Regulations for the study program *Artificial Intelligence and Machine Learning* *Master of Science (M.Sc.)*

Implementation terms with appendices
I: Study and examination plan
II: Competence descriptions
III: Module Description Handbook *(only published electronically)*

Resolution of the Faculty Council on 31.03.2022
Entry into force of the Regulations on 01.10.2023

TECHNISCHE UNIVERSITÄT DARMSTADT

INFORMATION:

This translation is not an official document. It is a service for our international students and prospective students.

The English translation is for information purpose only.
The legally binding document is the German version

Based on the approval of the Presidential Board of the TU Darmstadt dated 2023.05.11 (Ref.:652-7-1), the regulations of the study program Artificial Intelligence and Machine Learning (M.Sc.) (Department of Computer Science) dated 2023.02.09 concerning the General Examination Regulations of the TU Darmstadt (APB) are published.

Darmstadt, 11.05. 2023
The President of the TU Darmstadt Professor
Dr. Tanja Brühl

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Preamble

On 09.02.2023, the Faculty Council of the Department of Computer Science, in accordance with § 3 Para. 1 of the General Examination Regulations of the TU Darmstadt (APB), approved the following regulations for the Artificial Intelligence and Machine Learning Master of Science (M.Sc.) study program with the following components

1. Appendix I Study and examination plan
2. Appendix II Competence descriptions
3. Appendix III Module Description Handbook

Article 1

Implementation terms

for § 2 (1): Degree

The Artificial Intelligence and Machine Learning (M.Sc.) study program is maintained by the Department of Computer Science at TU Darmstadt. The Technical University Darmstadt awards the academic degree Master of Science once the total of 120 credit points (CP) required for the study program have been achieved.

for § 3 (4): Timing of the examinations

It is recommended that all examinations are taken in the order and semester as suggested in Appendix I.

for § 5 (3), (4): Modules, components and type of examination

In Appendix I of these regulations, the study and examination plan, specifies the type, the scope, the number and the form or category of the examination as well as the weighting with which these are included in the overall grade of the module.

Examinations taken in other departments are aligned according to by the regulations of the offering departments of TU Darmstadt.

for § 7 (1): Examination boards – joint examination board of consecutive Bachelor's / Master's study programs

A joint examination board is established for the study program Computer Science (M.Sc.) and the study programs Informatik (B.Sc.), Informatik (M.Sc.), Autonome Systeme und Robotik (M.Sc.) and Artificial Intelligence and Machine Learning (M.Sc.).

for § 11 (5): General admission requirements - language of instruction

The language of instruction for the study program is English.
Individual courses/modules may be offered in German. This is indicated in the module description.
It is to be assumed that scientific literature is also to be read and processed in German

for § 17a (1): Admission requirements for Master's programs

In the following, the admission requirements for the Master's program Artificial Intelligence and Machine Learning (M.Sc.) and, in particular, the previous knowledge and qualifications (entry competencies) required by the applicants are specified.

Applications for the Master's program Artificial Intelligence and Machine Learning (M.Sc.) are possible for applicants for a winter semester until July 15th of the year (cut-off deadline) and until January 15th of the year for a summer semester (cut-off deadline).

for § 17a (2): Entry competencies for a consecutive Master's program

The entry competencies for the consecutive Master's program Artificial Intelligence and Machine Learning (M.Sc.) result from the competence profile of the Bachelor's program Informatik (B.Sc.) of TU Darmstadt as the reference study program entitling to the Master's program.

The admission requirement for the Master's study program Artificial Intelligence and Machine Learning (M.Sc.) is a Bachelor's degree in Informatik (B.Sc.) from the TU Darmstadt or a degree in a study program which imparts competencies amounting to at least 180 CP, of which at least 60 CP are not significantly different from the entry competencies taught in the reference study program (comparable study program).

Details on the entry competencies taught in the reference study program at TU Darmstadt are provided in the competence description in Appendix II.

for § 17a (4) a) and b): Formal entrance examination

During the formal entrance examination, the proof of the required entrance competencies is verified on the basis of the written documents to be submitted by the applicants.

The following documents must be submitted: the certificate of the first degree and the Diploma Supplement or comparable documents of the study program leading to the first degree.

for § 17a (4) c) (5): Substantive Entrance Examination

If the entrance competencies could not be clearly clarified positively or negatively within the formal entrance examination, a substantive entrance examination is then conducted.

The entrance examination cannot be repeated in this application procedure.

