



Technische  
Universität  
Braunschweig



# Welcome to Data Science @ TU Braunschweig!

<https://www.tu-braunschweig.de/en/data-science>

[https://www.youtube.com/watch?v=vh0\\_IOrw3Fw](https://www.youtube.com/watch?v=vh0_IOrw3Fw)



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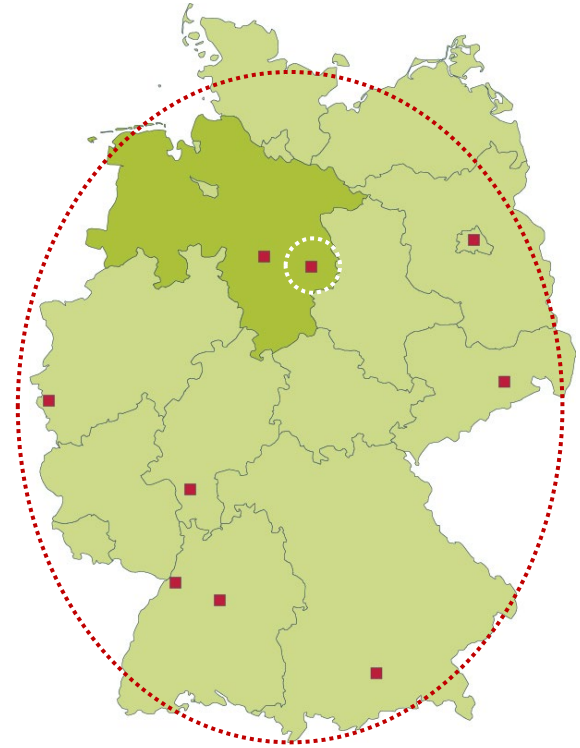
08.10.2024 | Prof. Dr. Martin Eisemann & Prof. Dr. Tim Kacprowski | Welcome Meeting Data Science | Slide 1

# Technische Universität Braunschweig

<b>84</b>	<b>Study Programms</b>
<b>3.600</b>	<b>First Year Students</b>
<b>18.500</b>	<b>Students</b>
<b>120</b>	<b>Institutes</b>
<b>2.300</b>	<b>Researchers</b>
<b>3.800</b>	<b>Total Staff</b>



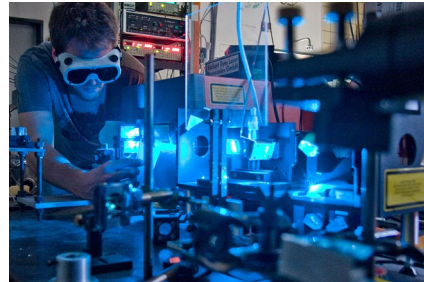
# Europe's Most Active Research Area



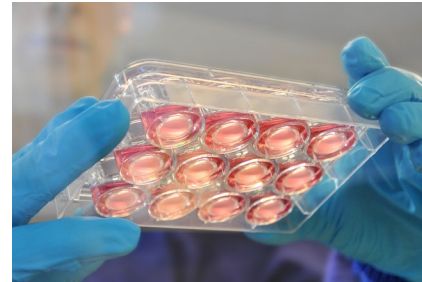
# Core Research Areas @ TUBS



**Mobility**



**Metrology**



**Infections &  
Therapeutics**



**Future Cities**

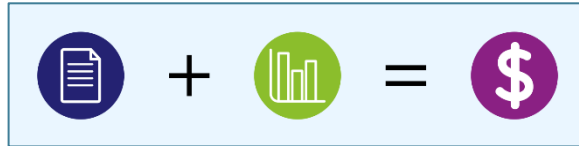
# Data Science @ TU Braunschweig

- Foundational Master Programme in Mathematics and Computer Science
- Innovative Application Areas in Core Research Areas of TU Braunschweig
- International Master Programme – Fully taught in English
- Mentoring Concept
- Flexible Choice of Modules
- 30 – 40 Study Places per Year



# Data Science - Relevance

- **Bitkom e.V.** Study of 2015
  - 48% of all companies generate value from data analyses.
  - 59% of all companies complain about the lack of data analysis specialists.
  - The added value of data analysis extends over all phases of the value chain.
- **Simple Message:**



