in Data Science, Lehramt Informatik
Semester	1st/2nd/3rd semester

CS 664	**Blockchain Security**
Form of module	Inverted classroom with exercises
Type of module	Specialization course
ECTS	6
Workload	Hours per semester present: 56h (4 SWS), Self-study: 112h
Prerequisites	There are no formal prerequisites but knowledge in cryptography and/or IT-security is recommended, e.g., by attending the lectures “Kryptographie I” or “Selected Topics in IT-Security”
Aim of module	Blockchains promise secure and reliable data storage and consensus in a trustless environment. In the light of their growing popularity, Blockchain security becomes increasingly important. The course will equip students with a solid understanding of blockchains, their design principles, underlying technologies, and cryptographic primitives. Bitcoin, Monero and Ethereum will be discussed in greater detail and a substantial part of the course will be devoted to security issues and possible attacks.
Learning outcomes and qualification goals	Expertise: Students will acquire profound knowledge of Blockchain technology as well as the skills to critically examine the security of Blockchain-based systems. (MK1, MK2)
	Methodological competence: Successful participants will be able to understand and evaluate the different ways in which different Blockchain systems try to achieve security. They will also be able to identify where, why, and how these security measures are broken for both, current and new systems. (MKO3)
	Personal competence: The analytic, concentrated, and precise thinking of the students is trained. As multiple different but related Blockchains are discussed, their abstraction capacity is further developed and the transfer of the learned concepts to related questions is trained. (MF1)
Media	Video recordings, annotated lecture slides
Literature	Will be announced in the lecture

Methods	Reworking the lecture and studying the relevant literature in self-study. During the lecture: discussing questions and ideas and working together on concrete examples. Solving exercises in self-study and in practice in cooperation with fellow students.
Form of assessment	Written exam
Admission requirements for assessment	-
Duration of assessment	90 Minutes
Language	English
Offering	HWS
Lecturer	Prof. Dr. Frederik Armknecht
Person in charge	Prof. Dr. Frederik Armknecht
Duration of Module	1 Semester
Further Modules	-
Range of application	M.Sc. Mannheim Master in Data Science, M.Sc. Wirtschaftsinformatik Lehramt Informatik M.Sc. Mathematik M.Sc. Wirtschaftsmathematik
Semester	1st/2nd/3rd semester

CS 666	**Digital Forensics and Incident Response**
Form of Module	Lecture with Exercise
Type of Module	Specialization Course
Level	Master
ECTS	6
Workload	Hours per semester present: 56 h (4 SWS)
	Self-study: 112 h
Prerequisites	There are no formal prerequisites but knowledge in IT Security is recommended, e.g., by attending the lecture “Selected Topics in IT-Security”. Also, basic knowledge of computer networks and operating systems (including basic practical skills such as how to work with a Windows console / Unix shell) is advisable.
Aim of Module	Digital technologies are increasingly finding their way into almost all areas of human life. Accordingly, many crimes today take place in the digital space or at least contain digital elements. Examples range from phishing and ransomware attacks, over a suspect ‘googling’ for how the buy a weapon, to white-collar crime such as electronic accounting fraud or inside-job data theft. Digital forensics deals with the investigation of corresponding digital traces. The aim of this module is to give an introduction to the techniques and ways of thinking of forensic computer science. For this purpose, an overview of the scientific foundation and problems of the area is given. In particular, the module aims to convey how digital traces can be interpreted professionally and presented in proper forensic reports. In addition, the module aims to create a basic understanding of how affected organizations and specialized external service providers can respond appropriately to such incidents. This includes corresponding organizational steps of incident response, but also concrete techniques of incident analysis.
Learning Outcomes and qualification goals	<u>Expertise:</u> After the course, the students have an overview over prominent areas of digital crime and related attack procedures. The students know the fundamental techniques and ways of thinking

	of forensic computer science. Moreover, they have a basic understanding of the incident response process and of incident analysis techniques.
	<u>Methodological competence:</u> After the course, the students know how to secure and interpret digital traces as well as how to present their findings in proper forensic reports. Moreover, they can perform basic incident analysis tasks in areas such as - network analysis, - file system analysis, - operating system analysis, - malware analysis, - memory analysis using corresponding tools.
	<u>Personal competence:</u> The course trains analytical and creative thinking in terms of uncovering digital traces and analyzing/interpreting these in order to understand the actions of perpetrators/attackers. The course also teaches precise, methodical work, which is essential for findings to be usable in court.
Media	Exercise sheets and lecture slides available online, blackboard, practical demonstrations, and exercises (the students need a computer which can run a virtualization solution such as VirtualBox)
Literature	- Jason T. Luttgens, Matthew Pepe, Kevin Mandia: Incident Response & Computer Forensics. McGraw Hill, 3rd Edition, 2014. - Andreas Dewald, Felix Freiling: Forensische Informatik, 2. Auflage, BoD, 2015. - Brian Carrier: File System Forensic Analysis. Addison-Wesley, 2005. - Eoghan Casey: Digital Evidence and Computer Crime: Forensic Science, Computers, and the Internet. Academic Press, 3rd Edition, 2011. - Alexander Geschonneck: Computer Forensik. dpunkt Verlag, 5. Auflage, 2011.
Methods	Lecture, exercises every two weeks, book studies
Form of assessment	Written or oral examination (TBA)

Admission requirements for assessment	-
Duration of assessment	90 minutes (written examination) or 30 minutes (oral examination)
Language	English
Offering	HWS
Person in Charge	Dr. Matthias Hamann
Duration of Module	1 Semester
Further Modules	-
Range of Application	M.Sc. Business Informatics, M.Sc. Mannheim Master in Data Science, Lehramt Informatik
Semester	1./2./3. Semester

ii. IE-Courses

IE 630	**Anfrageoptimierung** *Query Optimization*
Form der Veranstaltung	Vorlesung mit Übung
Typ der Veranstaltung	Vertiefung
Modulniveau	Master
ECTS	6
Arbeitsaufwand	Präsenzstudium: 4SWS
	Eigenstudium: 56h pro Semester • davon Vor- und Nachbereitung der Veranstaltung und freies Selbststudium: 28h pro Semester • davon Vorbereitung für die Prüfung: 28 h pro Semester
Vorausgesetzte Kenntnisse	DBSI, Kombinatorik, Statistik
Lehrinhalte	• Grundlagen der Anfrageoptimierung
Lern- und Kompetenzziele	Fachkompetenz: • Suchraumgroessen abschaetzen • Komplexitaetsanalysen • Indexeinsatz (MK1, MK2)
	Methodenkompetenz: • systematisches Auszaehlen und Aufzaehlen • Analyse komplexer Algorithmen (MF1, MF2, MF3, MF5)
	Personale Kompetenz: • Präzises Analysieren (MKO1, MKO3)
Medienformen	Präsentationen mit Tafelanschrieb
Begleitende Literatur	Skript
Lehr- und Lernmethoden	Vorlesung (2 SWS)
Art der Prüfungsleistung	Mündliche Prüfung
Prüfungsvorleistung	-
Prüfungsdauer	30 Minuten (mündliche Prüfung)
Sprache	Deutsch

Angebotsturnus	FSS (nicht im FSS24)
Lehrende/r	Moerkotte
Modulverantwortlicher	Moerkotte
Dauer des Moduls	1 Semester
Weiterführende Module	-
Verwendbarkeit	M.Sc. Wirtschaftsinformatik
Einordnung in Fachsemester	1./2./3. Fachsemester

IE 650	Knowledge Graphs
Form of module	Lecture
Type of module	Specialization course
Level	Master
ECTS	6
Workload	Hours per semester present at university: 56 h (4 SWS)
	Self-study: 124 h per semester • 82 h: pre and post lecture studying and revision • 42 h: examination preparation
Prerequisites	Java or Python programming skills
Aim of module	• The Role of knowledge graphs in the AI landscape • Semantic Web and its representation languages • Labeled property graphs • Query languages for knowledge graphs • Knowledge modeling and ontologies • Logical reasoning with knowledge graphs • Machine learning with knowledge graphs and knowledge graph embeddings
Learning outcomes and qualification goals	Expertise: The participants of this course learn about principles and applications of knowledge graphs. They become familiar with their technical foundations such as representation and query languages, or logical inference. After taking this course, the students will be aware of the problems and benefits of knowledge graph technologies in the context of tasks such as knowledge management, information search and data integration, and they will be capable of judging the applicability of these technologies for addressing practical challenges. (MK1, MK2)
	Methodological competence: The participants learn how to design and implement AI systems based on knowledge graphs. They are able to use standardized modeling languages for building knowledge

	representations, and to query these models by means of languages such as SPARQL. (MF3)
	Personal competence: By jointly building a knowledge graph-based application, the students learn how to effectively work in teams. They improve upon their presentation skills by showing the outcomes of their projects to the other participants of the course. (MKO1, MKO3)
Media	Lecture slides and exercise sheets will be available online
Literature	• Pascal Hitzler, Markus Krötzsch and Sebastian Rudolph, Foundations of Semantic Web Technologies, Chapman & Hall/CRC, 2009 • Allemang and Hendler (2008): Semantic Web for the Working Ontologist. Verlag Morgan Kaufmann. • Antoniou and van Harmelen (2004): A Semantic Web Primer. MIT Press. • Fensel et al. (2020): Knowledge Graphs: Methodology, Tools and Selected Use Cases. Springer. • Kerjwal et al. (2021): Knowledge Graphs: Fundamentals, Techniques, and Applications. MIT Press.
Methods	The course participants will take part in theoretical and practical exercises, the solutions of which are discussed in the tutorials. At the end of the course, they get the opportunity to apply their knowledge in a team project. Each student team will design and implement a semantic web application, and subsequently present the results to the other students. Besides the exercises, regular presentations including references to relevant course materials and recommended readings will be given by the lecturer. The lecturer as well as the tutors offer individual help and consulting to the participants of the course.
Form of assessment	Written examination
Admission requirements for assessment	Project report and oral presentation
Duration of assessment	60 minutes

