M. Sc. Data Science

Introductory Meeting
Master of Data Science

Program Coordination

Head of program
- Prof. Dr. Martin Grohe

Academic advisor
- Christof Löding
- email: data-science@cs.rwth-aachen.de
- Office Hours: see section “contact” on website
  www.data-science.rwth-aachen.de
Outline

1. Program Structure

![Program Structure Diagram]

2. Planning your Studies
Program Structure

Where to find information:

- Official Documents (only available in German):
  - “Übergreifende Prüfungsordnung” (general rules for all programs)
  - “Fachspezifische Prüfungsordnung” (subject specific rules)

- Slides from this meeting (will be published on the web)

- Descriptions on www.data-science.rwth-aachen.de
Program Structure

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General Structure:

- You need to complete 120 CP (credit points = ECTS) for your degree.
- Master thesis counts for 30 CP.
- You have to choose and complete courses for 90 CP in total from different areas according to some rules, as explained in the following.
Program Structure

Foundational (Core) Area
(44 - 64 CP)

- **Computer Science (at least 18 CP)**
  *Introduction to Data Science (6 CP) + further CS courses*

- **Mathematics (at least 18 CP)**
  *Mathematics of Data Science (9 CP) + further Math courses*

- **Data Science Ethics**
  *Ethics, Technology, and Data (4 CP)*

S/P (12 CP)

Seminar (5 CP), Practical Course (7 CP)

- **Specialisation Area**
  (14 - 22 CP)

- **Master’s Thesis**
  (30 CP)

- **Additional Competences**
  (0 - 12 CP)

  - Computer Science (CS)
  - Mathematics (M)
  - Computer Science and Mathematics
  - Application Area (BA, CLS, CSS or P)
  - Lecture courses from respective catalogues

  - Master’s thesis

  - Language course, non-technical courses from universities' program,

  + “Scientific Integrity”
Foundational (or Core) Area (44-64 CP)

Mandatory Courses

Introduction to Data Science (6 CP)
- Prof. Dr. Wil van der Aalst
- this semester

Mathematics of Data Science (9 CP)
- Prof. Dr. Erhard Cramer
- Prof. Dr. Holger Rauhut
- this semester

Ethics, Technology, and Data (4 CP)
- Prof. Dr. Sakia Nagel
- next semester
Foundational (or Core) Area (44-64 CP)

Elective Courses

**Computer Science** (at least 12 CP)
- Machine Learning \(\text{this semester} \) (6 CP)
- Data Analysis and Visualization \(\text{this semester} \) (4 CP)
- Probabilistic Programming (6 CP)
- Privacy Enhancing Technologies for Data Science \(\text{this semester} \) (4 CP)
- Algorithmic Foundations of Data Science (6 CP)
- Concepts and Models for Parallel Data-Centric Computation (6 CP)
- Semantic Web \(\text{this semester} \) (4 CP)

**Mathematics** (at least 9 CP)
- Applied Data Analysis (9 CP)
- Exploratory Data Analysis (6 CP)
- Nonlinear Optimization *Optimierung A* (9 CP)
- Combinatorial Optimization *Optimierung B* \(\text{this semester} \) (9 CP)
- Mathematical Methods of Signal and Image Processing \(\text{this semester} \) (9 CP)
- High-Dimensional Probability for Mathematicians and Data Scientists (9 CP)
- Mathematical Foundations of Machine Learning (9 CP)
Seminar and Lab Course (5+7 CP)

**Seminar:** oral presentation and written report on a subject assigned to you

**Lab course (practical course):** software project in a team

- Each semester, there is a variety of seminars and lab courses offered by the department.
- Registration and distribution of places outside of RWTHonline in a separate system already at the end of the previous semester.
- You will be informed via the mailing list when the process starts.
Specialisation Area (14 - 22 CP)

- Elective courses of 14-22 CP from one of the following areas:
  - Computer Science
  - Mathematics
  - Computer Science and Mathematics
  - Business Analytics
  - Computational Life Science
  - Computational Social Science
  - Physics (only for Students with a Bachelor’s Degree in Physics)

