Module Catalog
Master of Science in Data Science

BM3 Advanced Problem Solving Techniques				Number of credit points (CPs): 9
Module type (mandatory or elective module):	Elective module			
Content and objectives of module:	*Objectives* Students are able to define and interpret the particularities, limits, terminologies, and doctrines in the field of declarative problem solving. Students' knowledge and comprehension form the basis for the development and/or application of their own ideas in the field of declarative problem solving from a research-oriented viewpoint. Students have a broad, detailed, and critical comprehension of the latest findings in selected specialist areas in the field of declarative problem solving. Students are able to apply their knowledge and understanding, as well as their facility in solving problems, in new and unfamiliar situations that stand in a broader and multidisciplinary connection to the field of declarative problem solving. *Contents* This course is dedicated to the fundamentals, algorithms, systems, and application of declarative problem-solving methods. Declarative problem-solving methods employ general problem-solving techniques to automate the solution of (typically combinatorial) problems. These include design, diagnosis, action planning and scheduling, and configuration, to name just a few. In contrast to traditional programming, no programs are created to solve the problem; instead, we merely model the original problem (formally). Problem-solving systems today are in a position to solve problems with as many as several million variables. The resulting systems are being used in industry as well as the natural sciences and linguistics.			
Module (partial) exam(s) (number, form, scope):	Examination, 90 minutes			
Independent study time (in hours):	180			
Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related supplementary module (partial) exam(s) (number, form, scope)
		For completing the module	For admission to the module exam	
Lecture (lecture)	2	-	-	-
Tutorial (tutorial)	2	-	-	-
Lab (lab)	1	Oral discussion of certificates (15	-	-
Project (project)	2	Documentation (5 pages)	-	-
Offered:		Each year (in the winter semester)		
Prerequisite for taking the module:		None		
Teaching unit:		Computer science		

FM2: Foundations of Computer Science				Number of credit points (CPs): 6
Module type (mandatory or elective module):	Elective module			
Content and objectives of module:	*Objectives* Students have the required background knowledge in computer science to successfully complete the basic modules of this degree program. They have the self-organizational skills to acquire this knowledge self sufficiently and be able to describe subject matter and thematic connections out loud. *Contents* Algorithms and data structures: Growth of functions and O-notation; divide and conquer; sorting and searching; elementary data structures; dynamic programming; greedy algorithms; elementary graph algorithms. Formal languages: Chomsky hierarchy; regular languages and finite automata; context-free languages and push-down automata; finite state transducers; Turing machines. Theoretical foundations: Calculability; halting problem; non-determinism; recursion; inductive definitions (lists, trees). Content is presented via online video lectures, for example from Coursera or MIT OpenCourseWare.			
Module (partial) exam(s) (number, form, scope):	Oral exam, 20 minutes			
Independent study time (in hours):	150			
Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related supplementary module (partial) exam(s) (number, form, scope)
		For completing the module	For admission to the module exam	
Video lecture (lecture)	-	-	-	-
Tutorial (tutorial)	2	-	Successful completion of the exercises	-
Offered:	Each year (in the winter semester)			
Prerequisite for taking the module:	Examining Board decision under Section 5 subsection 1.			
Teaching unit:	Computer science			

INF-DSAM10: Research Data Management, Law, and Ethics	Number of credit points (CPs): 6
Module type (mandatory or elective module):	Elective module
Content and objectives of module:	**Contents** The module covers a selection of the following topics: research data management, data protection law, rules for good scientific practice, and the fundamentals of law and ethics in regard to Data Science. **Objectives** Students possess comprehensive, detailed, and specialized knowledge at the state of the art of selected subfields of data protection law, rules for good scientific practice, and fundamentals of law and ethics in regard to Data Science. They have the ability to analyze data assimilation and inference problems, to develop and implement solutions, and to ascertain the quality of solutions. They are familiar with and can apply the rules of good scientific practice. They are able to develop new ideas and methods, to consider the options given incomplete information, and to assess them based on various metrics.
Module (partial) exam(s) (number, form, scope):	Oral exam, 20 min
Independent study time (in hours):	180

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related supplementary module (partial) exam(s) (number, form, scope)
		For completing the module	For admission to the module exam	
Lecture or seminar (lecture or seminar)	2	-	-	-
Project (project)	2	Report (for example, a research data management plan),	-	-

Offered:	Every other year
Prerequisite for taking the module:	None
Teaching unit:	Computer science

INF-DSAM11: Applied Data Science Internship	Number of credit points (CPs): 12
Module type (mandatory or elective module):	Elective module
Content and objectives of module:	**Contents** Students complete an internship lasting at least eight weeks at a company or research institution, during which they work on a practical data analysis project. The topics are cleared with a university advisor. **Objectives** Students have the ability to analyze applied problems in Data Science, to map them to paradigms from the field, to develop and implement solutions, and to ascertain the quality of solutions. They are able to develop new ideas and methods, to consider the options given incomplete information, and to assess them based on various metrics. They are able to present and defend the results of their work in public using appropriate presentation media and have advanced communication and organizational skills.
Module (partial) exam(s) (number, form, scope):	Portfolio exam consisting of an internship report (10-20 report) and associated presentation (20 min)
Independent study time (in hours):	360