Language	English
Offering	Fall semester
Lecturer	Prof. Dr. Heiko Paulheim
Person in charge	Prof. Dr. Heiko Paulheim
Duration of module	1 semester
Further modules	-
Range of application	M.Sc. Wirtschaftsinformatik, M.Sc. Mannheim Master in Data Science, Lehramt Informatik
Semester	1st/2nd/3rd semester

IE 670	**Web Data Integration**
Form of module	Lecture
Type of module	Specialization course
Level	Master
ECTS	3
Workloadk	Hours per semester: 28 h (2 SWS)
	Self-study: 56 h per semester • 31 h: pre and post lecture studying and revision • 25 h: examination preparation
Prerequisites	-
Aim of module	Data integration is one of the key challenges in most IT projects and it is estimated that data scientists spend about 80% of their time on data integration. Within the enterprise context, data integration problems arise whenever data from separate sources needs to be combined as the basis for new applications or data analysis projects. Within the context of the Web, data integration techniques form the foundation for taking advantage of the ever-growing number of publicly-accessible data sources. The course will cover the following topics: 1. Heterogeneity and Distributedness 2. The Data Integration Process 3. Structured Data on the Web 4. Data Exchange Formats 5. Schema Mapping and Data Translation 6. Identity Resolution 7. Data Quality Assessment 8. Data Fusion It is highly recommended to attend the course web data integration project in the same semester as this course as the schedules of both courses are aligned to each other.
Learning outcomes and qualification goals	Expertise: Students will be able to identify opportunities for employing Web data in business applications and will learn to select and apply appropriate techniques for integrating and cleansing Web data. (MK1, MF1)

	Methodological competence: • Participants will acquire knowledge of the data integration process as well as the techniques that are used in each phase of the process. (MK2, MF3, MF4, MKO3)
	Personal competence: -
Media	slide set
Literature	• AnHai Doan, Alon Halevy, Zachary Ives: Principles of Data Integration. Morgan Kaufmann, 2012. • Luna Dong, Divesh Srivastava: Big Data Integration. Morgan & Claypool, 2015. • Ulf Leser, Felix Naumann: Informationsintegration. Dpunkt Verlag, 2007.
Methods	The course consists of a lecture that introduces students to state of the art data integration techniques.
Form of assessment	Written examination
Admission requirements for assessment	-
Duration of assessment	60 minutes
Language	English
Offering	Fall semester
Lecturer	Prof. Dr. Christian Bizer
Person in charge	Prof. Dr. Christian Bizer
Duration of module	1 semester
Further modules	-
Range of application	M.Sc. Wirtschaftsinformatik, M.Sc. Mannheim Master in Data Science, Lehramt Informatik
Semester	1st/2nd/3rd semester

IE 671	**Web Mining**
Form of module	Lecture and Exercise
Type of module	Specialization course
Level	Master
ECTS	3
Workload	Hours per semester: 28 h (2 SWS)
	Self-study: 56 h per semester • 31 h: pre and post lecture studying and revision • 25 h: examination and presentation preparation
Prerequisites	IE 500 Data Mining I (recommended). Fundamental notions of linear algebra and probability theory.
Aim of module	Structured and unstructured data available on the Web provide us with a goldmine of information that has the potential to enable cutting-edge intelligent applications. This class covers a variety of topics focused on mining techniques for Web data, including extracting knowledge from Web content (Web Content Mining), the link structure of the Web (Web Structure Mining), as well as mining usage data gathered by Web applications (Web Usage Mining). NOTE: It is highly recommended to attend the module "Web Mining Project" in the same semester since the schedule and topics of both modules are aligned.
Learning outcomes and qualification goals	Expertise: Students will acquire knowledge of the techniques, opportunities, and applications of Web mining. (MK1, MF1)
	Methodological competence: Successful participants will be able to identify opportunities for mining knowledge from Web content, select and apply appropriate techniques and interpret the results. (MK2, MF3, MF4)
	Personal competence: -
Media	slide set, exercise sheets, data sets for the exercises
Literature	• Bing Liu: Web Data Mining. 2nd Edition, Springer, 2011. • Wouter de Nooy, et al.: Exploratory Social Network Analysis with Pajek. 2nd Edition, Cambridge University Press, 2011.

	• Bing Liu. Sentiment Analysis and Opinion Mining, Morgan & Claypool Publishers, 2012.
Methods	The course consists of a lecture together with accompanying practical exercises as well as student team projects. In the exercises the participants will gather initial expertise in applying state of the art web mining tools.
Form of assessment	Written examination
Admission requirements for assessment	-
Duration of assessment	60 minutes
Language	English
Offering	Spring semester
Lecturer	Prof. Dr. Christian Bizer
Person in charge	Prof. Dr. Christian Bizer
Duration of module	1 semester
Further modules	-
Range of application	M.Sc. Wirtschaftsinformatik, M.Sc. Mannheim Master in Data Science, Lehramt Informatik
Semester	1st/2nd/3rd semester

IE 672	**Data Mining II**
Form of module	Lecture with exercises and project
Type of module	Specialization course
Level	Master
ECTS	6
Workload	Hours per semester: 56 h (4 SWS)
	Self-study: 112 h per semester • 56 h: pre and post lecture studying and revision • 56 h: examination and presentation preparation
Prerequisites	Knowledge in Data Mining, programming skills in Java
Aim of module	Data mining deals with the discovery of patterns in data, and with making predictions for the future, based on observations of the past. This course covers advanced issues in data mining which need to be addressed when applying data mining methods in real world projects, including: • Data Preprocessing • Dimensionality Reduction • Anomaly Detection • Time Series Analysis • Parameter Tuning • Ensemble Learning
Learning outcomes and qualification goals	Expertise: Students will acquire knowledge of advanced techniques and applications of data mining. (MK2, MF1, MF3)
	Methodological competence: • Successful participants will be able to address advanced issues in data mining projects, conduct complex projects and develop applications in the data mining field. • project organization skills (MK2, MF3, MF4, MF5, MKO1, MKO3)
	Personal competence: • presentation skills • teamwork skills (MKO2, MF2)

Media	slide set, exercise sheets, data sets for the exercises
Literature	• Pang-Ning Tan, Michael Steinbach, Vipin Kumar: Introduction to Data Mining, Pearson. • Ian H. Witten, Eibe Frank, Mark A. Hall: Data Mining: Practical Machine Learning Tools and Techniques, 3rd Edition, Morgan Kaufmann. • Jiawei Han and Micheline Kamber: Data Mining – Concepts and Techniques • Albert Bifet: Adaptive Stream Mining • Joao Gama: Knowledge Discovery from Data Streams
Methods	The course consists of a lecture together with accompanying practical exercises as well as student team projects. In the exercises the participants will gather initial expertise in applying state of the art web mining tools. In the team projects, which take place in the last third of the term, the students work on an advanced data mining task, which is provided by the annual Data Mining Cup and/or the course organizers.
Form of assessment	Written examination
Admission requirements for assessment	Project report and oral presentation
Duration of assessment	60 minutes
Language	English
Offering	Spring semester
Lecturer	Prof. Dr. Heiko Paulheim
Person in charge	Prof. Dr. Heiko Paulheim
Duration of module	1 semester
Further modules	-
Range of application	M.Sc. Wirtschaftsinformatik, M.Sc. Mannheim Master in Data Science, Lehramt Informatik
Semester	1st/2nd/3rd semester

IE 675b	**Machine Learning**
Form of module	Lecture with exercises
Type of module	Specialization Course
Level	Master
ECTS	9
Workload	Hours per semester: 70h (5 SWS)
	Assignments: 60h
	Self-study per semester: 100 h • 70 h: pre- and post-lecture studying and revision • 30 h: exam preparation
Prerequisites	IE 500 Data Mining I (recommended), knowledge of probability and statistics; No attempted or completed exam in IE 675
Aim of module	Machine learning is concerned with building computer systems that improve with experience as well as the study of learning processes, including the design of algorithms that are able to make predictions or extract knowledge from data. The aim of this module is to provide an introduction into the field of machine learning, and study algorithms, underlying concepts, and theoretical principles. • Basics of machine learning and probability theory • Inference and prediction • Selected classification and regression models • Latent linear models • Mixture models and EM • Kernel methods
Learning outcomes and qualification goals	Expertise: • Deep understanding of algorithms and underlying concepts of machine learning (MK1, MF1)
	Methodological competence: • Being able to apply machine learning techniques and systems for a given problem • Being able to model and implement new machine learning techniques (MK2, MF3, MF4)
	Personal competence: • writing skills