Within the substantive entrance examination, an oral examination lasting 30 minutes will be conducted on the premises of the TU Darmstadt or an oral examination procedure of 30 minutes will be conducted via video telephony, which is harmless in terms of data protection.

If it is foreseeable during the application period that more than 10 applicants will have to take a substantive entrance examination or that a video telephone call cannot be carried out properly, the examination board may decide that the suitability of the candidates will be checked instead by a written examination lasting 90 minutes on the premises of the Technische Universität Darmstadt or by a written examination procedure as an online test.

The examination board determines the form and time of the substantiveentrance examination and appoints examiners. The examiners determine the content of the examination with the aim of establishing the applicant's suitability for the M.Sc. Artificial Intelligence and Machine Learning study program at TU Darmstadt.

The examination board may exempt an applicant from the substantive entrance examination if it is to be expected that he or she will successfully complete the Master's program on the basis of an admission and aptitude test of another university or a private provider with corresponding standards (e.g. GRE or comparable tests).

for § 17a (8): Conditional Admission

If, after the entrance examination, it is found that the applicant lacks entrance competencies that can be compensated for by completing credits amounting to no more than 30 CP, a conditional admission may be granted. The letter of admission lists the modules or subject examinations that are imposed and by when they must be completed.

The conditions are governed by the General Examination Regulations (APB) of Technical University of Darmstadt with the exception of the second repeat examination in accordance with Section 31 APB and the oral supplementary examination in accordance with Section 32 APB, i.e. only two attempts per condition are permitted.

for § 18: Admission requirements

The admission requirements for examinations or modules, if any, are set out in Appendix I to these implementing regulations, the study and examination plan, and in Appendix III, the module descriptions.

for § 22 (1): Conduct of the examinations - Duration of the oral examination

The duration of the oral examination (at least 15 min. per person and examination) is specified in each case in Appendix I to these implementing regulations, the study and examination plan.

for § 22 (5): Conduct of the examinations - duration of proctored examinations

The duration of the proctored examinations (at least 45 min.) is specified in each case in Appendix I to these implementation provisions, the study and examination plan.

for § 22 (6): Conduct of examinations - special forms of examinations

The duration of the examination is specified in Appendix I to these implementation provisions, the study and examination plan, in accordance with § 22 (1) and (5) APB.

for § 23 (5): Thesis - processing time

The thesis comprises a workload of 30 CP (900 hours) and must be completed and submitted within 26 weeks.

for § 25 (1), (3): Formation and weighting of grades

The grading system for each examination performance is set out in Appendix I to these implementing provisions, the study and examination plan. The study and examination plan also specifies the weighting with which the grades of the subject examinations and coursework are included in the module grade.

for § 28 (2): Overall grade

Appendix I of these implementation provisions, the study and examination plan, specifies the weighting of the module grades in the overall grade. Unless otherwise specified in Appendix I, the module grades shall be included in the overall grade according to the credit points acquired in the modules.

Article 2

Appendixes

Appendix I Study and Examination Plan

Master study program

Artificial Intelligence and Machine Learning (M.Sc.)

TECHNISCHE UNIVERSITÄT DARMSTADT

Informatik

Study and examination plan (Appendix I)

