

# **Master's Program in Computer Science Study Guide**

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Department of Computer Science  
Administration Office

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

Address:

Department of Computer Science  
Universitätsstrasse 6 / CAB F 64.1  
ETH-Zentrum  
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 to plan your studies.

Please read the document carefully, as it will help you to choose your courses and plan your personal study program. It is the student's 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 Administration Office in written form.
- The **Administration Office** can help you with most issues, in particular with administrative concerns. In any case, the Administration Office can refer you to the right person.
- For questions concerning the military service (for Swiss citizens only) the Administration Office can be consulted as well.
- For questions on planning your studies, please contact the **Student Advisor**.
- To discuss your personal study program, please contact your **mentor** 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 students' association of Computer Science at ETH Zurich (<http://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 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 Computer Science 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. More information can be found on the following website: [www.vis.ethz.ch/en/About VIS/Committees/MOEB](http://www.vis.ethz.ch/en/About%20VIS/Committees/MOEB)

## 1.2 General Information

### 1.2.1 Course Catalogue

All courses are listed in the Course Catalogue: [www.vvz.ethz.ch](http://www.vvz.ethz.ch). There, you will find information about the objectives and contents of the courses, as well as information on the course language, time schedule, localities, details about the course examination and the amount of credits awarded after successful completion of the course. 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). Some institutions across the EU recognize the European Credit Transfer System. This enables students to obtain academic credits at another institution and get them accredited at ETH.

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 hours students are anticipated to study per week. The sum of weekly hours is composed of number (#) of hours of lectures (V), of exercises (U), of lectures combined with exercises (G), of hours of additional self-study (A) and of laboratories (P).

$$\# \text{ credits} = \#V + \#U + \#G + \#A + \#P + 1$$

### 1.2.3 Assessments

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

The semester-end examinations are organized by the department. You will be informed about the dates by the lecturers themselves or the 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), additional information on the language of examination and the mode (oral/written form and duration of examination) are described in the course catalogue ([www.vvz.ethz.ch](http://www.vvz.ethz.ch)). For further information on examinations, please contact the 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, RZ F 17) 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 old 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 completed and associated examinations have been passed successfully.

### 1.2.6 Students Exchange Programs

International experience, cross-cultural competence and knowledge of languages are becoming increasingly important in today's business world. The Student Exchange Office organizes study placements for ETH students at partner universities in Switzerland and abroad within the student exchange programs and various bilateral agreements.

The individual study plan for the Master in Computer Science can include credits taken at an exchange university in the amount of either 15 credit points for course work or 30 credit points for a Master thesis. The university which has awarded the bachelor degree is excluded from the student exchange program.

Students interested in studying abroad, please contact the Student Exchange Advisor of D-INFK and the Rectorate's Student Exchange Office.

The list of courses intended to be taken at another University must be approved by the Director of Studies of the Computer Science Department prior to the student exchange. The forms necessary are available at the Student 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 Administration Office or can be downloaded from the following website: [www.zivil-militaer.ch](http://www.zivil-militaer.ch).

## 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 introductory description. The Master's track in *General Computer Science* consists of an individual selection of focus courses, is not listed here. For a more detailed description, please see the corresponding websites.

#### 2.1.1 Distributed Systems

The track on 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. Information systems are important in 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 at any time from any time access to all information. 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 work right. The software engineering Master's teaches the techniques that distinguish the true software engineering professional; the resulting skills and knowledge are in high demand in 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 rooted 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 for 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 for 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 goals of Theoretical Computer Science (TCS) are to understand the fundamental concepts computation and information, comparable in spirit to the goals 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 listed in table 2.1. The least number of credits is stated next to the course categories. Several course categories are nested and allow more flexibility. The least number of credits required within the subordinate course categories do not sum up to the least number of credits required within the superordinate course category. The remaining credits can be distributed freely over the subordinate course categories.