	• presentation skills • statistical programming skills (MKO3, MF2)
Media	Slide set, exercise sheets, software, datasets
Literature	• K.P. Murphy. *Probabilistic Machine Learning: An Introduction*. The MIT Press, 2022 • D. Koller, N. Friedman. *Probabilistic graphical models*. The MIT Press, 2009 • I. Goodfellow, Y. Bengio, A. Courville. *Deep Learning*, The MIT Press, 2017 • Additional material and articles provided in lecture notes
Methods	The course consists of a lecture accompanied by theoretical and practical exercises as well as case studies with real data. In the exercises, students will deepen the material discussed in the lecture, apply the methods in practice, and present the result.
Form of assessment	Written examination
Admission requirements for assessment	Homework assignments (pass at least 3 assignments)
Duration of assessment	90 minutes
Language	English
Offering	Fall semester
Lecturer	Prof. Dr. Rainer Gemulla
Person in charge	Prof. Dr. Rainer Gemulla
Duration of module	1 Semester
Further modules	-
Range of application	M.Sc. Wirtschaftsinformatik, M.Sc. Mannheim Master in Data Science (Examination Regulation from 10.12.2019)
Semester	1st/2nd/3rd semester

IE 678	**Deep Learning**
Form of module	Lecture with exercises
Type of module	Specialization Course
Level	Master
ECTS	6
Workload	Hours per semester: 56h (4 SWS)
	Self-study per semester: 98 h • 70 h: pre- and post-lecture studying and revision • 28 h: exam preparation
Prerequisites	IE 675b Machine Learning or equivalent, no exam procedure must have been started in IE 674
Aim of module	Machine learning is concerned with building computer systems that improve with experience as well as the study of learning processes, including the design of algorithms that are able to make predictions or extract knowledge from data. Building upon IE 675b Machine Learning, this course focuses on deep learning and introduces basic and advanced deep learning architectures and techniques, training methods and hyperparameter optimization, as well as selected applications. Tentative topics include: • Feedforward neural networks • Training deep learning models • Recurrent neural networks • Convolutional neural networks • Attention and self-attention • Deep learning for graphs • Deep generative modelling • Hyperparameter optimization
Learning outcomes and qualification goals	Expertise: • Deep understanding of fundamental concepts, models, and algorithms of deep learning (MK1, MF1)
	Methodological competence: • Being able to build and train deep learning models • Being able to select suitable deep learning techniques for a given learning problem (MK2, MF3, MF4)
	Personal competence: • writing skills • presentation skills

	• statistical programming skills (MKO3, MF2)
Media	Slide set, exercise sheets, software, datasets
Literature	• I. Goodfellow, Y. Bengio, A. Courville. *Deep Learning*, The MIT Press, 2017 • K.P. Murphy. *Probabilistic Machine Learning: An Introduction*. The MIT Press, 2022 • D. Koller, N. Friedman. *Probabilistic graphical models*. The MIT Press, 2009 • Additional material and articles provided in lecture notes
Methods	The course consists of a lecture accompanied by theoretical and practical exercises as well as case studies with real data. In the exercises, students will deepen the material discussed in the lecture, apply the methods in practice, and present the result.
Form of assessment	Oral examination
Admission requirements for assessment	Homework assignments (pass at least 2 assignments)
Duration of assessment	25 minutes
Language	English
Offering	Spring semester
Lecturer	Prof. Dr. Rainer Gemulla
Person in charge	Prof. Dr. Rainer Gemulla
Duration of module	1 Semester
Further modules	-
Range of application	M.Sc. Wirtschaftsinformatik, M.Sc. Mannheim Master in Data Science
Semester	2nd/3rd semester

IE 692	Advanced Process Mining
Form of Module	Lecture
Type of Module	Specialization course
Level	Master
ECTS	6
Workload	150 h per semester
Prerequisites	You are expected to be familiar with the use of Petri nets and BPMN for process modeling and being able to do basic programming in Python. IS 515 or having experience with process mining are NOT prerequisites.
Aim of module	Process mining is an emerging branch of data science that aims at deriving qualitative and quantitative insights on the execution of organizational processes, based on the analysis of recorded event sequences. The course features lectures and exercises that focus on the formal foundations, algorithms, and techniques of process mining. Specifically, this course covers aspects such as: • Process discovery, which aims to derive a process model from recorded events • Conformance checking, which aims to identify deviations between event data and process models • Process enhancement, which aims to augment process models with information on the temporal, organizational, and data perspectives of a process • Predictive monitoring, which aims to make predictions about ongoing process instances • Techniques to preprocess, abstract, cluster event data for improved analyses For the above subjects, the course will cover fundamental algorithms as well as advanced, state-of-the-art techniques. During the exercises that follow each lecture, you will practice through pen-and-paper exercises, as well as implementation and evaluation using open-source process mining tools and libraries. • The lectures and exercises are complemented by a practical assignment in which students will work in

	groups on a project that involves implementation and/or evaluation of a process mining technique.
Learning Outcomes and Qualification Goals	Knowledge: • After completing the course, students will be familiar with fundamental and state-of-the-art techniques for the data-driven analysis of business processes, i.e., process mining. (MK1, MK2)
	Capabilities: • After completing the course, students will be able to analyze business processes using process mining techniques and opens-source process mining tools. (MF1, MF2, MF3)
	Competencies: • During the course, students will learn to apply, compare, and assess process mining techniques on synthetic and real-world data, in both individual and team-based settings. (MKO1, MKO3)
Media	• Pen-and-paper plus programming exercises (mainly Python). • Project involving open-source process mining tools and libraries, possibly with implementation (in Python or Java) • Pen-and-paper exam
Literature	• Wil van der Aalst: Process Mining: Data Science in Action, 2nd edition (Recommended) • Josep Carmona et al. Conformance checking, 1st edition (Recommended) • Additional academic papers suggested per lecture
Teaching and Learning Methods	• Lectures • Homework exercises to practice with joint discussion in exercise sessions
Form of assessment	80% written exam 20% group assignment
Admission requirements for assessment	-
Duration of assessment	The exam will take 60 minutes, the assignment will be spread over various weeks with a single deadline towards the end of the semester.

Language	English
Offering	Spring semester
Lecturers	Prof. Dr. Han van der Aa
Person in charge	Prof. Dr. Han van der Aa
Duration of module	1 semester
Further modules	-
Range of Application	M. Sc. Wirtschaftsinformatik, M.Sc. Mannheim Master in Data Science
Semester	2nd semester

IE 683	**Web Data Integration Project**
Form of module	Project
Type of module	Specialization course
Level	Master
ECTS	3
Workload	Hours per semester: 28 h (2 SWS)
	Self-study: 56 h per semester • 36 h: project work • 20 h: report writing and presentation preparation
Prerequisites	Programming skills in Java
Aim of module	The web data integration project allows students to apply the methods and techniques that they have learned in the lecture Web Data Integration in the context of a practical integration project. The projects cover all steps of the data integration process including data gathering, schema mapping, data translation, identity resolution, data quality assessment, and data fusion. It is highly recommended to attend the web data integration lecture in the same semester as the web data integration project as the schedules of both courses are aligned to each other.
Learning outcomes and qualification goals	Expertise: • Students will be able to identify opportunities for employing Web data in business applications and will learn to apply appropriate techniques for integrating and cleansing Web data. (MK1, MF1)
	Methodological competence: • Participants will acquire knowledge of the data integration process as well as the techniques that are used in each phase of the process. • project organization skills (MK2, MF3, MF4, MKO3)
	Personal competence: • presentation skills • team work skills (MKO2, MF2)

Media	exercise sheets; Java project template
Literature	• AnHai Doan, Alon Halevy, Zachary Ives: Principles of Data Integration. Morgan Kaufmann, 2012. • Luna Dong, Divesh Srivastava: Big Data Integration. Morgan & Claypool, 2015. • Ulf Leser, Felix Naumann: Informationsintegration. Dpunkt Verlag, 2007.
Methods	Students work on their integration projects in teams and will report about the results of their projects in the form of a written report as well as an oral presentation.
Form of assessment	Project report (70%), oral project presentation (30%)
Admission requirements for assessment	-
Duration of assessment	-
Language	English
Offering	Fall semester
Lecturer	Prof. Dr. Christian Bizer
Person in charge	Prof. Dr. Christian Bizer
Duration of module	1 semester
Further modules	-
Range of application	M.Sc. Wirtschaftsinformatik, Mannheim Master in Data Science Lehramt Informatik
Semester	1. /2. /3. Semester

IE 684	Web Mining Project
Form of module	Project
Type of module	Specialization course
Level	Master
ECTS	3
Workload	Hours per semester: 28 h (2 SWS)
	Self-study: 56 h per semester • 36 h: project work • 20 h: report writing and presentation preparation
Prerequisites	Programming skills in Java or Python. IE 671 Web Mining (recommended).
Aim of module	The Web Mining project allows students to apply the methods and techniques that they have learned in the lecture Web Mining in the context of a practical integration project. The projects can cover any of the topic of Web usage, content, or structure mining. NOTE: It is highly recommended to attend the module IE 671 "Web Mining" in the same semester since the schedule and topics of both modules are aligned.
Learning outcomes and qualification goals	Expertise: Students will be able to identify opportunities for employing Web Mining techniques in business applications and will learn to apply appropriate techniques for mining Web data. (MK1, MF1)
	Methodological competence: • Participants will acquire practical knowledge of techniques for mining Web data. • Project organization skills (MK2, MF3, MF4, MKO3)
	Personal competence: • Presentation skills • Teamwork skills (MKO2, MF2)
Media	Slide set with references to potential topics, datasets, etc.
Literature	• Bing Liu: Web Data Mining. 2nd Edition, Springer, 2011. • Wouter de Nooy, et al.: Exploratory Social Network Analysis with Pajek. 2nd Edition, Cambridge University Press, 2011.

