Technische Universität Braunschweig

Consolidated version for the second amendment of the special part of the examination regulations for the study program "Data Science" with the degree "Master of Science".

The legally binding document is the one published in the Official Announcement No. 1517 amendment document.

The amendment of the regulations comes into force on 01.10.2023.

Note: The English translation is a service. If any doubts occur, the German proclamation No. 1517 is binding.

Second Amendment to the Regulations of the Programme-specific Part of the Examination Regulations for the Master's Degree Program "Data Science" at Technische Universität Braunschweig

The Faculty Council of TU Braunschweig's Carl-Friedrich-Gauß Faculty has adopted on 30.08.2023 the following Programme-specific Part of the Examination Regulations Pertaining to the Data Science Master's Degree Programme at Technische Universität Braunschweig (*Besonderer Teil der Prüfungsordnung für den Masterstudiengang Data Science an der Technischen Universität Braunschweig*, Data Science BPO):

1
Standard period of study

The standard period of study (*Regelstudienzeit*) for this Master's degree programme is four semesters.

2
Degree and awarded certificate

(1) TU Braunschweig will award the academic degree Master of Science (MSc) to candidates who have successfully passed the Master's examination. The University will confirm this by issuing a transcript of results and a degree certificate according to Section 17, Paragraph 1 of the General Part of the Examination Regulations for Bachelor's, Master's, Diplom and Magister Degree Programmes at Technische Universität Braunschweig (Allgemeiner Teil der Prüfungsordnung für die Bachelor-, Master-, Diplom- und Magisterstudiengänge an der Technischen Universität Braunschweig, APO). A diploma supplement (APO, Appendix 1) will be attached to the degree certificate.

(2) According to the APO, Section 17, Paragraph 1, the transcript of results will specify the student's grade point average (GPA) as well as list the marks for the individual modules and the credits awarded. In case of a GPA of 1.2 or better, the distinction *mit Auszeichnung bestanden* will be awarded. Non-graded modules will be listed along with earned credits (APO, Section 3, Paragraph 9).

3
Degree programme structure

(1) The Master's degree programme in Data Science comprises the following parts:

- Ramp-up Phase (10 credits)
- Electives from the "Methods and Concepts in Computer Science" field (25 credits)
- Electives from the "Methods and Concepts in Mathematics" field (25 credits)
- Electives from the "Data Science in Practical Application" field (15-25 credits)

- Electives from the “Key Qualifications and Ethics” field (5-15 credits)
- Master's thesis and presentation (30 credits)

(2) The modules that may be chosen from each subject field are listed in Appendices 2 and 3.

(3) Each student develops an individual study plan with their advisor at the beginning of their studies, in order to set their own specific study priorities. The study plan, signed by the advisor, must be handed in to the Examination Office by the beginning of the student’s first exam registration period. Over the course of the Master’s programme, the student and advisor may adapt the study plan together as necessary. The adjusted study plan must be handed in to the Examination Office before the next exam registration period has started.

(4) The Ramp-up Phase is meant to ensure a successful entry into the study programme for students with different academic backgrounds. The fields in which modules must be attended during the Ramp-up Phase (either Mathematics or Computer Science) is determined by the Admissions Committee. The specific modules for the Ramp-up Phase will be selected in agreement with the student’s advisor and according to the requirements of the Examination Office. They will be set down in the study plan according to Paragraph 3.

(5) In the Data Science in Practical Applications field, students acquire specific skills for the practical use of Data Science in different application areas.

(6) The Key Qualifications and Ethics field covers methodical, social and personal skills. It consists of modules with an interdisciplinary, action-orientated focus that impart comprehensive and work-related qualifications and competencies.

(7) To successfully complete the degree programme, students must provide evidence of having accumulated a total of 120 credits. In addition to the Master’s thesis (30 credits), at least 65 credits points must be earned in graded modules. The same lecture/course may not be counted towards multiple modules.

4
Examinations and coursework

(1) The modules and learning objectives, as well as the type and scope of the associated examinations and coursework and the associated number of credits are set out in Appendices 2 and 3. The examination topics will reflect the learning objectives of the modules as well as work-related requirements.

(2) In addition to the options laid down in the APO, Section 9, an internship is a possible way of earning academic credits. An internship serves to deepen insights by applying the knowledge acquired in class to specific computing issues in a real work environment. There,

students are expected to successfully handle specific tasks, individually and as a team, and become skilled in subject-specific work methods.

(3) Homework assignments are another way of earning academic credit. Homework serves as a means to revise and follow up on lecture content. In a homework assignment, students independently practice and reinforce the terms and methods learnt in lectures by applying them to examples.

(4) Colloquiums and protocols are additional types of examination which cover the student's planning, preparation and execution of assignments, as well as their critical evaluation. A protocol consists of a description and a critical evaluation of the assignment and its solutions. A colloquium is an oral examination in the form of an interview between student and examiner concerning the description and critical evaluation of the assignment and its solution.

(5) For term papers, there is a special deadline for withdrawals and submissions. As an exception to the APO, Section 11, Paragraph 1, students may withdraw without giving a reason through 15 February of the winter semester in question and through 15 August of the summer semester in question. In addition to the APO, Section 9c, the due date for term papers is 15 March for winter semesters and 15 September for summer semesters. Students may only register to submit a term paper if they have received a topic for the term paper in advance. Registration for a term paper is considered proof that the student was given a term paper topic.

(6) During their Data Science Master's degree programme, every student must complete one compulsory seminar that concludes with an assessment. The seminar must relate to the field of Data Science. Additional seminars will not be counted. For seminars, there is a special deadline for withdrawals and submissions. Registration for a seminar is possible up until the day of the kick-off event for the particular seminar. Withdrawals are only possible during the first two weeks of lectures for the semester in question.

(7) The topic of the seminar may be determined by lecturers in the Department of Computer Science and the Department of Mathematics or by the full-time private lecturers in those Departments. In agreement with the Examination Office, the topic may also be determined by retired lecturers from the Departments of either Computer Science or Mathematics and by other persons authorised to hold examinations as set out in the APO, Section 5, Paragraph 1.

(8) A module that does not appear in the Appendices hereto nor in a list of additional modules approved by the Data Science Examination Office may be accepted at a student's request made to the Data Science Examination Office if that module provides a useful complement the student's study plan.

(9) Examinations in free or compulsory electives that were not passed, must be repeated during the degree programme. As an exception to this and to the APO, Section 13, Paragraph 4, a student may, in a maximum of three different failed attempts, apply to the Data Science Examination Office for waiver of the requirement to repeat the free or compulsory elective(s) if the student has passed alternative examinations. This application must be filed until the first day of the exam registration period of the second semester following the failed attempt. Compulsory modules cannot be waived.

(10) If an exam cannot be taken on the day of the exam due to illness, a doctor's note is required. This must be submitted to the examination office within three working days. The day of the exam is considered the first working day. Failure to do so will result in a grade of 5.0. If the student is unable to take the same examination for the third time due to illness, a certificate from a specialist doctor (Fachärztin bzw. Facharzt), psychologist or psychotherapist must be submitted instead of a medical certificate in accordance with § 11 Section 3 of the APO; this certificate must be significant enough to enable the board of examiners to determine the cause, degree, type and, if applicable, duration of the impairment. The same deadline of three working days applies here.

(11) According to the APO, Section 18, additional credits may be earned through the end of the semester in which the last credit required to complete the Data Science Master's degree programme is earned. An application to count these additional credits may only be filed if at least 30 credits have already been earned in Data Science modules.

(12) If an examination has only been completed in part, credits will not be awarded. Any applications for recognition of credits have to be filed within the first semester of the Master's degree programme or, if the credits are earned at a later date, by the end of the following semester. If parts of a module have been credited by the Data Science Examination Office, that particular module must necessarily be completed by the end of the degree programme.

(13) Students must register for all examinations and assessments with the Data Science Examination Office, within the semester's examination registration period – either in writing or electronically via the portal provided for this purpose within the examination registration period.

(14) For electronic communications during their studies, students must use their TU Braunschweig e-mail address to verify their identity.

(15) In addition to the APO, Section 12, Paragraph 2, examinations can also be graded as pass/fail (ungraded).

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5
Master's thesis

(1) The Master's thesis is the final paper as set out in the APO, Section 14. In addition, the following rules are binding:

(2) Only students who have completed modules of the Data Science Master's degree programme totalling a minimum of 75 credits will be permitted to register for their Master's thesis.

(3) The Master's thesis must address a topic in the field of Data Science in Practical Application. The topic of the Master's thesis may be issued by lecturers in the Department of Computer Science and the Department of Mathematics or by full-time private lecturers in those Departments. At a student's request and in agreement with the Examination Office, the topic may also be issued by a lecturer in the Data Science in Practical Application field or by a retired lecturer from the Departments of either Computer Science or Mathematics. In this case, the second examiner must be a full-time university professor in the Departments of either Computer Science or Mathematics.

