



Technische  
Universität  
Braunschweig



# Welcome to Data Science @ TU Braunschweig!

[www.tu-braunschweig.de/data-science](http://www.tu-braunschweig.de/data-science)

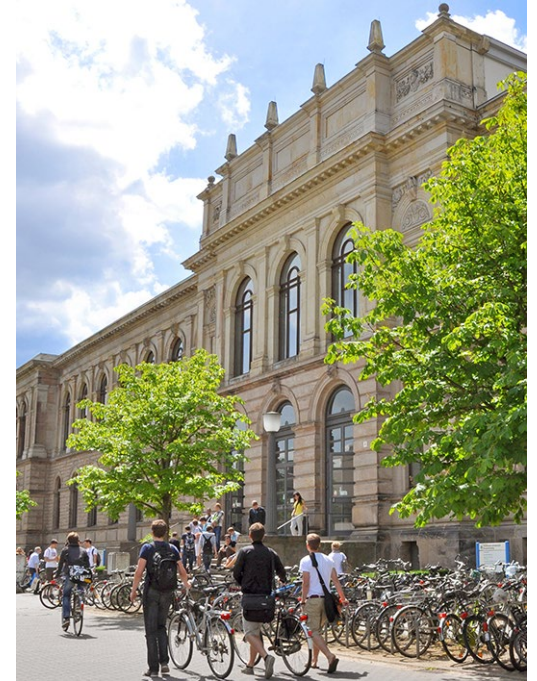
[https://www.youtube.com/watch?v=vh0\\_IOrw3Fw](https://www.youtube.com/watch?v=vh0_IOrw3Fw)



