

Master of Science (M.Sc.)
“Mannheim Master in Data Science”

University of Mannheim

– Module catalog –

for students starting in or after spring 2020

Academic Year
HWS 2023/ FSS 2024

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Foreword

This document describes the courses that will be offered in HWS 2023/ FSS 2024 for students studying M. Sc. Mannheim Master in Data Science (Examination Regulations for the Master's program from 10th December 2019). 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/en/academics/organizing-your-studies/mannheim-master-in-data-science/#c112237>

A. Overview

| | | ECTS |
|---------------------------------|---|---------|
| Fundamentals | “Fundamentals” courses with at most 14 ECTS | 0 – 14 |
| Data Management | Minimum of three “Data Management” courses | 18 – 36 |
| Data Analytics Methods | Minimum of four “Data Analytics Methods” courses | 30 – 54 |
| Responsible Data Science | Minimum of one “Responsible Data Science” course | 3 – 10 |
| Projects and Seminars | Team Project or Individual Project, Scientific Research and Seminars | 14 – 18 |
| Master Thesis | Six-months-long written academic assignment | 30 |
| Total | | 120 |

General constraints:

1. Fundamental courses with 0-14 ECTS can be taken (0 to 14 ECTS)
2. 3 to 6 Data Management courses must be taken (18 to 36 ECTS)
3. Data Analytics Methods courses worth a combined 30 to 54 ECTS must be taken
4. 1 to 2 Responsible Data Science courses must be taken (3 to 10 ECTS)
5. You must either take a Team Project course or an Individual Project course
6. You must take Scientific Research
7. You must take a Seminar
8. You must write a Master Thesis

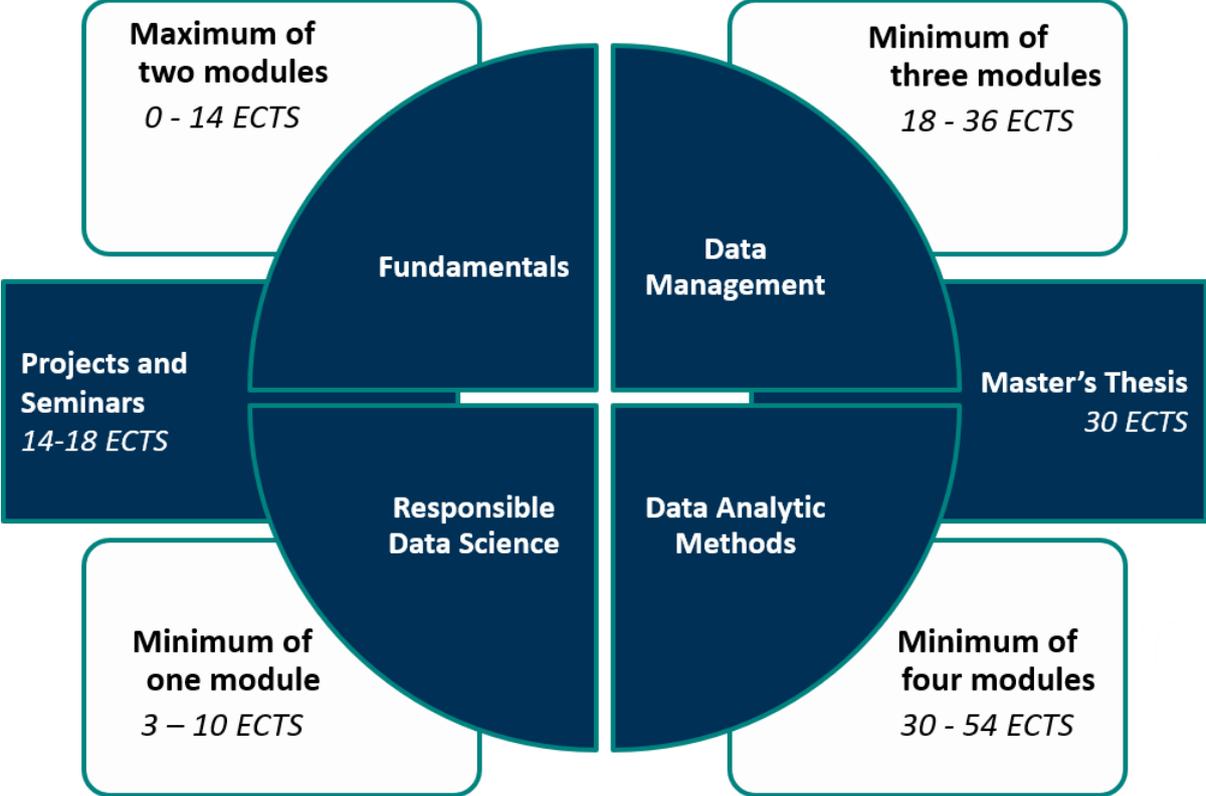
Abbreviations:

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.

