ETH zürich

Computer Science Master of Science ETH

Study Guide



Important addresses and contacts

Studies in Computer Science:	www.inf.ethz.ch/studies/master/master-cs.html	
Course Cataloge:	www.vvz.ethz.ch	
Rectorate:	ETH Zurich, HG Building Rämistrasse 101 CH-8092 Zurich kanzlei@rektorat.ethz.ch www.ethz.ch/students/en/studies/administrative.html Office HG F 19 Mo-Fr, 11:00-13:00 Phone +41 (0)44 632 30 00 Mo-Fri, 09:00-11:00, 14:00-16:00	
Department of Computer Science:	ETH Zurich, CAB Building Universitätstrasse 6 CH–8092 Zurich	
Director of Studies:	Prof. Peter Müller	
Study Coordinator:	Dr. Hermann Lehner UNG F 15 / +41 (0)44 632 28 66 hermann.lehner@inf.ethz.ch	
Student Counselling:	Dr. Felix Friedrich UNG F 14 / +41 (0)44 632 83 12 felix.friedrich@inf.ethz.ch	
Studies Administration Office:	Denise Spicher CAB F 64.2 / +41 (0)44 632 72 11 studiensekretariat@inf.ethz.ch	
Student Exchange Advisor:	Marion Wenger CAB F 62 / +41 (0)44 632 35 03 mobility@inf.ethz.ch	
VIS	Association of computer science students CAB E 31 / +41 (0)44 632 72 12 vis@vis.ethz.ch www.vis.ethz.ch	
Coaching:	Regula Cinelli HG F 69.1, Rämistrasse 101 regula.cinelli@sts.ethz.ch www.sts.ethz.ch	
Psychological Counseling Service:	Upon appointment +41 (0)44 634 22 80 pbs@ad.uzh.ch www.pbs.uzh.ch	

Master's Program in Computer Science Study Guide

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Department of Computer Science Studies Administration Office

+41 (0)44 632 72 11 studiensekretariat@inf.ethz.ch www.inf.ethz.ch

Address:

ETH Zurich Department of Computer Science Universitätstrasse 6 / CAB F 64.2 CH–8092 Zurich

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1 INTRODUCTION

This document contains important information for a successful completion of your Master's Program in Computer Science at ETH. It comprises a short description of the Master's program structure, the focus areas and other essential information on how to plan your studies.

Please read this document carefully, as it will help you to choose your courses and plan your personal study program. It is your responsibility to fulfill the requirements of the program in time. 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 programs, examination regulations, and for the validation of examination results. All requests addressed to the Director of Studies should be handed in at 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, the Studies Administration Office can refer you to the right person.
- For questions concerning the military service (for Swiss citizens only) the Studies Administration Office can be consulted as well.
- For questions on planning your studies, please contact the **Student Advisor**.
- To discuss your learning agreement, please contact your **Tutor** for advice (see section 3.2).
- Students interested in studying abroad, please contact the **Student Exchange Advisor** of the Department of Computer Science and the Student Exchange Office (see section 1.2.6).
- The **Psychological Counseling 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 Counseling Service is free of charge for all students enrolled at ETH Zurich.

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

The VIS is part of the VSETH, the overall student's association. As such, once you become a registered VSETH member (check the VSETH box on the registration form), you are automatically a VIS member as well. You are encouraged to also become a member of the organizing committee, as the VIS requires the active assistance of students. Pass by the VIS office (CAB E 31) for a coffee and make new acquaintances!

MOEB Committee (Committee for Master's students without an ETH Bachelor's degree) The MOEB Committee is a section of the VIS. MOEB has been 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 new Master's students into the students' community. Further information can be found on the following website: <u>www.vis.ethz.ch/en/about/committees/moeb.</u>

1.2 General Information

1.2.1 Course Catalog

All courses are listed in ETH's Course Catalog: <u>www.vvz.ethz.ch</u>. There you will find information about objective, content, teaching language, time schedule, and localities of the courses as well as details about the examination and the amount of credits awarded after successful completion of the courses. Please note that classes always start 15 minutes past the full hour. If the class is scheduled from 10-11, it will actually start at 10:15 and end at 11:00.