- For each area there is a catalogue of courses (see RWTHonline)
- Formal election of Specialisation Area together with the registration of Master’s Thesis (at the latest)
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Rule for upper credit limit: One course “overflowing” the 22 CP is allowed. Example:

- 4 courses with 6 CP (= 24 CP) would be fully counted.
- 5 courses with 6 CP are too many, one of them would not be counted.
Specialisation Area (14 - 22 CP)

Rules for Specialization

Business Analytics, Computational Life Science, Physics:
- at least 20 CP from the courses of the respective area

Computer Science, Mathematics, Computer Science and Mathematics:
- at least 10 CP from the courses of the respective area
- at most 6 CP of courses from any other specialization area

Computational Social Science
- at least 10 CP from the courses of the respective area
- at most 8 CP of courses from specialization CS or maths
Specialisation Area – Master’s Thesis (30 CP)

- Requirements for registration
  - at least 60 CP
  - completed course “Scientific Integrity”
  - recommended: completed the mandatory courses “Introduction to Data Science”, “Mathematics of Data Science”, “Ethics, Technology and Data”
  - specialization “Business Analytics”: at least one of “Combinatorial Optimization” or “Operations Research I”
Specialisation Area – Master’s Thesis (30 CP)

- Requirements for registration
  - at least 60 CP
  - completed course “Scientific Integrity”
  - **recommended**: completed the mandatory courses
    - “Introduction to Data Science”, “Mathematics of Data Science”, “Ethics, Technology and Data”
  - specialization “Business Analytics”: at least one of “Combinatorial Optimization” or “Operations Research I”

- topic from specialisation area; there is no central list of topics, you have to directly contact the research groups

- thesis (27 CP) + oral presentation (3 CP)

- 6 Months duration, max 100 pages

- first reviewer from the specialisation area, second reviewer from CS or math department

- written within RWTH, external theses are an exception and should be coordinated with a research group from your specialization
Additional Competences (0-12 CP)

This area is optional!

Twofold purpose:

- Opportunity to broaden your knowledge on non-technical subjects:
  - language course at RWTH language center (up to 4 CP): register today for this semester!
  - “non-technical” courses offered at RWTH Aachen (up to 6 CP) (philosophy, history, social sciences, economics, ...)

- You join with background on CS, maths, or physics. You can attend basic courses from CS or maths if this is not your background:
  - bridge courses (blended learning modules):
    - with background maths or physics: Algorithms and Data Structures, Databases (every semester)
    - with background CS or physics: Stochastics II (winter)
  - or corresponding courses from CS/math bachelor (in German)

Grades of courses in additional competences do not count for the final grade (but the credits do count).
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Grades of courses in additional competences do not count for the final grade (but the credits do count).

**Approval needed:** Except for the language course, your choices for additional competences currently need to be approved by the academic advisor.
Scientific Integrity

- Online Course about good scientific practice (offered each semester)
- Mandatory for all master students of RWTH Aachen who started from October 1st 2020.
- Exam as so-called homework via Dynexite (offered twice per semester)
- No credits for this course
- More information: Web page for course Scientific Integrity
Program Structure – Summary

See also descriptions on the website [www.data-science.rwth-aachen.de](http://www.data-science.rwth-aachen.de)

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<th>Course Details</th>
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| S/P (12 CP) | Seminar (5 CP), Practical Course (7 CP) |
| Specialisation Area (14 - 22 CP) | Computer Science (CS)  
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Computer Science and Mathematics  
Application Area (BA, CLS, CSS or P) |
| Master’s Thesis (30 CP) | Lecture courses from respective catalogues  
Master’s thesis |
| Additional Competences (0 - 12 CP) | Language course, non-technical courses from universities’ program,.... |

+ “Scientific Integrity”
Outline

1. Program Structure

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Lecture courses from respective catalogues

| Additional Competences (0 - 12 CP) | Language course, non-technical courses from universities' program,... |