Course Structure



B. Fundamentals

1. Overview

| Module no. | Name of Module | Offered | Language | ECTS | Page |
|------------|---|---------|----------|------|------|
| CS 450 | Programming Course | HWS | E | 6 | 7 |
| CS 460 | Database Technology | FSS | E | 6 | 9 |
| | Quantitative Methods | HWS | E | 8 | PS* |
| | Tutorial Quantitative Methods | HWS | E | 2 | PS* |
| | Empirische Methoden der Politikwissenschaft | HWS | G/E | 6 | PW* |
| IS 557 | Scientific Programming with Python** | HWS | E | 6 | MMM* |

* For a detailed description, please see the module catalogues of the respective following degree programs:

- PW: B.A. Politikwissenschaft
<https://www.sowi.uni-mannheim.de/en/academics/students/political-science/ba-in-political-science/>
(only available in German)
- PS: M.A. Political Science
<https://www.sowi.uni-mannheim.de/en/academics/students/political-science/ma-in-political-science/>
- MMM: M.Sc. Mannheim Master in Management
<https://www.bwl.uni-mannheim.de/studium/master/mmm/>

**Prerequisites: No completed exam in CS 470 Programming with Python

2. Detailed descriptions

| CS 450 | Programming Course |
|---|--|
| Form of module | Lecture and accompanying tutorial/practical sessions |
| Type of module | MMDS Fundamental |
| Level | Master |
| ECTS | 6 |
| Workload | Hours per semester present: 56h (4 SWS) |
| | Self-study: 84h per semester <ul style="list-style-type: none"> • 28h: pre and post lecture studying and revision • 56h: preparation and presentation of tutorial exercises |
| Prerequisites | None |
| Aim of module | <p>The course will provide data scientists with the knowledge they need to be able to apply Python3 in data science projects. It assumes that students are familiar with another object-programming language such as Java, C#, or C++, but does not assume any prior Python knowledge. Topics covered include –</p> <ul style="list-style-type: none"> • The Python interpreter & programming paradigms • Basic expressions & control flow statements • Functions & scoping • Data structures • Modules • Classes & object-oriented concepts • Errors and exceptions • Testing and debugging • Exploring & visualizing data with Python • Machine learning applied - clustering and classification • Project management & (third-party) software repositories |
| Learning outcomes and qualification goals | Expertise: After taking the course, students will be familiar with Python3 and will be able to use it in data science projects <div style="text-align: right;">(MK1, MK2)</div> |
| | Methodological competence: Students will acquire the skills to develop high-quality Python software for data science and other applications |

| | |
|---------------------------------------|---|
| | (MF1, MF3) |
| | Personal competence: Students will acquire the ability to work, (1) independently, and (2) in a team, when developing Python programs. (MKO1, MKO3) |
| Media | Projector, PC (Linux), printed lecture slides |
| Literature | <ul style="list-style-type: none"> • Introduction to Computation and Programming Using Python, Third Edition (John. V. Guttag), MIT Press • Think Python: How to Think Like a Computer Scientist, 2nd Edition, Allen B. Downey, O`Reilly • The (Official) Python Tutorial |
| Methods | lectures, tutorials/practical sessions, independent study |
| Form of assessment | Programming test |
| Admission requirements for assessment | Successful completion of a programming project |
| Duration of assessment | 180 minutes |
| Language | English |
| Offering | Fall Semester |
| Lecturer | Dr. Ursula Rost |
| Person in charge | Dr. Ursula Rost |
| Duration of module | 1 semester |
| Further modules | - |
| Range of application | MMDS |
| Semester | 1 st /2 nd semester |

