



Computer Science Study Guide

Master of Science ETH

Master's Programme in Computer Science Study Guide

Programme Regulations 2020

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1 Introduction

This document contains important information for successful completion of the Master's programme in Computer Science at ETH. It comprises a short description of the Master's programme structure, the majors and minors, and other essential information on how to plan your studies. All students should read this document carefully, as it will help them to choose their courses and plan their personal study programme. It is the student's responsibility to fulfill the requirements of the programme. Do not hesitate to contact one of the persons below for further advice.

1.1 Study Administration and Student Advisory Services

For questions not covered by this study guide, the Department of Computer Science (D-INFK) offers various services. For names and addresses of the following officials, see the inside front cover.

- The Director of Studies is responsible for the degree programmes, examination regulations and the validation of examination results. All requests addressed to the Director of Studies should be submitted to the Studies Administration Office in written form.
- The Studies Administration Office can help you with most issues, in particular with administrative concerns. In any case, it can refer students to the right person.
- For questions concerning military service (for Swiss citizens only), the Studies Administration Office can be consulted as well.
- Students interested in studying abroad, please contact the Mobility Advisor of the Department of Computer Science and the Student Exchange Office (see section Student Exchange Programme)
- The Psychological Counselling Service offers a variety of services for confidential assistance with personal and academic problems; for example, how to deal with competitive situations such as examinations. It is of great advantage to seek help early. The Psychological Counselling Service is free

of charge for all students enrolled at ETH Zurich.

- In difficult situations during your studies (e.g. coping with pressure and stress, low motivation, fear of exams, making decisions, learning how to study), students can contact the Counselling & Coaching team.

The **Verein der Informatik Studierenden (VIS)** is the computer science student union at ETH Zurich (www.vis.ethz.ch). One of its valuable services is to collect and provide previous examination papers for the purpose of exam preparation. VIS also organises several events, such as barbecues and a ski camp in winter. Furthermore, VIS helps networking, organises excursions to companies and provides contacts for internships.

VIS is part of VSETH, the overall student's association. As such, when a student becomes a registered VSETH member (check the VSETH box on the registration form), they automatically become a VIS member as well. They are encouraged to also become a member of the organising committee, as VIS requires the active assistance of students. Drop in at the VIS office (CAB E 31) for a coffee and make new friends!

MoEB (Committee for Master's students without an ETH Bachelor's degree)

MoEB is a section of VIS. It was founded to support Master's students without an ETH Bachelor's degree by representing their interests within the department and by offering activities to integrate them into the student community. Further information can be found at: www.vis.ethz.ch/moeb

1.2 General Information

1.2.1 Course Catalogue

All courses are listed in ETH's course catalogue: www.vvz.ethz.ch. Students will find information about the objective, content, teaching language, time schedule, and localities of the courses, as well as details about the examination and the number of credits awarded after successful completion of the courses. Please note that classes always start at 15 minutes past the hour. If the class is scheduled from 10–11, it will start at 10:15 and end at 11:00.

Note that this applies only to courses. Examinations and meetings always start punctually at the time stated.

1.2.2 Credits

All study programmes at ETH are based on the European Credit Transfer System (ECTS). For a Master's degree the acquisition of 120 ECTS credits is required. The number of credits assigned to a course is determined by the number (#) of weekly hours spent in lectures (V), in exercises (U), in lectures combined with exercises (G), in laboratories (P) and additional self-study(A).
$$\# \text{ credits} = \#V + \#U + \#G + \#A + \#P + 1$$

1.2.3 Assessments

Any method to evaluate the achievements of students on a course can serve as an assessment. Most courses, however, rely on examinations. The examinations may take place at the end of the semester (end-of-semester examinations) or at the end of the semester break (session examinations).

End-of-semester examinations are organised by the department. Students are informed of the dates by the lecturers themselves or by the Studies Administration Office. The session examinations are organised by the ETH Examinations Office and information given via *myStudies* and email.

Repetition of a failed examination is possible only after re-enrolment and full participation in the relevant course. An examination may be taken only twice.

The type of examination (end-of-semester/ session examination) the examination mode (oral/written form) and the duration are described in the course catalogue (www.vvz.ethz.ch). For further information, please contact the Studies Administration Office of D-INFK.