<b>Master in Computer Science</b>		<b>90</b>
Focus and Elective Computer Science Courses	36	
Focus	26	
Core Focus Courses	10	
Elective Focus Courses	0	
Seminar in Focus	2	
Elective Computer Science Courses	8	
Inter Focus Courses	12	
Elective Courses	0	
GESS Courses	2	
Internship	0	
Master's Thesis	30	

Table 2.1 Course categories with the least number of credits required for the Master's Degree.

In the following, all course categories are described, including the rules that apply to all Master's tracks.

### 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 track have different lists for the focus courses to choose from. The lists and specific track mentors can be found on the following website:

[http://www.inf.ethz.ch/education/master/master\\_CS/CSmasterstracks](http://www.inf.ethz.ch/education/master/master_CS/CSmasterstracks)

#### **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 current paper or a selected topic and contribute to the discussions following the presentations of other seminar attendees. The choice of topics and details about the performance assessment are defined by the professor organizing the seminar. A failed seminar cannot be repeated. The missing credits have to be acquired in other seminars.

### 2.2.2 Elective Computer Science Courses

The *Elective Computer Science Courses* can be selected from all Master 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 level courses offered by ETH Zurich, EPF Lausanne and the University of Zurich may be chosen as *elective courses*. Courses of other Swiss universities can be accepted for credit by sending a written request to the Director of Studies. A justification of the choice based on the study plan is required.

Bachelor level courses can only be selected for credit with the permission of the Director of Studies. Mandatory focus courses of the B.Sc. in Computer Science (“obligatorische Fächer der Vertiefung”) do 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.

For language courses, note the following restrictions:

1. Language courses are eligible as *Elective Courses*, provided that the languages are not previously studied ones. 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 4 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 Compulsory Electives GESS

For Master's studies, 2 credits must be obtained at the Department of Humanities, Social and Political Sciences (D-GESS). The course catalogue can be found on: <http://www.gess.ethz.ch> or <http://www.vz.ethz.ch> (Programme: Humanities, Social and Political Sciences)

The languages English, French, Italian and Spanish will be accredited only from level B2 upwards, German courses starting from level C2. Language courses offered by the language center that are accredited by GESS have an 851-xxxx-xx course number. For further questions or requests, please contact the Student Advisor.

Students who already have obtained their Bachelor's degree at ETH can acquire a maximum of 4 credits from language courses (including credits obtained for the Bachelor's degree).

### 2.2.6 Internship

An internship provides opportunities to gain experience in an industrial environment and it creates a network of contacts. Even though the internship is not mandatory, we strongly encourage students to register for an internship.

If the internship company is listed among the accredited companies, you may directly register the internship at the Administration Office. If the company is not listed, see below for the additionally required information. The list of accredited companies may be downloaded from: [http://www.inf.ethz.ch/education/Formulare\\_Dokumente](http://www.inf.ethz.ch/education/Formulare_Dokumente)

To register the internship, please submit a document to the Administration Office containing the following information, no later than two weeks before the beginning of your internship:

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

If you intend to complete your internship with a company not listed among the accredited companies, you will have to apply for acceptance of the company, before the internship. In addition to the above listed information, please submit the following documents:

- company profile: name, address, founding year, products, number of employees in computer science
- profile of work environment: CV of the supervisor including education, number of educated computer scientist in your direct work environment

As internships are conducted outside academic institutions, no credits are assigned to internships.

## 2.2.7 Master's Thesis

During the Master's thesis students shall demonstrate that they are able to use the knowledge acquired during their Master's studies to solve a complex computer science problem. It requires the knowledge and skills to conduct a scientific project under the supervision of a professor.

## 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.)

<b>Course Category</b>	<b>Weight</b>
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 containing 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 Personal Study Plan for your Master's Studies

You need to plan your complete Master's studies, including all courses you intend to take. Please consult the course catalogue for detailed information on the courses and course schedules. For future semesters, please take a look at the corresponding semester of the previous year. Usually, the courses offered and their 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 *Personal Study Plan*. The form for the *Personal Study Plan* can be downloaded from: [http://www.inf.ethz.ch/education/current/forms\\_documents](http://www.inf.ethz.ch/education/current/forms_documents)

If you need any advice on planning your Master's studies, please contact the Student Advisor or your mentor (see next section).