| CS 460 | Database Technology |
|---|---|
| Form of module | Lecture with Exercise |
| Type of module | MMDS Fundamental |
| Level | Master |
| ECTS | 6 |
| Workload | Hours per semester present: 56 h (4 SWS) |
| | Self-study per semester: 98 h <ul style="list-style-type: none"> • 70 h: pre and post lecture studying and revision • 28 h: examination preparation |
| Prerequisites | - |
| Aim of module | <p>The course provides an introduction to relational database systems. The course will cover the following topics:</p> <ul style="list-style-type: none"> • Principles of data storage • Database query languages (SQL) • Relational modelling • Keys and normal forms • Hash and index structures • Transactions and concurrency |
| Learning outcomes and qualification goals | <p>Expertise: Basic understanding of relational data modelling and database design, as well as the functionality of relational database management systems, query handling, and transaction management.</p> <p>(MK1, MK 2, MK3)</p> |
| | <p>Methodological competence: Abstraction, modelling, complexity consideration.</p> <p>(MF1, MF2)</p> |
| | <p>Personal competence: Understanding the role of data management in enterprises.</p> <p>(MK01, MK02)</p> |
| Media | Electronic slides and exercise sheets |
| Literature | Avi Silberschatz, Henry F. Korth, S. Sudarshan: Database System Concepts |

| | |
|---------------------------------------|---|
| Methods | The course consists of a lecture together and exercises. The exercises encompass both theoretical exercises as well as practical assignments, which are conducted with a free modern database management system and allow the students to deepen their theoretical understanding of the course contents, as well as to gather hands-on experience with database management systems. |
| Form of assessment | Written or oral examination |
| Admission requirements for assessment | - |
| Duration of assessment | 60 minutes (written exam)/30 minutes (oral exam) |
| Language | English |
| Offering | Spring semester |
| Lecturer | Prof. Dr. Heiko Paulheim |
| Person in charge | Prof. Dr. Heiko Paulheim |
| Duration of module | 1 semester |
| Further modules | Database Systems II, Transaktionssysteme, Anfrageoptimierung, Large Scale Data Management |
| Range of application | MMDS |
| Semester | 1 st /2 nd semester |

C. Data Management

1. Overview

| Module no. | Name of Module | Offered | Language | ECTS | Page |
|------------|---|---------|----------|---------|------|
| AC 651 | Additional Course – Data Management | HWS/FSS | E | Max. 18 | 12 |
| CS 500 | Advanced Software Engineering | HWS | E | 6 | BI* |
| CS 550 | Algorithmics | FSS/HWS | E | 6 | BI* |
| CS 560 | Large Scale Data Management | HWS | E | 6 | BI* |
| CS 600 | Model-driven Development | HWS | E | 6 | BI* |
| CS 660** | Compiler Construction | HWS | E | 6 | BI* |
| CS 661** | Parallel Programming | FSS | E | 6 | BI* |
| CS 664** | Blockchain Security | HWS | E | 6 | BI* |
| CS 666** | Digital Forensics and Incident Response | HWS | E | 6 | BI* |
| IE 650 | Knowledge Graphs (formerly Semantic Web Technologies) | HWS | E | 6 | BI* |
| IE 670 | Web Data Integration | HWS | E | 3 | BI* |
| IE 683 | Web Data Integration Project | HWS | E | 3 | BI* |
| IS 540 | Management of Enterprise Systems | HWS | E | 6 | MMM* |
| IS 556 | Public Blockchains | FSS | E | 6 | MMM* |

* For a detailed description, please see the module catalogue of the respective following degree programs:

- BI: M.Sc. Business Informatics, <https://www.wim.uni-mannheim.de/studium/studienorganisation/m-sc-business-informatics/>
- MMM: M.Sc. Mannheim Master in Management, <https://www.bwl.uni-mannheim.de/studium/master/mmm/>

**Additional offer to the Examination Regulations.

| AC 651 | Additional Course – Data Management |
|--|--|
| Form of module | Depends on course |
| Level | Master |
| ECTS | Max. 18 |
| Workload | Depends on course |
| Prerequisites | Depends on course |
| Aim of module | The course falls into the data management area of the MMDS and covers topics related to data management but is not directly equivalent to any course in the MMDS module catalogue. The course level equals a regular course in MMDS study program. The module can be taken either at the University of Mannheim or at any other university in Germany or abroad. |
| Learning outcomes and qualification goals | Depends on course |
| Media / Literature / Methods / Form and duration of assessment | Depends on course |
| 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 | MMDS |
| Semester | 2 nd /3 rd /4 th semester |