(4) At a student's request, the Data Science Examination Office may agree that the second examiner may come from outside TU Braunschweig. Such a request must be filed one week before the written registration of the Master's thesis itself.

(5) The Master's thesis must be completed within six months of receiving the topic. Candidates wishing to change their topic may do so only once and only within two months of having been given the topic. At the student's justified request, the Examination Office may extend the deadline for completion by up to two months.

(6) In case of illness while working on the Master's thesis, a doctor's note must be submitted to the Examination Office on the third working day after the illness was detected, with the day of detection counting as the first working day. If that note is sent by post, the postmark date will serve as proof. Saturday is considered a working day. If the deadline falls on a Saturday, Sunday or a public holiday, the doctor's note may be handed in the following working day. Once two doctor's notes have been handed in within the allowed working time of six months for the Master's thesis, the third and each subsequent doctor's note in accordance with § 11 section 3 of the APO must be a specialist doctor's note from an specialist doctor (Fachärztin/ Facharzt), which must be significant enough for the examination committee to be able to determine the cause and degree, type and, if applicable, duration of the impairment. The same submission deadline of three working days applies here.

(7) Before the Master's thesis' grading, the student must give an oral presentation of it, lasting approximately 30 minutes. The presentation may count for up to 3 of the 30 credits towards the grading of the thesis if, for the chosen topic, the presentation makes a useful contribution towards reaching the degree programme's objectives. The examiner will announce the extent to which the presentation will count towards the overall mark on the day the topic is issued.

6
Calculation of the grade point average (GPA)

(1) Subject to the APO, Section 16, Paragraph 2, the GPA of the Master's examination derives from the average of the different module marks, weighted by number of credits, including the Master's thesis. If module marks are weighted differently than set out in the APO, Section 16, Paragraph 2, this will be indicated in Appendix 3.

(2) Coursework may be completed either graded or ungraded. Coursework marks will not be listed on the degree certificate and will not count towards the student's GPA.

(3) If more modules have been completed than required by the Examination Regulations and the student has not requested them to be counted as additional examinations, module marks will be counted chronologically, according to the date they were earned, until the maximum number of credits has been reached or exceeded, in accordance with the APO, Section 16, Paragraph 2. Extra modules will be deleted. Deleted modules will not be listed on the degree certificate and cannot be converted into additional examinations.

(4) A student may request the inclusion of additional examinations on their degree certificate. Such a request must be filed within four weeks after passing the last additional examination, in accordance with the APO, Section 18, Paragraph 2. Examination results and coursework listed as additional examinations will not count towards the final degree. Once this request has been made, it cannot be reversed.

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7
Mentors and consultations

(1) At the start of their studies, the Examination Office will assign each student a mentor from the lecturers in the Departments of either Computer Science or Mathematics to support the student. A change of mentor is possible at any time at the request of one of the parties.

(2) The mentor works with the student to develop an individual study plan at the beginning of the degree programme in order to set specific study priorities (see Section 3 Paragraph 5 and 6). In the course of the Master's studies, student and mentor will meet regularly to discuss the student's progress and – if necessary – adapt the study plan.

(3) Students who have not accrued at least 30 credits by the end of their second semester must attend a consultation. To be permitted to complete further coursework or examinations, candidates must provide proof that they have attended this consultation by the first day of the examination registration period for their third semester. If such proof is not provided during the third semester, permission to complete further coursework or examinations will be withheld for all following semesters until proof is provided within the deadline (the first day of the examination registration period of a semester).

Section II

(1) This revision will come into force on 1 October 2023.

(2) The following transitional provisions will apply to students who are in their second or later programme semester as of 1 October 2023:

a. If the module "Deep Learning in Remote Sensing" (BAU-STD5-59 - 6 credits) has been successfully completed, it will be credited towards the Application field. In this case, the student cannot take or submit the modules "Deep Learning in Remote Sensing" (BAU-STD5-86 - 5 credits) and "Machine Learning" (BAU-STD5-87 - 5 credits).

b. The module "Ramp Up Course Computer Science" or "Ramp Up Course Mathematics" must be completed with an ungraded examination. If a request for the grade has been submitted by December 31, 2022, this grade will be included in the calculation of the overall grade.

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Annex 1 Diploma Supplement: Programme-specific components

2. ANGABEN ZUR QUALIFIKATION	2. INFORMATION IDENTIFYING THE QUALIFICATION
2.1 Bezeichnung der Qualifikation und (wenn vorhanden) verliehener Grad (in Originalsprache)	**2.1 Name of qualification and (if applicable) title conferred (in original language)**
Master of Science (M. Sc.)	Master of Science (M. Sc.)
2.2 Hauptstudienfach oder –fächer für die Qualifikation	**2.2 Main Field(s) of study for qualification**
Data Science	Data Science
2.3 Name und Status (Typ/Trägerschaft) der Einrichtung, die die Qualifikation verliehen hat (in Originalsprache)	**2.3 Name and status of awarding institution (in original language)**
Technische Universität Carolo-Wilhelmina zu Braunschweig Carl-Friedrich-Gauß-Fakultät Universität/Staatliche Einrichtung	Technische Universität Carolo-Wilhelmina zu Braunschweig Carl-Friedrich-Gauß-Fakultät University/State institution
2.4 Name und Status (Typ/Trägerschaft) der Einrichtung (falls nicht mit 2.3 identisch), die den Studiengang durchgeführt hat (in Originalsprache)	**2.4 Name and status of institution (if different from 2.3) administering studies (in original language)**
Technische Universität Carolo-Wilhelmina zu Braunschweig Carl-Friedrich-Gauß-Fakultät Universität/Staatliche Einrichtung	Technische Universität Carolo-Wilhelmina zu Braunschweig Carl-Friedrich-Gauß-Fakultät University/State institution
2.5 Im Unterricht / in der Prüfung verwendete Sprache(n)	**2.5 Language(s) of instruction/examination**
Englisch, in einigen Fällen Deutsch	English, in some cases German
3. ANGABEN ZU EBENE UND ZEITDAUER DER QUALIFIKATION	**3. INFORMATION ON THE LEVEL AND DURATION OF THE QUALIFCATION**
3.1 Ebene der Qualifikation	**3.1 Level of the qualification**
Master-Studium (Graduate/Second Degree)	Graduate/Second Degree, by research with thesis
3.2 Offizielle Dauer des Studiums (Regelstudienzeit) in Leistungspunkten und/oder Jahren	**3.2 Official duration of programme in credits and/or years**
2 Jahre Vollzeitstudium (inkl. Schriftlicher Abschlussarbeit), 120 ECTS Leistungspunkte	2 years full-time study (incl. thesis), 120 ECTS credits
3.3 Zugangsvorraussetzung(en)	**3.3 Access requirements**
Qualifizierter Bachelor-Abschluss (oder gleichwertiger Abschluss) Bachelor in Informatik oder Mathematik oder vergleichbarer Abschluss im selben oder thematisch ähnlichen Gebiet	Bachelor Degree in Computer Science or Mathematics or equivalent degree (three or four years) in the same or closely related field
4. ANGABEN ZUM INHALT DES STUDIUMS UND ZU DEN ERZIELTEN ERGEBNISSEN	**4. INFORMATION ON THE PROGRAMME COMPLETED AND THE RESULTS OBTAINED**
4.1 Studienform	**4.1 Mode of study**
Vollzeitstudium	Full-time
4.2 Lernergebnisse des Studiengangs	**4.2 Programme learning outcomes**
Gegenstand des Masterstudiums sind fachliche Vertiefungen und fortgeschrittene Kenntnisse in allen für Data Science relevanten Bereichen. Die Absolventen erlangen vertiefte Kenntnisse über mathematische und informatische Methoden der Data Science. Sie erlangen ergänzend Einblicke in Anwendungsgebiete für Techniken der Data Science und in die damit verbundene aktuelle Forschung. In einem der ausgewählten Vertiefungsbereiche aus mathematischen oder informatischen Grundlagen oder aus einem Anwendungsbereich muss eine Master-Abschlussarbeit im Umfang eines Semesters selbständig angefertigt werden. Die Absolventen • können Methoden und Konzepte der Datenakquisition, Datenintegration und Datenhaltung analysieren und effektiv nutzen. • können Analysemethoden und Algorithmen für verschiedene Fragestellungen kompetent	Subject of the Master programme is the deepening of knowledge in the data science field. Students get deepened knowledge about mathematical and informatical methods of data sciene. They get additional insights into application areas for techniques of data science and the connected research. The students have to complete a master thesis of one semester in the mathematical, computer science or application fields of the data science programme. The graduates • can analyze methods and concepts of data acquisition, data integration and data storage and use them effectively. • can competently select analysis methods and algorithms for various problems, combine them, adapt them to a selected field of application and develop them further.