- **Harvard Business Review: Data Scientist is the Sexiest Job of the 21st Century!**

# Skills and Competencies

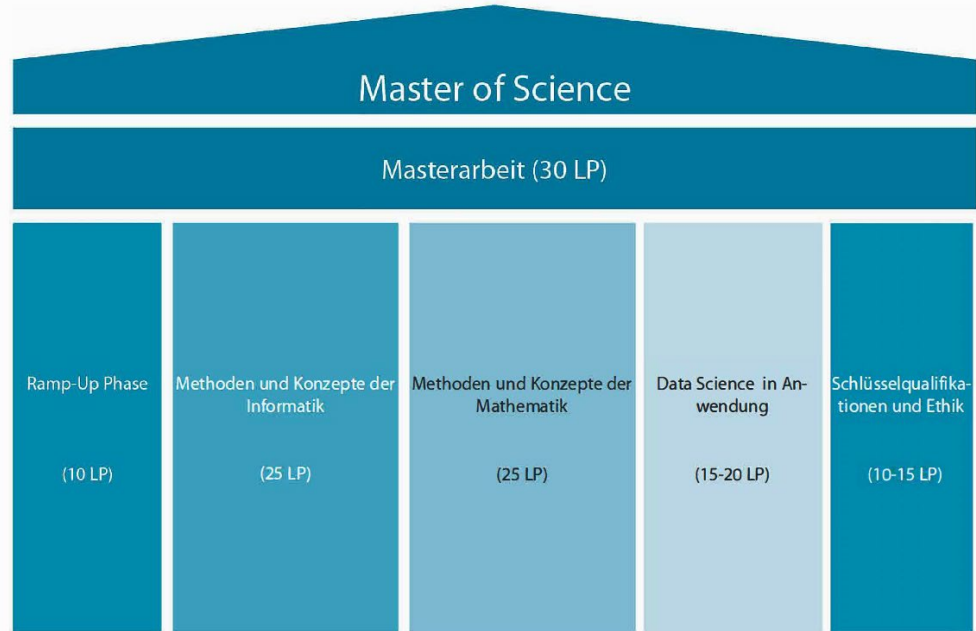
- Graduates as **Master of Data Science** can
  - Use Methods of Data Acquisition, Data Integration and Data Management efficiently
  - Select Analysis Methods competently and adapt it to the Special Requirements of an Application
  - Evaluate and assess the Expressiveness of Analysis Methods and Results
  - Lead Data Projects in Companies and effectively manage Corporate Decision Processes



- **Simply: Data Science = Mathematics + Computer Science + Applications**

# Design and Structure of the Study Program (120 Credits)

- 3 Core Areas:
  - 25 Credits **Mathematics**
  - 25 Credits **Computer Science**
  - 15-20 Credits **Applications**
- Application Areas
  - Biology, Chemistry, Pharmacy
  - Medicine
  - Engineering
  - Image and Signal Processing
- Mandatory seminar and lab courses
- Optional research project





# Modularization of the Degree Program

The course contents taught in the individual areas are combined into modules. A module consists of courses with related content.

Example "Approximation Algorithms":  
Excerpt from the module guide for the  
Examination Regulations

(=> see study program website "[Documents](#)"  
Module Guide)

Technische Universität Braunschweig | Module Guide: Data Science (Master)

<b>Title</b>	Approximation Algorithms			
<b>Number</b>	4227270	<b>Module version</b>	V2	
<b>Shorttext</b>	ENF-ALG-27	<b>Language</b>		
<b>Frequency of offer</b>	every 2 years in the summer term	<b>Teaching unit</b>	Carl-Friedrich-Gauß-Facultät	
<b>Module duration</b>		<b>Institution</b>		
<b>Hours per Week / ECTS</b>	4 / 5,0	<b>Module owner</b>	Sandor Fekete	
<b>Workload (h)</b>	150			
<b>Class attendance (h)</b>	56	<b>Self studying (h)</b>	94	
<b>Compulsory requirements</b>				
<b>Recommended requirements</b>				
<b>Expected performance/ Type of examination</b>	graded work: written exam (120 minutes) or oral exam (30 minutes) minutes) or Take-Home-Exam. The form of the examination depends on the number of participants and will be announced at the beginning of the lecture.			
<b>Course achievement</b>	non-graded work: 50% of the exercises must be passed			
<b>Module grade composition</b>				
<b>Contents</b>				
- A basic introduction to NP-completeness and approximation - Approximation for vertex and set cover - Packing problems - Tour problems and variations - Current research problems In the context of various problems, a wide spectrum of techniques and concepts will be provided.				
<b>Objective qualification</b>				
Participants know the necessity and role of approximation algorithms. They can master the most important techniques for analysis and complexity of approximation algorithms for designing, including the validity of upper and lower bounds.				
<b>Literature</b>				
- Vijay V. Vazirani: Approximation Algorithms. 1st edition. Springer Verlag, 2001. - Dorit Hochbau: Approximation Algorithms for NP-hard Problems. Course Technology Inc, 1996.				