Key			Examination components							Course					Semester			
Grading system	St= Standard (graded); bnb= passed/not passed														Examinations are assigned to semesters for guidance only.			
Forms of examinations	A = submission, B = report, E = essay, H = research assignment, HÜ = homework, worksheets, K = written exam, Kq = colloquium, M = oral examination as specified in module description, mP = oral examination, M/S = oral/written examination as specified in module description, P = log, Pt = presentation, R = seminar paper, S = written examination as specified in module description, SF = special form, Th = thesis																	
Status:	o= compulsory; f= optional																	
Forms of teaching	VL=Lecture; S=Seminar; Ü=tutorial; iV= integrated lecture; VÜ=lecture and tutorial; PR=Lab; …																	
Compulsory attendance:	yes = courses with compulsory attendance according to §11 (6) APB, except lectures, justification in the module description. MHB = see module handbook, modules with compulsory attendance in this area, if applicable.														Study Load per semester (CPs)			
Grade improvement attempt (optional):	x = A grade improvement attempt in accordance with § 30 (1a) APB is only possible in the examination(s) correspondingly marked with x.																	
Prerequisite for admission	MHB: see module handbook, for this examination or module there is a prerequisite for admission according to §18 APB.																	
CP:	Credit Point																	
TUCaN number and assignment of CPs to module elements are informative in nature. The CPs are given once the module is completed.		Prerequisite for admission	Subject examinations (Fachprüfungen)	Study credits (Studienleistungen)	Form of examination	Grade improvement attempt in accordance with § 30 (1a) APB	Duration (min)	Weighting for module grade (%)	Weighting for overall grade (factor)	Contact hours per week (SWS)	Status	Form of teaching	Compulsory attendance	Total CPs	1.	2.	3.	4.
Elective Areas and Generale Education														**90**	**30**	**30**	**30**	
A Elective Areas (open catalogues)											o			**72-84**	72-84			
A.1 Subject examinations from the elective areas of the M.Sc. Artificial Intelligence and Machine Learning (open catalogues)											o			**60-72**	60-72			
Foundations of Artificial Intelligence (Typ § 30 Abs. 5 APB)											o							
Foundations of Artificial Intelligence (Typ § 30 Abs. 5 APB)									1		o			**18-30**	18-30			
AI Models and Methods (Typ § 30 Abs. 5 APB)											o							
AI Models and Methods (Typ § 30 Abs. 5 APB)									1		o			**18-30**	18-30			
AI Systems (Typ § 30 Abs. 5 APB)											o							
AI Systems (Typ § 30 Abs. 5 APB)									1		o			**12-24**	12-24			
AI Domains and Applications (Typ § 30 Abs. 5 APB)											o							
AI Domains and Applications (Typ § 30 Abs. 5 APB)									1		o			**12-24**	12-24			
A.2 Seminars, Labs, Practical Labs in Teaching (Type § 30 Abs. 6 APB). Choice from the listed catalogues of the M.Sc. Artificial intelligence and Machine Learning. Examination form and duration according to the specifications of the department offering the course. Open catalogues min. 12 CP - max. 24 CP											o			**12-24**	12-24			
Seminar (min. 1)									1		o			3-18	3-18			
Practical lab in teaching (max. 1)									1		f			0-5	0-5			
Lab, Project Lab, etc. (min. 1)									1		o			6-21	6-21			
Research Paper									1		**f**			0-9	0-9			

B General Education (Type § 30 Abs. 6 APB) Courses from the overall catalogues of TU Darmstadt except for the Department of Computer Science (other catalogues can be added if necessary). Examination form and duration according to the specifications of the department offering the course. min. 6 CP - max. 18 CP											o			**6-18**	6-18			
Electives: Languages											f			**0-18**				
Gesamtkatalog des Sprachenzentrums								1			f				0-18			
Electives: Humanities, Social Science, Economics & Business Administration											f			**0-18**				
Gesamtkataloge der Fachbereiche 01, 02, und 03								1			f				0-18			
Electives: Environmental Studies, Engineering, Natural Sciences											f			**0-18**				
Gesamtkataloge der Fachbereiche 04, 05, 07, 10, 11, 13, 15, 16, 18								1			f				0-18			
Masterarbeit														**30**				
20-AM-5700	Master Thesis Artificial Intelligence and Machine Learning		St		Th			1			o							30
								Total						**120**	30	30	30	30

Appendix II Competence Descriptions

Entry competencies:

The entry competencies described below are essential for the successful completion of the M.Sc. Artificial Intelligence and Machine Learning. It is a selection of the most important competencies taught in the reference study program at the TU Darmstadt. These also provide the essential prerequisites for the successful continuation of the study program in a subsequent Master's study program.

Within the competencies of at least 180 CP to be proven from their previous degree, applicants for the M.Sc. Artificial Intelligence and Machine Learning must prove entry competencies of a total of 60 CP from the reference study program or equivalent competencies for an admission.

The following describes the entry competencies for the M.Sc. Computer Science:

- **Theoretical Computer Science:** the ability to use mathematical notations and methods for the foundation of concepts in computer science, in particular for the formal modelling and verification of software and hardware systems. Courses in which these entry-level competencies are taught in the reference study program at TU Darmstadt are: Propositional and Predicate Logic; Automata, Formal Languages and Decidability; Modelling, Specification and Semantics.
- **Practical computer science:** the ability,
    - to independently select the standard algorithms and data structures required for the solution from a problem description according to the functional and non-functional requirements or to construct and assess new algorithms and data structures for solving the problem on the basis of known strategies, if necessary taking parallelism into account.
    - to combine the individual components of a programming language independently and without an analogous example within the framework of a programming task into an overall solution.
    - to solve programming tasks in different, also parallel, programming languages that follow different paradigms, have different application areas and are located on the whole range of abstraction levels.
    - to ensure the quality of the created implementations through formalised test procedures and design methods.
    - to apply this knowledge in practically relevant areas of computer science such as networks and distributed systems, databases, as well as the creation of programming tools themselves. In each case, non-functional aspects, in particular also the security of the IT systems created, should also be taken into account.