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related supplementary module (partial) exam(s) (number, form, scope)
		For completing the module	For admission to the module exam	
Internship (8 weeks minimum) (internship)	-	-	-	-

Offered:	Every semester
Prerequisite for taking the module:	None
Teaching units:	Computer science (20%) Mathematics (20%) Business informatics (20%) Earth sciences (20%) Biology/Biochemistry (20%)

INF-DSAM1A: Advanced Machine Learning A	Number of credit points (CPs): 9
Module type (mandatory or elective module):	Elective module
Content and objectives of module:	**Contents** Building on the module INF-DS-C1, this module covers a selection of additional topics in machine learning such as graphical models, deep neural networks, neural networks for processing images and time sequences, recommendation algorithms, reinforcement learning, and cluster algorithms. **Objectives** Students possess comprehensive, detailed, and specialized knowledge at the state of the art of the main specialized subfields of machine learning. Students have the ability to analyze model-building problems, to map paradigms of machine learning and Bayesian statistics, to develop and implement solutions, and to ascertain the quality of solutions with suitable evaluation protocols. They are able to develop new ideas and methods, to consider the options given incomplete information, and to assess them based on various metrics.
Module (partial) exam(s) (number, form, scope):	Oral exam, 30 min
Independent study time (in hours):	210

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related supplementary module (partial) exam(s) (number, form, scope)
		For completing the module	For admission to the module exam	
Lecture and lab (lecture and lab)	2L + 2T	Successful completion of the exercises (70%) and a project task	-	-

Offered:	Winter semester
Prerequisite for taking the module:	Recommended: INF-DS-C1
Teaching unit:	Computer science

INF-DSAM1B: Advanced Machine Learning B	Number of credit points (CPs): 6
Module type (mandatory or elective module):	Elective module
Content and objectives of module:	**Contents** Building on the module INF-DS-C1, students familiarize themselves with additional specialized topics in machine learning and work on a project task. **Objectives** Students possess comprehensive, detailed, and specialized knowledge at the state of the art of the main specialized subfields of machine learning. Students have the ability to analyze model-building problems, to map paradigms of machine learning and Bayesian statistics, to develop and implement solutions, and to ascertain the quality of solutions with suitable evaluation protocols. They are able to develop new ideas and methods, to consider the options given incomplete information, and to assess them based on various metrics. They are able to present and defend the results of their work in public using appropriate presentation media and possess advanced communication and organizational skills.
Module (partial) exam(s) (number, form, scope):	Project report, 10-20 pages
Independent study time (in hours):	120

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related supplementary module (partial) exam(s) (number, form, scope)
		For completing the module	For admission to the module exam	
Project (project)	2	-	-	-
Seminar (seminar)	2	-	Presentation (20 min)	-

Offered:	Winter semester
Prerequisite for taking the module:	Recommended: INF-DS-C1
Teaching unit:	Computer science

INF-DSAM4A: Advanced Infrastructures and Software Engineering A	Number of credit points (CPs): 6
Module type (mandatory or elective module):	Elective module
Content and objectives of module:	**Contents** Building on the module INF-DS-C2, the follow-up module covers additional content from the fields of software engineering, information systems, databases, and parallel programming paradigms that underlie the field of Data Science. **Objectives** Students possess comprehensive, detailed, and specialized knowledge at the state of the art of selected specialties of software engineering, information systems, databases, and parallel programming paradigms that underlie the field of Data Science. Students have the ability to analyze problems, to map them to paradigms from the field, to develop and implement solutions, and to ascertain the quality of solutions. They are able to develop new ideas and methods, to consider the options given incomplete information, and to assess them based on various metrics.
Module examinations (number, form, scope):	One exam of the following format: Written exam, 90 min Oral exam, 30 min
Independent study time (in hours):	120

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related supplementary module (partial) exam(s) (number, form, scope)
		For completing the module	For admission to the module exam	
Lecture and tutorial (lecture and tutorial)	2L + 2T	Successful completion of the exercises (70%)	-	-

Offered:	Every semester
Prerequisite for taking the module:	Recommended: INF-DS-C2
Teaching unit:	Computer science

INF-DSAM4B: Advanced Infrastructures and Software Engineering B	Number of credit points (CPs): 6
Module type (mandatory or elective module):	Elective module
Content and objectives of module:	**Contents** Building on the module INF-DS-C2, the follow-up module covers additional content from the fields of software engineering, information systems, databases, and parallel programming paradigms that underlie the field of Data Science. **Objectives** Students possess comprehensive, detailed, and specialized knowledge at the state of the art of selected specialties of software engineering, information systems, databases, and parallel programming paradigms that underlie the field of Data Science. Students possess the ability to analyze problems, to map them to paradigms from the field, to develop and implement solutions, and to ascertain the quality of solutions. They are able to develop new ideas and methods, to consider the options given incomplete information, and to assess them based on various metrics.
Module examinations (number, form, scope):	One exam of the following format: Written exam, 90 min Oral exam, 30 min Portfolio exam consisting of seminar presentation (20 min) and accompanying written elaboration (10-20 pages)
Independent study time (in hours):	120