D. Data Analytics Methods

1. Overview

| Module no. | Name of Module | Offered | Language | ECTS | Page |
|------------|--|-----------|----------|---------|------|
| AC 652 | Additional Course – Data Analytics Methods | HWS/FSS | E | Max. 18 | 15 |
| DA 110 | Computational Analysis of Communication | HWS/FSS | E | 6 | 16 |
| IE 697 | Data Science in Action | HWS | E | 6 | 18 |
| IE 500 | Data Mining I | HWS/FSS | E | 6 | BI* |
| IE 560 | Decision Support | HWS | E | 6 | BI* |
| IS 661 | Text Analytics | HWS | E | 6 | MMM* |
| IE 671 | Web Mining | FSS | E | 3 | BI* |
| IE 672 | Data Mining II | FSS | E | 6 | BI* |
| IE 675b | Machine Learning | HWS | E | 9 | BI* |
| IE 678 | Deep Learning | FSS | E | 6 | BI* |
| IE 684 | Web Mining Project | FSS | E | 3 | BI* |
| IE 692 | Advanced Process Mining | FSS | E | 6 | BI* |
| IE 694 | Artificial Intelligence Applications in Industry | FSS | E | 6 | BI* |
| IE 696 | Advanced Methods in Text Analytics | HWS/FSS | E | 6 | BI* |
| IS 616 | Large Scale Data Analysis and Visualization | HWS | E | 6 | MMM* |
| IS 622 | Network Science** | FSS | E | 6 | MMM* |
| MAA 519 | Stochastic Calculus | HWS | E | 5 | MBE* |
| MAB 504 | Mathematics and Information | irregular | G | 8 | MBE* |
| MAB 508 | Algebraische Statistik | irregular | G/E | 8 | MBE* |
| MAB 519 | Reinforcement Learning*** | FSS | E | 10 | MBE* |
| MAB 520 | Reinforcement Learning II | HWS | E | 5 | MBE* |
| MAC 404 | Optimierung | HWS | G | 8 | WM* |
| MAC 502 | Computational Finance | FSS | G/E | 6 | MBE* |
| MAC 507 | Nichtlineare Optimierung | FSS | G/E | 6 | MBE* |

| | | | | | |
|---------|--|-----|---|---|------|
| MAC 527 | Markov Processes | FSS | E | 4 | MBE* |
| MKT 511 | Marketing Analytics | FSS | E | 6 | MMM* |
| MKT 545 | Customers, Markets and Firm Strategy | FSS | E | 6 | MMM* |
| | Lecture Cross Sectional Data Analysis | HWS | E | 6 | Soc* |
| | Tutorial Cross Sectional Data Analysis | HWS | E | 3 | Soc* |
| | Lecture Advanced Quantitative Methods | FSS | E | 6 | PS* |
| | Tutorial Advanced Quantitative Methods | FSS | E | 2 | PS* |
| | Lecture Longitudinal Data Analysis | FSS | E | 6 | Soc* |
| | Tutorial Longitudinal Data Analysis | FSS | E | 3 | Soc* |
| | Lecture Research Design | HWS | E | 6 | Soc* |
| | Tutorial Research Design | HWS | E | 3 | Soc* |

* For a detailed description, please see the module catalogues of the respective following degree programs:

- BI: M.Sc. Business Informatics
<https://www.wim.uni-mannheim.de/studium/studienorganisation/m-sc-business-informatics>
- WM: B.Sc. Wirtschaftsmathematik
<https://www.wim.uni-mannheim.de/studium/studienorganisation/b-sc-wirtschaftsmathematik/> (only available in German)
- MBE: M.Sc. Mathematics in Business and Economics
<https://www.wim.uni-mannheim.de/studium/studienorganisation/m-sc-wirtschaftsmathematik/> (only available in German)
- PS: M.A. Political Science
<https://www.sowi.uni-mannheim.de/studium/studierende/politikwissenschaft/ma-political-science/> (only available in German)
- Soc: M.A. Sociology
<https://www.sowi.uni-mannheim.de/studium/studierende/soziologie/ma-sociology/>
- MMM: Mannheim Master in Management
<https://www.bwl.uni-mannheim.de/studium/master/mmm/#c176637>