Assigned to the following degree programs				
Degree program	Area	Compulsory form	Semester	ECTS
Master Data Science PO 2	Methoden und Konzepte der Informatik			

↑

# Modules in Mathematics Core

- **Optimization:** Discrete Optimization, Dynamic Optimization, Polynomial Optimization, Optimization in Machine Learning, Algorithms and Complexity for Quantum Computing, ...
- **Statistics:** Statistical and Machine Learning, Time Series Analysis, Statistical Methods, ...
- **Numerics:** Model Reduction, Numerical Analysis and Learning from Data, ...
- **Applied Analysis and Algebra:** Inverse Problems, Computer Algebra, Machine Learning with Neural Networks, Introduction to Quantum Information Theory, Mathematical Foundations of Data Science, ...

# Modules in Computer Science Core

- **Algorithmics:** Online Algorithms, Approximation Algorithms, Computational Geometry, Graphs Geometry and Algorithms, ...
- **Machine Learning:** Introduction to Machine Learning, Pattern Recognition, Machine Learning for IT-Security, Deep Learning Lab, ...
- **Databases and Information Systems:** Data Warehousing and Data Mining, Information Retrieval und Web Search Engines, Knowledge-based Systems, ...
- **Software Engineering:** Software Product Lines, Python Lab, Project Management, ...
- **Computer Graphics:** Visualization Techniques, Image Aspects, ...

# Application Areas

- **Biology, Chemistry and Pharmacy:** Network Biology, Immunometabolism, Biophysical Chemistry, Machine Learning in Computational Chemistry, Elucidation and Modelling of Biological Structures, Advanced Theoretical Chemistry, Theoretical Spectroscopy, ...
- **Medicine:** Biomedical Data Analysis, Accident Informatics, Health-Enabling Technologies, Biomedical Image and Signal Analysis, Medical Methodology, Selected Topics of Representation and Analysis of Medical Data, ...
- **Data Science in Engineering:** Deep Learning in Remote Sensing, Machine Learning, Fundamentals of Turbulence Modeling, Ecological Modeling, Data-driven Material Modeling, Introduction to Finite Element Methods, ...
- **Image and Signal Processing:** Mathematical Image Processing, Digital Signal Processing, Computer Vision and Machine Learning, Deep Learning for Imaging in Nano and Quantum Science, Computer Lab Pattern Recognition, ...

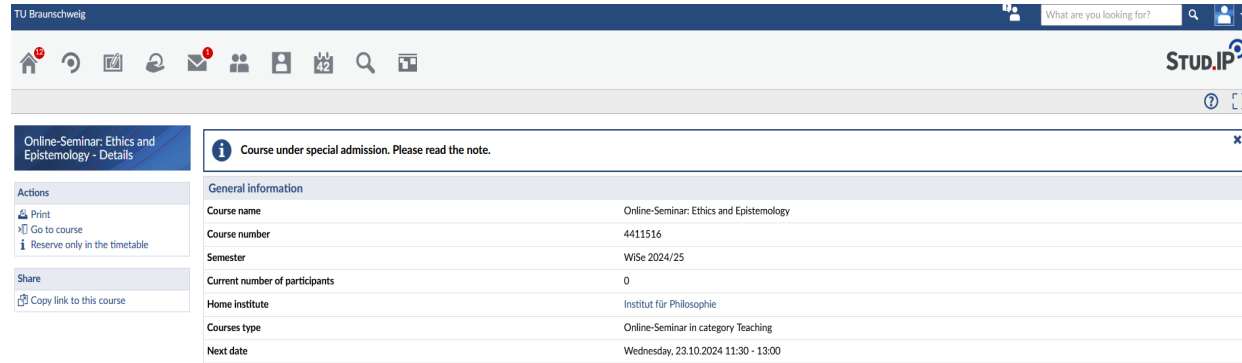
# Area „Key Qualifications and Ethics“ (10-15 CP)