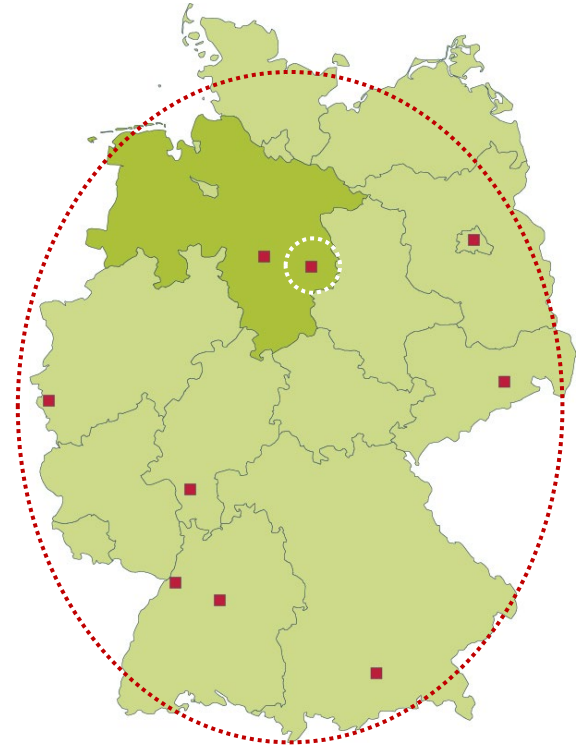
Technische  
Universität  
Braunschweig

# 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>



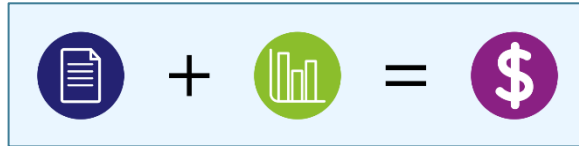
# Europe's Most Active Research Area





# 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

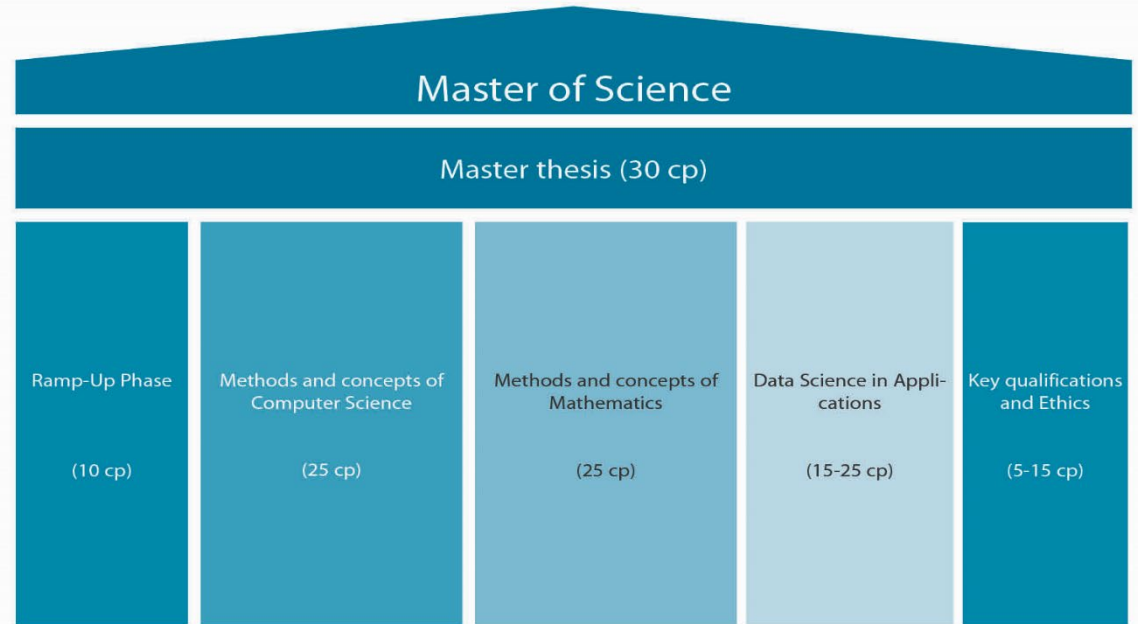
- Graduates as **Master of Data Science** can
  - Use Methods of Data Acquisition, Data Integration and Data Management efficiently
  - Select Analysis Methods competently and adapt it to the Special Requirements of an Application
  - Evaluate and assess the Expressiveness of Analysis Methods and Results
  - 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**
  - 15-25 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 | Modulhandbuch: Master Data Science (MPO 2022)

Modulbezeichnung: <b>Approximation Algorithms (MPO 2014)</b>			Modulnummer: <b>INF-ALG-27</b>		
Institution: <b>Algorithmik</b>			Modulkürzelung: <b>AA</b>		
Werkload:	150 h	Prüsenzzeit:	56 h	Semester:	1
Leistungspunkte:	5	Selbststudium:	94 h	Anzahl Semester:	1
Pflichtform:	Wahlpflicht	SWS:			4
Lehrveranstaltungen/Übersichten: Approximation Algorithms (V) Approximation Algorithms (U) Approximation Algorithms (KIU)					
Belegungslogik (wenn alternative Auswahl, etc.): ---					
Lehrende: <b>Prof. Dr. Sándor Fekete</b>					
Qualifikationsziele: (DE) Die Absolventen dieses Moduls kennen die Notwendigkeit und Berechtigung von Approximationsalgorithmen. Sie beherrschen die wichtigsten Techniken zur Analyse der Komplexität von Algorithmen und zum Entwurf von Approximationsmethoden, einschließlich des Beweises oberer und unterer Schranken. (EN) 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.					
Inhalte: (DE) - NP-Vollständigkeit - Approximationsbegriff - Vertex Cover - Set Cover - Scheduling - Packprobleme - Geometrische Probleme - Fallstudien aus der aktuellen Forschung (EN) - 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.					
Leistungsform: (DE) Vorlesung und Übung (EN) Lectures and Exercises					
Prüfungsmodalitäten / Voraussetzungen zur Vergabe von Leistungspunkten: (DE) 1 Studienleistung: 50% der Übungen müssen bestanden sein 1 Prüfungsleistung: Klausur, 120 Minuten oder mündliche Prüfung, 30 Minuten. Prüfungsform ist abhängig von der Teilnehmerzahl und wird zu Beginn der Vorlesung bekanntgegeben. (EN) graded work: written exam (30 minutes) or oral exam (30 minutes) non-graded work: 50% of the exercises must be passed					
Turnus (Beginn): alle zwei Jahre im Sommersemester					