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auswählen, kombinieren, an ein ausgewähltes Anwendungsfeld anpassen und weiterentwickeln. • können die Aussagekraft von Dateninstanzen und den verwendeten Analysemethoden korrekt und dem Analysezweck entsprechend einschätzen. • können in einem ausgewählten Anwendungsfeld datengetriebene Lösungen entwickeln und Analysemethoden zielführend einsetzen. • können Datenprojekte in Unternehmen leiten und Entscheidungsprozesse in der Datenhaltung und -analyse effektiv managen. • tragen zur Lösung von Aufgabenstellungen im Bereich Data Science sowohl aus erklärungsorientierter als auch aus gestaltungsorientierter Sicht bei. • kennen, auch zur eigenständigen Weiterentwicklung, relevante Informationsquellen sowie die einschlägigen Regelwerke und den Zugang zu diesen Materialien. • können analytisch denken, komplexe Zusammenhänge erkennen, vorhandene und neue Problemlösungen einschätzen und mit Hilfe einer Anwendung integraler Kenntnisse aus dem Bereich Data Science eigene Lösungen entwickeln. • können erfolgreich in einer Gruppe arbeiten und effizient mit verschiedenen Zielgruppen kommunizieren. • können sich in aktuelle Forschungsergebnisse des Fachs einarbeiten und diese weiter entwickeln. • sind damit befähigt eine wissenschaftliche Tätigkeit mit dem Ziel einer Promotion auszuüben.	• are able to correctly assess the informative value of data instances and the analysis methods used and in accordance with the purpose of the analysis. • can develop data-driven solutions in a selected field of application and use analysis methods in a targeted manner. • can lead data projects in companies and effectively manage decision-making processes in data storage and analysis. • contribute to solving tasks in the field of data science from both an explanatory and a design-oriented perspective. • know, also for independent further development, relevant sources of information as well as the relevant regulations and access to these materials. • can think analytically, recognize complex relationships, assess existing and new solutions to problems and develop their own solutions with the help of integral knowledge from the field of data science. • can work successfully in a group and communicate efficiently with different stakeholders. • can familiarize themselves with current research results in the subject and develop them further. • are thus able to carry out a scientific activity with the aim of a doctorate.
4.3 Einzelheiten zum Studiengang, individuell erworbene Leistungspunkte und erzielte Noten Einzelheiten zu den belegten Kursen und erzielten Noten sowie den Gegenständen der mündlichen und schriftlichen Prüfungen sind im „Prüfungszeugnis“ enthalten. Siehe auch Thema und Bewertung der Masterarbeit.	**4.3 Programme details, individual credits gained and grades/ marks obtained** See (ECTS) Transcript for list of courses and grades; and “Prüfungszeugnis” (Final Examination Certificate) for subjects assessed in final examinations (written and oral)thesis; and topic of thesis, including grading.
4.4 Notensystem und (wenn vorhanden) Notenspiegel Allgemeines Notenschema (Abschnitt 8.6): 1,0 bis 1,5 = „sehr gut“ 1,6 bis 2,5 = „gut“ 2,6 bis 3,5 = „befriedigend“ 3,6 bis 4,0 = „ausreichend“ Schlechter als 4,0 = „nicht bestanden“ 1,0 ist die beste Note. Zum Bestehen der Prüfung ist mindestens die Note 4,0 erforderlich. Ist die Gesamtnote 1,2 oder besser wird das Prädikat „mit Auszeichnung bestanden“ vergeben. ECTS-Note: Nach dem European Credit Transfer System (ECTS) ermittelte Note auf der Grundlage der Ergebnisse der Absolvent*innen der zwei vergangenen Jahre: A (beste 10 %), B (nächste 25 %), C (nächste 30 %), D (nächste 25 %), E (nächste 10 %)	**4.4 Grading system and (if available) grade distribution table** General grading scheme (Sec. 8.6): 1.0 to 1.5 = “excellent” 1.6 to 2.5 = “good” 2.6 to 3.5 = “satisfactory” 3.6 to 4.0 = “sufficient” Inferior to 4.0 = “Non-sufficient” 1.0 is the highest grade, the minimum passing grade is 4.0. In case the overall grade is 1.2 or better the degree is granted “with honors”. In the European Credit Transfer System (ECTS) the ECTS grade represents the percentage of successful students normally achieving the grade within the last two years: A (best 10 %), B (next 25 %), C (next 30 %), D (next 25 %), E (next 10 %)

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6. WEITERE ANGABEN	**6. ADDITIONAL INFORMATION**
6.2 Weitere Informationsquellen	**6.2 Further information sources**
www.tu-braunschweig.de www.tu-braunschweig.de/fk1 www.tu-braunschweig.de/data-science	www.tu-braunschweig.de www.tu-braunschweig.de/fk1 www.tu-braunschweig.de/en/data-science

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Annex 2 Field: Key Qualifications and Ethics

In the Key Qualifications and Ethics field, the ”Ethics and Epistemology” module is compulsory.

Additional ECTS credits can be earned in courses that allow students to acquire key qualifications. These can be selected from the general programme of interdisciplinary courses (Pool) at Technische Universität Braunschweig. Courses in the fields Computer Science, Mathematics or Application, as well as Sports Centre courses, will not be credited towards the Key Qualifications field.

The Data Science Examination Office can exclude courses from the Pool or permit additional courses. To receive credit towards the Key Qualifications field for other courses/modules, a written request must be submitted to the Examination Office.

Language Centre courses can be included up to a maximum of 8 credits.

Language courses may be included from the following level:
- Foreign languages level B1 or higher
- German language courses may only be included by foreign students (level B1 or higher) after prior application to the Examination Office.

Language courses in the student’s native language or in the official language of their home country will not be credited, nor will English courses.

An active performance record is required for the selected courses/modules (written examinations, term papers, presentations, notes, etc.). A certificate of attendance is not sufficient. The type of academic assessment used will depend on the module or course.

Annex 3 Module descriptions

Module descriptions (see module handbook)

Modules of the degree program

Data Science (Master)
PO 1

Date: 09.10.2023

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ECTS	120

Ramp Up Phase	
ECTS	10

Title	Ramp up Course Mathematics
Number	1294580
ECTS	10,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	1 ungraded examination (Prüfungsleistung): 1 written exam (120 minutes) according to examiner's specifications. After approval by the examination board mathematics (Prüfungs-ausschuss Mathematik), the examiner can also choose the take-home exam as the form of examination. The exact examination specifications will be announced at the beginning of the course.
Course achievement	
Module grade composition	
Objective qualification	
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	

↑

Title	Ramp up Course Computer Science
Number	4298040
ECTS	10,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	Ungraded examination (Prüfungsleistung): 1 written exam (120 min.), oral exam (30 minutes) or Take-Home-Exam
Course achievement	
Module grade composition	
Objective qualification	
After successful completion of this module, students have a basic understanding of the underlying concepts of computer science that are necessary for data science. They are able to - design and develop software systems for data analysis - understand and implement distributed analysis processes - apply and operate modern database systems - evaluate and protect the security and privacy of data Further, students have a general overview of the methods of data science and the application areas. They know the general principles and processes of data science projects.	

↑

Methods and concepts of Computer Science	
ECTS	25

Title	Pattern Recognition
Number	2424690
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	
Course achievement	
Module grade composition	
Objective qualification	

↑

Title	Deep Learning Lab
Number	2424750
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	
Course achievement	
Module grade composition	
Objective qualification	

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Title	Replication and Consistency
Number	4212620
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	1 written exam, 90 minutes or oral exam, 30 minutes or Take-Home-Exam
Course achievement	50% of exercises must be passed
Module grade composition	
Objective qualification	
After successful completion of this module, students will have a basic understanding of data replication strategies, consistency notions, and the corresponding programming methods. We cover all levels of abstraction, from hardware consistency models to geo-replicated databases. Confronted with an application, students will be able to develop and implement a suitable data replication scheme and argue for its correctness.	

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Title	Knowledge based systems and deductive database systems
Number	4214620
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	1 written exam (90 minutes) or oral exam (30 minutes)
Course achievement	50% of the exercises must be passed
Module grade composition	
Objective qualification	
On completion of this module, students are aware of the challenges and problems which arise from reasoning processes over large knowledge bases. This covers technical aspects (algorithms,implementations, etc.) and also methodological aspects (e.g. uncertainty, etc.). Furthermore, the students will be able to discuss the strengths and weaknesses of different approaches to reasoning and will be able to competently propose solution strategies to practical problem scenarios.	