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related supplementary module (partial) exam(s) (number, form, scope)
		For completing the module	For admission to the module exam	
Lecture or seminar (lecture or seminar)	2	-	-	-
Exercise or project (exercise)	2	Successful completion of the exercise assignments	-	-

Offered:	Every semester
Prerequisite for taking the module:	Recommended: INF-DS-C2
Teaching unit:	Computer science

INF-DSAM5A: Advanced Business Analytics A				Number of credit points (CPs): 9
Module type (mandatory or elective module):	Elective module			
Content and objectives of module:	**Contents** Students familiarize themselves with advanced topics in business analytics. **Objectives** The students are familiar with the basic concepts, methods, approaches, and tools used in business analytics and be able to explain, assess, and apply them self-sufficiently. They are able to recognize appropriate issues self-sufficiently, especially in business, analyze them methodically, present results, and if applicable extrapolate the practical implications. They are able to present and defend the results of their work in public using appropriate presentation media and possess advanced communication and organizational skills.			
Module (partial) exam(s) (number, form, scope):	Term paper, 15-20 pages			
Independent study time (in hours):	180			
Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related supplementary module (partial) exam(s) (number, form, scope)
		For completing the module	For admission to the module exam	
Individual research project (project)	2	-	-	-
Seminar 2 (seminar)	2	Presentation (15-20 min)	-	-
Seminar 1 (seminar)	2	Presentation (15-20 min)	-	-
Offered:		Summer semester		
Prerequisite for taking the module:		Recommended: INF-DS-C3		
Teaching unit:		Business informatics		

INF-DSAM5B: Advanced Business Analytics B	Number of credit points (CPs): 6
Module type (mandatory or elective module):	Elective module
Content and objectives of module:	**Contents** Students familiarize themselves with advanced topics in business analytics. **Objectives** The students are familiar with the basic concepts, methods, approaches, and tools used in business analytics and be able to explain, assess, and apply them self-sufficiently. They are able to recognize appropriate issues self-sufficiently, especially in business, analyze them methodically, present results, and if applicable extrapolate the practical implications. They are able to present and defend the results of their work in public using appropriate presentation media and possess advanced communication and organizational skills.
Module (partial) exam(s) (number, form, scope):	Portfolio exam consisting of a term paper (approx. 25 pages) [75%] and associated presentation (20 min) [25%]
Independent study time (in hours):	120

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related supplementary module (partial) exam(s) (number, form, scope)
		For completing the module	For admission to the module exam	
Seminar (seminar)	2	-	-	-
Individual research project (project)	2	-	-	-

Offered:	Winter semester
Prerequisite for taking the module:	Recommended: INF-DS-C3
Teaching units:	Computer science (60%) Business informatics (40%)

INF-DSAM6A: Advanced Applied Data Science A	Number of credit points (CPs): 9
Module type (mandatory or elective module):	Elective module
Content and objectives of module:	**Contents** The module broadens at least one application area of Data Science. The module goes into the specific data analysis issues and performance metrics in this field, explains the models used in this application area, and covers the challenges of applying Data Science methods. Students work on a project related to this application and present their results. **Objectives** Participants have acquired a deepened understanding of an application area for Data Science methods. Students have the ability to analyze problems in this application area of Data Science, to map them to paradigms of Data Science, to develop and implement solutions, and to ascertain the quality of solutions. They are able to develop new ideas and methods, consider the options given incomplete information and assess them based on various metrics. They are able to present and defend the results of their work in public using appropriate presentation media and possess advanced communication and organizational skills.
Module examinations (number, form, scope):	One exam of the following format: Written exam, 90 min Oral exam, 30 min Portfolio exam consisting of seminar presentation (20 min.) and accompanying text. elaboration (10-20 pages)
Independent study time (in hours):	180

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related supplementary module (partial) exam(s) (number, form, scope)
		For completing the module	For admission to the module exam	
Lecture / seminar / tutorial / Project (lecture or seminar or tutorial)	4	-	-	-
Lecture / seminar / tutorial / Project (lecture or seminar or tutorial)	2	-	-	-

Offered:	Winter semester
Prerequisite for taking the module:	Recommended: INF-DS-C-4
Teaching units:	Computer science (20%) Mathematics (20%) Earth sciences (20%) Biology/biochemistry (20%) Business informatics (20%)