	• Bing Liu. Sentiment Analysis and Opinion Mining, Morgan & Claypool Publishers, 2012.
Methods	Students work on their projects in teams and report about the results of their projects in the form of a written report as well as an oral presentation.
Form of assessment	Project report (70%), oral project presentation (30%)
Admission requirements for assessment	-
Duration of assessment	-
Language	English
Offering	Spring semester
Lecturer	Prof. Dr. Christian Bizer
Person in charge	Prof. Dr. Christian Bizer
Duration of module	1 semester
Further modules	-
Range of application	M.Sc. Wirtschaftsinformatik, Mannheim Master in Data Science Lehramt Informatik
Semester	1. /2. /3. Semester

IE 694	Artificial Intelligence Applications in Industry
Form of module	Lectures and Accompanying Tutorials
Type of module	Specialization Course
Level	Master
ECTS	6
Workload	Hours per semester present: 56 h (2 + 2 SWS)
	Self-study: 124 h per semester Including the creation of a learning portfolio
Prerequisites	Necessary Knowledge: • Machine Learning Concepts and Techniques • Programming in Python
Aim of module	Participants will learn about the use of Artificial Intelligence methods, mostly from the field of machine learning in different sectors and industries. They will learn about application areas in the primary, secondary, and tertiary sector, get an introduction to examples of such applications that have been published on a scientific level and gather some experience in working with data from the respective fields using publicly available datasets.
Learning outcomes and qualification goals	Expertise: • Students will acquire knowledge about possible applications of machine learning in different branches of industry as well as the dominant methods used in these areas. (MK2, MK3)
	Methodological competence: Successful participants will be able to: • Identify potential for applying AI methods in different areas of industry; • Decide on a suitable method for addressing typical problems in these industries (MF2)
	Personal competence: • Participants will learn to reflect and document their own learning process (MKO2)

Media	Slides, Data Sets, Software Tools.
Literature	Various Scientific Publications – details in the lecture slides
Methods	Lectures, tutorials, independent study
Form of assessment	Learning Portfolio
Admission requirements for assessment	n/a
Duration of assessment	-
Language	English
Offering	FSS
Lecturer	Prof. Dr. Heiner Stuckenschmidt
Person in charge	Prof. Dr. Heiner Stuckenschmidt
Duration of module	1 Semester
Further modules	-
Range of application	M.Sc. Wirtschaftsinformatik, Mannheim Master in Data Science
Semester	2.-4.

IE 696	Advanced Methods in Text Analytics
Form of module	Lecture with exercises
Type of module	Specialization course
Level	Master
ECTS	6
Workload	Hours per semester: 56 h (4 SWS)
	Self-study: 112 h per semester • 84 h: pre and post lecture studying and revision • 28 h: examination preparation
Prerequisites	Fundamental notions of linear algebra and probability theory. Successful completion of “Text Analytics” (IE661), “Machine Learning” (IE675b) or “Deep Learning” (IE678).
Aim of module	This module builds upon the introduction to Natural Language Processing (NLP) from “Text Analytics” (IE661) and introduces students to cutting-edge problems, techniques, and state-of-the-art methods in NLP. The course will focus on neural models of meaning in context and present a variety of “Deep Learning” architectures for different applications in human language technology (e.g., summarization, dialogue systems and machine translation). Moreover, we will cover open research areas, such as the explainability and interpretability of NLP models and methods to quantify the degree of bias they exhibit.
Learning outcomes and qualification goals	Expertise: Students will acquire knowledge of state-of-the-art principles and methods of Natural Language Processing, specifically focusing on applying statistical methods to human language technologies. (MK1, MK2, MF3)
	Methodological competence: Successful participants will be able to understand state-of-the-art methods for Natural Language Processing and select, apply and evaluate the most appropriate techniques for various practical and application-oriented scenarios. (MF3)

Media	Lecture and tutorial slides, exercise sheets
Literature	• Dan Jurafsky and James H. Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition (3rd edition, online available at https://web.stanford.edu/~jurafsky/slp3/).
Methods	Lectures, tutorials
Form of assessment	Written examination
Admission requirements for assessment	-
Duration of assessment	90 minutes
Language	English
Offering	Fall/Spring semester
Lecturer	Prof. Dr. Simone Paolo Ponzetto
Person in charge	Prof. Dr. Simone Paolo Ponzetto
Duration of module	1 semester
Further modules	-
Range of application	M.Sc. Wirtschaftsinformatik, MSc. Mannheim Master in Data Science, Lehramt Informatik
Semester	1st/2nd/3rd semester

iii. IS-Courses

Please check the course list on page 26.

For a detailed description please use the module catalog of the „Mannheim Master in Management “:
https://www.bwl.uni-mannheim.de/en/programs/master/mmm/module-catalogs-2011-2020/

iv. International Course & other Specialization Courses

BI 656	**International Course**
Form of module	Depends on course taken abroad
Type of module	Specialization course
Level	Master
ECTS	Max. 18
Workload	Depends on course taken abroad
Prerequisites	Depends on course taken abroad
Aim of module	The course level equals a regular 600-level course in the MSc. Business Informatics program. The module can be taken during a study abroad term / semester and complements the Mannheim curriculum of the student.
Learning outcomes and qualification goals	Depends on course taken abroad
Media / Literature / Methods / Form and duration of assessment	Depends on course taken abroad
Language	English preferred, but any other language possible if Mannheim faculty member is able to identify content and level
Offering	Spring semester / Fall semester
Lecturer	Lecturer at the host university
Person in charge	Lecturer at the host university
Duration of module	1 Semester
Further modules	-
Range of application	M.Sc. Wirtschaftsinformatik
Semester	$2^{nd}/3^{rd}/4^{th}$ semester

MAB 519	Reinforcement Learning
For a detailed description please use the module catalog of the following degree programs M.Sc. WiMA and M.Sc. Mathematik: https://www.wim.uni-mannheim.de/studium/studienorganisation/m-sc-wirtschaftsmathematik/#c109976	

D. Projects and Seminars

1. Overview

i. Team Project

Module no.	Name of Module	Offered	Language	ECTS	Page
TP 500	Team Project	HWS/FSS	E	12	75

ii. Scientific Research

Module no.	Name of Module	Offered	Language	ECTS	Page
SQ 500	Scientific Research	HWS/FSS	E	2	78

iii. Seminar

Module no.	Name of Module	Offered	Language	ECTS	Page
CS 701	Selected Topics in Algorithmics and Cryptography	Irregular	E	4	80
CS 704	Master Seminar Artificial Intelligence	Irregular	E	4	82
CS 707	Seminar Data and Web Science	Irregular	E	4	84
CS 708	Seminar Software Engineering – Prof. Atkinson	Irregular	E	4	86
CS 709	Seminar Text Analytics	Irregular	G/E	4	88
CS 710	Selected Topics in Data Science	Irregular	G/E	4	90
CS 715	Large-Scale Data Integration Seminar	Irregular	E	4	92
CS 716	IT-Security	Irregular	E	4	94
CS 719	Seminar on Process Analysis	Irregular	E	4	96
CS 720	Uncertainty Estimation	Irregular	E	4	98
CS 721	Seminar Data-Science I	Irregular	E	4	100
CS 722	Seminar Ethical Aspects of AI	Irregular	E	4	102
CS 730	Advanced Implementation Techniques for Database Systems	Irregular	E	4	104
CS 731	Database Theory	Irregular	E	4	106
IE 704	Seminar AI Systems Engineering	Irregular	E	4	108
IS 712	Contemporary Issues in Information Systems Research	Irregular	E	4	110

IS 722	Seminar Context - Aware and Distributed Systems	MMM*	E	4	MMM*
IS 742	Seminar Trends in Enterprise Systems	MMM*	E	4	MMM*
IS 751	E-Government Adoption and Societal Change	MMM*	E	4	MMM*
IS 752	Seminar on Process and Management Analytics	MMM*	E	4	MMM*

* For a detailed description please use the module catalog of the „Mannheim Master in Management“: https://www.bwl.uni-mannheim.de/studium/master/mmm/#c176637