Beware: The rule above applies only to courses. Examinations and meetings always start at the time stated sharp.

1.2.2 Credits

All study programs at ETH are based on the European Credit Transfer System (ECTS). For a Master's degree the acquisition of 90 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-studying (A).

credits = #V + #U + #G + #A + #P + 1

1.2.3 Assessments

Any method to evaluate the achievements of students in a course can serve as an assessment. Most courses, however, rely on examinations. The examinations may either 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 organized by the department. You will be informed about the dates by the lecturers themselves or by the Studies Administration Office. The session examinations are organized by the ETH Examinations Office and you will be informed via *mystudies* and e-mail.

Repetition of a failed examination is only possible after re-enrollment and full participation in the corresponding course. Every examination may only be taken twice.

The type of examination (end-of-semester/ session examination) and the examination mode (oral/written form) as well as the duration of examination are described in the course catalog (<u>www.vvz.ethz.ch</u>). For further information on examinations, 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 you 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, especially if the course is taught by the same professor. Therefore, it is worth taking a closer look at the past examinations.

1.2.5 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 when the course requirements have been fulfilled and associated examinations have been passed successfully. If a course has been completed successfully, the full amount of credits is awarded independently of the grade obtained.

1.2.6 Students Exchange Programs

International experience, cross-cultural competence and language skills are becoming increasingly important in today's business world. The Student Exchange Office organizes 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 programs and various bilateral agreements. The individual study plan for the Master's in Computer Science can include credits taken at an exchange university in the amount of either 15 credit points for coursework or 30 credit points for a Master's thesis.

Students interested in studying abroad should contact the Student Exchange Advisor of D-INFK and the ETH's Student Exchange Office.

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

1.2.7 Military Service

For Swiss citizens only: Official requests for deferral or dispensation of military services have to be completed and handed in 14 weeks prior to the commencement of the military service. The forms necessary are available at the Studies Administration Office or can be downloaded from the following website: <u>www.zivil-militaer.ch</u>.

2 MASTER'S PROGRAM

The Master's Program in Computer Science can be completed by taking one of eight tracks. Seven tracks focus on a specific area of computer science and one track covers *General Computer Science*. The Master's track in *General Computer Science* allows for a broad education with the most freedom of choice as it allows a combination of courses from the different Master's tracks with focus. The seven Master's tracks with focus ensure a deep insight of specific subjects in one of the following areas: *Computational Science*, *Distributed Systems*, *Information Systems*, *Information Security*, *Software Engineering*, *Theoretical Computer Science* and *Visual Computing*.

The degree program structure is the same for all tracks. However, depending on the track, the constraints imposed on the choice of the courses vary.

The following two sections give an overview of the seven areas of focus (section 2.1) and the structure of the Master's program (section 2.2).

2.1 Focus Areas

Each focus area below begins with an introductive description. The Master's track in *General Computer Science* consists of an individual selection of focus courses and is not listed here. For a more detailed description, please see the corresponding websites.

2.1.1 Distributed Systems

The track in distributed systems provides an in-depth perspective on advanced topics that range from pervasive and mobile computing (wireless networks, sensor networks, mobile computing) to large scale distributed information systems (grid, enterprise application integration) and includes modern operating systems as well as system design in multi-core computers. The track places special emphasis on systems design and systems development at all levels.

The track covers the following areas: distributed systems and distributed computing, wireless communication, advanced networking, advanced operating systems, pervasive and ubiquitous computing, web services, and service oriented architectures.

Students in the track are given access to several well-equipped laboratories for extensive experimental work during the laboratory course, seminars, course projects, and the Master's thesis.

2.1.2 Information Systems

Information systems are one of the core areas of computer science and are important to almost all application areas; in particular, for business applications (e.g., banks, consulting, tourism), private information (e.g., pictures, letters), science (e.g., geographic information systems, protein databases), and e-government.