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Title	Warehousing and Data Mining Techniques
Number	4214680
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	1 written exam (90 minutes), oral exam (30 minutes) or Take-Home-Exam
Course achievement	50% of the exercises must be passed
Module grade composition	
Objective qualification	
Data warehousing and mining the data within warehouses represent an important basis for corporate decision support. Students understand possible data warehouse architectures and their essential processes and know the details of the major data mining algorithms used, to be able to correctly and meaningfully underpin decisions with data. They are enabled to critically analyze and evaluate the respective application of various algorithms.	

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Title	Information retrieval and web search engines
Number	4214690
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	1 written exam (90 minutes) or oral exam (30 minutes)
Course achievement	50% of the exercises must be passed
Module grade composition	
Objective qualification	
Information retrieval techniques play a central role not only in Web search engines, but in all kinds of document-centric applications. Students need to understand different techniques, their typical application areas and limitations, as well as their advantages and disadvantages. They are enabled to choose the right techniques for the respective practical problem and to critically reflect their use in the respective application context.	

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Title	Introduction to Machine Learning
Number	4215370
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	1 graded work: Written exam (90 minutes) or oral exam (30 minutes)
Course achievement	
Module grade composition	

Objective qualification

With successful completion of the module, the students possess the following knowledge and capabilities. They are able to
- understand and correctly apply basic concepts of machine learning
- analyse and formalize a machine learning problem
- distinguish between typical machine learning methods
- select a suitable method for a learning problem
- compare and judge machine learning methods wrt their capacity
- implement machine learning methods and apply them practically
apply and parametrise respective tools
- judge strength and weaknesses of machine learning in applications
- recognize ethical issues in the application of machine learning

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Title	Visualization Techniques
Number	4216340
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	
Course achievement	1 Presentation
Module grade composition	
Objective qualification	
This course offers an overview of computer graphics visualization. It conveys the psychological foundations of visual information perception and provides insight into their algorithmic implementation as basis for various visualization techniques. Graduates of this course will be familiar with relevant aspects of visual perception and cognition theory as well as algorithmic concepts of visualization.	

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Title	Image Aspects
Number	4216350
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	
Course achievement	1 Presentation
Module grade composition	
Objective qualification	
This course offers insight into the formation, perception, and cognition of images. The natural phenomenon of images will be considered from the viewpoint of physics, information theory, neuroscience, and arts history. Graduates of this course will be familiar with relationships between optics, digital image processing, image statistics, visual perception, cognitive science and visual arts	

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Title	Python Lab
Number	4217850
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	
Course achievement	1 Team-based development and documentation of a data science software tool
Module grade composition	

Objective qualification

After successful completion of this module, students will have the competence to apply Python for designing and implementing small to medium software projects and analytic workflows with a focus on statistics and machine learning. During an interactive learning phase during which the students will be able to apply common packages such as scikit-learn, and they will be able to
synthesize analysis workflows for diverse data science questions. These workflows will be presented and discussed in a mini-conference among the students. After the mini-conference, students will form small teams to develop data science software tools which will be presented during the closing event. They will gain the competence to critically evaluate machine learning workflows.

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Title	Advanced Software Engineering Lab
Number	4220370
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	graded work: software development. Assessment of skills and effort by the supervisor
Course achievement	
Module grade composition	

Objective qualification

After completing this module, the students have a profound comprehension in developing complex software systems. They gained practical experience in running software development projects and quality assurance of the results. They are capable of understanding the task, convert it in a software architecture, implementing the architecture, and testing the whole system.

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Title	Software Quality 1
Number	4220480
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	1 written exam (90 min) or 1 oral exam (30 min) or 1 term paper or 1 take-at-home-exam
Course achievement	
Module grade composition	
Objective qualification	
After completing this module, the students will know the fundamental basics of software testing. They can apply the testing process and master activities and techniques to support it. The students will be able to define test cases in all phases of the software life cycle. They know common testing procedures and methods to efficiently and effectively prepare and execute software tests. The students will know both the underlying theoretical management processes as well as the practical testing tools to automate software testing.	

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Title	Software Architecture
Number	4220400
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	
Course achievement	
Module grade composition	
Objective qualification	

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Title	Cloud Computing
Number	4223450
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	
Course achievement	non-graded work: Successful completion of the homework assignments: Every assignment must be completed with at least 30% of the attainable points, and 50% of the total points across all assignments must be achieved.
Module grade composition	
Objective qualification	
After completing this module, the students know the fundamentals, methods and, techniques of Cloud Computing. Further, the students know existing Cloud Computing techniques and can develop and assess applications in this setting.	

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Title	Computational Geometry
Number	4227250
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	graded work: written exam (120 minutes) or oral exam (30 minutes)
Course achievement	nongraded work: 50% of the exercises must be passed
Module grade composition	
Objective qualification	
Participants know basic modeling for geometric algorithms. They can gauge the algorithmic difficulty of geometric problems and formulate appropriate objectives. They can master different solution techniques and are capable of developing algorithmic methods for new problems. They understand the practical relevance of problems and solutions.	

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Title	Approximation Algorithms
Number	4227270
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	graded work: written exam (120 minutes) or oral exam (30 minutes)
Course achievement	non-graded work: 50% of the exercises must be passed
Module grade composition	
Objective qualification	
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.	

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Title	Solving NP-hard Optimization Problems (lab)
Number	4227290
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	
Course achievement	active participation and final presentation
Module grade composition	
Objective qualification	
Participants understand theory and practice of dealing with NP-hard problems. They can master exact solution methods, in particular based on integer linear programming. They have gained experience with implementing, testing and refining practical techniques and software, including the generation of benchmark instances, and visualization of results and performance.	

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Title	Machine Learning for Computer Security
Number	4229010
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	graded work (examination): written exam (90 minutes) or oral exam (20 minutes)
Course achievement	non-graded work: presentation of a solved homework task in the exercises
Module grade composition	
Objective qualification	
After completing this course, the students possess the following knowledge and capabilities. They are able to … - differentiate different types of learning algorithms - identify the application of learning algorithms in computer security - design approriate feature spaces for learning algorithms - explain learning algorithms for classification and anomaly detection - develop learning-based methods for attack detection - explain learning algorithms for clustering and dimension reduction - develop learning-based methods for malware and vulnerability analysis - differentiate methods for evading learning-based methods	

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Title	Data Science Seminar
Number	4299990
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	1 Presentation
Course achievement	
Module grade composition	The grade is determined by the active participation in the seminar and the quality of the presentation and the accompanying paper.
Objective qualification	
- The students are able to independently familiarize themselves with a scientific Topic. - They are able to prepare the topic and present it in an oral presentation. - The students are able to use adequate presentation technique and rhetorical skills.	

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Title	
Number	4227300
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	
Course achievement	
Module grade composition	
Objective qualification	

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Methods and concepts of Mathematics	
ECTS	25

Title	Statistical and machine learning
Number	1294310
ECTS	7,0
Compulsory requirements	Mathematical knowledge in "Einführung in die Stochastik", "Wahrscheinlichkeitstheorie" and linear regression is required.
Compulsory attendance	
Expected performance/ Type of examination	graded examination (Prüfungsleistung): 1 written exam (90 minutes) or 1 oral exam (20-30 minutes) according to examiner’s specifications. After approval by the examination board mathematics (Prüfungsausschuss Mathematik), the examiner can also choose the take-home exam as the form of examination. The exact examination specifications will be announced at the beginning of the course.
Course achievement	Non-graded coursework (Studienleistung): Homework according to examiner’s specifications. The exact examination specifications will be announced at the beginning of the course.
Module grade composition	
Objective qualification	
The students - understand the of the complex links between their previous mathematical knowledge and the contents of the lecture - understand the theoretical body of the lecture as a whole and master the corresponding methods - are able to analyze and apply the methods of the lecture - know and understand the basic ideas and methods in machine and statistical learning - are able to analyze and evaluate these method and apply them to practical problems	

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Title	Risk and Extreme Value Theory
Number	1294330
ECTS	5,0
Compulsory requirements	Mathematical knowledge in "Wahrscheinlichkeitstheorie" is required.
Compulsory attendance	
Expected performance/ Type of examination	graded examination (Prüfungsleistung): 1 written exam (90 minutes) or 1 oral exam (20-30 minutes) according to examiner’s specifications. After approval by the examination board mathematics (Prüfungsausschuss Mathematik), the examiner can also choose the take-home exam as the form of examination. The exact examination specifications will be announced at the beginning of the course.
Course achievement	Non-graded coursework (Studienleistung): Homework according to examiner’s specifications. The exact examination specifications will be announced at the beginning of the course.
Module grade composition	
Objective qualification	
The students - understand the of the complex links between their previous mathematical knowledge and the contents of the lecture - understand the theoretical body of the lecture as a whole and master the corresponding methods - are able to analyze and apply the methods of the lecture - know and understand the fundamental methods of non-life insurance mathematics including premium calculation, provisions tariffing and claim reservation and are ably to apply them - know and understand classical ruin theory, re-insurance and extreme value statistic	