# Modules in Mathematics Core

- **Optimization:** Discrete Optimization, Dynamic Optimization, Polynomial Optimization, Optimization in Machine Learning, Algorithms and Complexity for Quantum Computing, ...
- **Statistics:** Statistical Learning, Risk and Extreme Value Theory, Non-parametric Statistics, 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, Mathematical Foundations of Information Theory and Coding Theory, ...

# Modules in Computer Science Core

- **Algorithmics:** Online Algorithms, Approximation Algorithms, Computational Geometry, Graphs Geometry and Algorithms, ...
- **Machine Learning:** Foundations of 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 Architecture, Software Quality, Python Lab, Project Management, ...
- **Distributed Systems:** Cloud Computing, Replication and Consistency, ...

# Application Areas

- **Biology, Chemistry and Pharmacy:** Network Biology, System Biology, Immune Metabolism, Bioinformatics, Theoretical Chemistry, Chemometrics, ...
- **Medicine:** Biomedical Data Analysis, Accident Informatics, Health-Enabling Technologies, Biomedical Image and Signal Analysis, ...
- **Data Science in Engineering:** Deep Learning for Remote Sensing, Machine Learning, Coastal Engineering, Railway Timetabling, Fundamentals of Turbulence Modeling, Ecological Modeling, Data-driven Material Modeling, ...
- **Image and Signal Processing:** Speech Dialogue Systems, Mathematical Image Processing, Digital Signal Processing, Computer Vision and Machine Learning, Deep Learning for Quantum and Nano Science, Computer Lab Pattern Recognition, ...

# Area „Key Qualifications and Ethics“ (5-15 CP)

- modules (compulsory module “Ethics and Epistemology” 5 CP) 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. 8 CP)

- excludes courses in computer science, mathematics, and applications, as well as events of the sports center

The screenshot shows the course page for 'Online-Seminar: Ethics and Epistemology [WiSe 2023/24]' on the TU Braunschweig website. The page includes a navigation bar with 'STUD.IP' and a search bar. The main content is organized into sections: 'General information', 'Actions', 'Share', 'Inhalte', 'Literatur', 'Synchronisierung mit LSF', and 'Lecturers'. The 'General information' section provides details such as course name, number (4411516), semester (WiSe 2023/24), current number of participants (12), home institute (Institut für Philosophie), courses type (Online-Seminar in category Teaching), and next date (Wednesday, 01.11.2023 11:30 - 13:00). The 'Inhalte' section contains a detailed course description. The 'Literatur' section lists the course literature. The 'Synchronisierung mit LSF' section indicates that the course is synchronized with the Learning Support Forum (LSF). The 'Lecturers' section lists Prof. Dr. Hans-Christoph Schmidt am Busch and Prof. Dr. Nicole Karafyllis.

General information	
Course name	Online-Seminar: Ethics and Epistemology [WiSe 2023/24]
Course number	4411516
Semester	WiSe 2023/24
Current number of participants	12
Home institute	Institut für Philosophie
Courses type	Online-Seminar in category Teaching
Next date	Wednesday, 01.11.2023 11:30 - 13:00