The overall goal is to allow everybody to all information at any time for an unlimited amount of time. Access is only constrained by security and access rights. The goal of this specialization track is to study data models, implementation techniques, and management techniques for modern information systems. In particular, the following topics are covered:

- Data Models: modern design techniques, object-oriented data models, semi-structured data models and XML, web services and service-oriented architectures, semantic web
- Implementation and optimization techniques: transaction management, query processing, distributed and parallel information systems, adaptive and provably efficient algorithms (worst and average case)

 Management: modern database applications, web-based information systems, client/ server and peer-to-peer architectures

2.1.3 Software Engineering

Software systems, small and large, lie at the heart of many processes throughout society. The main task of software engineering is to make sure these systems function correctly. The software engineering Master's teaches the techniques that distinguish the true software engineering professional; the resulting skills and knowledge are in high demand on today's job market and will remain a particularly attractive qualification as software systems become increasingly pervasive and ever more challenging.

2.1.4 Computational Science

Advances in computer science provide us today with an unprecedented potential for innovation across all disciplines.

Computational science integrates software and hardware advances with computational mathematics and discipline specific models, leading to validated, verifiable and efficient simulations of challenging scientific and engineering problems. Computational scientists form a new generation of innovative, computationally oriented thinkers and problem solvers that can navigate the rapidly changing frontiers among disciplines and job descriptions.

2.1.5 Visual Computing

The digital processing of visual information has become a core topic in modern computer science and information technology. Visual computing builds upon foundations from computer science and applied mathematics and has a wide range of applications.

Methodologically, visual computing is routed in computer graphics, algorithmic geometry, image processing and computer vision as well as machine learning. Strong conceptual and algorithmic links to computational science provide visual computing with the modeling breath and the computational expertise to solve large-scale visualization and inference problems.

2.1.6 Information Security

Information security is one of the cornerstones of the continued expansion and acceptance of the information society and at the same time a fundamental research discipline within computer science. The electronic representation and exchange of information differs radically from traditional approaches; e.g., electronic data can be copied without cost, erased without leaving traces, and communicated without effort over large distances. However, protecting information, which is crucial to our information society, has become increasingly difficult.

Efforts in information security therefore strive for solutions to pressing security problems in computer systems, networks and their applications, and for laying the foundations for developing a secure information infrastructure for the future. This Master's specialization track is offered in collaboration with the Department of Information Technology and Electrical Engineering (ITET).

2.1.7 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 like 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 program at ETH focuses on:

- algorithms, data structures, and their applications
- theory of combinatorial and geometric algorithms
- randomized algorithms and probabilistic methods
- cryptography and information security
- mathematical foundations of these topics

2.2 Master's Program Structure

The Master's Program 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. Several course categories are nested to allow more flexibility, as the least number of credits required within subordinate course categories do not sum up to the least number of credits required for the superordinate course category. The remaining credits can be distributed freely over all subordinate course categories. See next for a detailed description of the course categories, including the rules that apply to all Master's tracks.

Ма	aste	er's in Computer Science			90
	Fo	cus and Elective Computer Science Courses		36	
		Focus			
		Core Focus Courses 10			
		Elective Focus Courses -			
		Seminar in Focus 2			
		Elective Computer Science Courses	8		
	Inter Focus Courses			12	
	Elective Courses			-	
	Sc	ience in Perspective		2	
	Internship			-	
	Ma	aster's Thesis		30	

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

2.2.1 Focus

The aim of the focus courses is to ensure a high level of competence in the chosen area of specialization. The subordinate course categories of the *Focus Courses* are the *Core Focus Courses*, the *Elective Focus Courses*, and the *Seminar in Focus*.

All eight Master's tracks have different lists for the focus courses to choose from. The lists and specific track tutors can be found on the following website: www.inf.ethz.ch/studies/master/master-cs.html.

Core Focus Courses & Elective Focus Courses

The *Core Focus Courses* cover knowledge essential for the specific focus area. To allow individualization, students make a choice of *Elective Focus Courses*.

Seminar in Focus

In seminars, students are trained in reading and understanding scientific publications. Participants are expected to present a paper or 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 program.

2.2.2 Elective Computer Science Courses

The *Elective Computer Science Courses* can be selected from all Master's level courses offered by D-INFK including the chosen focus area.