INF-DSAM6B: Advanced Applied Data Science B	Number of credit points (CPs): 6
Module type (mandatory or elective module):	Elective module
Content and objectives of module:	**Contents** The module broadens at least one application area of Data Science. The module goes into the specific data analysis issues and performance metrics in this field, explains the models used in this application area, and covers the challenges of applying Data Science methods. Students investigate a research question from this area of application and present their results. **Objectives** Participants have acquired a deepened understanding of an application area for Data Science methods. Students have the ability to analyze problems in this application area of Data Science, to map them to paradigms of Data Science, to develop and implement solutions, and to ascertain the quality of solutions. They are able to develop new ideas and methods, consider the options given incomplete information and assess them based on various metrics. They are able to present and defend the results of their work in public using appropriate presentation media and possess advanced communication and organizational skills.
Module examinations (number, form, scope):	One exam of the following format: Written exam, 90 min Oral exam, 30 min Portfolio exam consisting of seminar presentation (20 min) and accompanying written elaboration (10-20 pages)
Independent study time (in hours):	120

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related supplementary module (partial) exam(s) (number, form, scope)
		For completing the module	For admission to the module exam	
Lecture / seminar / tutorial / Project (lecture or seminar or tutorial)	4	-	-	-

Offered:	Once per year
Prerequisite for taking the module:	Recommended: INF-DS-C-4
Teaching units:	Computer science (20%) Mathematics (20%) Earth sciences (20%) Business informatics (20%) Biology/biochemistry (20%)

INF-DSAM7: Computer Engineering for Big Data	Number of credit points (CPs): 6
Module type (mandatory or elective module):	Elective module
Content and objectives of module:	**Contents** The module introduces students to the topics of process architecture for Big Data applications, high performance computing architectures, data analysis, and applications of predictive models (such as neural networks) to embedded systems and hardware design in Data Science. **Objectives** Students possess comprehensive, detailed, and specialized knowledge at the state of the art of hardware architecture for Big Data applications. Students are able to assess the suitability of various processor architectures to specific data analysis problems and to select appropriate architectures. They are familiar with challenges in implementing analytical and predictive procedures in embedded systems. They are able to develop new ideas and methods, to consider the options given incomplete information, and to assess them based on various metrics.
Module examinations (number, form, scope):	One exam of the following format: Written exam, 90 min Oral exam, 30 min
Independent study time (in hours):	120

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related supplementary module (partial) exam(s) (number, form, scope)
		For completing the module	For admission to the module exam	
Lecture or seminar (lecture or seminar)	2	-	-	-
Exercise or project (exercise)	2	Successful completion of the exercise assignments	-	-

Offered:	Summer semester
Prerequisite for taking the module:	None
Teaching unit:	Computer science

INF-DSAM9: Computational Foundations of Data Science	Number of credit points (CPs): 6
Module type (mandatory or elective module):	Elective module
Content and objectives of module:	**Contents** The module imparts some of the computational foundations of Data Science. It covers a selection of topics in algorithm engineering and complexity, the science of computing, and methods of artificial intelligence. **Objectives** Students possess comprehensive, detailed, and specialized knowledge at the state of the art of some of the computational foundations of Data Science. Students possess in-depth knowledge of selected Data Science methods. They have the ability to analyze novel problems in machine learning, to develop and implement solutions, and to ascertain the quality of solutions. They are able to develop new ideas and methods, to consider the options given incomplete information, and to assess them based on various metrics.
Module examinations (number, form, scope):	One exam of the following format: Written exam, 120 min, oral exam, 30 min
Independent study time (in hours):	180

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related supplementary module (partial) exam(s) (number, form, scope)
		For completing the module	For admission to the module exam	
Lecture and tutorial (lecture and tutorial)	4	Successful completion of the exercises (70%)	-	-

Offered:	Every semester
Prerequisite for taking the module:	None
Teaching unit:	Computer science

INF-DS-C1: Machine Learning	Number of credit points (CPs): 9
Module type (mandatory or elective module):	Mandatory module
Content and objectives of module:	**Contents** The module covers a selection of topics in machine learning, such as generalized linear classification and regression models, neural networks, graphical models, reinforcement learning, recommendation algorithms. **Objectives** Students possess comprehensive, detailed, and specialized knowledge at the state of the art of selected specialties in machine learning. Students have the ability to analyze model-building problems, to map paradigms of machine learning and Bayesian statistics, to develop and implement solutions, and to ascertain the quality of solutions with suitable evaluation protocols. They are able to develop new ideas and methods, to consider the options given incomplete information, and to assess them based on various metrics.
Module (partial) exam(s) (number, form, scope):	Oral exam, 30 min
Independent study time (in hours):	120

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related supplementary module (partial) exam(s) (number, form, scope)
		For completing the module	For admission to the module exam	
Inverted classroom (seminar)	2	-	-	-
Online lecture (lecture)	-	-	-	-
Lab exercise (tutorial)	2	Successful completion of the exercise assignments	-	-

Offered:	Summer semester
Prerequisite for taking the module:	None
Teaching unit:	Computer science

<table>
<tr><td colspan="2">INF-DS-C2: Data Infrastructures and Software Engineering</td><td colspan="3">Number of credit points (CPs): 6</td></tr>
<tr><td>Module type (mandatory or elective module):</td><td colspan="4">Mandatory module</td></tr>
<tr><td>Content and objectives of module:</td><td colspan="4">Contents

The module covers content in software engineering, information systems, databases, and parallel programming paradigms.