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Title	Optimization in machine learning and data analysis 1
Number	1294340
ECTS	5,0
Compulsory requirements	Knowledge of Linear Algebra, Analysis, Linear and combinatorial optimization and Discrete optimization is required, as well as basic knowledge of probability theory.
Compulsory attendance	
Expected performance/ Type of examination	graded examination (Prüfungsleistung): 1 written exam (90 minutes) or 1 oral exam (20-30 minutes) according to examiner's specifications. After approval by the examination board mathematics (Prüfungsausschuss Mathematik), the examiner can also choose the take-home exam as the form of examination. The exact examination specifications will be announced at the beginning of the course.
Course achievement	Non-graded coursework (Studienleistung): Homework according to examiner's specifications. The exact examination specifications will be announced at the beginning of the course.
Module grade composition	
Objective qualification	
The students - understand the of the complex links between their previous mathematical knowledge and the contents of the lecture - understand the theoretical body of the lecture as a whole and master the corresponding methods - are able to analyze and apply the methods of the lecture - know and understand optimization methods for machine learning and machine learning in algorithms for optimization, in particular, discrete optimization and network optimization	

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Title	Numerical Methods and Learning from Data
Number	1294350
ECTS	10,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	graded examination (Prüfungsleistung): 1 written exam (120 minutes) or "Portfolio" according to examiner’s specifications. After approval by the examination board mathematics (Prüfungsausschuss Mathematik), the examiner can also choose the take-home exam as the form of examination. The exact examination specifications will be announced at the beginning of the course.
Course achievement	Non-graded coursework (Studienleistung): Homework according to examiner’s specifications. The exact examination specifications will be announced at the beginning of the course.
Module grade composition	
Objective qualification	
The students - understand the of the complex links between their previous mathematical knowledge and the contents of the lecture - understand the theoretical body of the lecture as a whole and master the corresponding methods - are able to analyze and apply the methods of the lecture - know and understand numerical methods that are employed for Data Science applications such as Deep Learning or Machine Learning - know and understand basics of machne learning, e.g. deep neural networks	

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Title	Numerical Linear Algebra in Data Science
Number	1294360
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	graded examination (Prüfungsleistung): 1 written exam (90 minutes) or 1 oral exam (20-30 minutes) according to examiner's specifications. After approval by the examination board mathematics (Prüfungsausschuss Mathematik), the examiner can also choose the take-home exam as the form of examination. The exact examination specifications will be announced at the beginning of the course.
Course achievement	Non-graded coursework (Studienleistung): Homework according to examiner's specifications. The exact examination specifications will be announced at the beginning of the course.
Module grade composition	
Objective qualification	
The students - understand the of the complex links between their previous mathematical knowledge and the contents of the lecture - understand the theoretical body of the lecture as a whole and master the corresponding methods - are able to analyze and apply the methods of the lecture - know and understand the methods of linear algebra in the context of data mining - are able to anaylze and evaluate problems in this field and to develop methods for their solution on the basis of the content of the lecture	

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Title	Nonparametric Statistics
Number	1294370
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	graded examination (Prüfungsleistung): 1 written exam (90 minutes) or 1 oral exam (20-30 minutes) according to examiner's specifications. After approval by the examination board mathematics (Prüfungsausschuss Mathematik), the examiner can also choose the take-home exam as the form of examination. The exact examination specifications will be announced at the beginning of the course.
Course achievement	Non-graded coursework (Studienleistung): Homework according to examiner's specifications. The exact examination specifications will be announced at the beginning of the course.
Module grade composition	

Objective qualification

The students
- understand the of the complex links between their previous mathematical knowledge and the contents of the lecture
- understand the theoretical body of the lecture as a whole and master the corresponding methods
- are able to analyze and apply the methods of the lecture

- know and understand kernel estimators and other smoothing techniques
- know and understand the basic methodological approach
- know and understand Bootstrap procedures and further resampling methods and are able to apply them

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Title	Nonnegativity and polynomial optimization
Number	1294380
ECTS	10,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	graded examination (Prüfungsleistung): 1 written exam (120 minutes) or 1 oral exam (25-35 minutes) according to examiner's specifications. After approval by the examination board mathematics (Prüfungsausschuss Mathematik), the examiner can also choose the take-home exam as the form of examination. The exact examination specifications will be announced at the beginning of the course.
Course achievement	Non-graded coursework (Studienleistung): Homework according to examiner's specifications. The exact examination specifications will be announced at the beginning of the course.
Module grade composition	
Objective qualification	
The students - understand the of the complex links between their previous mathematical knowledge and the contents of the lecture - understand the theoretical body of the lecture as a whole and master the corresponding methods - are able to analyze and apply the methods of the lecture - know and understand the core statements of real algebraic geometry on nonnegativity and its relation to polynomial optimization - know and understand the common methods in polynomial optimization in theory and practice	

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Title	Statistical methods: Optimality and high dimensionality
Number	1294390
ECTS	10,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	graded examination (Prüfungsleistung): 1 written exam (120 minutes) or 1 oral exam (25-35 minutes) according to examiner's specifications. After approval by the examination board mathematics (Prüfungsausschuss Mathematik), the examiner can also choose the take-home exam as the form of examination. The exact examination specifications will be announced at the beginning of the course.
Course achievement	Non-graded coursework (Studienleistung): Homework according to examiner's specifications. The exact examination specifications will be announced at the beginning of the course.
Module grade composition	

Objective qualification

The students
- understand the of the complex links between their previous mathematical knowledge and the contents of the lecture
- understand the theoretical body of the lecture as a whole and master the corresponding methods
- are able to analyze and apply the methods of the lecture

- remember and understand core methods of mathematical statistics in order to assess power and optimality of statistical methods
- are able to construct (optimal) confidence sets
- understand selected statistical methods for high dimensional data
- understand the basic probabilistic treatment of financial time series
- understand properties of statistical methods in theory and application
- are to model real data

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Title	Mathematical Seminar
Number	1294400
ECTS	4,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	1 "Referat" according to examiner’s specifications. The exact examination specifications will be announced at the beginning of the course.
Course achievement	
Module grade composition	
Objective qualification	
The students - know selected methods of moderation and presentation of mathematical content and are able to apply them - know different types of information and communication technology and are able to apply them - are able to write mathematical and technical texts, are able to set up correct bibliographies, to excerpt and to develop scientific arguments - are able to asses and evaluate mathematics in the historical and societal contex	

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Title	Machine learning with neural networks
Number	1294410
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	graded examination (Prüfungsleistung): 1 written exam (90 minutes) or 1 oral exam (20-30 minutes) according to examiner's specifications. After approval by the examination board mathematics (Prüfungsausschuss Mathematik), the examiner can also choose the take-home exam as the form of examination. The exact examination specifications will be announced at the beginning of the course.
Course achievement	Non-graded coursework (Studienleistung): Homework according to examiner's specifications. The exact examination specifications will be announced at the beginning of the course.
Module grade composition	
Objective qualification	
The students - understand the of the complex links between their previous mathematical knowledge and the contents of the lecture - understand the theoretical body of the lecture as a whole and master the corresponding methods - are able to analyze and apply the methods of the lecture - know and understand neural networks and are able to characterize them in mathematical terms - know different use cases and applications of neural networks - know and understand optimization methods for the training of neural networks and are able to apply them	

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Title	Continuous Optimization in Data Science
Number	1294420
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	graded examination (Prüfungsleistung): 1 written exam (90 minutes) or 1 oral exam (20-30 minutes) according to examiner's specifications. After approval by the examination board mathematics (Prüfungsausschuss Mathematik), the examiner can also choose the take-home exam as the form of examination. The exact examination specifications will be announced at the beginning of the course.
Course achievement	Non-graded coursework (Studienleistung): Homework according to examiner's specifications. The exact examination specifications will be announced at the beginning of the course.
Module grade composition	

Objective qualification

The students
- understand the of the complex links between their previous mathematical knowledge and the contents of the lecture
- understand the theoretical body of the lecture as a whole and master the corresponding methods
- are able to analyze and apply the methods of the lecture

- remember and understand exemplary problems in Data Science
- master selected problem solving abilities using methods of continuous optimization and are able to apply them
- understand theory and algorithms of continuous optimization in the context of statistical phenomena of the data basis