1.2.4 Preparing for Examinations

Solving the exercises accompanying a given course is not always mandatory. Nevertheless, we strongly encourage students to do so, as it is the best way to prepare for the examination. The Student Union (VIS, CAB E31) offers a collection of old examination papers. In general, the style of examinations does not change much from one year to another, particularly if the course is taught by the same professor. Therefore, it is worth taking a close look at the past papers.

1.3 Grading System

The grading scale at ETH ranges from 1.0 to 6.0 in quarter grade steps (0.25). The pass grade is 4.0, and the maximum grade is 6.0. The numerical grades correspond to the following predicates:

Grade	Meaning
6	Excellent (the best possible grade)
5	Good
4	Sufficient (the lowest passing grade)
3	Insufficient (fail)
2	Poor
1	Very poor (the lowest possible grade)

For some courses, the pass/fail rating is used instead of grades. Credits are awarded only if the course requirements have been fulfilled and the associated examinations have been passed successfully. If a course has been completed successfully, the full number of credits is awarded independently of the grade obtained.

1.3.1 Student Exchange Programmes

International experience, cross-cultural competence and language skills are becoming increasingly important in today's business world. The Student Exchange Office organises study placements for ETH students who hold a Bachelor's degree issued by ETH Zurich at partner universities in Switzerland and abroad within the student exchange programmes and various bilateral agreements. The individual study plan for the Master's in computer science can include credits taken at an exchange university amounting to 20 credit points. Students interested in studying abroad should contact the Mobility Advisor of D-INFK and ETH's Student Exchange Office.

The list of courses to be taken at the exchange university must be approved by the D-INFK Student Mobility Advisor in consultation with the Director of Studies of the Department of Computer Science before the exchange. The necessary forms are available at the Studies Administration Office of D-INFK.

1.3.2 Military Service

For Swiss citizens only: Official requests for deferral or dispensation of military services must be completed and handed in 14 weeks before the commencement of the military service. The forms necessary are available at the Studies Administration Office or can be downloaded at: www.zivil-militaer.ch

1.3.3 Internship

Doing an internship during your studies at ETH Zurich may be a great opportunity, but note that it is not a part of the curriculum. Therefore, the Studies Administration Office is not in position to supply a letter stating this (sometimes employers ask for such a letter in order to get the necessary work permit).

2 Master's Programme

The Master's programme in Computer Science can be completed by taking one of five majors. Each major focuses on a specific area of computer science ensuring a deep insight into a specific subject in the following areas: Data Management Systems, Machine Intelligence, Secure and Reliable Systems, Theoretical Computer Science, Visual and Interactive Computing.

The degree programme structure is the same for all majors. However, depending on the major, the constraints imposed on the choice of courses vary. The major must be chosen within the first four weeks of the start of the Master's programme. Note that the major may be changed only once during the programme; a change of major does not extend the overall duration of the programme. The following two sections give an overview of the seven areas of focus (section 2.1) and the structure of the Master's programme (section 2.2).

2.1 Majors

An introductory description of each major follows. For a more detailed description, please see the corresponding websites.

2.1.1 Data Management Systems

Modern data management involves a wide variety of systems and functionality that is at the core of any software endeavour. From machine learning to web sites, from electronic commerce to the Internet of Things, any application these days involves the management of large amounts of data. This track covers the design, development, use, operation and application of data management systems, including relational database engines, data streaming engines, key-value stores, noSQL, Spark/Hadoop and other Big Data platforms, and semi-structured graph data management systems. As a computing platform, the track looks at implementations ranging from single node to data centres, with a special emphasis on cloud computing. The track provides an in-depth look into data management systems (via core courses) and connects students (via elective courses) with relevant areas closely related to modern data management systems. The track covers the following topics:

- Data management systems
- Data processing in clusters, data centres and the cloud
- Big Data platforms
- Implementation and the system architecture of modern data management systems
- Cloud architecture
- Networking
- Operating systems
- Distributed systems

2.1.2 Machine Intelligence

Machine intelligence pursues the goal to automatically create models and design inference and decision procedures based on empirical evidence, i.e., data and human-provided knowledge. Notions of generalisation and learnability determine central conceptional challenges. Different modes of learning – supervised, weakly supervised, unsupervised, online and adaptive learning – are studied with a rigorous mathematical and statistical framework. The interplay of statistical estimation and computation touches on hardware architecture for machine learning, machine perception, high performance computation and efficient information systems. An important aspect consists of developing intelligent systems that can cope with unstructured real-world data.