**Prerequisite: Not completed exam in IE 676

***Prerequisite: Not completed exam in IE 695

| AC 652 | Additional Course – Data Analytics Methods |
|--|--|
| Form of module | Depends on course |
| Level | Master |
| ECTS | Max. 18 |
| Workload | Depends on course |
| Prerequisites | Depends on course |
| Aim of module | The course falls into the data analytics methods area of the MMDS and covers topics related to data analytics methods but is not directly equivalent to any course in the MMDS module catalogue. The course level equals a regular course in MMDS study program. The module can be taken either at the University of Mannheim or at any other university in Germany or abroad. |
| Learning outcomes and qualification goals | Depends on course |
| Media / Literature / Methods / Form and duration of assessment | Depends on course |
| 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 | MMDS |
| Semester | 2 nd /3 rd /4 th semester |

| DA 110 | Computational Analysis of Communication |
|---|--|
| Form of module | Exercise |
| Type of module | Data Analytics Methods |
| Level | Master |
| ECTS | 6 |
| Workload | Hours per semester present: 28 (2 SWS) |
| | Self-study: 145h (70h lectures/exercises, 75h research report) |
| Prerequisites | Basic skills in descriptive and inferential statistics, basic knowledge of data structures and data wrangling procedures, machine learning, web-scraping/web-mining |
| Aim of module | <p>As “big data” and “algorithms” affect our daily communication, new research questions arise at the intersection between societies and technologies. Many of these questions are of great social relevance and are therefore prominently discussed both by researchers and in the media. One outstanding, recent example from the field of media psychology is a rising interest in the association of (social) media use and mental health. Another example, from the realm of political communication, is the ongoing debate about the role of new communication technologies during political campaigns (e.g., to spread disinformation). Both questions revolve around the process of communication. Sound research in this area thus requires both a solid foundation from communication theory as well as expertise in handling new and “big” data. To close this gap, the growing discipline of Computational Communication Science (CCS) takes on a combinatorial perspective between social and computer science. The present course will provide an overview about the current state of CCS and intends to motivate students to approach pressing social questions from a different perspective.</p> |
| Learning outcomes and qualification goals | <p>Expertise: After the course the students are aware of the typical research topics and questions in automated media content analyses and the different methodological approaches for tackling them; they know the different methods’ potentials, limitations, and typical fields of application; they are able to develop their own specific research questions and can make an informed decision about which method to apply for answering it</p> |

| | |
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| | <p>Methodological competence: Students are able to independently develop a research question and design in the area of automated media content analysis and can conduct a respective analysis using one of the different methodological approaches introduced in the exercise; they are able to document the results of their analyses in a research report and reflect upon their findings' limitations with regards to reliability and validity</p> <p>Personal competence: The course supports students to develop problem-solving competences with regards to research-design oriented questions. By solving exercises independently, the transfer of the learned material to related questions is promoted and self-confidence with regards to research-oriented tasks is gathered.</p> |
| Media | Exercise sheets and lecture slides are available online |
| Literature | van Atteveldt, W., Trilling, D., & Arcila, C. (2021). Computational Analysis of Communication: A practical introduction to the analysis of texts, networks, and images with code examples in Python and R. http://cssbook.net/ |
| Methods | Lecture elements, student presentations, weekly exercises, literature studies |
| Form of assessment | Written research report |
| Admission requirements for assessment | - |
| Duration of assessment | - |
| Language | English |
| Offering | HWS/FSS |
| Lecturer | MKW |
| Person in charge | MKW |
| Duration of module | 1 semester |
| Further modules | - |
| Range of application | M.Sc. Data Science |
| Semester | 1 st / 2 nd /3 rd semester |

| IE 697 | Data Science in Action |
|---|--|
| Form of module | Lecture |
| Type of module | Elective |
| Level | Master |
| ECTS | 6 |
| Workload | Hours per semester present: 28 h (2 SWS) |
| | Self-study: 112 h per semester |
| Prerequisites | Recommended: Knowledge in Data Mining, Machine Learning, Statistics, or empirical research methods |
| Aim of module | Participants get insights in current Data Science Research in Computer Science as well as the economic and social sciences. The participants get an insight in the different perspectives on Data Science present in different research communities. |
| Learning outcomes and qualification goals | Expertise: Students will acquire knowledge of current research in Data Science (MK2, MK3) |
| | Methodological competence: Students learn to understand and summarize the state of the art in a certain area and discuss achievements and open problems. (MF2, MKO2) |
| | Personal competence: - |
| Media | Slides, Research Papers |
| Literature | Recommended Papers from invited speakers |
| Methods | Lectures, independent study |
| Form of assessment | Written Essay |
| Admission requirements for assessment | - |
| Duration of assessment | 4-6 weeks |
| Language | English |