- modules (1. compulsory module “Ethics and Epistemology” 5 CP-4411516) provide students with interdisciplinary qualifications → course “Ethics and Epistemology” only available in winter semester

- Future Data Scientists must be able to reflect on the ethical implications of their actions and must be able to recognize and interpret social and technical problems.*

- additional credit points can be selected from the overall program (pool) of interdisciplinary courses or the Language Center (max. 5 CP)

- 2. compulsory module “Scientific and Method-Oriented Working 5 CP → course is only available in summer semester



The screenshot shows the TU Braunschweig STUD.IP interface. At the top, there is a navigation bar with icons for home, back, print, refresh, mail, users, calendar, search, and a calendar icon. A search bar on the right contains the text 'What are you looking for?'. Below the navigation bar, there is a blue header for the course 'Online-Seminar: Ethics and Epistemology - Details'. To the left of the main content area, there is a sidebar with 'Actions' (Print, Go to course, Reserve only in the timetable) and 'Share' (Copy link to this course). The main content area features a blue information box stating 'Course under special admission. Please read the note.' Below this is a 'General information' table.

General information	
Course name	Online-Seminar: Ethics and Epistemology
Course number	4411516
Semester	WiSe 2024/25
Current number of participants	0
Home institute	Institut für Philosophie
Courses type	Online-Seminar in category Teaching
Next date	Wednesday, 23.10.2024 11:30 - 13:00

# Your Rights and Obligations: The Examination Regulations

- The general and special examination regulations for the Data Science degree program are available on the program's website.
- Please read these rules carefully so that there won't be any "unpleasant surprises" later.
- Where can I find the Examination Regulations: Program Websites

<https://www.tu-braunschweig.de/en/data-science/documents>

## Examination Regulations, Entry and Admission Regulations and Module Manuals

Master Data Science

### Examination Regulations

General Examination Regulations (APO) for the Bachelor's, Master's, Diploma, and Magister Degree Programmes at Technische Universität Braunschweig

- General Examination Regulations (APO) for the Bachelor's, Master's, Diploma, and Magister Degree Programmes at Technische Universität Braunschweig ↓ (Status: 03.05.2023)

Programme-specific Part to the Examination Regulations Pertaining to the Data Science Master's Degree Programme (MPO)

- PO2: Programme-specific Part to the Examination Regulations Pertaining to the Data Science Master's Degree Programme at Technische Universität Braunschweig from winter semester 2024/2025 ↓ (PDF) valid from 01.10.2024
- PO1: Programme-specific Part of the Examination Regulations Pertaining to the Data Science Master's Degree Programme at Technische Universität Braunschweig for students starting up to and including summer semester 2024 ↓ (PDF)

# Duration of Study and Credit Points

## Duration of study:

- Master Data Science: 4 semester


## Credit point system:

- 1 LP (Credit Point) = Workload 25-30 hours
- 30 LP should be achieved per semester
- 120 LP's are required for successful completion of your studies.

# Example Study Plan; Profile Medicine

Data Science - Profile 1 (MSc Data Science, Field of application: Medicine)					
	1. Semester (WiSe)	2. Semester (SoSe)	3. Semester (WiSe)	4. Semester (SoSe)	
Computer Science	Elective Course Computer Science 5 ECTS	Elective Course Computer Science 5 ECTS	Seminar Computer Science 5 ECTS	Master Thesis 30 ECTS	55 ECTS
	Elective Course Computer Science 5 ECTS				
	Elective Course Computer Science 5 ECTS				
Mathematics	RampUp Mathematics 10 ECTS	Elective Course 1 Mathematics 10 ECTS	Elective Course 1 Mathematics 10 ECTS		35 ECTS
			Practical Course Mathematics 5 ECTS		
Field of application	Medical-methodological specialisation module 1 5 ECTS	Accident Informatics 5 ECTS	Biomed. Image and Signal Analysis 5 ECTS		20 ECTS
		Medical-methodological Course 2 5 ECTS			
Ethics and Mandatory Courses		Scientific and Method-oriented working 5 ECTS	Ethics and Epistemology 5 ECTS		10 ECTS
<b>Total</b>	30 ECTS	30 ECTS	30 ECTS	30 ECTS	120 ECTS