2. Planning your Studies

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Add. Comp. 0-12

Master's Thesis 30

Core Area 44 - 64

Math 18

CS 18

P/S 12

Seminar 5

Practical Course 7

≥ 12

≤ 6

≥ 6

≥ 6

≥ 20

≥ 20

≥ 10

≤ 8

≥ 20

Electives from Computational Social Science

Electives from CS oder Maths

Electives from Physics

Electives from Computer Science

Modules from other Specialisations

Electives from Mathematics

Modules from other Specialisations

Electives from Business Analytics

Electives from Computational Life Science

CSS

Electives from Computational Social Science

Electives from CS oder Maths

Electives from Physics

Electives from Computer Science

Modules from other Specialisations

Electives from Mathematics

Modules from other Specialisations

Electives from Business Analytics

Electives from Computational Life Science

CSS
Planning your Studies

Example for a first semester:

- Introduction to Data Science (6 CP, mandatory CS, core area)
- Mathematics of Data Science (9 CP, mandatory math, core area)
- Machine Learning (6 CP, electives CS, core area)
- Data Analysis and Visualization (4 CP, electives CS, core area)
- Language course (4 CP, additional competences)
Planning your Studies

Example for a first semester:

- Introduction to Data Science (6 CP, mandatory CS, core area)
- Mathematics of Data Science (9 CP, mandatory math, core area)
- Machine Learning (6 CP, electives CS, core area)
- Data Analysis and Visualization (4 CP, electives CS, core area)
- Language course (4 CP, additional competences)

Example for a second semester:

- Ethics, Technology, and Data (4 CP, mandatory, core area)
- Algorithmic Foundations of Data Science (6 CP, electives CS, core area)
- Concepts and Models for Parallel Data-Centric Computation (6 CP, electives CS, core area)
- Mathematical Foundations of Machine Learning (9 CP, electives maths, core area)
- first course from specialization CS (6 CP)
Planning your Studies

Example for a third semester:

- Seminar (5 CP)
- Software Lab (7 CP)
- Privacy Enhancing Technologies for Data Science (4 CP, electives CS, core area)
- second course from specialization CS (8 CP)
- third course from specialization CS (6 CP)

Fourth semester: Master thesis (30 CP)
Planning your Studies

Example for a third semester:

- Seminar (5 CP)
- Software Lab (7 CP)
- Privacy Enhancing Technologies for Data Science (4 CP, electives CS, core area)
- second course from specialization CS (8 CP)
- third course from specialization CS (6 CP)

Fourth semester: Master thesis (30 CP)

Remarks:

- This is just an illustrative example for specialization CS. There is no guarantee that the mentioned courses are offered in the corresponding semester.
- Some courses might be overlapping. But for almost all courses, a lot of digital material is provided, such that studying overlapping courses is possible.
- It is also possible to do courses in parallel with the thesis.
Finding and Choosing Courses

- Catalogue of courses generally offered in the data science program in RWTHonline
- See also FAQ on www.data-science.rwth-aachen.de
  Question: “Where can I get information on the curriculum?”
- Before a semester starts, you can check in RWTHonline which courses are offered in that semester
- Elective courses of the computer science department (in general, not specific to data science) are usually presented at the beginning of the semester: Webpage for elective courses of CS department in winter 2021/22
- Teaching is done in English. Ask the lecturers if not.
Registration for Courses and Exams

Courses:
- Register in RWTHonline at beginning of semester (see there for deadlines, usually until a few weeks after start of semester)
- Registration does not imply that you actually have to take the course

Exams:
- Register in RWTHonline once you have decided which courses to take
- Current registration deadlines:
  - First exam: November 15 – January 15
  - Second exam: One week before exam
- Deadlines might vary because of Covid-19
- You can deregister from an exam until a few days before the exam (again, exact deadlines currently vary)
- Details on the exams (written, oral, or other components) are announced in the courses
- In some courses you need to do weekly exercises to get an admission for the exam
Who is Doing What?

Individual research groups:
- offer courses and corresponding exams (look at the webpages of the individual research groups to find out more about their research and teaching)
- set up and administer registration for courses and exams

ZPA (central examination office):
- administration of your academic record

Academic advisor:
- answer questions, give advice, approve additional competences, ...
The End

Contact: data-science@cs.rwth-aachen.de

Office hours via zoom: see section “Contact” for M.Sc. Data Science on www.data-science.rwth-aachen.de