2. Detailed Descriptions

i. Team Project

TP 500	**Team Project**
Form of module	Project
Type of module	Team Project
Level	Master
ECTS	12 in two consecutive semesters or 12 in one semester
Workload	Hours per semester: 12 month-project: 28 h (2 SWS) 6 month-project: 56 h (4 SWS)
	Self-study: 140 h per semester (12 month project); • 112 h: pre and post lecture studying, revision and free self-study • 28 h: preparation of examination/presentation Self-study: 280 h per semester (6 month project) • 224 h: pre and post lecture studying, revision and free self-study • 56 h: preparation of examination/presentation
Prerequisites	Depends on topic
Aim of module	The students solve a practical problem as a team. The participants have to analyze and refine the problem and come up with a project plan for developing a concrete solution that will be carried out by the team over the duration of a whole year. Concrete topics for projects are defined by the supervisors and offered to the students who can apply for different topics. Problem area and techniques involved depend on the expertise of the offering chair.
Learning outcomes and qualification goals	Depending on the actual topic of the project, participants will acquire • in depths knowledge in a certain application of business informatics • knowledge about methods and technologies typically applied in the application area

	• knowledge about practical problems and challenges when applying a certain technique in a given application area Participants will learn to • refine a given problem statement by analyzing requirements and the state of the art using techniques like literature research and expert interviews. • Define a workplan including tasks, milestones, deliverables, and resources and continually assess and modify the plan according to the actual progress of the work. Being a team effort, the project explicitly targets personal competence in terms of • working in and managing a team of experts possibly from different academic and cultural backgrounds • taking part in discussions and learning to contribute the own opinion without overruling other opinions • self-management and responsibility within the requirements of collaborative work
Media	Depends on project
Literature	Depends on topic
Methods	Team-discussions, Presentations, Teamwork, Individual preparation of empirical contributions; self-study
Form of assessment	Final report and presentation
Admission requirements for assessment	12 month project: withdrawal within the first 6 weeks possible without failing 6 month project: withdrawal within the first 3 weeks possible without failing
Duration of assessment	30 minutes (presentation)
Language	English
Offering	Spring semester/Fall semester
Lecturer	Professors of the Institute of Computer Science and Business Informatics or of the Area Information Systems of the Business School

Person in charge	A professor of the Institute of Computer Science and Business Informatics or of the Area Information Systems of the Business School
Duration of module	1 semester or 2 semesters
Further modules	-
Range of application	M.Sc. Wirtschaftsinformatik, M.Sc. Mannheim Master in Data Science
Semester	1st/2nd/3rd semester

ii. Scientific Research

SQ 500	**Scientific Research**
Form of module	Seminar
Type of module	Key Qualification
Level	Master
ECTS	2
Workload	Block seminar
Prerequisites	None
Aim of module	This course focuses on the basic key competences that are needed to successfully write a scientific paper or a thesis. It is recommended that you take this module before you participate in a seminar. Topics include: • Scientific process and scientific writing • Bibliographic research methodology • Search strategies in bibliographic databases • Finding data for your research • How to read, understand and cite scientific literature • Reference management systems and LaTeX
Learning outcomes and qualification goals	Expertise: The students understand how to work scientifically and how to write a thesis.
	Methodological competence: The students can find relevant publications for a research question.
	Personal competence: • Everybody wrote a short overview of their research question. • Everybody installed and used exemplary tools to support the work process
Literature	• The craft of research / Wayne C. Booth; Gregory G. Colomb; Joseph M. Williams (Chicago guides to writing, editing, and publishing); 3. ed.; Chicago, Ill. ; [u.a.] :

	University of Chicago Press, 2008 ; XVII, 317 S. : graph. Darst.; 22cm. • LaTeX (Wikibook): http://en.wikibooks.org/wiki/LaTeX
Methods	Seminar
Form of assessment	Written examination
Admission requirements for assessment	-
Duration of assessment	150 minutes
Language	English
Offering	Spring semester/Fall semester
Lecturer	Lecturer from the University Library (UB)
Person in charge	Lecturer from the University Library (UB)
Duration of module	3 days
Further modules	-
Range of application	M.Sc. Wirtschaftsinformatik
Semester	1st/2nd/3rd semester

iii. Seminars

CS 701	**Selected Topics in Algorithmics and Cryptography**
Form of module	Seminar
Type of module	Seminar
Level	Master
ECTS	4
Workload	120 h per Semester
Prerequisites	Algorithmics (CS 550) or Cryptography II (CS 651) or Courses in Algorithms or Cryptography or Theoretical Computer Science or Complexity Security at Bsc or Msc Level, key qualification scientific research.
Aim of module	The students prepare a scientific report on a current research topic on the basis of published papers under guidance of a scientific staff member and gives a presentation. The topic will be proposed by the professor, but the students may also propose topics. Active participation in the seminar presentations of fellow students will be expected.
Learning outcomes and qualification goals	Expertise: The students gain a deep understanding of the research topic, are able to explain the topic in detail in a clean and transparent ways and are able to classify the significance of the topic and the results in relation to the current state of research in the corresponding research area.
	Methodological competence: The students are able to read, to understand and to explore scientific literature relevant to the topic. They are aware of the need to avoid plagiarism.
	Personal competence: The student has learned how to find relevant literature for a research topic, write a well-structured and clear report about it and give a presentation. The seminar serves also as preparation for writing and presenting the master thesis.
Media	Scientific papers and books. Presentation systems like PowerPoint or beamer Latex.

Literature	Depends on the topic.
Methods	Do scientific work independently under the guidance of a research staff member and manage an active discussion on the topic in a group of peers.
Form of assessment	Presentation, Paper, Participation
Admission requirements for assessment	Timely hand-in of seminar papers and presentation materials
Duration of assessment	60 min presentation and 15 min discussion
Language	English
Offering	Irregular
Lecturer	Matthias Krause, Alexander Moch
Person in charge	Prof. Dr. Matthias Krause
Duration of module	1 Semester
Further modules	-
Range of application	M.Sc. Wirtschaftsinformatik, M.Sc. Mannheim Master in Data Science, M.Sc. Wirtschaftsmathematik
Semester	3rd semester

CS 704	Master Seminar Artificial Intelligence
Form of Module	Seminar
Type of Module	Seminar
Level	Master
ECTS	4
Workload	120 h per semester
Prerequisites	Decision Support or Data Mining or Knowledge Management
Aim of module	The student prepares a scientific paper and gives a presentation on a current research topic based on published research. State-of-the-art topics are proposed by the professors. The paper and the presentation are prepared under the guidance of a professor or a research staff member. Active participation in the seminar discussions is expected.
Learning Outcomes and Qualification Goals	Expertise: The student gains a deep understanding of the research topic. They are able to describe/summarize the topic in detail in their own words. They reflect on the topic and judges the contribution of the research papers.
	Methodological competence: The student is able to write a well-structured scientific paper and to present their results. They are also aware of the need to avoid plagiarism. The key qualification Scientific Research is highly recommended as a prerequisite for the seminar.
	Personal qualification: The student has learned how to write a well-structured, concise paper and give a presentation. This is part of the preparation to write and present a Master's Thesis.
Media	Scientific papers and books; final presentation with latex slides
Literature	Depends on the topic of the seminar
Teaching and Learning Methods	Do scientific reading independently under the guidance of a professor or a research staff member. Active discussions in a group of peers.
Form of Assessment	Presentation and Seminar Report, individual or as a group

Admission requirements for assessment	-
Duration of Assessment	N/A
Language	English
Offering	Irregular
Lecturers	Prof. Dr. Heiner Stuckenschmidt
Person in charge	Prof. Dr. Heiner Stuckenschmidt
Duration of module	1 semester
Further modules	-
Range of Application	M.Sc. Wirtschaftsinformatik, M.Sc. Mannheim Master in Data Science
Semester	3rd semester

CS 707	**Seminar Data and Web Science**
Form of Module	Seminar
Type of Module	Seminar
Level	Master
ECTS	4
Workload	120 h per semester
Prerequisites	Bachelor's degree, the fundamentals
Aim of module	The student prepares a scientific report and gives at least one presentation on a current research topic based on published research papers. The topics lie in the area of Data and Web Science and are proposed by the professor or the student. Report and presentations are prepared under the guidance of a professor or a research staff member. The student may also moderate a discussion of a presentation of a fellow student, act as a peer reviewer for the presentations or reports of other students, or experiment with a data analysis system. Active participation in the seminar discussions is expected.
Learning Outcomes and Qualification Goals	Expertise: The student gains a deep understanding of the research topic. They are able to describe/summarize the topic in detail in their own words. They reflect on the topic and judges the contributions of the research papers.
	Methodological competence: The student is able to read, understand, and explore scientific literature relevant to their topic. They are also aware of the need to avoid plagiarism. The key qualification Scientific Research is recommended as a prerequisite for this seminar.
	Personal qualification: The student has learned how to find relevant literature for a research topic, write a well-structured, concise report about it and give presentations. They will be well prepared to write and present a Bachelor's/Master's Thesis.
Media	Scientific papers and books; software and datasets; final presentation with PowerPoint or similar software
Literature	Depends on the topic of the seminar

Teaching and Learning Methods	Do scientific work independently under the guidance of a professor or a research staff member. Active discussions in a group of peers.
Form of Assessment	Individual grading of the seminar paper, the oral presentations, the peer reviews (if applicable), the created source code (if applicable), the active participation in the seminar, and the timeliness of hand-ins. (Notification will be given at the start of the lecture period for this module)
Admission requirements for assessment	-
Duration of Assessment	N/A
Language	English
Offering	Irregular
Lecturers	Prof. Dr. Rainer Gemulla or research staff member
Person in charge	Prof. Dr. Rainer Gemulla or research staff member
Duration of module	1 semester
Further modules	-
Range of Application	M.Sc. Wirtschaftsinformatik, MSc. Mannheim Master in Data Science, Lehramt für Gymnasien
Semester	3rd semester