Objectives

Students possess comprehensive, detailed, and specialized knowledge at the state of the art of selected specialties of software engineering, information systems, databases, and parallel programming paradigms. Students possess the ability to analyze problems, to map them to paradigms from the field, to develop and implement solutions, and to ascertain the quality of solutions. They are able to develop new ideas and methods, to consider the options given incomplete information, and to assess them based on various metrics.</td></tr>
<tr><td>Module examinations (number, form, scope):</td><td colspan="4">One exam of the following format:
Written exam, 90 min
Oral exam, 30 min</td></tr>
<tr><td>Independent study time (in hours):</td><td colspan="4">120</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td rowspan="2">Courses (type of teaching)</td><td rowspan="2">Contact time (in semester hours)</td><td colspan="2">Supplementary exam work (number, form, scope)</td><td rowspan="2">Course-related supplementary module (partial) exam(s) (number, form, scope)</td></tr>
<tr><td>For completing the module</td><td>For admission to the module exam</td></tr>
<tr><td>Lecture and tutorial (lecture and tutorial)</td><td>2L + 2T</td><td>Successful completion of the exercises (70%)</td><td>-</td><td>-</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="2">Offered:</td><td colspan="3">Every semester</td></tr>
<tr><td colspan="2">Prerequisite for taking the module:</td><td colspan="3">None</td></tr>
<tr><td colspan="2">Teaching unit:</td><td colspan="3">Computer science</td></tr>
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<tr><td colspan="2">INF-DS-C3: Data Science and Business Analytics</td><td colspan="3">Number of credit points (CPs): 9</td></tr>
<tr><td>Module type (mandatory or elective module):</td><td colspan="4">Mandatory module</td></tr>
<tr><td>Content and objectives of module:</td><td colspan="4">Contents

The module covers a selection of the following topics: programming and employing analytical frameworks (in Python, for example), preparing and visualizing data, gathering data by crawling and using web services, using parallelization frameworks (such as Spark), data warehousing.

Objectives

The students are familiar with the basic concepts, methods, approaches, and tools used in business analytics and be able to explain, assess, and apply them self-sufficiently. They are able to recognize appropriate issues, especially business, analyze them methodically, present results, and if applicable extrapolate the practical implications. They are able to present and defend the results of their work in public using appropriate presentation media and possess advanced communication and organizational skills.</td></tr>
<tr><td>Module examinations (number, form, scope):</td><td colspan="4">One exam of the following format:
Written exam, 90 min
Oral exam, 30 min</td></tr>
<tr><td>Independent study time (in hours):</td><td colspan="4">150</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td rowspan="2">Courses (type of teaching)</td><td rowspan="2">Contact time (in semester hours)</td><td colspan="2">Supplementary exam work (number, form, scope)</td><td rowspan="2">Course-related supplementary module (partial) exam(s) (number, form, scope)</td></tr>
<tr><td>For completing the module</td><td>For admission to the module exam</td></tr>
<tr><td>Lecture and lab (lecture and lab)</td><td>2L + 2T</td><td>Successful completion of the exercises (70%)</td><td>-</td><td>-</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="2">Offered:</td><td colspan="3">Winter semester</td></tr>
<tr><td colspan="2">Prerequisite for taking the module:</td><td colspan="3">None</td></tr>
<tr><td colspan="2">Teaching units:</td><td colspan="3">Computer science (50%)
Business informatics (50%)</td></tr>
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INF-DS-C4: Applied Data Science	Number of credit points (CPs): 6
Module type (mandatory or elective module):	Mandatory module
Content and objectives of module:	**Contents** The module covers the basics of at least one application area of Data Science. The module goes into the specific data analysis issues and performance metrics in this field, explains the models used in this application area, and covers the challenges of applying Data Science methods. **Objectives** Participants have acquired an understanding of fundamental concepts and the ability to use various approaches in an area of application of Data Science methods. Students have the ability to analyze problems in this application area of Data Science, to map them to paradigms of Data Science, to develop and implement solutions, and to ascertain the quality of solutions. They are able to develop new ideas and methods, consider the options given incomplete information and assess them based on various metrics.
Module examinations (number, form, scope):	One exam of the following format: Written exam, 90 min Oral exam, 30 min Portfolio exam consisting of a project report (10-20 report) and associated seminar presentation (20 min)
Independent study time (in hours):	120

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related supplementary module (partial) exam(s) (number, form, scope)
		For completing the module	For admission to the module exam	
Lecture or seminar (lecture or seminar)	4	-	-	-
Exercise or project (exercise)	2	Successful completion of the exercise assignments	-	-

