

University of Tübingen exam regulations for the degree program in Machine Learning culminating in an examination for a Master of Science (M. Sc.) – Special Provisions –

In accordance with §§ 19 (1) sentence 2 no. 9, 32 (3) LHG (GBl. 2005, 1), as amended on 1 April 2014 (GBl. p. 99), most recently amended by article 2 of the law dated 23 February 2016 (GBl. 2016, p. 108), the University of Tübingen Senate on ... passed the Special Provisions of these exam regulations for the study program in Machine Learning at the University of Tübingen culminating in an examination for a Master of Science (M. Sc.) degree.

Approved by the President and Vice-Chancellor on ...

§ 1 Validity of General Provisions

The University of Tübingen exam regulations for the Machine Learning degree program culminating in the academic degree of Master of Science (M.Sc.) – General Provisions – as amended are part of these exam regulations, insofar as no other special provisions have been made.

I. Goals, contents and structure of the program

§ 2 Contents and goals, prescribed minimum period for completion, volume, and start date of program

1. The Master's program is a research-oriented program following on from a Bachelor's degree in the same field. The M.Sc. in Machine Learning program allows students to obtain long-term scientific qualifications aimed at obtaining and increasing knowledge in a systematic and critical way, and justifying a general scientifically-based occupational qualification for students in the field of Machine Learning; the program builds upon a first degree in the field. Machine learning is a branch of informatics dealing with the automatic and efficient construction of models for data, and particularly with the construction and adaptation of hypotheses and explanations for latent relationships in the physical and man-made social environment. Students are required to learn to deal with problems and challenges associated with data sources and the development of models and algorithms for this purpose, using scientific methods, and to critically evaluate the scientific literature. Students learn the theoretical methods for problem solving and their practical application.
2. The prescribed minimum period of study in the Machine Learning Master's program is set out in § 1 (5) of the General Provisions of these exam regulations. A total of 120 credit points must be obtained to successfully complete this M.Sc. degree program. The start of the program (winter or summer semester) is set out in the regulations governing admission and enrollment at the University of Tübingen, as amended.

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3. A prerequisite for enrollment in this Master's program is a Bachelor's degree in Informatics or a related subject, particularly Mathematics or Physics, with a regular duration of study of six semesters and courses worth 180 credit points, or an equivalent degree. This degree must have been completed with a grade of 2.3 or better. In particular, these skills in the following areas are required, equivalent in content and scope to those in the B.Sc. in Informatics program in Tübingen:

- Mathematics: single- and multi-dimensional analysis, linear algebra and either
- Numerics or stochastic processes
- Informatics: Programming, algorithms and data structures

A further requirement for admission to the Master's program is very good English language skills; this must be documented by one of the following:

- German Abitur certificate with proof of 6 (G8) or 7 years (G9) of English lessons
- TOEFL iBT test with at least 94 points
- IELTS test with points of at least 7.0
- Cambridge Certificate in Advanced English (CAE)
- Higher education entrance qualification from the United Kingdom, Ireland, USA, Canada, Australia, New Zealand

In exceptional circumstances the examination board may accept other certificates documenting an equivalent level of language competence. The examination board decides on whether candidates are qualified. The examination board may transfer the making of this decision revocably to the head of the board.

§ 3 Structure

(1) The Master's degree program in Machine Learning is structured as a two-year program. It concludes with the Master's examination.

(2) Students complete a program of 120 credit points. Classes and required studies are divided into the following study areas:

- Foundations of Machine Learning*
- Diverse Topics in Machine Learning*
- General Computer Science*
- Expanded Perspectives*
- Master's thesis

Only graded modules may be credited.

Students must select modules so as to make up the required total of ECTS credits. Within these areas, the modules given in the table below may be selected (subject to when each module is offered; see module handbook). Further elective modules may be set out in the module handbook. If such elective options exist, students must make use of them so that the exact required number of credit points is reached in each study area or sub-area, unless the examination board approves a different schedule. ECTS

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credit points obtained beyond the total required number are not included in the final grade.