| | |
|----------------------|---|
| Offering | Fall semester |
| Lecturer | Prof. Dr. Heiner Stuckenschmidt, Invited Speakers |
| Person in charge | Prof. Dr. Heiner Stuckenschmidt |
| Duration of module | 1 Semester |
| Further modules | - |
| Range of application | Mannheim Master in Data Science |
| Semester | 2.-4. |

E. Responsible Data Science

1. Overview

| Module no. | Name of Module | Offered | Language | ECTS | Page |
|------------|--|---------|----------|--------|------|
| CS 652 | Data Security and Privacy | FSS | E | 6 | BI* |
| | Legal and Ethical Aspects of Privacy | HWS | E | 3 | 21 |
| CS 718 | AI and Data Science in Fiction and Society | HWS | E | 4 | 23 |
| AC 654 | Additional Course – Responsible Data Science | HWS/FSS | E | Max 18 | 25 |

* For a detailed description, please see the module catalogues of the respective following degree programs:

- BI: M.Sc. Business Informatics, <https://www.wim.uni-mannheim.de/studium/studienorganisation/m-sc-business-informatics/>

2. Detailed Description

| | Legal and Ethical Aspects of Privacy |
|---|--|
| Form of module | Lecture |
| Type of module | Responsible Data Science |
| Level | Master |
| ECTS | 3 |
| Workload | Hours per semester present: 28 h (2 SWS) |
| | Self-study per semester: 60 h <ul style="list-style-type: none"> • Pre-and post-lecture studying and preparation (30h) • Examination preparation (30h) |
| Prerequisites | None |
| Aim of module | <p>In a first section the course will acquaint the students with the origins and basic principles of privacy law mainly in Europe. Furthermore, it will contrast the European privacy foundations with the U.S. approach. At the core of this course stands the new European General Data Protection Regulation (GDPR) and its applicability to specific cases and basic principles. Moreover, the course will cover current challenges to the existing privacy paradigms by big data and big data analytics.</p> <p>In a second section the course will cover ethical aspects of the use of personal and non-personal data. Data potentially allows to identify and target individuals and offer individualized products to them. However, sometimes this kind of individualization might be legal, but the question arises whether it is also desirable from an ethical and societal point of view? The course will use selected examples (e.g., first-degree price discrimination) in order to illustrate the ambivalence of legality, legitimacy, and ethics. In this context, the use of artificial intelligence and its impact on privacy will be addressed.</p> |
| Learning outcomes and qualification goals | <p>Students will...</p> <ul style="list-style-type: none"> • have a basic knowledge on the applicability of the General Data Protection Regulation (GDPR) and its basic principles; • be aware of privacy issues and potential legal limitations when processing data; • be aware of current challenges to the existing privacy • have an understanding why privacy issues are treated differently in Europe and the U.S.; • paradigms by big data and big data analytics; • be aware of currently discussed new approaches to privacy (e.g., privacy by design); |

| | |
|---------------------------------------|--|
| | <ul style="list-style-type: none"> • be aware of ethical issues of using personal as well as non-personal data • be aware of the chances and challenges the use of artificial intelligence will bring |
| Media | Video tutorials, lectures, online quizzes |
| Literature | Students will receive reading assignments for each unit together with the syllabus at the beginning of the semester. |
| Methods | The class will generally be conducted as a lecture. However, some of the sessions will be conducted on an inverted classroom principle. Students will be able to access the video lectures at the beginning of the semester. The content of these videos will be discussed along with additional reading in the individual class sessions. |
| Form of assessment | written examination |
| Admission requirements for assessment | Successful participation in 5 out of at least 7 online quizzes |
| Duration of assessment | 90 minutes |
| Language | English |
| Offering | HWS |
| Lecturer | Prof. Dr. Thomas Fetzer |
| Person in charge | Prof. Dr. Thomas Fetzer |
| Duration of module | 1 semester |
| Further modules | - |
| Range of application | MMDS |
| Semester | 1 st /2 nd /3 rd semester |