Offered:	Winter semester
Prerequisite for taking the module:	None
Teaching units:	Computer science (20%) Mathematics (20%) Business informatics (20%) Earth sciences (20%) Biology/Biochemistry (20%)

INF-DS-RMA: Research Module A	Number of credit points (CPs): 12
Module type (mandatory or elective module):	Elective module
Content and objectives of module:	**Contents** Students familiarize themselves with a research topic in the field of Data Science and work on an individual research question developed under the advisor's supervision as a part of a research team. The complexity of the research question is adapted to the scope of the module. **Objectives** Students have the ability to analyze problems in this application area of Data Science, to map them to paradigms of Data Science, to develop and implement solutions, and to ascertain the quality of solutions. They are able to develop new ideas and methods, to consider the options given incomplete information, and to assess them based on various metrics. They are able to present and defend the results of their work in public using appropriate presentation media and have advanced communication and organizational skills. They are able to take on extra responsibility within a team.
Module (partial) exam(s) (number, form, scope):	Portfolio exam consisting of a presentation (20 min.) and a project report (10-20
Independent study time (in hours):	300

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related supplementary module (partial) exam(s) (number, form, scope)
		For completing the module	For admission to the module exam	
Exercise or project (exercise)	2	-	-	-
Lecture or seminar (lecture or seminar)	2	-	-	-

Offered:	Every semester
Prerequisite for taking the module:	None
Teaching units:	Computer science (20%) Mathematics (20%) Business informatics (20%) Earth sciences (20%) Biology/Biochemistry (20%)

INF-DS-RMB: Research Module B	Number of credit points (CPs): 15
Module type (mandatory or elective module):	Elective module
Content and objectives of module:	**Contents** Students familiarize themselves with a research topic in the field of Data Science and work on an individual research question developed under the advisor's supervision as a part of a research team. The complexity of the research question is adapted to the scope of the module. **Objectives** Students have the ability to analyze research questions in this application area of Data Science, to map them to paradigms of Data Science, to develop and implement solutions, and to ascertain the quality of solutions. They are able to develop new ideas and methods, to consider the options given incomplete information, and to assess them based on various metrics. They are able to present and defend the results of their work in public using appropriate presentation media and have advanced communication and organizational skills. They are able to take on extra responsibility within a team.
Module (partial) exam(s) (number, form, scope):	Portfolio exam consisting of seminar presentation (30 min.) and accompanying project
Independent study time (in hours):	390

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related supplementary module (partial) exam(s) (number, form, scope)
		For completing the module	For admission to the module exam	
Lecture or seminar (lecture or seminar)	2	-	-	-
Exercise or project (exercise)	2	-	-	-

Offered:	Every semester
Prerequisite for taking the module:	None
Teaching units:	Computer science (20%) Mathematics (20%) Business informatics (20%) Earth sciences (20%) Biology/Biochemistry (20%)

MAT-DSAM2A Advanced Statistical Data Analysis A	Number of credit points (CPs): 9
Module type (mandatory or elective module):	Elective module
Content and objectives of module:	**Contents** Building on the content of the module MATVMD837, this module covers additional topics in statistical data analysis, such as statistical learning theory, high-dimensional statistics, or computation-intensive statistical models. **Objectives** Students possess comprehensive, detailed, and specialized knowledge at the state of the art of selected specialties of statistical analysis. Students have the ability to analyze data analysis problems, to map them to statistical paradigms, to develop and implement solutions, and to ascertain the quality of those solutions. They are able to develop new ideas and methods, to consider the options given incomplete information, and to assess them based on various metrics.
Module examinations (number, form, scope):	One exam of the following format: Written exam, 120 min, oral exam, 30 min
Independent study time (in hours):	180

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related supplementary module (partial) exam(s) (number, form, scope)
		For completing the module	For admission to the module exam	
Lecture and seminar (lecture and seminar)	4	-	-	-
Tutorial (tutorial)	2	Successful completion of the exercises (70%)	-	-

Offered:	Summer semester
Prerequisite for taking the module:	Recommended: MATVMD837
Teaching unit:	Mathematics

MAT-DSAM2B: Advanced Statistical Data Analysis B	Number of credit points (CPs): 6
Module type (mandatory or elective module):	Elective module
Content and objectives of module:	**Contents** Building on the content of the module MATVMD837, this module covers additional topics in statistical data analysis, such as statistical learning theory, high-dimensional statistics, or computation-intensive statistical models. **Objectives** Students possess comprehensive, detailed, and specialized knowledge at the state of the art of selected specialties of statistical analysis. Students have the ability to analyze data analysis problems, to map them to statistical paradigms, to develop and implement solutions, and to ascertain the quality of those solutions. They are able to develop new ideas and methods, to consider the options given incomplete information, and to assess them based on various metrics.
Module examinations (number, form, scope):	One exam of the following format: Written exam, 120 min, oral exam, 30 min
Independent study time (in hours):	120