**Inhalte**

Course Description: This course is taught digitally, mainly by texts and podcasts. It provides students with philosophical knowledge in order to reason thoughtfully, judge effectively and act morally in the field of data science. Students learn to differentiate between concepts, phenomena and actions, which is relevant for understanding the presuppositions and implications of machine ethics. This new field is, on the one hand, concerned with established ethical approaches (Kant, Utilitarianism); on the other hand, with giving machines ethical principles, i.e. programs and operations for discovering a way to resolve ethical dilemmas they might encounter. Whereas enabling machines to function in an ethically responsible manner through their own ethical decision making is a long wished-for in AI and robotics, philosophers and society highlight basic questions still in need for an answer; for example: can machines be moral agents? When adopting norms and values, who should they take as paradigmatic role model? Who has the right to judge about that, and why? Students will learn the preconditions and limits of modeling the world according to machines. Not last, which kind of world machines 'face' by means of artificial sensory perception matters for understanding the difficult questions of embodiment, and really being in the world instead of only having one. The assigned texts and podcasts are due weekly. Objectives/Qualifikationsziele: The course: - provides a philosophical framework and moral compass for guiding the judgement of students regarding data science and its applications (artificial intelligence, robotics, etc.). - aims to develop critical thinking and communication skills, social and civic competences, - reassures students on the limits of machines, machinery settings, and machine and data-related ethics, - strengthens personal development in the light of digit(al)ization and related claims of social change. Prüfungsleistung for students of the Master program in Data Science: written exam ("Klausur") at the end of the course; date to be announced via Stud.IP. Prüfungsleistung for students of the Humanities (philosophy, KTW) and Social Sciences: "Hausarbeit". Prior consultation on the suggested topic is mandatory. Please contact Prof. Schmidt am Busch or Prof. Karafyllis by 15 Dec. latest. Studienleistung for all student groups: report ("Protokoll") 2 pages on one selected course session, due by 15. Feb. 2021 at the latest (via Stud.IP upload, incl. name, Email and student registration number).

**Literatur**

Literature: Anderson, Michael/Anderson, Susan Leigh (eds.): Machine Ethics, 2011 Misselhorn, Catrin: Grundfragen der Maschinenethik, 3rd ed. 2018 Nagel, Thomas: What is it like to be a Bat? Englisch/Deutsch, Reclam 201

**Synchronisierung mit LSF**

ja

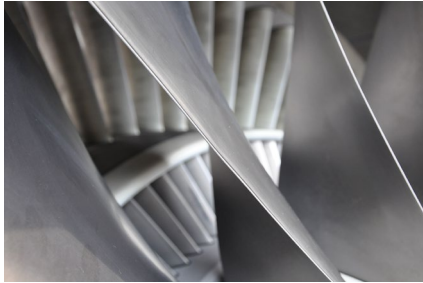
**Letzte Nachricht des Synchronisierungsskriptes**

Letzter H1 Import: 2023-09-06T13:38:32+02:00

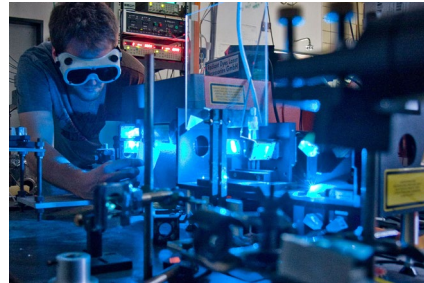
**Lecturers**

Prof. Dr. Hans-Christoph Schmidt am Busch , Prof. Dr. Nicole Karafyllis

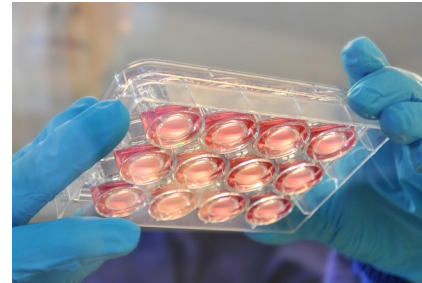
# Core Research Areas @ TUBS



**Mobility**



**Metrology**



**Infections &  
Therapeutics**



**Future Cities**

# 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)

- Programme-specific Part to the Examination Regulations Pertaining to the Data Science Master's Degree Programme at Technische Universität Braunschweig Wintersemester 2023/2024 ↓ (PDF) (binding from 01.10.2023)
- Programme-specific Part to the Examination Regulations Pertaining to the Data Science Master's Degree Programme at Technische Universität Braunschweig Wintersemester 2022/2023 ↓ (PDF) (binding until 30.09.2023)