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Title	Inverse problems
Number	1294430
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	graded examination (Prüfungsleistung): 1 written exam (90 minutes) or 1 oral exam (20-30 minutes) according to examiner's specifications. After approval by the examination board mathematics (Prüfungsausschuss Mathematik), the examiner can also choose the take-home exam as the form of examination. The exact examination specifications will be announced at the beginning of the course.
Course achievement	Non-graded coursework (Studienleistung): Homework according to examiner's specifications. The exact examination specifications will be announced at the beginning of the course.
Module grade composition	
Objective qualification	
The students • understand the of the complex links between their previous mathematical knowledge and the contents of the lecture • understand the theoretical body of the lecture as a whole and master the corresponding methods • are able to analyze and apply the methods of the lecture • know and understand the notion of well- and ill-posedness and of regularization methods and their properties • are able to understand, analyze and apply methods to approximately solve ill-posed problems and use them with mathematical software	

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Title	Advanced Computerlab
Number	1294440
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	
Course achievement	Homework according or Portfolio to examiner's specifications. The exact examination specifications will be announced at the beginning of the course.
Module grade composition	
Objective qualification	
The students - remember and understand the basic tasks and method of mathematicl algorithms and their praktical appliastion - are able to use mathematical programming tools - are able to apply, analyze and implement mathematical algorithms - are able to document and present mathematical algorithms	

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Title	Dynamic Optimization
Number	1294450
ECTS	10,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	graded examination (Prüfungsleistung): 1 written exam (120 minutes) or 1 oral exam (25-35 minutes) according to examiner's specifications. After approval by the examination board mathematics (Prüfungsausschuss Mathematik), the examiner can also choose the take-home exam as the form of examination. The exact examination specifications will be announced at the beginning of the course.
Course achievement	Non-graded coursework (Studienleistung): Homework according to examiner's specifications. The exact examination specifications will be announced at the beginning of the course.
Module grade composition	
Objective qualification	
The students - understand the of the complex links between their previous mathematical knowledge and the contents of the lecture - understand the theoretical body of the lecture as a whole and master the corresponding methods - are able to analyze and apply the methods of the lecture - know and understand the problems of optimal control, parameter estimation, optimal experimental design and model discrimination - know and understand the different fundamental approaches in the field of optimal control are are able to apply and analyze them - are able to analyze, interpret, refine and enhance the methods, especially to increase the efficiency of numerical algorithms exemplified for optimal control	

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Title	Discrete Optimization
Number	1294460
ECTS	10,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	graded examination (Prüfungsleistung): 1 written exam (120 minutes) or 1 oral exam (25-35 minutes) according to examiner's specifications. After approval by the examination board mathematics (Prüfungsausschuss Mathematik), the examiner can also choose the take-home exam as the form of examination. The exact examination specifications will be announced at the beginning of the course.
Course achievement	Non-graded coursework (Studienleistung): Homework according to examiner's specifications. The exact examination specifications will be announced at the beginning of the course.
Module grade composition	
Objective qualification	
The students - understand the of the complex links between their previous mathematical knowledge and the contents of the lecture - understand the theoretical body of the lecture as a whole and master the corresponding methods - are able to analyze and apply the methods of the lecture - know and understand combinatorial and discrete optimization problems - understand the notions and results of theory of complexity - understand the important theorems, proofs and procedures of discrete and combinatorial optimization and are able to apply and analyze them - know general algorithmic principles and problem structures - are able to design, apply and analyze algorithms for applications, in particular, for NP-hard problems	

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Title	Computeralgebra
Number	1294470
ECTS	10,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	graded examination (Prüfungsleistung): 1 written exam (120 minutes) or 1 oral exam (25-35 minutes) according to examiner's specifications. After approval by the examination board mathematics (Prüfungsausschuss Mathematik), the examiner can also choose the take-home exam as the form of examination. The exact examination specifications will be announced at the beginning of the course.
Course achievement	Non-graded coursework (Studienleistung): Homework according to examiner's specifications. The exact examination specifications will be announced at the beginning of the course.
Module grade composition	

Objective qualification

The students
- understand the of the complex links between their previous mathematical knowledge and the contents of the lecture
- understand the theoretical body of the lecture as a whole and master the corresponding methods
- are able to analyze and apply the methods of the lecture

- understand the basic concepts of computer algebra techniques in theory and practice, such as the Euclidean algorithm and Gröbner bases, their calculation and application
- understand number theoretic and algebraic techniques and are able to apply and analyze them
- are able to calculate factorizations and to apply and analyze methods to solve systems of nonlinear equations and for working with algebraic objects

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Title	Algorithms and complexity for quantum computing
Number	1294480
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	graded examination (Prüfungsleistung): 1 written exam (90 minutes) or 1 oral exam (20-30 minutes) according to examiner's specifications. After approval by the examination board mathematics (Prüfungsausschuss Mathematik), the examiner can also choose the take-home exam as the form of examination. The exact examination specifications will be announced at the beginning of the course.
Course achievement	Non-graded coursework (Studienleistung): Homework according to examiner's specifications. The exact examination specifications will be announced at the beginning of the course.
Module grade composition	
Objective qualification	
The students - understand the of the complex links between their previous mathematical knowledge and the contents of the lecture - understand the theoretical body of the lecture as a whole and master the corresponding methods - are able to analyze and apply the methods of the lecture - master the fundamentals to understand the model of a quantum computer - know the algorithmic applications of this model - know and understand the quantum computer model in light of the theory complexity	

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Title	Model Order Reduction
Number	1294500
ECTS	10,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	graded examination (Prüfungsleistung): 1 written exam (120 minutes) or 1 oral exam (25-35 minutes) or "Portfolio" according to examiner’s specifications. After approval by the examination board mathematics (Prüfungsausschuss Mathematik), the examiner can also choose the take-home exam as the form of examination. The exact examination specifications will be announced at the beginning of the course.
Course achievement	Non-graded coursework (Studienleistung): Homework according to examiner’s specifications. The exact examination specifications will be announced at the beginning of the course.
Module grade composition	

Objective qualification

The students
- understand the of the complex links between their previous mathematical knowledge and the contents of the lecture
- understand the theoretical body of the lecture as a whole and master the corresponding methods
- are able to analyze and apply the methods of the lecture

- understand the concept of model reduction
- know and understand the most important methods of (non)linear model reduction
- are able to analyze the method and understand of the basic limits of the applicability of the methods
- are able to interpret the goodness and optimality of the achievable approximation

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Title	Mathematical Foundations of Information Theory and Coding Theory
Number	1294600
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	1 oral exam (20-30 minutes) according to examiner's specifications. The exact examination specifications will be announced at the beginning of the course.
Course achievement	Non-graded coursework (Studienleistung): Homework or presentation according to examiner's specifications. The exact examination specifications will be announced at the beginning of the course.
Module grade composition	
Objective qualification	
The students - understand the of the complex links between their previous mathematical knowledge and the contents of the lecture - understand the theoretical body of the lecture as a whole and master the corresponding methods - are able to analyze and apply the methods of the lecture - understand the applied methods and are able to analyze these - master the foundations of the field - are able to them into a larger context	

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Title	Mathematical Foundations of Data Science
Number	1294490
ECTS	10,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	graded examination (Prüfungsleistung): 1 written exam (120 minutes) or 1 oral exam (25-35 minutes) according to examiner's specifications. After approval by the examination board mathematics (Prüfungsausschuss Mathematik), the examiner can also choose the take-home exam as the form of examination. The exact examination specifications will be announced at the beginning of the course.
Course achievement	Non-graded coursework (Studienleistung): Homework according to examiner's specifications. The exact examination specifications will be announced at the beginning of the course.
Module grade composition	
Objective qualification	
The students - understand the of the complex links between their previous mathematical knowledge and the contents of the lecture - understand the theoretical body of the lecture as a whole and master the corresponding methods - are able to analyze and apply the methods of the lecture - understand the applied methods and are able to analyze these - master the foundations of the field - are able to them into a larger context	

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Title	Introduction to Quantum Information Theory
Number	1294540
ECTS	6,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	graded examination (Prüfungsleistung): 1 written exam (90 minutes) or 1 oral exam (20-30 minutes) according to examiner's specifications. After approval by the examination board mathematics (Prüfungsausschuss Mathematik), the examiner can also choose the take-home exam as the form of examination. The exact examination specifications will be announced at the beginning of the course.
Course achievement	Non-graded coursework (Studienleistung): Homework according to examiner's specifications. The exact examination specifications will be announced at the beginning of the course.
Module grade composition	

Objective qualification

The students
- understand the of the complex links between their previous mathematical knowledge and the contents of the lecture
- understand the theoretical body of the lecture as a whole and master the corresponding methods
- are able to analyze and apply the methods of the lecture

- acquainted with the basic objects, constructions, and mathematical theorems and their proofs of quantum information theory
- obtain an understanding of the similarities of, and the fundamental differences between, classical information theory and quantum information theory
- learn about applications of quantum information theory in quantum computing and communication.