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related supplementary module (partial) exam(s) (number, form, scope)
		For completing the module	For admission to the module exam	
Lecture and tutorial (lecture and tutorial)	4	Successful completion of the exercises (70%)	-	-

Offered:	Summer semester
Prerequisite for taking the module:	Recommended: MATVMD837
Teaching unit:	Mathematics

MAT-DSAM3A: Advanced Data Assimilation and Modeling A	Number of credit points (CPs): 9
Module type (mandatory or elective module):	Elective module
Content and objectives of module:	**Contents** The module covers a selection of additional content relating to data assimilation or to how mathematical models can be linked to data from recorded measurements. The topics deal with statistical data analysis and modeling temporal processes. **Objectives** Students possess comprehensive, detailed, and specialized knowledge at the state of the art of selected specialties of data assimilation. Students have the ability to analyze data assimilation and inference problems, to map them to paradigms in the field, to develop and implement solutions, and to ascertain the quality of solutions. They are able to develop new ideas and methods, to consider the options given incomplete information, and to assess them based on various metrics.
Module examinations (number, form, scope):	One exam of the following format: Written exam, 120 min, oral exam, 30 min
Independent study time (in hours):	180

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related supplementary module (partial) exam(s) (number, form, scope)
		For completing the module	For admission to the module exam	
Lecture or seminar (lecture or seminar)	4	-	-	-
Tutorial (tutorial)	2	Successful completion of the exercises (70%)	-	-

Offered:	Winter semester
Prerequisite for taking the module:	None
Teaching unit:	Mathematics

MAT-DSAM3B: Advanced Data Assimilation and Modeling B	Number of credit points (CPs): 6
Module type (mandatory or elective module):	Elective module
Content and objectives of module:	**Contents** The module covers a selection of additional content relating to data assimilation or to how mathematical models can be linked to data from recorded measurements. The topics deal with statistical data analysis and modeling temporal processes. **Objectives** Students possess comprehensive, detailed, and specialized knowledge at the state of the art of data assimilation. Students have the ability to analyze data assimilation and inference problems, to map them to paradigms in the field, to develop and implement solutions, and to ascertain the quality of solutions. They are able to develop new ideas and methods, to consider the options given incomplete information, and to assess them based on various metrics.
Module examinations (number, form, scope):	One exam of the following format: Written exam, 120 min, oral exam, 30 min
Independent study time (in hours):	120

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related supplementary module (partial) exam(s) (number, form, scope)
		For completing the module	For admission to the module exam	
Lecture and tutorial (lecture and tutorial)	2L + 2T	Successful completion of the exercises (70%)	-	-

Offered:	Winter semester
Prerequisite for taking the module:	None
Teaching unit:	Mathematics

MAT-DSAM8A: Mathematical Foundations of Data Science A	Number of credit points (CPs): 9
Module type (mandatory or elective module):	Elective module
Content and objectives of module:	**Contents** The module imparts some of the mathematical foundations of Data Science. A selection of topics are covered including analyzing graphs, stochastic models, and signal analysis with wavelets. **Objectives** Students possess comprehensive, detailed, and specialized knowledge at the state of the art of selected foundational areas of Data Science. Students possess in-depth knowledge of selected Data Science methods. They have the ability to analyze data assimilation and inference problems, to develop and implement solutions, and to ascertain the quality of solutions. They are able to develop new ideas and methods, consider the options given incomplete information, and to assess them based on various metrics.
Module examinations (number, form, scope):	One exam of the following format: Written exam, 120 min, oral exam, 30 min
Independent study time (in hours):	180

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related supplementary module (partial) exam(s) (number, form, scope)
		For completing the module	For admission to the module exam	
Lecture or seminar (lecture or seminar)	4	-	-	-
Tutorial (tutorial)	2	Successful completion of the exercises (70%)	-	-

Offered:	Every semester
Prerequisite for taking the module:	None
Teaching unit:	Mathematics

<table>
<tr><td colspan="5">MAT-DSAM8B: Mathematical Foundations of Data Science B Number of credit points (CPs): 6</td></tr>
<tr><td>Module type (mandatory or elective module):</td><td colspan="4">Elective module</td></tr>
<tr><td>Content and objectives of module:</td><td colspan="4">Contents
The module imparts some of the mathematical foundations of Data Science. A selection of topics are covered including analyzing graphs, stochastic models, and signal analysis with wavelets.