# Duration of Study and Credit Points

## Duration of study:

- Master Data Science: 4 semester

## Credit point system:

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



# Sample Study Plan: Application Field Image and Signal Processing

Data Science - Profile 3 (BSc Mathematics, Application Field Image and Signal Processing)					
	1st Semester (SS)	2nd Semester (WS)	3rd Semester (SS)	4th Semester (WS)	
Computer Science	RampUp Computer Science 10 CP	Computer Science Elective 5 CP  Computer Science Elective 5 CP	Computer Science Seminar 5 CP  Computer Science Elective 5 CP  Computer Science Elective 5 CP		35 CP
Mathematics	Mathematics Elective 10 CP  Mathematics Elective 10 CP	Practical Course Mathematics 5 CP			25 CP
Applications		Computer Vision and Machine Learning 5 CP  Spoken Language Processing 5 CP	Project Work 15 CP	Master Thesis 30 CP	55 CP
Key qualifications and Ethics		Ethics 5 CP			5 CP
Total	30 CP	30 CP	30 CP	30 CP	120 CP

     Compulsory Modules
      Compulsory Electives

# Sample Study Plan: Application Field Data Science in Engineering

Data Science - Profile 4 (BSc Mathematics/Physics, Application Field Data Science in Engineering)

	1st Semester (SS)	2nd Semester (WS)	3rd Semester (SS)	4th Semester (WS)	
Computer Science	RampUp Computer Science 10 CP	Computer Science Elective 5 CP  Computer Science Elective 5 CP	Computer Science Seminar 5 CP  Computer Science Elective 5 CP  Computer Science Elective 5 CP		35 CP
Mathematics	Mathematics Elective 10 CP  Mathematics Elective 10 CP	Practical Course Mathematics 5 CP		Master Thesis 30 CP	55 CP
Applications		Basic Coastal Engineering 6 CP  Introduction to Finite Elements 5 CP	Ecological Modeling 6 CP  Modeling 5 CP		22 CP
Key qualifications and Ethics		Ethics 5 CP	Key qualifications 3 CP		8 CP
Total	30 CP	31 CP	29 CP	30 CP	120 CP

Compulsory Modules
Compulsory Electives

# Sample Study Plan: Application Field Medicine


Data Science - Profile 1 (BSc Computer Science, Application Field Medicine)					
	1st Semester (WS)	2nd Semester (SS)	3rd Semester (WS)	4th Semester (SS)	
Computer Science	Computer Science Elective 5 CP	Computer Science Elective 5 CP	Computer Science Seminar 5 CP	Master Thesis 30 CP	55 CP
	Computer Science Elective 5 CP				
	Computer Science Elective 5 CP				
Mathematics	RampUp Mathematics 10 CP	Mathematics Elective 10 CP	Mathematics Elective 10 CP	Practical Course Mathematics 5 CP	35 CP
Applications		Med-meth. Specialization 1 5 CP	Med.-meth. Specialization 2 5 CP		20 CP
		Accident Informatics 5 CP			
		Biomedical Image & Signal Analysis 5 CP			
Key qualifications and Ethics	Ethics 5 CP		Key qualifications 5 CP		10 CP
<b>Total</b>	<b>30 CP</b>	<b>30 CP</b>	<b>30 CP</b>	<b>30 CP</b>	<b>120 CP</b>

■ Compulsory Modules    
 ■ Compulsory Electives

# Sample Study Plan: Application Field Biology, Chemistry, Pharmacy

Data Science - Profile 2 (BSc Bioinformatics, Application Field Biology, Chemistry, Pharmacy)