Study area	Module name	Recommended semester (subject to availability and any changes set out in the module handbook)	ECTS credits
Foundations of Machine Learning	Statistical Learning	1-2	9
	Probabilistic Inference and Learning	1-2	9
	Statistical Learning	1-2	6
Diverse Topics in Machine Learning	Mathematics for ML	1	9
	Data Literacy	1	6
	ML internship	1-3	6
	ML seminar	1-3	3
	Statistical Learning Theory	2-3	6
	Numerical Algorithms of ML	2-3	6
	ML in Graphics and Vision	1-3	6
	Self-Driving Cars	1-3	6
	Time Series	1-3	6
	Convex and Non-convex Optimization	2-3	9
General Computer Science	All graded Master's and Bachelor's classes in Informatics (see sentence 4 below).	1-3	18
Expanded Perspectives	All graded University classes except those of the University Sports Center (details in sentence 5 below).	1-3	12
Master's thesis	Master's thesis including lecture	4	30

(3) The shares of the areas mentioned above in the program structure are limited as follows:

- (a) 24 ECTS points must be obtained in the **Foundations of Machine Learning** study area.
- (b) 36 credit points must be earned in the study area **Diverse Topics in Machine Learning**. Of those credit points, 6 at most may be obtained through seminars, and 6 credits at most may be earned via an internship.
- (c) 18 ECTS credit points must be obtained in the **General Computer Science** study area.

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- (d) In the study area **Expanded Perspectives** 18 ECTS credit points must be completed.
- (e) A successfully completed **Master's thesis** including lecture is credited with 30 ECTS points.

(4) All graded Master's and Bachelor's classes in Informatics may be accredited to the *General Computer Science* study area. Some classes may be excepted; the examination board shall decide on a list of exceptions.

(5) For the *Expanded Perspectives* study area, all graded University classes except those of the University Sports Center may be accredited. Some classes may be excepted; the examination board shall decide on the list of exceptions. Grades obtained from classes in the *Expanded Perspectives* study area are not included in the calculation of the final grade (see also §10).

II. Teaching of material

§ 4 Types of classes within the module

Classes of the following types in particular may be scheduled:

1. Lecture (with or without practical work)
2. Seminars and colloquia
3. Exercises and internships
4. guided project collaboration in the context of a working group (research project)

Within the framework of § 30 (5) sentence 1 LHG the number of participants in seminars, colloquia, exercises, internships and/or project work may be restricted if correct training cannot otherwise be guaranteed in accordance with the regulations or a limitation is necessary for other reasons of research or teaching. Subject-related techniques in particular are to be taught in these classes along with interdisciplinary, professionally-oriented qualifications. In addition, students are to have the opportunity to work in small groups to develop the ability to present the knowledge obtained both verbally and in written form. In addition, within the framework of § 30 (5) sentence 1 LHG the right to participate in classes may be restricted or admission to part of the course may be made dependent on the completion of certain coursework, if training could not otherwise be guaranteed in accordance with the regulations or a limitation is necessary for other reasons of research, teaching or patient care.

§ 5 Languages of instruction and examination

English is the language of instruction and examination in this Master's degree program. All coursework is to be done in English. Students are required to be sufficiently competent in English.

§ 6 Types of assessment

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The assessed work required in each of the modules is set out in § 3 and/or in the module handbook.

III. Organization of program

§ 7 Volume of material

The required volume of study arises from the General Provisions of the exam regulations, the structure of the program and the modules - particularly from § 3 of the Special Provisions of the exam regulations and/or the module handbook.

IV. Master's examination and overall grade

§ 8 Nature and procedure of Master's examination

There are no requirements for admission to the Master's thesis process or possible oral examinations to be completed in the final phase of the program other than those set out under § 15 of the General Provisions.

§ 9 Master's thesis

Provisions governing the Master's thesis are set out in § 17 of the General Provisions of these exam regulations. A Master's thesis in a field relating to Machine Learning may be done under the auspices of any professorship within the Department of Informatics.

§ 10 Calculation of the Master's overall grade

The overall grade of the Master's examination is calculated from the average (as weighted by credit points) of all grades given in the credited graded modules, including the Master's thesis module, and taking account of the further provisions in § 21 of the General Provisions of these exam regulations. Modules in the *Expanded Perspectives* study area are not included in the overall grade.

V. Closing remarks

§ 11 Effective date

These exam regulations come into effect on the date of their publication in the University of Tübingen's official bulletin, the Amtliche Bekanntmachungen. Their first semester of validity is the winter semester 2019/2020.

Tübingen, 26.06.2015

Professor Dr. Bernd Engler, President