The Programme at ETH focuses on:

- Foundational questions in machine learning, i.e. notions of generalisation and learnability, statistical and computational complexity
- Computer vision and machine perception
- Statistical learning with computational constraints
- Optimisation principles for machine learning with provable guarantees
- Probabilistic artificial intelligence
- Applications in the natural sciences, life sciences and engineering
- Machine learning for medical informatics

2.1.3 Secure and Reliable Systems

Secure and reliable systems are a cornerstone of the continued expansion and acceptance of the information society. Their development and analysis is at the heart of several research disciplines within computer science, including information security, programming languages and software engineering.

Students in this programme learn how to systematically construct and analyse a secure and reliable range of modern systems, including software, hardware and networks. Topics covered in this programme include:

- Cryptography
- Formal methods for the analysis and development of systems
- Programming languages and systems for reliable, secure and performant software
- Network security
- Reliability and security of machine learning
- Security and software engineering

2.1.4 Visual and Interactive Computing

The digital processing of visual information has become a core topic in modern computer science and information technology. Building on theoretical foundations from computer science and applied mathematics, visual computing is core to a diverse array of application domains: image generation and analysis, computational photography, modelling and control of robotic systems, virtual and augmented reality, computational fabrication, user interfaces, interaction techniques and interactive devices, etc.

Methodologically, visual computing is rooted in computer graphics, algorithmic geometry, digital image processing and computer vision. Strong conceptual and algorithmic links to computational sciences and machine learning provide visual computing with the tools necessary to solve large-scale visualisation and inference problems.

2.1.5 Theoretical Computer Science

The goal of theoretical computer science (TCS) is to understand the fundamental concepts of computation and information, comparable in spirit to the goal of physics: understanding fundamental concepts such as matter and energy. TCS topics include models of computation (from automata theory to quantum computers), algorithms and data structures, computability and computational complexity theory, information theory and cryptography. Randomness is a core concept cutting across all areas of TCS.

The programme at ETH focuses on:

- Algorithms, data structures, and their applications
- Theory of combinatorial and geometric algorithms
- Randomised algorithms and probabilistic methods
- Cryptography and information security
- Mathematical foundations of these topics

2.2 Master’s Programme Structure

The Master’s Programme in Computer Science is divided into several course categories as shown in Figure 1. The minimum number of credits required for completing the degree is listed next to the course categories. The major requires 26 credits, from which at least 16 credits must be obtained from the Core Courses. The remaining 10 credit points may be obtained from the Core Electives or from the Core Courses. The accumulated minimum credits from all categories amount to 102. The remaining 18 credit points can be obtained from all categories, except the seminar and Master’s thesis. Further information on each course category, its characteristics and applicable rules can be found on the following pages.

Master ETH Zurich in Computer Science	120
Major	26
Core Courses	16
Core Electives	
Minor	18
Inter Focus Courses	16
Seminars	2
Practical Work	8
Free Elective Courses	
Science in Perspective	2
Master’s Thesis	30

Figure 1: Course categories with the minimum number of credits required.

2.2.4 Inter Focus Courses

The Inter Focus Courses cover crosscutting computer science topics that are of central importance beyond the selected major and minor. They teach algorithmic reasoning – from real world problems to algorithmic modelling, to implementation – and introduce students to advanced systems design issues. In total, two Inter Focus Courses must have been passed in at most four attempts. That is, failing more than two attempts will lead to exclusion from the programme. When determining the number of failed attempts, it is irrelevant if two separate courses have been failed once each or one course has been failed twice.

- Autumn semester: Algorithms Lab, Information Security Lab
- Spring semester: Computational Intelligence Lab, Advanced Systems Lab

2.2.5 Free Elective Courses

Free Electives serve to expand the subject knowledge specific to the degree program and are primarily related to computer science. They can be taken to gain a deeper insight into, or a broader foundation in, computer science or a closely related field. Eligible are Master's level courses offered by ETH Zurich (no lab courses), EPFL and the University of Zurich. The acceptance of credit of courses at other Swiss universities requires a written request to the Director of Studies. No more than two courses may be accredited outside the ETH's course offer (except mobility courses). Within this category, a research project in computer science may be conducted. Please note that for this project only those students will be admitted who fulfill the requirements outlined in the course catalogue, i.e. have earned at least 20 credits and have a GPA of 5.0 in each individual semester of their Master's studies. Elective courses offered in our Bachelor curriculum cannot be accredited. Furthermore, only one mandatory focus course of the BSc in Computer Science ("Kernfächer") can be accredited. Language courses are not permitted in this category.