  These entry-level competencies in practically relevant areas of computer science are taught in the reference study program at the TU Darmstadt in the following courses: Algorithms and Data Structures; Operating Systems; Computer Security; Computer Networks and Distributed Systems; Introduction to Compiler Construction; Introduction to Artificial Intelligence; Functional and Object-oriented Programming Concepts; Formal Methods in Software Design; Information Management; Parallel Programming; Probabilistic Methods in Computer Science; Scientific Computing; Software Engineering; Visual Computing.

- **Computer engineering**: the ability,
    - to independently combine the individual design principles and basic elements of digital circuits, as introduced separately one after the other in the lectures, into an overall solution within the framework of a hardware design task without using an analogue example.
    - to solve design tasks at different levels of abstraction and from different application areas by means of structured design methods in different description languages and using a spectrum of design tools and evaluate them with regard to suitable quality measures.
    - to understand the interaction of computer, processor and microarchitectures and make appropriate implementation decisions from this for the system and application software level.

  Courses in which these entry-level competencies are taught in the reference study program at TU Darmstadt are Digital Design and Computer Organisation.

- **Artificial intelligence and machine learning:** the ability to,
    - independently conclude from the description of a computer science problem that artificial intelligence (AI) is required to solve it, identify the necessary AI approaches, AI standard algorithms and AI representations in accordance with the functional requirements, apply individual design principles and basic methods from artificial intelligence, as well as independently combine them into an overall solution within the framework of an AI system design task without using an analogue example.
    - solve design tasks in data science and machine learning at different levels of abstraction and from different application areas through structured design methods in different description languages and using a spectrum of design tools and evaluate them with regard to suitable quality measures.

These entry-level competencies are taught in the following courses of the reference study program at TU Darmstadt: Introduction to Artificial Intelligence; Information Management; Probabilistic Methods in Computer Science.

Qualification goals:

In the research-oriented Master of Science program Artificial Intelligence and Machine Learning (AIM), students develop their subject-specific and interdisciplinary competencies in the field of Artificial Intelligence (AI) and Machine Learning (ML), building on prior knowledge from a previous Bachelor's program in Computer Science or a Bachelor's program with comparable competencies. These competencies are characteristic for the program's requirements and are an essential prerequisite for a subsequent doctorat.

After completing the study program, graduates are able,

- to independently process complex problems and tasks from artificial intelligence and machine learning with scientific methods, considering different solution approaches, with their improved methodological competence,

- to implement these competencies in new and unfamiliar situations with incomplete information and to think in systemic contexts,
- to solve tasks and problems with a high level of abstraction and an eye for complex interrelationships,
- to recognise future problems, technologies and scientific developments and to take them into account appropriately in their work,
- communicate and present the results of their analyses or the elaborated solutions to different target groups, also in foreign languages,
- to organise and carry out complex projects efficiently and to work in teams in a goal-oriented manner,
- to further their professional education independently and to work scientifically to a large extent on their own,
- in addition, within the framework of the general Education, students have expanded their skills and experience in self-selected extracurricular areas.

In summary, the Master's program in Artificial Intelligence and Machine Learning (AIM) develops students' abilities to solve complex problems with incomplete information using approaches from Artificial Intelligence and Machine Learning, to develop new methodological approaches and abstract models for Artificial Intelligence and/or Machine Learning, to realize new AI/ML systems and to use them in application problems that cannot be solved with traditional computer science problems. In addition, students should be able to deal with the current research literature and be able to work scientifically in an area of AI/ML of their choice and independently solve current problems in practice.

Appendix III Module Descriptions

The module descriptions are published electronically as a module handbook in accordance with § 1 Para. (1) of the statutes of the Technische Universität Darmstadt regulating the publication of statutes of the Technische Universität Darmstadt of 18 March 2010.

Article 3

Entry into force

These regulations of the study program come into force on October 1st 2023. They are published in the statute supplement of TU Darmstadt.

Darmstadt, 22 May 2023

The Dean of the Department of Computer Science at TU Darmstadt