CS 708	**Seminar Software Engineering**
Form of Module	Seminar
Type of Module	Seminar
Level	Master
ECTS	4
Workload	120 h per semester
Prerequisites	Bachelor's degree, the fundamentals
Aim of module	Students prepares a scientific paper and gives a presentation on a current software engineering research topic based on published research papers. State-of-the-art topics are proposed by the software engineering group. Active participation in the seminar discussions is expected.
Learning Outcomes and Qualification Goals	Expertise: The student gains a deep understanding of the research topic. They are able to describe/summarize the topic in detail in their own words. They reflect on the topic and judges the contribution of the research papers.
	Methodological competence: The student is able to find the relevant literature for their topic, to write a well-structured scientific paper and to present their results. They are also aware of the need to avoid plagiarism. The key qualification Scientific Research is highly recommended as a prerequisite for the seminar.
	Personal qualification: The student has learned how to find relevant literature for a research topic, write a well-structured, concise paper about it and give a presentation.
Media	Scientific papers and books, final presentation
Literature	Depends on the topic of the seminar
Teaching and Learning Methods	Scientific work performed independently under the guidance of a member of the software engineering group. Active discussions in a group of peers.
Form of Assessment	Quality of the seminar paper and the oral presentation. (Notification will be given at the start of the lecture period for this module)

Language	English
Offering	Irregular
Lecturer	Member of the software engineering group
Duration	1 semester
Range of Application	M.Sc. Wirtschaftsinformatik, M.Sc. Mannheim Master in Data Science,
Semester	1./ 2. /3. Semester

CS 709	**Seminar Text Analytics**
Form of Module	Seminar
Type of Module	Seminar
Level	Master
ECTS	4
Workload	120 h per semester
Prerequisites	IS 661 “Text Analytics” or IE 663 “Web Search and Information Retrieval”. Fundamental notions of linear algebra and probability theory.
Aim of module	In this seminar, students write a survey/scientific paper and provide an overview presentation of state-of-the-art research, as found within the existing literature (i.e., published research papers). Topics of interest focus around a variety of problems and tasks from the fields of Natural Language Processing and Information Retrieval. The paper and the presentation are prepared under the guidance of a professor or a research staff member.
Learning Outcomes and Qualification Goals	Expertise: Students will acquire a deep understanding of the research topic. They are expected to describe in-depth and summarize the topic in detail in their own words, as well as to judge the contribution of the research papers to ongoing research.
	Methodological competence: Students will develop methods and skills to find relevant literature for their topic, to write a well-structured survey/scientific paper and to present their results. They will be also aware of the need to avoid plagiarism. The key qualification Scientific Research is highly recommended as a prerequisite for the seminar.
	Personal qualification: Students will acquire skills on how to find relevant literature for a research topic, write a well-structured, concise paper about it and present the results of their work. They are well prepared to write and present a Master’s Thesis.
Media	Scientific papers and books; presentation with PowerPoint or LaTeX.
Literature	Depends on the topic of the seminar

Teaching and Learning Methods	Do scientific work independently under the guidance of a professor or a research staff member. Active discussions in a group of peers.
Form of Assessment	Seminar report (70%), oral presentation (30%)
Admission requirements for assessment	-
Duration of Assessment	N/A
Language	English or German
Offering	Irregular
Lecturers	Prof. Dr. Simone Paolo Ponzetto
Person in charge	Prof. Dr. Simone Paolo Ponzetto
Duration of module	1 semester
Further modules	-
Range of Application	M.Sc. Wirtschaftsinformatik, M.Sc. Mannheim Master in Data Science
Semester	3rd semester

CS 710	**Selected Topics in Data Science**
Form of Module	Seminar
Type of Module	Seminar
Level	Master
ECTS	4
Workload	120 h per semester
Prerequisites	Bachelor's degree, the fundamentals
Aim of module	In this seminar, students perform scientific research, either in the form of a literature review or by conducting a small experiment, or a mixture of both, and prepare a written report about the results. Topics of interest focus around a variety of problems and tasks from the fields of Data Mining, Web Mining, or the Semantic Web.
Learning Outcomes and Qualification Goals	Expertise: Students will acquire a deep understanding of the research topic. They are expected to describe in-depth and summarize the topic in detail in their own words, as well as to judge the contribution of the research papers to ongoing research.
	Methodological competence: Students will develop methods and skills to find relevant literature for their topic, to prepare methodologically sound scientific experiments, and to write a well-structured scientific paper and to present their results. They will be also aware of the need to avoid plagiarism. The key qualification Scientific Research is highly recommended as a prerequisite for the seminar.
	Personal qualification: Students will acquire skills on how to find relevant literature for a research topic, organize a small research task, write a well-structured, concise paper about it, and present the results of their work. They are well prepared to write and present a Master's Thesis.
Media	Scientific papers and books
Literature	Depends on the topic of the seminar
Teaching and Learning Methods	Do scientific work independently under the guidance of a professor or a research staff member

Form of Assessment	Grading of the seminar paper, Peer Review, Presentation
Admission requirements for assessment	-
Duration of Assessment	N/A
Language	English or German
Offering	Irregular
Lecturers	Prof. Dr. Heiko Paulheim and research staff members
Person in charge	Prof. Dr. Heiko Paulheim
Duration of module	1 semester
Further modules	-
Range of Application	M. Sc. Wirtschaftsinformatik, M.Sc. Mannheim Master in Data Science, Lehramt für Gymnasien
Semester	3rd semester

CS 715	**Large-Scale Data Integration Seminar**
Form of Module	Seminar
Type of Module	Seminar
Level	Master
ECTS	4
Workload	120 h per semester
Prerequisites	Bachelor's degree, the fundamentals
Aim of module	In this seminar, students perform scientific research, either in the form of a literature review or by conducting a small experiment, or a mixture of both, and prepare a written report about the results. Topics of interest focus around a variety of problems and tasks from the fields of Information Extraction, Schema Matching, Identity Resolution, Data Fusion, Data Mining, Web Mining.
Learning Outcomes and Qualification Goals	Expertise: Students will acquire a deep understanding of the research topic. They are expected to describe in-depth and summarize the topic in detail in their own words, as well as to judge the contribution of the research papers to ongoing research.
	Methodological competence: Students will develop methods and skills to find relevant literature for their topic, to prepare methodologically sound scientific experiments, and to write a well-structured scientific paper and to present their results. They will be also aware of the need to avoid plagiarism. The key qualification Scientific Research is highly recommended as a prerequisite for the seminar.
	Personal qualification: Students will acquire skills on how to find relevant literature for a research topic, organize a small research task, write a well-structured, concise paper about it, and present the results of their work. They are well prepared to write and present a Master's Thesis.
Media	Scientific papers and books
Literature	Depends on the topic of the seminar

Teaching and Learning Methods	Do scientific work independently under the guidance of a professor or a research staff member
Form of Assessment	Grading of the seminar paper
Admission requirements for assessment	-
Duration of Assessment	N/A
Language	English
Offering	Irregular
Lecturers	Prof. Dr. Christian Bizer and research staff members
Person in charge	Prof. Dr. Christian Bizer
Duration of module	1 semester
Further modules	-
Range of Application	M. Sc. Wirtschaftsinformatik, M.Sc. Mannheim Master in Data Science, Lehramt für Gymnasien
Semester	3rd semester

CS 716	**IT-Security**
Form of Module	Seminar
Type of Module	Seminar
Level	Master
ECTS	4
Workload	120 h per semester
Prerequisites	Bachelor’s degree, the fundamentals
Aim of module	The student gives a presentation on a current research topic based on published research papers. The topics are proposed by the professor (but the student may also propose topics). The presentation is prepared under the guidance of a professor or a research staff member. The student may also moderate a discussion of a presentation of a fellow student or act as a peer reviewer for the presentations or reports of other students. Active participation in the seminar discussions is expected.
Learning Outcomes and Qualification Goals	Expertise: The student gains a deep understanding of the research topic. They are able to describe/summarize the topic in detail in their own words. They reflect on the topic and judges the contributions of the research papers.
	Methodological competence: The student is able to read, understand, and explore scientific literature relevant to their topic. They are also aware of the need to avoid plagiarism. The key qualification Scientific Research is recommended as a prerequisite for this seminar.
	Personal qualification: The student has learned how to find relevant literature for a research topic, write a well-structured, concise report about it and give a presentation. They will be well prepared to write and present a Bachelor's/Master's Thesis.
Media	Scientific papers and books; final presentation with PowerPoint or similar software
Literature	Depends on the topic of the seminar

Teaching and Learning Methods	Do scientific work independently under the guidance of a professor or a research staff member. Active discussions in a group of peers.
Form of Assessment	Grading of the seminar paper, the oral presentation, and the participation in the group discussions and review phases.
Admission requirements for assessment	Timely hand-in of seminar paper, presentation, peer-reviews
Duration of Assessment	60 minutes talk, 30 minutes discussion
Language	English
Offering	Irregular
Lecturers	Prof. Dr. Armknecht
Person in charge	Prof. Dr. Armknecht
Duration of module	1 semester
Further modules	-
Range of Application	M.Sc. Wirtschaftsinformatik, Lehramt für Gymnasien, M.Sc. Wirtschaftsmathematik
Semester	3rd Semester