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Data Science in Applications - Engineering

Title	Ecological Modelling
Number	1116130
ECTS	6,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	Examination: Generation and documentation of computer programs
Course achievement	
Module grade composition	
Objective qualification	
After successful completion of the module, students have knowledge of the key - statistical and machine learning - methods of species distribution modelling. They also have knowledge of the most important approaches to population dynamic modelling. The students are able to apply both modelling methods for dealing with geoecological and conservation biological questions and they know the advantages and disadvantages of these methods. They are capable to visualise and interpret data and models and to check underlying assumptions as well as to evaluate parameter sensitivities.	

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Title	Fundamentals of Turbulence Modeling
Number	2512380
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	
Course achievement	
Module grade composition	
Objective qualification	

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Title	Automotive Software Engineering
Number	4220450
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	graded work: portfolio
Course achievement	non-graded work: all practical tasks must have been successfully completed.
Module grade composition	
Objective qualification	
After completing this module, students will know the essential fundamentals and suitable methods and tools for software development in the automotive sector. The students can apply basic software development methods of embedded systems and the techniques for complexity and quality management.	

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Title	Basic Coastal Engineering
Number	4398090
ECTS	6,0
Compulsory requirements	
Compulsory attendance	There is an attendance obligation in the presentation seminar.
Expected performance/ Type of examination	Written exam (90 min.)
Course achievement	Presentation (20 min.)
Module grade composition	

Objective qualification

After successful completion of the module, students will have a broad and solid basic knowledge of the mechanics of water waves and hydrodynamic processes in the coastal area, which enables them to determine the load, erosion and transport parameters for the required constructive and functional planning of engineering measures.
The students are able to use the linear and nonlinear theory of water waves to calculate the total wave induced current parameters and the associated effects on sediments, structures and other obstacles. By the mediated calculation basics for wave transformation the students can calculate the effects of the bottom in shallow water (shoaling, refraction, wave breaking) as well as of buildings and other obstacles (reflection, diffraction) on the parameters (height, length, direction) of the waves and their stability (refraction criterion) at the given planning location.
On the basis of the acquired basics of the origin, parameterization, mathematical/statistical description and prediction of the sea state, the students are able to determine the design waves for the functional and constructive planning. They can determine the design water levels on the basis of the acquired knowledge on the formation and prediction of tides on open coasts and in estuaries as well as of storm surges on the German North Sea and Baltic Sea coasts. In the seminar, students are enabled to conduct scientific research and to present research results from current publications in an appropriate manner.

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Title	Introduction to Finite Element Methods
Number	4398470
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	
Course achievement	
Module grade composition	
Objective qualification	

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Title	Railway Timetabling & Simulations
Number	4398580
ECTS	6,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	Portfolio
Course achievement	term paper (timetable data and simulation results)
Module grade composition	
Objective qualification	
The students have a fundamental understanding of the models for the estimation of the operational capacity of railway networks. They are familiar with the possibilities and limits of analytical methods and simulations in railway operations research and can select the appropriate method for a given problem. They got practical experience in the use of computer-based scheduling systems and in testing of timetables with different simulation tools.	

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Title	Deep Learning in Remote Sensing
Number	4398860
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	
Course achievement	
Module grade composition	
Objective qualification	
Upon completion of this module, the students will be able to understand basic principles and applications of deep learning and to apply them on Remote Sensing as well as similar problems.	

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Title	
Number	4398870
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	
Course achievement	
Module grade composition	
Objective qualification	
Upon completion of this module, the students will be able to understand basic principles and applications of machine learning and to apply them on practical examples.	

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Title	Basic Measurement Methods in Fluid Mechanics
Number	2512410
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	
Course achievement	
Module grade composition	
Objective qualification	

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Title	Data-Driven Material Modeling
Number	4398690
ECTS	6,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	
Course achievement	
Module grade composition	
Objective qualification	

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Data Science in Applications - Image and Signal Processing

Title	Mathematical Image Processing
Number	1294300
ECTS	10,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	graded examination (Prüfungsleistung): 1 written exam (120 minutes) or 1 oral exam (25-35 minutes) according to examiner's specifications. After approval by the examination board mathematics (Prüfungsausschuss Mathematik), the examiner can also choose the take-home exam as the form of examination. The exact examination specifications will be announced at the beginning of the course.
Course achievement	Non-graded coursework (Studienleistung): Homework according to examiner's specifications. The exact examination specifications will be announced at the beginning of the course.
Module grade composition	
Objective qualification	
The students - understand the of the complex links between their previous mathematical knowledge and the contents of the lecture - understand the theoretical body of the lecture as a whole and master the corresponding methods - are able to analyze and apply the methods of the lecture - know and understand the characterization of the quality of an image through mathematical quantities - know and understand the most important basic tasks in image processing and various methods of solving them	

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Title	Information Theory and Signal Processing
Number	1294320
ECTS	10,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	graded examination (Prüfungsleistung): 1 written exam (120 minutes) or 1 oral exam (25-35 minutes) according to examiner's specifications. After approval by the examination board mathematics (Prüfungsausschuss Mathematik), the examiner can also choose the take-home exam as the form of examination. The exact examination specifications will be announced at the beginning of the course.
Course achievement	Non-graded coursework (Studienleistung): Homework according to examiner's specifications. The exact examination specifications will be announced at the beginning of the course.
Module grade composition	
Objective qualification	
The students - understand the of the complex links between their previous mathematical knowledge and the contents of the lecture - understand the theoretical body of the lecture as a whole and master the corresponding methods - are able to analyze and apply the methods of the lecture - know and understand the optimal coding of random data sources - know and understand the calculation of optimal codings with the help of the entropy rate of the associated stochastic process as a central variabl	

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Title	Deep Learning for imaging in nano and quantum science
Number	1520500
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	
Course achievement	
Module grade composition	
Objective qualification	

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Title	Network Information Theory
Number	2424650
ECTS	6,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	
Course achievement	
Module grade composition	
Objective qualification	

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Title	Spoken Language Processing
Number	2424680
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	
Course achievement	
Module grade composition	
Objective qualification	

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Title	Fundamentals of Digital Signal Processing
Number	2424760
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	
Course achievement	
Module grade composition	
Objective qualification	

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Title	Digital Signal Processing
Number	2424770
ECTS	8,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	
Course achievement	
Module grade composition	
Objective qualification	

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Title	Computer Vision and Machine Learning
Number	4216330
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	1 exam: written exam, 90 minutes or oral exam, 30 minutes
Course achievement	1 study achievement: 50% of the exercises must be passed
Module grade composition	
Objective qualification	
Upon successful completion of this module, students will have a basic understanding of how to develop complex computer vision applications. They are able to analyze computer vision problems and to design and implement appropriate solutions.	

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Title	Biomedical Image and Signal Analysis
Number	4217760
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	graded work: written exam (90 minutes) or oral exam (30 minutes) or experimental work or Portfolio
Course achievement	
Module grade composition	
Objective qualification	
Passing this module, the students can classify and compare different methodologies for medical signal and image acquisition. They can differ and compare linear with non-linear filtering and analyze electrocardiography (ECG) data into their components. They can segment medical images in two and three dimensions and are able to apply model-based approaches for image and signal analytics.	

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Title	Deep Learning in Remote Sensing
Number	4398860
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	
Course achievement	
Module grade composition	
Objective qualification	
Upon completion of this module, the students will be able to understand basic principles and applications of deep learning and to apply them on Remote Sensing as well as similar problems.	

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Title	
Number	4398870
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	
Course achievement	
Module grade composition	
Objective qualification	
Upon completion of this module, the students will be able to understand basic principles and applications of machine learning and to apply them on practical examples.	

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Title	Computer Lab Pattern Recognition
Number	2424000020
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	
Course achievement	
Module grade composition	

Objective qualification

In this course, students acquire the competencies to independently select and apply appropriate machine learning and deep learning methods for complex problems. The students ...