2.2.3 Inter Focus Courses

The *Inter Focus Courses* cover topics important to all computer scientists. They teach algorithmic reasoning – from real world problems to algorithmic modeling, to implementation – and introduce students to advanced systems design issues.

2.2.4 Elective Courses

All Master's level courses offered by ETH Zurich, EPF Lausanne and the University of Zurich may be chosen as *elective courses* (except Inter Focus Courses). The acceptance for credit of courses of other Swiss universities requires a written request to the Director of Studies. A justification of the choice based on the study plan is obligatory.

One core course of the B.Sc. in Computer Science ("Kernfächer") does not require permission by the Director of Studies.

If you intend to follow courses outside of computer science, we recommend choosing all courses from one area of study only.

The following restrictions apply for language courses:

- 1. Language courses are eligible as *Elective Courses* provided that a language has not been studied previously. This excludes in particular native language and the official teaching language(s) of a previously attended study program. English courses will be accredited only from level C1 upwards.
- 2. In the categories *Elective Courses* and *GESS*, a maximum of 3 credits can be acquired by language courses.
- 3. In the category *Elective Courses*, language courses have to be approved by the Director of Studies.

2.2.5 Science in Perspective

For Master's studies, 2 credits must be obtained at the Department of Humanities, Social and Political Sciences (D-GESS). The course catalog can be found on: <u>www.gess.ethz.ch</u> or <u>www.vvz.ethz.ch</u> (Program: GESS Science in Perspective).

Language courses offered by the language center that are accredited by GESS have an 851-xxxx-xx course number. Students who have already obtained their Bachelor's degree from ETH can acquire a maximum of 3 credits through language courses (including those credits obtained for the Bachelor's degree).

2.2.6 Internship

An internship provides opportunities to gain experience in an industrial environment as well as building up a network of contacts. Although an internship is not compulsory, we strongly encourage students to register for an internship. In order to register for an internship, please submit a written request to the Studies Administration Office containing the following details no later than two weeks prior to the beginning of your internship:

- detailed job description: task, technologies, milestones, etc.
- start and end date of the internship (the minimal duration of an internship to be listed in the transcript is 10 weeks.)
- supervisor's name and academic degree

Since internships are conducted outside of academic institutions, no credits are assigned to internships. If students need a work permit for their internship, the Studies Administration Office may issue a letter of support provided that at least two inter focus courses have been successfully passed. The department considers your study the main objective of your stay at ETH Zurich.

2.2.7 Master's Thesis

A student's Master's thesis shall demonstrate that she or he is able to use the knowledge and skills acquired during Master's studies to solve a complex computer science problem.

2.2.8 Grade Point Average

The grade point average in the final academic record is a weighted mean using the following weights. (Not listed course categories get weight zero.)

Course Category	Weight
weighted average of all performances assigned to the <i>Focus Courses</i> *	3
weighted average of all performances assigned to the <i>Inter Focus Courses</i> *	1
weighted average of all performances assigned to the <i>Elective Computer Science Courses</i> *	1
grade of the Master's thesis	2

* To calculate the weighted average, all individual grades and credits listed in the given course category are taken into account.

2.3 Study Duration

The Master's program of 90 credits is designed to be completed in 3 semesters. In general, students follow a course load worth 30 credits per semester. The overall study duration including the Master's thesis may not exceed six semesters. The completion of an internship during your Master's studies extends the maximal study duration by at most one additional semester.

2.4 Master's Degree

The Master's diploma in Computer Science at ETH entitles graduates to have 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 YOUR MASTER's STUDIES

The following chapter outlines major administrative aspects and shall help you preparing your studies at ETH.

3.1 Learning Agreement on your Master's Studies

It is your responsibility to plan your Master's studies including all courses you intend to take. Please consult ETH's Course Catalog (<u>www.vvz.ethz.ch</u>) for detailed information on courses and course schedules. We advise you to refer to the corresponding semesters of the previous years, since the courses offered and time schedules differ only slightly from year to year.

Please note the following issues:

- 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).

Once you have completed planning your Master's studies, you will put together your *Learning Agreement (formerly known as Personal Study Plan)*. An example how to set up a *Learning Agreement* can be found here: www.inf.ethz.ch/studies/forms-and-documents.html.