### 3.2 Approval of your Personal Study Plan

Your mentor may be any professor involved in, or associated with your focus area. You can find the list of professors on the website of the focus areas: [http://www.inf.ethz.ch/education/master/master\\_CS/CSmasterstracks](http://www.inf.ethz.ch/education/master/master_CS/CSmasterstracks)

For the Master's track in *General Computer Science* any faculty member of the D-INFK may be chosen. Send an e-mail to the professor stating that you are a new Master's student at ETH and ask whether he/she would be willing to be your mentor. Then fix an appointment to discuss your *Personal Study Plan*. The compilation of the *Personal Study Plan* is your responsibility, but mentors are happy to advise.

Once you and your mentor agree on your *Personal Study Plan*, both need to sign the document. Your mentor also has to sign the *Internal Registration Form* which can be found on the same website as the *Personal Study Plan*.

If you want to get courses accredited that are not listed in the course catalogue then you need to send a request to the Director of Studies. The mentor is not authorized to validate any deviations from the regular Master's tracks.

### 3.3 Internal Registration

Please hand in the *Internal Registration Form* and your *Personal Study Plan* at the Administration Office no later than the end of the first semester of your Master's studies.

## 3.4 Enrolling for Courses and Examinations

Please enroll online for the courses of the upcoming semester via [www.mystudies.ethz.ch](http://www.mystudies.ethz.ch). Course registration has to be completed by the end of the second week of the semester.

You will need your *nethz* password to log on in *mystudies*. This is the same account that enables you to access the computers in the labs. If you do not receive your personal account within this period of time, you will get an extension of the course registration deadline.

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

## 3.5 Admission to and Registration for the Master's Thesis

The Master's thesis must be chosen within the focus area. It is strongly recommended to acquire most or all of the 60 credits required to be obtained by attending courses, before starting the Master's thesis. The Master's thesis consists of 6 months full time study/work. Not more than two courses may be attended concurrently.

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.

Before starting a Master's thesis it is important to agree with your 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 supervisors can rely on this written agreement.

For the internal registration of the thesis, please request the original *Internal Registration Form* at the D-INFK Administration Office, complete Section 4 of the form and have it signed by the supervisor of your thesis. Next, return the form and the Master's thesis agreement to the Administration Office of D-INFK. This needs to be done no later than by the end of the first week after starting your Master's thesis.

It is possible to write a Master's thesis in the industry, provided that a professor of D-INFK 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, and another project has to be found.

Further details on internal regulations of the Master's thesis can be downloaded from the following website: [http://www.inf.ethz.ch/education/current/forms\\_documents](http://www.inf.ethz.ch/education/current/forms_documents)

## 3.6 Request for the Master's Degree

Students who fulfill the Master's degree requirements may hand over the request for degree certification to the Administration Office. After submission of the request, the following documents will be issued: the final academic record, possibly with addendum, the diploma certificate and the diploma supplement. Finally, deregistration from the Master's program will be accomplished automatically.

### 3.6.1 Request to Issue the Degree

The request to issue the degree, to be found in *myStudies*, has to be printed out. It must be signed and handed over to the Student Administration Office. Please submit it personally such that any potential uncertainties can be solved immediately.

The request consists of three parts:

#### **Part 1: Performances in the final academic record**

These are the successfully completed (passed) performances assigned to the categories in the study plan. These courses will be listed in the final report.

#### **Part 2: Performances on the addendum**

- Successfully completed (passed) performances not assigned to any category in the Program Regulations (*Performances without a category*).
- Successfully completed (passed) performances from additional requirements.

#### **Part 3: Performances not listed anywhere**

As a rule, the performance assessments not passed successfully are listed here.