- ... master the programming language Python as well as the basics of the deep learning libraries PyTorch and Tensorflow.
- ... evaluate the effectiveness of simple machine learning models and neuronal networks for classification and regression problems.
- ... evaluate the quality of deep learning models on appropriate data (sub)sets with meaningful metrics
- ... know and use different types of neural networks for problems in the areas of image processing, time series processing and generative problems
- ... know and use different strategies for data preprocessing and data augmentation
- ... know and use different training and regularization methods for the optimization of neural networks
- ... evaluate the complexity of a neural network on the basis of various parameters

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Data Science in Applications - Biology, Chemistry and Pharma

Title	Immunmetabolism
Number	1398590 Bio-BB 31
ECTS	10,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	
Course achievement	
Module grade composition	
Objective qualification	

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Title	CM-B-3 Elucidation and Modelling of Biological Structures
Number	1498680
ECTS	8,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	oral or written exam+ (30% of the practical work mark are taken into account in the overall module mark)
Course achievement	Practical work (marked)
Module grade composition	Practical work (marked) oral or written exam+ (30% of the practical work mark are taken into account in the overall module mark)
Objective qualification	
The students are familiar with modern methods for modelling the structure of biomacromolecules and for simulating their thermodynamic properties. The know empirical force field methods, methods for performing molecular dynamics simulations, as well as modern multicale simulation methods. The students are able to judge the applicability and the limitations of such methods, to choose suitable simulation methods for their own research projects and to perform, analyze, and evaluate molecular dynamics simulations.	

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Title	CB-B-4 Theoretical Biophysical
Number	1498690
ECTS	8,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	oral or written exam+ (20% of the coursework and 20% of the practical work mark are taken into account in the overall module mark)
Course achievement	Solve coursework problems (umarked) Practical work (marked)
Module grade composition	Solve coursework problems (umarked) Practical work (marked) oral or written exam+ (20% of the coursework and 20% of the practical work mark are taken into account in the overall module mark)
Objective qualification	
The students have aquired knowledge on modern methods of quantum chemistry. They are familiar with the foundations of important methods and possess an overview of commonly used quantum-chemical methods, their implementation in scientific software, and their use in chemistry. They are able to judge the applicability and the limits of different quantum-chemical methods and to use choose suitable methods for their own research projects, to perform quantum-chemical calculations and to analyse, evaluate, and assess their results.	

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Title	Introduction to Chemometrics for Pharmaceutical Engineers
Number	4011130
ECTS	6,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	
Course achievement	
Module grade composition	
Objective qualification	

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Title	Network Biology
Number	4217840
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	written exam, 90 minutes, or oral exam, 30 minutes or Take-Home-Exam
Course achievement	50% of exercises must be passed
Module grade composition	
Objective qualification	
After successful completion of this module, students will have a basic understanding of graph theory and its applications for the analysis of biomedical data. They will be able to use network biology tools and critically assess network analyses. They will be capable to devise new graph-based strategies for the analysis of biomedical data.	

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Data Science in Applications - Medicine

Title	Medical-methodological specialization module 1
Number	4217720
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	graded work: oral exam (30 minutes) or development and documentation of computer programs or Portfolio
Course achievement	
Module grade composition	
Objective qualification	
Passing this module, the students develop a fundamental understanding for methodological aspects of medical informatics. They can plan and conduct scientific studies and can develop novel research projects in the field of electronic health. The students can use, compare, and evaluate specific IT tools in medical informatics. They know about data privacy and security issues for medical data in Europe.	

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Title	Medical Methodology Course 2
Number	4217730
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	written exam (90 minutes) or oral exam (30 minutes) or Portfolio
Course achievement	
Module grade composition	
Objective qualification	
Passing this module, the students have earned a fundamental understanding of the methodological aspects of medical informatics. They can plan and conduct clinical trials and apply appropriate statistics to evaluate the recorded data. They can assess the systematics of scientific research in the broad biomedical field of applied computer science. They can compare IT tools for medical statistics and significance tests.	

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Title	Accident Informatics
Number	4217740
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	graded work: written exam (90 minutes) or Portfolio
Course achievement	
Module grade composition	
Objective qualification	
Passing this module, the students can define the goals and perform a technical analysis of traffic accidents. The understand accident and emergency informatics on a more general level, and know the components of this novel field of research. They can use IT systems for accident research and build systems using appropriate data formats, standards, and protocols. Furthermore, they can construct scientific experiments in the field of accident and emergency informatics.	

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Title	Biomedical Image and Signal Analysis
Number	4217760
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	graded work: written exam (90 minutes) or oral exam (30 minutes) or experimental work or Portfolio
Course achievement	
Module grade composition	
Objective qualification	
Passing this module, the students can classify and compare different methodologies for medical signal and image acquisition. They can differ and compare linear with non-linear filtering and analyze electrocardiography (ECG) data into their components. They can segment medical images in two and three dimensions and are able to apply model-based approaches for image and signal analytics.	

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Title	Health-Enabling Technologies A
Number	4217800
ECTS	6,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	graded work: written exam, 90 minutes, or oral exam, 30 minutes, or Portfolio
Course achievement	
Module grade composition	
Objective qualification	
Passing this module, the students are able to name different health enabling technologies (HET) and explain their ethical, regulatory and social aspects. The students can use methods and tools to build HET systems.	

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Title	Health-Enabling Technologies B
Number	4217810
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	graded work: written exam (90 minutes) or oral exam (30 minutes) or Portfolio
Course achievement	
Module grade composition	
Objective qualification	
Passing this module, the students can explain and compare health enabling technologies (HET). This includes knowledge and practical use of HET applications, and its underlying scientific foundation. The students are able to build HET systems using recent technologies and can plan, conduct, and analyze experiments to evaluate HET technologies.	

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Title	Selected Topics of Representation and Analysis of Medical Data
Number	4217880
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	written exam (90 minutes) or oral exam (30 minutes) or Portfolio or Take-Home-Exam
Course achievement	
Module grade composition	
Objective qualification	
The students can recall recent trends and technologies to represent and analyze medical data. They are able to compare approaches and report their key characteristics resp. differences. They can construct tools and scientific methodologies for data modelling and analytics. The students recognize quality criterions and can recommend specific approaches.	

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Data Science in Applications - Project Work

Title	Project Work Data Science
Number	4299980
ECTS	15,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	Software/program development and report on a data science project. Successful participation will be confirmed and graded by the supervisor. Graded project thesis (3 months processing time).
Course achievement	
Module grade composition	
Objective qualification	
The project thesis can serve as preparation for the master's thesis. The students are able to use scientific methods systematically to solve a complex task in the area of data science. They are able to plan the work independently and estimate the work time required. They are able to carry out the project controlling and quality assurance e.g. using milestones which they have set for themselves.	

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Key Qualifications and Ethics

Title	Data Privacy & Data Governance
Number	2216010
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	written exam, 60 minutes, or oral exam, 20 minutes, or term paper or Portfolio or Take-Home-Exam
Course achievement	
Module grade composition	
Objective qualification	
The students understand the differences between the two main legal systems (case law vs. common law) in the EU. They know different sources of legal knowledge. The students are able to assess company privacy regulations and business models in relation to the legal provisions.	

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Title	Key Qualifications
Number	4298010
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	
Course achievement	An active performance record is required for the selected courses/modules (e.g. written examination, term paper, presentation, minutes). A certificate of attendance is not sufficient. The type of academic achievement depends on the module or course.
Module grade composition	
Objective qualification	
Superordinate reference/ embedding of the field of study Students will be able to classify their field of study in societal, historical, legal or professionally oriented references (depending on the focus of the course). They are able to recognize, analyze and evaluate higher-level, subject-related connections and their significance. The students acquire an insight into the networking possibilities of the field of study and application references of their field of study in professional life.	

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Title	Scientific Presentation and Writing
Number	4298030
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	
Course achievement	1 Presentation and elaboration (short article) on a research topic
Module grade composition	
Objective qualification	
Students will learn the principles of scientific oral and written presentation and how to improve their talking according to the audience and their writing for successful publishing. They will be enabled to properly criticize existing visualizations and create new visualizations that are ef-fective, efficient, and appropriate. They will also learn how to properly structure a talk, how to prepare adequate visual aids (“presentations”), and how oral presentations are different from written text.	

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Title	
Number	4411440
ECTS	5,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	
Course achievement	
Module grade composition	
Objective qualification	

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Master's Thesis	
ECTS	30

Title	Master's Thesis Data Science
Number	4299970
ECTS	30,0
Compulsory requirements	
Compulsory attendance	
Expected performance/ Type of examination	Written thesis (final thesis) The presentation can be included in the evaluation with up to 3 of 30 credit points according to § 5 paragraph 7 (BPO)
Course achievement	
Module grade composition	

Objective qualification

The students are able to work on a problem in the field of data science independently using scientific methods within a given time period.

The following points are particularly important:
- The student can familiarize themselves with the topic of the work independently.
- They can systematically work on a research problem relevant to data science using scientific methods.
- They are able to present the methods and the results in the form of an report.
- They present the main results in an understandable form in a presentation.
- They able to research literature and put their work into context.

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