If you need any advice on planning your Master's studies, please contact your tutor (see next section) or the Student Counselor (see the inside front cover).

3.2 Approval of your Learning Agreement

Your tutor may be any professor involved in your focus area. You can find the list of professors on the track sheet of your focus area: www.inf.ethz.ch/studies/master/master-cs.html.

For the Master's track in *General Computer Science* any D-INFK faculty member may be chosen. Send an e-mail to the professor stating that you are a newly enrolled Computer Science Master's student at ETH and ask whether he/she would be willing to be your tutor. Then fix an appointment to discuss your *Learning Agreement*. The compilation of the *Learning Agreement* is your responsibility, but tutors are happy to give advice.

If you want to get courses accredited that are not listed in the course catalog, you need to send a request to the Director of Studies. The tutor is not authorized to allow deviations from regular Master's tracks.

3.3 Internal Registration

Your *Learning Agreement* must be submitted via <u>www.mystudies.ethz.ch</u> within four weeks after the first semester of your Master's studies has started. Moreover, it needs the approval of your tutor. Instructions how to submit the Learning Agreement in myStudies can be found on the department's website: <u>www.inf.ethz.ch/studies/forms-and-documents.html.</u>

3.4 Enrolling for Courses and Examinations

Please enroll for the courses of the upcoming semester via <u>www.mystudies.ethz.ch</u> with your *nethz* login. To ensure that you will receive all information the lecturer sends to students registered in the course, please enroll for your courses as soon as possible.

Enrolling for a course does not automatically result in the registration for the corresponding examination. Via e-mail, you will be asked to register online through *mystudies* for examinations. After the registration for an examination, the deadline for **deregistration** will be shown. Until this deadline you may deregister from examinations without any consequences. Once the deadline has passed, you cannot deregister from any examination any longer. Nonattendance of an examination you registered for will be graded as failed. In case of illness, you will have to provide a doctor's certificate.

3.5 Admission to and Registration for the Master's Thesis

The topic for the Master's thesis must be chosen within your focus area. We strongly recommend that you acquire all course credits before the start of the Master's thesis, which requires 6 months of full-time study/work, and we strongly discourage you from attending any courses in parallel.

The minimal prerequisites for the Master's thesis registration are:

- Completed Bachelor's program
- All additional requirements completed (additional requirements, if any, are listed in the admission decree)
- Inter Focus Courses (12 credits) completed
- *Focus Courses* (26 credits) completed from which at least 10 credits must come from the Core Focus Courses as well as 2 credits from the Seminar.
- The final version of the <u>learning agreement</u> must have been submitted and approved.

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

It is possible to write a Master's thesis in the industry, provided that a D-INFK professor supervises the thesis and your mentor approves it.

In order to successfully complete the Master's thesis, a grade of 4.0 or higher must be obtained. In case of failure, the Master's thesis can be repeated once. Please note that for the second attempt students have to work on a different project than during the first attempt.

Further details on internal regulations of the Master's thesis can be downloaded from the following website: www.inf.ethz.ch/studies/forms-and-documents.html.

3.6 Master's Degree Request

When the Master's degree requirements are fulfilled, you may file the diploma degree request. The degree request is available in *myStudies*. The printed request must be signed and handed over to the Studies Administration Office. Please submit it personally in order that any potential problems with the request can be solved immediately. The degree will be issued either 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. You can assign performances to three different sections:

Section 1: Performances in the final transcript

All successfully completed (passed) courses that shall be listed in the final transcript should be assigned to this section. Please note that the assignment of courses to course categories must correspond to your learning agreement. Only courses in this section will count towards your final GPA.

Section 2: Performances in the addendum

Courses you assign 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

Section 3: Performances not listed anywhere

Indicate those courses that you passed but that shall not be listed in the final transcript. (Note that failed courses, which were not repeated, must be listed in addendum).

Note that deregistration from the Master's program will be accomplished automatically, once you have submitted the degree request.

>Doctor of Science ETH / 3-4 years





>Professional career

Contact

ETH Zurich Department of Computer Science Universitätstrasse 6, CAB 8092 Zurich

www.inf.ethz.ch

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