2.2.6 Seminar

In seminars, students are trained in how to read and understand scientific publications. Participants are expected to present a paper on a selected topic and contribute to the discussions following the presentations of other seminar attendees. Note that only one seminar can be accredited within the Master's programme.

2.2.7 Practical Work

Practical Work fosters the student's ability to solve technological scientific problems by applying acquired knowledge and social competencies. It refers either to a semester project or a lab course, conducted under the supervision of a professor in the Department of Computer Science or an associated professor. It can be conducted as a group work, provided that each student's performance may be assessed individually. Furthermore, the distribution of the tasks and grading terms must be defined before the start of the group's semester project. Practical Work is graded by a pass/fail rating. A semester project or lab course can be repeated only once, whereby a new topic must be chosen when repeating a semester project. In total, 10 credits can be accredited in this category. Students are asked to refer to the department and/or institute's website, or talk to research groups in the preferred area in order to find a suitable project. Further information can be found under "Memo Practical Work" at: www.inf.ethz.ch/studies/forms-and-documents

2.2.8 Science in Perspective

For the Master's studies, two credits must be obtained at the Department of Humanities, Social and Political Sciences (D-GESS). The course catalogue can be found at: www.gess.ethz.ch or www.vvz.ethz.ch (Programme: GESS Science in Perspective). No more than six credits can be accredited in this category.

Language courses offered by the language centre that are explicitly accredited by GESS have an 851-xxxx-xx course number. A maximum of three credits from language courses may be recognized. Students, who have already obtained credits from a language course during their bachelor's degree at ETH cannot acquire more than three credits accumulated.

2.2.9 Master's Thesis

A student's Master's thesis demonstrates that they are able to use the knowledge and skills acquired during their Master's studies to solve a complex computer science problem.

2.2.10 Grade Point Average

The grade point average (GPA) listed in the final academic record is the weighted average of all grades listed in the final transcript, where the number of credits obtained in a course corresponds to the weight.

2.3 Study Duration

The Master's programme of 120 credits is designed to be completed in four semesters. In general, students follow a course load worth 30 credits per semester. The overall study duration including the Master's thesis must not exceed eight semesters.

2.4 Master's Degree

The Master's Degree in Computer Science at ETH entitles graduates to hold the following academic title:

German: **Master of Science ETH in Informatik** (MSc ETH Inf.-Ing.)

English: **Master of Science ETH in Computer Science** (MSc ETH CS)

3 Planning the Master's Studies

The following chapter outlines the main administrative aspects in order to help students plan their studies at ETH.

3.1 Tutor System

At the beginning of the study programme, every student is assigned to a tutor determined by D-INFK. The tutor is a faculty member and advises the student in how to plan studies. Students are informed of their tutor by email after the start of the first semester.

3.2 Guidelines

It is the student's responsibility to plan their Master's studies, including all courses they intend to take. It is strongly recommended that at least one Inter Focus Course and at least one Core Course of the Major are taken in each of the first two semesters of the Master's programme. Please consult ETH's course catalogue (www.vvz.ethz.ch) for detailed information on courses and course schedules. Please refer to the corresponding semesters of the previous years, as the courses offered and time schedules differ only slightly from year to year.

Please note the following points:

- Usually, the workload for one semester is about 30 ECTS credits.
- The least number of credits required within each course category must be fulfilled (see chapter 2.2 for more information on the course categories).

For advice on planning the Master's studies, please contact the Studies Administration Office or the assigned tutor.

3.3 Enrolment for Courses and Examinations

Students must enrol for the courses of the upcoming semester via www.mystudies.ethz.ch with their nethz login. To ensure that they receive all information the lecturer sends to students registered on the course, students should enrol for their courses as soon as possible.