CS 719	**Seminar on Process Analysis**
Form of Module	Seminar
Type of Module	Seminar
Level	Master
ECTS	4
Workload	120 h per semester
Prerequisites	Any course about process modeling, analysis, or mining
Aim of module	In this seminar, students perform scientific research, either in the form of a literature review or by conducting a small experiment (or a mixture of both) and prepare a written scientific report and presentation about the results. Topics of interest relate to research areas such as process analysis, process mining, stream processing, and robotic process automation. The paper and the presentation are prepared under the guidance of a professor and/or a research staff member. Specific topics shall be suggested by the lecturers, though students are free to make proposals as well.
Learning Outcomes and Qualification Goals	Expertise: Students will acquire a deep understanding of the research topic. They are expected to describe and summarize the topic in their own words, as well as to judge the contribution of the research papers to ongoing research.
	Methodological competence: Students will develop methods and skills to find relevant literature for their topic, to prepare methodologically sound scientific experiments (if applicable), to write a well-structured scientific paper, and to present their results. Students will also be aware of the need to avoid plagiarism. The key qualification Scientific Research is highly recommended as a prerequisite for the seminar.
	Personal qualification: Students will acquire skills on how to find relevant literature for a research topic, organize a small research task, write a well-structured, concise paper about it, and present the results of their work. They will be well prepared to write and present a Master's Thesis.

Media	Scientific papers and books; presentation with PowerPoint or LaTeX
Literature	Depends on the selected topic of the seminar
Teaching and Learning Methods	Conduct scientific work independently under the guidance of a professor or research staff member
Form of assessment	Seminar report (70%), oral presentation (30%)
Admission requirements for assessment	-
Duration of assessment	N/A
Language	English
Offering	Irregular
Lecturers	Prof. Dr. Han van der Aa and research staff members
Person in charge	Prof. Dr. Han van der Aa
Duration of module	1 semester
Further modules	-
Range of Application	M. Sc. Wirtschaftsinformatik, M.Sc. Mannheim Master in Data Science
Semester	3rd semester

CS 720	**Uncertainty Estimation**
Form of Module	Seminar
Type of Module	Seminar
Level	Master
ECTS	4
Workload	120 h per semester
Prerequisites	Bachelor's degree, the fundamentals
Aim of module	In this seminar, students perform scientific research, either in the form of a literature review or by conducting a small experiment, or a mixture of both, and prepare a written report about the results. Topics of interest focus around a variety of problems and tasks from the fields of Data Mining, Web Mining, or the Semantic Web.
Learning Outcomes and Qualification Goals	Expertise: Students will acquire a deep understanding of the research topic. They are expected to describe in-depth and summarize the topic in detail in their own words, as well as to judge the contribution of the research papers to ongoing research.
	Methodological competence: Students will develop methods and skills to find relevant literature for their topic, to prepare methodologically sound scientific experiments, and to write a well-structured scientific paper and to present their results. They will be also aware of the need to avoid plagiarism. The key qualification Scientific Research is highly recommended as a prerequisite for the seminar.
	Personal qualification: Students will acquire skills on how to find relevant literature for a research topic, organize a small research task, write a well-structured, concise paper about it, and present the results of their work. They are well prepared to write and present a Master's Thesis.
Media	Scientific papers and books
Literature	Depends on the topic of the seminar
Teaching and Learning Methods	Do scientific work independently under the guidance of a professor or a research staff member

Form of Assessment	Grading of the seminar paper, Peer Review, Presentation
Admission requirements for assessment	-
Duration of Assessment	N/A
Language	English or German
Offering	Irregular
Lecturers	Tobias Weller
Person in charge	Prof. Dr. Heiko Paulheim
Duration of module	1 semester
Further modules	-
Range of Application	M. Sc. Wirtschaftsinformatik, M.Sc. Mannheim Master in Data Science, Lehramt für Gymnasien
Semester	3rd semester

CS 721	**Seminar Data-Science I**
Form of Module	Seminar
Type of Module	Seminar
Level	Master
ECTS	4
Workload	120 h per semester
Prerequisites	There are no formal requirements. However, previous participation in the courses “Network Science” and “Text Analytics” are recommended.
Aim of module	In this seminar, students perform scientific research, either in the form of a literature review or by conducting a small experiment, or a mixture of both, and prepare a written report about the results. Topics of interest focus around a variety of problems and tasks from the fields of Data-Science, Network Science and Text Mining.
Learning Outcomes and Qualification Goals	Expertise: Students will acquire a deep understanding of the research topic. They are expected to describe in-depth and summarize the topic in detail in their own words, as well as to judge the contribution of the research papers to ongoing research.
	Methodological competence: Students will develop methods and skills to find relevant literature for their topic, to prepare methodologically sound scientific experiments, and to write a well-structured scientific paper and to present their results. They will be also aware of the need to avoid plagiarism. The key qualification Scientific Research is highly recommended as a prerequisite for the seminar.
	Personal qualification: Students will acquire skills on how to find relevant literature for a research topic, organize a small research task, write a well-structured, concise paper about it, and present the results of their work. They are well prepared to write and present a Master’s Thesis.
Media	slides, scientific papers, blackboard (electronic)
Literature	Depends on topic.

Teaching and Learning Methods	self-study of assigned material, presentation of scientific articles, joint discussion of work, collaboration with peers
Form of Assessment	Written report with oral presentation
Admission requirements for assessment	-
Duration of Assessment	N/A
Language	English
Offering	Irregular
Lecturers	Markus Strohmaier, Marlene Lutz
Person in charge	Markus Strohmaier, Marlene Lutz
Duration of module	1 semester
Further modules	-
Range of Application	M. Sc. Wirtschaftsinformatik, M.Sc. Mannheim Master in Data Science, M. Sc. Mannheim Master Management
Semester	3rd semester

CS 722	**Seminar Ethical Aspects of AI**
Form of Module	Seminar
Type of Module	Seminar
Level	Master
ECTS	4
Workload	120 h per semester
Prerequisites	IS 661 "Text Analytics" or IE 675b "Machine Learning" or IE 678 "Deep Learning" or IE 560 "Decision Support"
Aim of module	In this seminar, students perform scientific research, either in the form of a literature review or by conducting a small experiment, or a mixture of both, and prepare a written report about the results. Topics of interest focus around a variety of problems and tasks from the fields of Data-Science, Network Science and Text Mining.
Learning Outcomes and Qualification Goals	Expertise: Students will acquire a deep understanding of the research topic. They are expected to describe in-depth and summarize the topic in detail in their own words, as well as to judge the contribution of the research papers to ongoing research.
	Methodological competence: Students will develop methods and skills to find relevant literature for their topic, to prepare methodologically sound scientific experiments, and to write a well-structured scientific paper and to present their results. They will be also aware of the need to avoid plagiarism. The key qualification Scientific Research is highly recommended as a prerequisite for the seminar.
	Personal qualification: Students will acquire skills on how to find relevant literature for a research topic, organize a small research task, write a well-structured, concise paper about it, and present the results of their work. They are well prepared to write and present a Master's Thesis.
Media	Scientific papers and books; presentation with PowerPoint or LaTeX.
Literature	Up-to-date literature will be assigned during the seminar.

Teaching and Learning Methods	Review scientific work independently under the guidance of a professor or a research staff member. Active discussions in a group of peers.
Form of Assessment	Written report with oral presentation
Admission requirements for assessment	-
Duration of Assessment	N/A
Language	English
Offering	Irregular
Lecturers	Markus Strohmaier, Simone Ponzetto
Person in charge	Markus Strohmaier, Simone Ponzetto
Duration of module	1 semester
Further modules	-
Range of Application	M. Sc. Wirtschaftsinformatik, M.Sc. Mannheim Master in Data Science, M. Sc. Mannheim Master Management
Semester	3rd semester

CS 730	Advanced Implementation Techniques for Database Systems
Form of module	Seminar
Type of module	Seminar
Level	Master
ECTS	4
Workload	120h per semester
Prerequisites	DBSI, DBSII, Query Optimization
Aim of module	The student prepares a scientific paper and gives a presentation on a current research topic based on published research. State-of-the-art topics are proposed by the professors. The paper and the presentation are prepared under the guidance of a professor or a research staff member. Active participation in the seminar discussions is expected.
Learning outcomes and qualification goals	Expertise: The student gains a deep understanding of the research topic. They are able to describe/summarize the topic in detail in their own words. They reflect on the topic and judges the contribution of the research paper.
	Methodological competence: The student is able to write a well-structured scientific paper and to present their results. They are also aware of the need to avoid plagiarism. The key qualification Scientific Research is highly recommended as a prerequisite for the seminar.
	Personal qualification: The student has learned how to write a well-structured, concise paper and give a presentation. This is part of the preparation to write and present a Master's Thesis.
Media	Slides, blackboard
Literature	To be announced in the seminar
Teaching and Learning Methods	Do scientific work independently under the guidance of a professor or a research staff member. Active discussions in a group of peers.