 Compulsory modules

 Elective modules



# Example Study Plan; Profile Biology, Chemistry, Pharmacy

Data Science - Profile 2 (MSc Data Science, Field of application: Biology, Chemistry, Pharmacy)

	1. Semester (WiSe)	2. Semester (SoSe)	3. Semester (WiSe)	4. Semester (SoSe)	
Computer Science	Elective Course Computer Science 5 ECTS	Elective Course Computer Science 5 ECTS	Seminar Computer Science 5 ECTS		25 ECTS
	Elective Course Computer Science 5 ECTS		Elective Course Computer Science 5 ECTS		
Mathematics	RampUp Mathematics 10 ECTS	Elective Course 1 Mathematics 10 ECTS	Elective Course Mathematics 5 ECTS		35 ECTS
		Elective Course 1 Mathematics 10 ECTS			
Field of application	Theoretical Biophysical Chemistry 5 ECTS		Project Work 15 ECTS	Master Thesis 30 ECTS	50 ECTS
Ethics and Mandatory Courses	Ethics and Epistemology 5 ECTS	Scientific and Method-oriented Working 5 ECTS			10 ECTS
<b>Total</b>	30 ECTS	30 ECTS	30 ECTS	30 ECTS	120 ECTS

Compulsory modules
  Elective modules

# Example Study Plan; Profile Image and Signal Processing

Data Science - Profile 3 (MSc Data Science, Field of application: Image- and Signalanalysis)

	1. Semester (SoSe)	2. Semester (WiSe)	3. Semester (SoSe)	4. Semester (WiSe)	
<b>Computer Science</b>	RampUp Computer Science 10 ECTS	Elective Course Computer Science 5 ECTS  Elective Course Computer Science 5 ECTS	Practical Course Computer Science 5 ECTS  Elective Course Computer Science 5 ECTS  Elective Course Computer Science 5 ECTS		25 ECTS
<b>Mathematics</b>	Elective Course 1 Mathematics 10 ECTS	Elective Course 1 Mathematics 10 ECTS  Seminar Mathematics 5 ECTS			25 ECTS
<b>Field of application</b>	Computer Vision and Machine Learning 5 ECTS		Project Work 15 ECTS	Master Thesis 30 ECTS	50 ECTS
<b>Ethics and Mandatory Courses</b>	Scientific and Method-oriented Working 5 ECTS	Ethics and Epistemology 5 ECTS			10 ECTS
<b>Total</b>	30 ECTS	30 ECTS	30 ECTS	30 ECTS	120 ECTS

Compulsory modules
  Elective modules

# Example Study Plan; Profile Data Science in Engineering

Data Science - Profile 4 (MSc Data Science, Field of application: Data Science in Engineering)					
	1. Semester (SoSe)	2. Semester (WiSe)	3. Semester (SoSe)	4. Semester (WiSe)	
Computer Science	RampUp Computer Science 10 ECTS	Elective Course Computer Science 5 ECTS	Seminar Computer Science 5 ECTS		35 ECTS
		Elective Course Computer Science 5 ECTS	Elective Course Computer Science 5 ECTS		
			Elective Course Computer Science 5 ECTS		
Mathematics	Elective Course 1 Mathematics 10 ECTS	Practical Course Mathematics 5 ECTS		Master Thesis 30 ECTS	55 ECTS
	Elective Course 1 Mathematics 10 ECTS				
Field of application		Machine Learning 5 ECTS	Deep Learning in Remote Sensing 5 ECTS		20 ECTS
		Introduction to Finite Elements 5 ECTS	Fundamentals of Turbulence Modeling 5 ECTS		
Ethics and Mandatory Courses		Ethics and Epistemology 5 ECTS	Scientific and Method-Oriented Working 5 ECTS		10 ECTS
<b>Total</b>	30 ECTS	30 ECTS	30 ECTS	30 ECTS	120 ECTS

Compulsory modules
  Elective modules

# What do I have to consider at the beginning of my studies? 1/2

## Mentoring and Study Planning:

At the beginning of the program, each student is assigned a mentor from the faculty of the Department of Computer Science or the Department of Mathematics by the Data Science Examination Committee.