| CS 718 | AI and Data Science in Fiction and Society |
|---|---|
| Form of Module | Seminar |
| Type of Module | Seminar |
| Level | Master |
| ECTS | 4 |
| Workload | 120 h per semester |
| Prerequisites | Bachelor's degree |
| Aim of module | In this seminar, students analyse and discuss fictional works in the area of AI and data science with respect to technological and societal aspects. The present the results orally and in a written report. |
| Learning Outcomes and Qualification Goals | <p>Expertise: Students will learn about societal effects of AI and data science and become aware of potential threats and dangers, but also of chances of those new technologies.</p> <p style="text-align: right;">(MK1)</p> |
| | <p>Methodological competence: Students will develop methods and skills to find relevant literature for his/her topic, and to write a well-structured scientific paper and to present his/her results. He/she will be also aware of the need to avoid plagiarism. The key qualification Scientific Research is highly recommended as a prerequisite for the seminar.</p> <p style="text-align: right;">(MF1, MF2, MF3)</p> |
| | <p>Personal qualification: Students will acquire skills on how to find relevant literature for a research topic, discuss a fictional work using secondary literature as background material, write a well-structured, concise paper about it and present the results of their work. He/she is well prepared to write and present a Master's Thesis.</p> <p style="text-align: right;">(MKO2)</p> |
| Media | Fictional and non-fictional texts |
| Literature | A detailed literature list is compiled for each offering. |
| 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 |
| Offering | Fall semester |
| 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 | MMDS, M. Sc. Wirtschaftsinformatik, Lehramt für Gymnasien |
| Semester | 3. Semester |

| AC 654 | Additional Course – Responsible Data Science |
|--|--|
| Form of module | Depends on course |
| Level | Master |
| ECTS | Max. 18 |
| Workload | Depends on course |
| Prerequisites | Depends on course |
| Aim of module | The course falls into the responsible data science area of the MMDS and covers topics related to responsible data science but is not directly equivalent to any course in the MMDS module catalogue. The course level equals a regular course in MMDS study program. The module can be taken either at the University of Mannheim or at any other university in Germany or abroad. |
| Learning outcomes and qualification goals | Depends on course |
| Media / Literature / Methods / Form and duration of assessment | Depends on course |
| 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 | MMDS |
| Semester | 2 nd /3 rd /4 th semester |

F. Projects and Seminars

1. Overview

| Module no. | Name of Module | Offered | Language | ECTS | Page |
|------------|--|-----------|----------|---------|------|
| AC 653 | Additional Course – Projects and Seminars | HWS/FSS | E | Max. 18 | 27 |
| TP 500 | Team Project | HWS/FSS | G/E | 12 | BI* |
| IP 500 | Individual Project | HWS/FSS | G/E | 8 | 28 |
| SQ 500 | Scientific Research | Irregular | E | 2 | BI* |
| CS 701 | Seminar Selected Topics in Algorithmics and Cryptography | Irregular | E | 4 | BI* |
| CS 704 | Master Seminar Artificial Intelligence | Irregular | E | 4 | BI* |
| CS 707 | Seminar Data and Web Science | Irregular | E | 4 | BI* |
| CS 708 | Seminar Software Engineering | Irregular | E | 4 | BI* |
| CS 709 | Seminar Text Analytics | Irregular | G/E | 4 | BI* |
| CS 710 | Seminar Prof. Paulheim | Irregular | G/E | 4 | BI* |
| CS 715 | Seminar Large Scale Data Integration | Irregular | E | 4 | BI* |
| CS 716 | Seminar Prof. Armknecht | Irregular | E | 4 | BI* |
| CS 719 | Seminar on Process Analysis | Irregular | E | 4 | BI* |
| CS 720 | Uncertainty Estimation | Irregular | E | 4 | BI* |
| CS 721 | Seminar Data-Science I | Irregular | E | 4 | BI* |
| CS 722 | Seminar Ethical Aspects of AI | Irregular | E | 4 | BI* |
| IE 704 | Seminar AI Systems Engineering | Irregular | E | 4 | BI* |

* For a detailed description, please see the module catalogues of the respective following degree programs:

- BI: M.Sc. Business Informatics
<https://www.wim.uni-mannheim.de/studium/studienorganisation/m-sc-business-informatics/>