Enrolling for a course does not automatically result in registration for the corresponding examination. Students will be asked via email to register online through *myStudies* for an examination. After registration for an examination, the deadline for deregistration will be shown. Until this deadline, it's possible to deregister from an examination without any consequences. When the deadline has passed, students can no longer deregister from any examination. Nonattendance of an examination registered for will be graded as failed. In the case of illness, students must provide a doctor's certificate.

3.4 Admission to and Registration for the Master's Thesis

We strongly recommend that all course credits are acquired before the start of the Master's thesis. The duration of the MT is 28 weeks (full-time), where the 28 weeks are composed of 26 weeks of actual processing time and 2 weeks to compensate for public holidays, sick days and other short-term absences. Attendance at any further courses simultaneously is not recommended.

The minimum prerequisites for the registration are:

- All additional requirements completed (see admission decree)
- Major (26 credits) completed from which at least 16 credits must come from the Major Core Courses
- Two Inter Focus Courses (16 credits) completed
- Practical Work completed (8 credits) and
- in total, no more than 8 credits may be missing

Before starting a Master's thesis, it is important to agree with the tutor/supervisor on the task and the assessment scheme. Both should be documented thoroughly. If problems occur during the Master's thesis, students and tutor/supervisors can then consult this written agreement.

It is possible to write a Master's thesis in industry, provided that a D-INFK professor supervises the thesis and your tutor approves it. In order to successfully complete the Master's thesis, a grade of 4.0 or higher must be obtained. In the case of failure, the thesis can be repeated once. Please note that for the second attempt students must work on a different project than the first attempt.

Further details on the internal regulations of the Master's thesis can be downloaded from the department's website:

www.inf.ethz.ch/studies/forms-and-documents.html

3.5 Master's Degree Request

When the Master's degree requirements have been fulfilled, students may file the diploma degree request. The degree request must be submitted via *myStudies*. Please note the deadlines for participation in the next Master's Graduation Ceremony. The degree will be issued in German, French or Italian. An English version of the transcript of records, the diploma supplement and any ranking information will be added in any case. Performances can be assigned to two different sections:

Section 1: Performances in the final transcript

All successfully completed (passed) courses to be listed in the final transcript should be assigned to this section. In total, 130 credits can be accredited in the Master's programme. Please note that the assignment of courses to course categories must correspond to current regulations. Only courses in this section will count towards the final GPA.

Section 2: Performances in the addendum

Courses assigned to this section will be listed in the addendum of the final transcript and will not count towards the final GPA. This section includes:

- Successfully completed courses not assigned to any category
(Performances without a category)
- Additional requirements
- Failed performance assessments

Important addresses and contacts

Studies in Computer Science	www.inf.ethz.ch/studies/master/master-cs.html
Course catalogue	www.vvz.ethz.ch
Rectorate	<p>ETH Zurich, HG Building Rämistrasse 101 8092 Zurich, Switzerland kanzlei@ethz.ch www.ethz.ch/students-admin Office HG F 19 Mon+Thu, 11:00–13:00 Phone +41 (0)44 632 30 00 Mon–Fri, 09:00–11:00</p>
Department of Computer Science	<p>ETH Zurich, CAB Building Universitätstrasse 6 8092 Zurich, Switzerland</p>
Director of Studies	<p>Prof. Dennis Hofheinz studiensekretariat@inf.ethz.ch</p>
Study Coordinator	<p>Dr. Felix Friedrich CAB H 33.3 / +41 (0)44 632 83 12 felix.friedrich@inf.ethz.ch</p>
Studies Administration Office	<p>Denise Spicher CAB H 37.2 / +41 (0)44 632 72 11 studiensekretariat@inf.ethz.ch</p>
Student Exchange Office	<p>Brigitte Marti CAB H 36.1 / +41 (0)44 633 71 26 mobility@inf.ethz.ch</p>
VIS	<p>Association of computer science students CAB E 31 / +41 (0)44 632 72 12 vis@vis.ethz.ch www.vis.ethz.ch</p>
Coaching	<p>Prisca Erb HG F 68.3, Rämistrasse 101 prisca.erb@sts.ethz.ch www.sts.ethz.ch</p>
Psychological Counselling Service	<p>By appointment +41 (0)44 634 22 80 pbs@ad.uzh.ch www.pbs.uzh.ch</p>

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