- if you have any **specific subject-oriented questions** about your studies, please get in touch with him/her at the beginning of the semester
- Mentors often also offer **group appointments** where you can make contact with other mentees

# What do I have to consider at the beginning of my studies? 2/2

## Joint RampUp Phase in the first week of the semester

**These events are compulsory. Please make sure you attend both dates:**

- **Monday, 14.10.2024, 15:00-16:30 in PK 4.1 "The Data Science Project"** (Wolf-Tilo Balke/Tim Kacprowski)
- **Thursday, 17.10.2024, 11:30-13:00 in IZ 404 (Informatikzentrum) "Data Science at PLRI/Lab Tour"** (Thomas Deserno/Julian Bollmann)
- **Friday, 18.10.2024, 09:45-11:15 in PK 4.1 "Studying in Germany and Community Management"/"Introduction to Academic Work and Plagiarism"** (Muhammad Usman)
  - <https://campusplan.tu-braunschweig.de/>

**Starting from the 2nd week of the semester, the Mathematics and Computer Science RampUp will again take place separately. Further information about the two modules can be found here:**

further information about the following weeks:

- [Computer Science RampUp](#)
- [Mathematics RampUp](#)

# Stud.IP – The teaching and learning platform of TU Braunschweig

- central tool for the digital accompaniment of classroom courses
- it provides information on the organisation of teaching and serve as a communication platform
- registration for courses
- contact to the lecturers
- information and access to the courses
- access to the files of the courses
- create your own study groups

The screenshot displays the Stud.IP interface for a course titled "Vorlesung/Übung: Ramp up Course Mathematics". The interface includes a navigation bar at the top with icons for home, back, print, refresh, mail, user, calendar, search, and help. A search bar is located in the top right corner. The course details are presented in a table format with the following information:

General information	
Course name	Vorlesung/Übung: Ramp up Course Mathematics
Course number	12969160103
Semester	WiSe 2024/25
Current number of participants	16
Home institute	Department Mathematik
Courses type	Vorlesung/Übung in category Teaching
Next date	Wednesday, 16.10.2024 11:30 - 13:00, Room: (4202.00.007 - UP 3.007)
	(de) Prüfungsleistung: 1 unbenotete Prüfungsleistung in Form einer Klausur (120 Minuten) nach Vorgabe der Prüferin oder des Prüfers. Die genauen Prüfungsmodalitäten gibt die Dozentin bzw. der Dozent zu Beginn der Veranstaltung bekannt.
Performance record	(en) Ungraded examination (Prüfungsleistung): 1 written exam (120 min.) according to examiner's specifications. The exact examination specifications will be announced at the beginning of the course.
Inhalte	(de) * Einführung in die Data Science (2 Wochen) - gemeinsam mit RampUp Informatik * Algebra (2 Wochen) * Numerische Mathematik (2 Wochen) * Diskrete Mathematik (2 Wochen) * Analysis (2 Wochen) * Mathematische Stochastik (2 Wochen) * Kontinuierliche Optimierung (2 Wochen) (en) * Introduction to Data Science (2 weeks) - jointly with RampUp Computer Science * Algebra (2 weeks) * Numerics (2 weeks) * Discrete mathematics (2 weeks) * Analysis (2 weeks) * Stochastics (2 weeks) * Continuous optimization (2 weeks)
Qualifikationsziele	(de) Die Studierenden * kennen und verstehen die Mathematik, die für ein Masterstudium "Data Science" notwendig ist * verstehen die Methoden und Verfahren der Analysis, Algebra, Mathematische Optimierung, Diskreten Mathematik, Mathematischen Stochastik und Numerischen Mathematik und können diese anwenden (en) The students * know understand the underlying concepts of mathematics that are necessary for data science * understand the concepts of analysis, algebra, optimization, discrete mathematics, stochastics and numerics and are able apply them in the context of data science
Literatur	(de/en) * Mathematics for machine learning, Deisenroth, Faisal, Ong, Cambridge University Press, available at <a href="https://mml-book.com/">https://mml-book.com/</a> * Networks, Crowds, and Markets: Reasoning about a Highly Connected World, Easley, Kleinberg, Cambridge University Press, available at <a href="https://www.cs.cornell.edu/home/kleinber/networks-book/networks-book.pdf">https://www.cs.cornell.edu/home/kleinber/networks-book/networks-book.pdf</a>
Lecturers	Prof. Dr. Sebastian Stiller , Prof. Dr. Timo de Wolff , Prof. Dr. Christian Kirches , Prof. Dr. Nicole Mücke , Prof. Dr. Volker Bach , Prof. Dr. Benedikt Jahnel , Jakob Stoye