2. Detailed descriptions

| AC 653 | Additional Course – Projects and Seminars |
|--|--|
| Form of module | Depends |
| Level | Master |
| ECTS | Max. 18 |
| Workload | Depends |
| Prerequisites | Depends |
| Aim of module | The course equals a seminar in the MMDS study program. The module can be taken either at the University of Mannheim or at any other university in Germany or abroad. |
| Learning outcomes and qualification goals | Depends on course |
| Media / Literature / Methods / Form and duration of assessment | Depends |
| 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 | MMDS |
| Semester | 2 nd /3 rd /4 th semester |

| IP 500 | Individual Project |
|--|---|
| Form of module | Project |
| Type of module | Individual Project |
| Level | Master |
| ECTS | 8 |
| Workload | Self study: 240 h per semester |
| Prerequisites | Depends on topic |
| Aim of Modules | The student solves a practical problem individually. The student has to analyse and refine the problem and come up with a project plan for developing a concrete solution. 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 qualifications goals | <p>Depending on the actual topic of the project, participants will acquire</p> <ul style="list-style-type: none"> • in-depth knowledge in a certain application of data science • 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 <p>Participants will learn to</p> <ul style="list-style-type: none"> • refine a given problem statement by analysing 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. |
| Media | Depends on project |
| Literature | Depends on topic |
| Methods | Self study, presentations |
| Form of Assessment | Final report and presentation |

| | |
|---------------------------------------|---|
| Admission requirements for assessment | - |
| Duration of Assessment | 15 minutes (presentation) |
| Language | English/German |
| Offering | Spring semester/Fall semester |
| Lecturer | Professors of the Institute of School of Business Informatics and Mathematics or of the School of Social Sciences |
| Person in Charge | A professor of the Institute of School of Business Informatics and Mathematics of the School of Social Sciences |
| Duration of module | 1 semester |
| Further modules | - |
| Range of Applications | MMDS |
| Semester | 1 st /2 nd /3 rd semester |

G. Master Thesis

| | Master Thesis |
|--|--|
| Form of module | Master Thesis |
| Type of module | Thesis |
| Level | Master |
| ECTS | 30 |
| Workload | Self study: 840 h per semester |
| Prerequisites | - |
| Aim of Modules | Develop a deep understanding of an advanced topic of data science |
| Learning outcomes and qualifications goals | <p>Expertise: The student has a deep understanding of an advanced topic. (MK1)</p> |
| | <p>Methodological competence: The student is familiar with methods for analysing and independently solving advanced, complex problems. (MK1, MK2, MK3)</p> |
| | <p>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)</p> |
| Media | Various |
| Literature | Topic dependent |
| Methods | Independent research work |
| Form of Assessment | Written thesis |
| Admission requirements for assessment | To be permitted to write the master thesis, the student is to obtain at least 60 ECTS |
| Duration of Assessment | - |

| | |
|-----------------------|--|
| Languages | English only |
| Offering | Every semester |
| Person in Charge | Examiners: University teachers, auxiliary professors, honorary professors and senior academic staff members of the School of Business informatics and mathematics or of the School of Social Sciences. Supervisors of other faculties are possible upon application to the examination board and after examination of the content. |
| Duration of module | 1 semester |
| Further modules | - |
| Range of Applications | MMDS |
| Semester | 4 th semester |

Abbreviations

Explanation of abbreviations

Knowledge

This degree program provides students with a solid theoretical foundation as well as practical skills for data management, data analytics methods and responsible data science. The courses are divided into two groups – fundamental courses and advanced courses. After studying optional fundamental courses in computer science and empirical social sciences, in their advanced courses students can focus on the concepts and methods of computers science and advanced empirical methods and the application of these methods. In addition to the regular lecture courses, students participate in a one or two semester team project or individual 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 informatics.
- (MK3) social sciences-oriented students develop a deep understanding of how to set up, analyse and interpret advanced empirical research questions.

As part of this education, students become familiar with a wide range of models, modelling languages, methods, and tools. Regardless of their specialization, students also learn how to collect, structure, manipulate, prepare, interpret, communicate, and use data, information, and knowledge.

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 data management and analytics 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) evaluate the latest changes in programming languages, systems, models and, wherever possible, exploit them to develop better solutions to data-science related problems.