Objectives
Students possess comprehensive, detailed, and specialized knowledge at the state of the art of selected foundational areas of Data Science. Students possess in-depth knowledge of selected Data Science methods. They have the ability to analyze data assimilation and inference problems, to develop and implement solutions, and to ascertain the quality of solutions. They are able to develop new ideas and methods, consider the options given incomplete information, and to assess them based on various metrics.</td></tr>
<tr><td>Module examinations (number, form, scope):</td><td colspan="4">One exam of the following format:
Written exam, 120 min
Oral exam, 30 min</td></tr>
<tr><td>Independent study time (in hours):</td><td colspan="4">120</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td rowspan="2">Courses (type of teaching)</td><td rowspan="2">Contact time (in semester hours)</td><td colspan="2">Supplementary exam work (number, form, scope)</td><td rowspan="2">Course-related supplementary module (partial) exam(s) (number, form, scope)</td></tr>
<tr><td>For completing the module</td><td>For admission to the module exam</td></tr>
<tr><td>Lecture and tutorial (lecture and tutorial)</td><td>4</td><td>Successful completion of the exercises (70%)</td><td>exercises (50%)</td><td>-</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="2">Offered:</td><td colspan="3">Winter semester</td></tr>
<tr><td colspan="2">Prerequisite for taking the module:</td><td colspan="3">None</td></tr>
<tr><td colspan="2">Teaching unit:</td><td colspan="3">Mathematics</td></tr>
</table>

MAT-DSBM1: Foundations of Stochastics	Number of credit points (CPs): 6
Module type (mandatory or elective module):	Elective module
Content and objectives of module:	**Contents** This course lays the foundations for stochastics. After contextualizing and introducing the basic concepts at length, it covers the concepts of the independence of random variables, conditional probabilities and factors (expected value and variance). Then it presents the Law of Large Numbers and the Central Limit Theorem (approximation via the Gauss distribution). The lecture concludes with basic statistical applications. **Objectives** Students have the required background knowledge in linear algebra and stochastics to successfully complete the basic modules of this degree program. They have the self-organizational skills to acquire this knowledge self-sufficiently and be able to describe subject matter and thematic connections aloud.
Module examinations (number, form, scope):	One exam of the following format: Written exam, 90 min Oral exam, 20 min
Independent study time (in hours):	150

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related supplementary module (partial) exam(s) (number, form, scope)
		For completing the module	For admission to the module exam	
Online lecture (lecture)	-	-	-	-
Exercise or inverted classroom (seminar or tutorial)	2	Successful completion of the exercises (70%)	-	-

Offered:	Winter semester
Prerequisite for taking the module:	Examining Board decision under Section 5 subsection 1.
Teaching unit:	Mathematics

MATVMD837: Statistical Data Analysis	Number of credit points (CPs): 9
Module type (mandatory or elective module):	Mandatory module
Content and objectives of module:	Contents This module centers on the statistical study and quantitative analysis of the dependency between observed random variables (such as production yield/setting variables; longevity/treatment type and injury type). The linear regression model, which the course examines in detail, provides important foundations for statistically representing such relationships. This is the framework for considering research questions involving estimation, testing, and quantifying uncertainty (variance analysis). The second part of the module provides an introduction to advanced methods and approaches for investigating relationships. These include non-linear and nonparametric regression models. In addition, it covers issues of classification and dimension reduction. Objectives Students possess comprehensive, detailed, and specialized knowledge at the state of the art of the linear regression model. They have also acquired basic concepts and methods of nonparametric statistics. They can also solve complex statistical data analysis problems, consider the advantages and drawbacks of alternative modeling approaches, and evaluate them based on different metrics. They are able to use features of statistical software packages for this purpose. Academic Competences Organizing work: Self-organization, planning skills: identifying steps. Analytical techniques: Scientific thinking and working methods (devising solutions to complex research questions), discussing methods, verifying hypotheses, applying mathematical methods, working with statistical methods, working with software packages.
Module examinations (number, form, scope):	One exam of the following format: Examination, 120-180 minutes Oral exam, 30 minutes
Independent study time (in hours):	180

Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related supplementary module (partial) exam(s) (number, form, scope)
		For completing the module	For admission to the module exam	
In-depth lecture in the field of Statistical data analysis and tutorial (lecture and tutorial)	6	-	Successful completion of the Exercises and presentation of individual solutions	-

Offered:	Winter semester
Prerequisite for taking the module:	None
Teaching unit:	Mathematics

MATVMD838: Bayesian Inference and Data Assimilation				Number of credit points (CPs): 9
Module type (mandatory or elective module):	Mandatory module			
Content and objectives of module:	Contents This course covers random variables and conditional distributions, Monte Carlo processes, the Bayes Theorem, point estimates, importance sampling, Markov processes, sequential Monte Carlo processes, and data assimilation for stochastic processes. Objectives The students are familiar with the basic concepts and foundational methods and techniques of Bayes inference and assimilating data into mathematical models. There are able to apply the techniques of Bayes inference self-sufficiently and deploy their skills for solving concrete tasks.			
Module examinations (number, form, scope):	One exam of the following format: Examination, 90 minutes Oral exam, 30 minutes			
Independent study time (in hours):	180			
Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (number, form, scope)		Course-related supplementary module (partial) exam(s) (number, form, scope)
		For completing the module	For admission to the module exam	
Intermediate lecture on Bayes inference and data assimilation and tutorial (lecture and tutorial)	6	-	Successful completion of the Exercises and presentation of individual solutions	-
Offered:	Summer semester			
Prerequisite for taking the module:	None			
Teaching unit:	Mathematics			