# Stud.IP – Support

Our support team is your central address for all questions and problems concerning Stud.IP. We are at your disposal for questions concerning the daily use and support you in the use of tools and plugins as well as in the implementation of didactic concepts.

## Support Times

Please refer to the following web link: <https://www.tu-braunschweig.de/en/studip>

## Contact

✉ [studip@tu-braunschweig.de](mailto:studip@tu-braunschweig.de)

☎ +49 531 391-14040

# Exam registration

## Exam registration:

- online: <https://connect.tu-braunschweig.de>
- registration period in winter semester: **15.12.2024 – 15.01.2024**
- written exam registration: only for additional exams and other exceptions

## Cancelling exam registrations:

- written exam: until penultimate working day before exam
- oral exam: until one week before exam (please use deregistration form)
- homework (term paper): until 15.02. (winter semester), 15.08. (summer semester)
- portfolio exams: possible up to four weeks after the start of the lecture period

## Seminar:

- registration: until day of kick-off event of the particular semester (the Data Science seminar module can only be taken from the 2nd semester onwards!)
- de-registration: until 2 weeks after beginning of lectures in that particular semester



# Mailinglist Data Science

In the study it is essential to be always quickly supplied with the most important information.

The central information channel for Data Science is **the mailing list**.

**Please make sure that you are registered as a subscriber to the list with your TU mail address and that you receive the messages at the beginning of the semester.**

- **Mailinglist Data Science** ([ds-studs@lists.tu-braunschweig.de](mailto:ds-studs@lists.tu-braunschweig.de))

# Always stay up to date (Weblinks)

1. [Programme-specific Part to the Examination Regulations Pertaining to the Data Science Master's Degree](#)
2. [Module Guide Winter Semester 2024](#)
3. [TU Connect](#)
4. [StudIP TU Braunschweig](#)
5. [Data Science First-Semester Students](#)
6. [Institutes](#)
7. [Contacts](#)

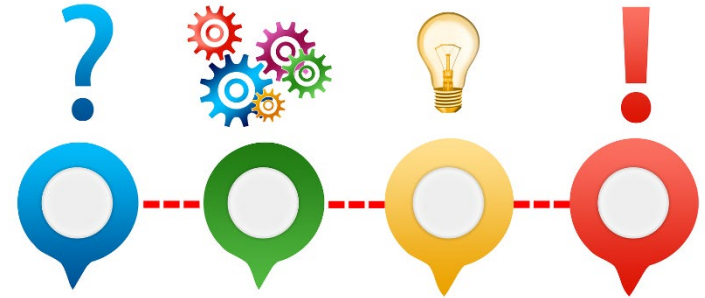


# Examination Office

## Contact

### Janine Werner

- Rebenring 58 A (1st floor)
- Room 117
- Phone: +49-531-391-2851
- Mail: [pa-mathe@tu-braunschweig.de](mailto:pa-mathe@tu-braunschweig.de)
- Office hours: By arrangement



# Program Coordination and Study Guidance

## Contact

### Marvin Plagge

- Rebenring 58 A (1st floor)
- Room 124
- Phone: +49-531-391-2831
- Mail: [ds-studium@tu-braunschweig.de](mailto:ds-studium@tu-braunschweig.de)
- Office hours: By arrangement



# "German University System & Community Management"

## Bloom's Taxonomy