	1st Semester (WS)	2nd Semester (SS)	3rd Semester (WS)	4th Semester (SS)	
Computer Science	Computer Science Elective 5 CP  Computer Science Elective 5 CP	Computer Science Elective 5 CP	Practical Course Computer Science 5 CP  Computer Science Elective 5 CP		25 CP
Mathematics	RampUp Mathematics 10 CP	Mathematics Elective 10 CP  Mathematics Elective 10 CP	Mathematics Elective 5 CP		35 CP
Applications	Network Biology 5 CP	Numerical Ecology (Seminar) 5 CP	Project Work 15 CP	Master Thesis 30 CP	55 CP
Key qualifications and Ethics	Ethics 5 CP				5 CP
<b>Total</b>	<b>30 CP</b>	<b>30 CP</b>	<b>30 CP</b>	<b>30 CP</b>	<b>120 CP</b>

 Compulsory Modules

 Compulsory Electives

# 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.

- please get in touch with your mentor (within the first two weeks of lectures)
- create a study plan together
- submit the countersigned study plan before the start of the first examination registration period (before 01.06.2024) to the Examination Office (pa-mathe@tu-braunschweig.de / Janine Werner)

# 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:**

- **Wednesday, 03.04.2024**, 09:45 – 11:15 am in **PK 3.4**, *Prof. Tim Kacprowski & Prof. Wolf-Tilo Balke* "Data Science Project LifeCycle"
- **Thursday, 04.04.2024**, 11:30 – 13:00 am in **LK 19a1**, *Muhammad Usman* "German University System & Community Management" + "Introduction to Academic Work and Plagiarism"
  - <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, refresh, print, share, mail, user, calendar, search, and a search bar. A sidebar on the left contains 'Actions' (Print, Go to course, Reserve only in the timetable) and 'Share' (Copy link to this course). The main content area shows a notification 'Course under special admission. Please read the note.' followed by a table of course information.

General information	
Course name	Vorlesung/Übung: Ramp up Course Mathematics
Course number	1294583
Semester	SoSe 2024
Current number of participants	0
Home institute	Department Mathematik
Courses type	Vorlesung/Übung in category Teaching
Next date	Wednesday, 03.04.2024 09:45 - 11:15, Room: (4206.02.0215 - PK 3.4)
	(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)
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>
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**Lecturers**  
Prof. Dr. Matthias Bollhöfer, Prof. Dr. Sebastian Stiller, Prof. Dr. Timo Wolff, Prof. Dr. Christian Kirches, Prof. Dr. Nicole Mücke, Prof. Dr. Benedikt Jahnel



# 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 summer semester: **01.06.2024 – 30.06.2024**
- written exam registration: only for additional exams and other exceptions

## Cancelling exam registrations:

- written exam: until penultimate working day before exam (Saturday and Sunday = no working day)
- oral exam: until one week before exam (please use deregistration form)
- homework (term paper): until 15.02. (winter semester), 15.08. (summer semester)

## Seminar:

- registration: until day of kick-off event of the particular semester
- withdrawal: 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 Summer Semester 2024](#)
3. [TU Connect](#)
4. [StudIP TU Braunschweig](#)
5. [Data Science First-Semester Students](#)
6. [Institutes](#)
7. [Contacts](#)

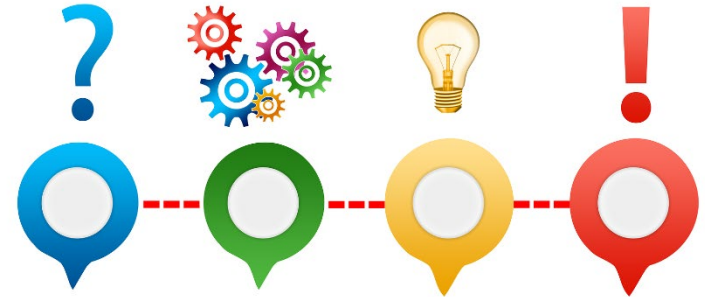


# Examination Office

## 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