Form of assessment	Individual grading of the seminar paper, the oral presentations, the peer reviews (if applicable), the created source code (if applicable), the active participation in the seminar, and the timeliness of hand-ins. (Notification will be given at the start of the lecture period for this module)
Admission requirements for assessment	-
Duration of assessment	N/A
Language	English
Offering	Irregular
Lecturer	Moerkotte
Person in charge	Moerkotte
Duration of module	1 Semester
Further modules	-
Range of application	Master Wirtschaftsinformatik
Semester	2./3. Semester

CS 731	**Database Theory**
Form of module	Seminar
Type of module	Seminar
Level	Master
ECTS	4
Workload	120h per semester
Prerequisites	Theoretical Computer Science, Complexity Theory, Decidability Theory, DBSI
Aim of module	The student prepares a scientific paper and gives a presentation on a current research topic based on published research. State-of-the-art topics are proposed by the professors. The paper and the presentation are prepared under the guidance of a professor or a research staff member. Active participation in the seminar discussions is expected.
Learning outcomes and qualification goals	Expertise: The student gains a deep understanding of the research topic. They are able to describe/summarize the topic in detail in their own words. They reflect on the topic and judges the contribution of the research paper.
	Methodological competence: The student is able to write a well-structured scientific paper and to present their results. They are also aware of the need to avoid plagiarism. The key qualification Scientific Research is highly recommended as a prerequisite for the seminar.
	Personal qualification: The student has learned how to write a well-structured, concise paper and give a presentation. This is part of the preparation to write and present a Master's Thesis.
Media	Slides, blackboard
Literature	To be announced in the seminar
Teaching and Learning Methods	Do scientific work independently under the guidance of a professor or a research staff member. Active discussions in a group of peers.

Form of assessment	Individual grading of the seminar paper, the oral presentations, the peer reviews (if applicable), the created source code (if applicable), the active participation in the seminar, and the timeliness of hand-ins. (Notification will be given at the start of the lecture period for this module)
Admission requirements for assessment	-
Duration of assessment	N/A
Language	English
Offering	Irregular
Lecturer	Moerkotte
Person in charge	Moerkotte
Duration of module	1 Semester
Further modules	-
Range of application	Master Wirtschaftsinformatik
Semester	2./3. Semester

IE 704	Seminar AI Systems Engineering
Form of Module	Seminar
Type of Module	Seminar
Level	Master
ECTS	4
Workload	120 h per semester
Prerequisites	None
Aim of module	The student prepares a scientific paper and gives a presentation on a current research topic based on published research. State-of-the-art topics are proposed by the supervisors. The paper and the presentation are prepared under the guidance of a research staff member. Active participation in the seminar discussions is expected.
Learning Outcomes and Qualification Goals	<u>Expertise:</u> The student gains a deep understanding of the research topic. They are able to describe/summarize the topic in detail in their own words. They reflect on the topic and judges the contribution of the research papers.
	<u>Methodological competence:</u> The student is able to write a well-structured scientific paper and to present their results. They are also aware of the need to avoid plagiarism. The key qualification Scientific Research is highly recommended as a prerequisite for the seminar.
	<u>Personal qualification:</u> The student has learned how to write a well-structured, concise paper and give a presentation. This is part of the preparation to write and present a Master's Thesis.
Media	Scientific papers and books; final presentation with PowerPoint
Literature	Depends on the topic of the seminar.
Teaching and Learning Methods	Do scientific work independently under the guidance of a professor or a research staff member. Active discussions in a group of peers.

Form of Assessment	25% Reviews and Discussion 25% Presentation 25% Seminar paper submitted for review 25% "Camera-ready" seminar paper
Admission requirements for assessment	-
Duration of Assessment	N/A
Language	English
Offering	Irregular
Lecturers	Dr. Christian Bartelt
Person in charge	Dr. Christian Bartelt
Duration of module	1 Semester
Further modules	-
Range of Application	M.Sc. Wirtschaftsinformatik, M.Sc. Mannheim Master in Data Science
Semester	3. Semester

IS 712	**Contemporary Issues in Information Systems Research**
Form of Module	Seminar
Type of Module	Seminar
Level	Master
ECTS	4
Workload	120 h per semester
Prerequisites	Bachelor's degree, the fundamentals
Aim of module	The primary objective of the seminar is to analyze information systems development and use from different perspectives. The secondary objective is to provide students with techniques of scientific writing in a fascinating real-world setting. Important aspects are the evaluation, structuring, and classification of existing research work and the presentation of a detailed and thorough overview of the current state of the art. In addition, scientific work also includes the creation of new knowledge. The participation in the seminar can be regarded as an important preliminary step towards a successful completion of the final thesis.
Learning Outcomes and Qualification Goals	<u>Expertise</u>: The student gains a deep understanding of the research topic. They are able to conduct basic scientific research. They reflect on the topic and judges the contribution of the research papers.
	<u>Methodological competence</u>: The student is able to find the relevant literature for their topic, to write a well-structured scientific paper and to present their results. They are also aware of the need to avoid plagiarism. The key qualification Scientific Research is highly recommended as a prerequisite for the seminar.
	<u>Personal qualification</u>: The student has learned how to find relevant literature for a research topic, write a well-structured, concise paper about it and give a presentation. They are well prepared to write and present a Master's Thesis.
Media	Scientific papers and books; final presentation with PowerPoint

Literature	Depends on the topic of the seminar.
Teaching and Learning Methods	Do scientific work independently under the guidance of a professor or a research staff member. Active discussions in a group of peers.
Form of Assessment	Grading of the seminar paper, the oral presentation, and the participation in the group discussions (Notification will be given at the start of the lecture period for this module)
Admission requirements for assessment	-
Duration of Assessment	N/A
Language	English
Offering	Irregular
Lecturers	Prof. Dr. Armin Heinzl and research assistants
Person in charge	Dr. Monica Fallon
Duration of module	1 Semester
Further modules	-
Range of Application	Mannheim Master in Management, M.Sc. Business Informatics
Semester	3. Semester

IS 722	**Seminar Context-Aware and Distributed Systems**

IS 742	**Seminar Trends in Enterprise Systems**

IS 751	**E-Government Adoption and Societal Change**

For a detailed description please use the module catalog of the „Mannheim Master in Management”:
https://www.bwl.uni-mannheim.de/studium/master/mmm/#c176637

E. Master Thesis

MA 650	Master Thesis
Form of module	Master Thesis
Type of module	Thesis
Level	Master
ECTS	30
Workload	Self-study: 840 h per semester
Prerequisites	The student is required to have obtained at least 60 ECTS credits in order to register for his or her master thesis
Aim of Modules	Develop a deep understand of an advanced topic of business informatics or computer science
Learing outcomes and qualifications goals	Expertise: The student has a deep understanding of an advanced topic. (MK1)
	Methodological competence: The student is familiar with methods for analysing and independently solving advanced, complex problems. (MK1, MK2, MK3)
	Personal competence: The student has the capability to understand, analyse and independently find solutions to advanced, complex problems. The student has the capability to assess and understand the state-of-the-art in business informatics and adapt the latest technologies and methods to solve real world problems. The student is able to present a complex topic in written and oral form in a clear and understandable way. (MF1, MF2, MF3, MF4, MKO2, MKO3)
Media	Various
Literature	Topic dependent
Methods	Independent research work
Form of Assessment	Written thesis
Admission requirements for assessment	-
Duration of Assessment	-

Language	English or German
Offering	Every semester
Person in Charge	Professors of the Institute of Computer Science and Business Informatics or of the Area Information Systems of the Business School
Duration of module	1 semester
Further modules	-
Range of Applications	M.Sc. Wirtschaftsinformatik
Semester	4. Semester

Part 2: Abbreviations

Explanation of abbreviations

Knowledge

The courses are divided into two groups – fundamental courses and specialization courses. After studying mandatory fundamental courses in computer science and business administration, in their advanced courses students can focus on the concepts and methods of computers science, the application of these methods in system design and development, or on the use of information technology in business processes. In addition to the regular lecture courses, students participate in a team project.

During their studies -

(MK1) all students develop a deep understanding of the relevant concepts, methods and problem-solving strategies used in different application domains.

(MK2) technology-oriented students learn the concepts, algorithms and strategies used to solve concrete, practical application-oriented problems in business informatics.

(MK3) business-oriented students develop a deep understanding of how to deploy, develop and manage information systems.

As part of this education, students become familiar with a wide range of models, modelling languages, methods, and tools. Students also learn how to collect, structure, manipulate, prepare, communicate, and use data, information, and knowledge to define and control processes in companies and industrial scenarios.

Capabilities

After completing their studies, students have the ability to –

(MF1) apply a wide range of abstraction and analysis techniques.

(MF2) understand, interpret, describe, and present relevant scientific publications.

(MF3) exploit the latest scientific results.

(MF4) independently tackle problems in business informatics and describe their results in a structured, written form.

(MF5) continue their studies at the PhD level, if their results are of sufficient quality.

Competencies

After completing their studies, students have the competences needed to –

(MKO1) apply their knowledge and capabilities to solve specific problems in a team context.

(MKO2) use their interdisciplinary education to mediate between technical and non-technical individuals.

(MKO3) to evaluate the latest changes in programming languages, systems, business models and process models and, wherever possible, exploit them to develop better solutions to business informatics problems.