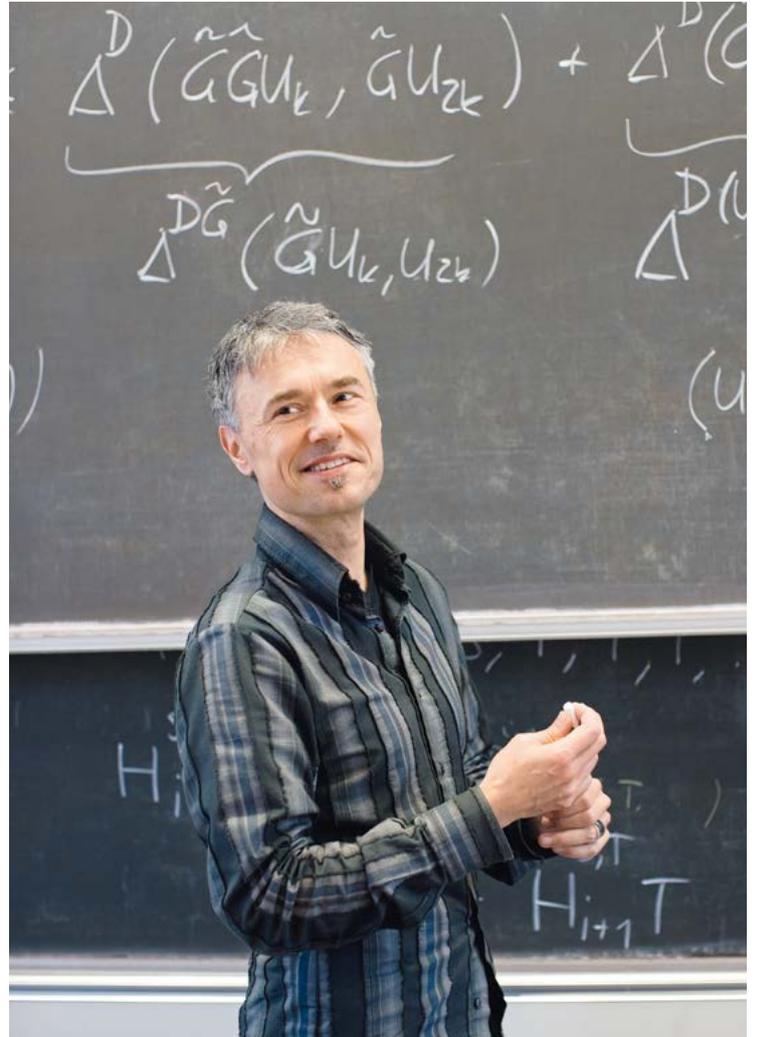


Master

Master of Science ETH in Computer Science





WELCOME



Computer Science at ETH Zurich – this stands for the harmonic triad of one of the 21st century’s most important and dynamic scientific fields at one of the world’s leading research universities in one of Europe’s most enjoyable cities.

If you strive for highest quality education in a field that continues to change the world, ETH Zurich is the perfect choice!

ETH’s Computer Science Department runs a broad international Master’s Program taught exclusively in English. Students can choose general computer science or a track in one of the targeted focus areas, such as Theoretical Computer Science, Information Security, Software Engineering, Information Systems, Distributed Systems, Visual Computing, and Computational Science. The study program is closely connected to the department’s world-class research groups, led by an internationally diverse faculty of over 30 professors.

Students have ample opportunities to quickly participate in one of the many exciting research projects, often in collaboration with industry or with the local research centers of international companies. The possibility of doing an interdisciplinary master thesis in cooperation with other ETH departments offers further fascinating opportunities – from building flying robots or developing cell simulations to exploring the possibilities of machine learning and artificial intelligence. After graduation, Switzerland’s strong economic environment offers excellent job opportunities.

Do you want to become one of us? I invite you to explore on the following pages the many exciting facets of Computer Science at ETH Zurich – enjoy the journey!

A handwritten signature in blue ink, which appears to read "Emo Welzl". The signature is fluid and cursive.

Prof. Emo Welzl
Department Head

ETH ZÜRICH - EXCELLENCE IN RESEARCH AND TEACHING

ETH Zurich represents the highest standards of education, groundbreaking fundamental research, and applied results that are beneficial for society as a whole.

The institution has asserted itself as one of the world's leading universities in science and engineering.



Pioneering Research

21 Nobel laureates such as Wilhelm Konrad Roentgen, Albert Einstein and Kurt Wuethrich have studied, taught, or conducted research at ETH. Currently, more than 500 professors maintain and extend the institution's superb reputation and scientific scores. Since its foundation in 1855, ETH has believed and invested in long-term research. In the years ahead, ETH will focus on nine strategic research areas, which address society's most pressing and challenging issues: world food system, cities of the future, climate change, energy, health, risk, information processing, new materials, and industrial processes.

First-class Education

"High-quality teaching must be close to research," said Prof. Ralph Eichler, ETH's former President. The university continually strives to bring some of the world's brightest thinkers to Zurich, fostering a vibrant intellectual community for the students. ETH promotes access to excellence and inspires through education. The institution appears regularly at the top of international rankings as one of the best universities in the world. It now has more than 19,000 students from over 80 countries, who contribute to the richness and diversity of the institution.

Financial Stability

Based on the federal financial contribution and successful acquisition of research funds, ETH has been able to maintain financial stability and flexibility. This solid balance sheet is complemented by tapping into new sources of third-party funding and donations from fundraising campaigns generated by the ETH Foundation. The strong financial cushion provides opportunities to enhance the university's high-quality academic performance and curricular programs.

Incubator for Start-ups

Transferring knowledge and technology to the private sector and society at large is one of ETH's primary missions. Its success is demonstrated by an average of 80 new patent applications each year and 327 spin-off companies set up between 1996 and 2015. These spin-offs have a survival rate of about 90%. These successes are fostered by strengthened ties and close partnerships to business and industry, venture capital firms, and private investors. ETH is more than just a university; it stimulates the economy and is the ultimate independent think tank in Switzerland.

Switzerland and Zurich

Switzerland is known for its political and economic stability, safety, and extraordinary beauty. Swiss cities have a deep and rich history and combine traditions with the highest standards of modern living. Zurich, one of the world's leading financial hubs, is Switzerland's largest city and its economic and cultural center. For many years it has been ranked in the top two cities in the world for quality of life. Within walking distance of ETH, Zurich's core is a beautiful old town with excellent restaurants, quaint cafés, world-class museums and galleries, and a long promenade next to the lake that stretches more than 30 km into the mountains. But Zurich is also international, ethnically diverse, ultramodern in architecture and life style, and offers a vibrant night life. These are just a few reasons why some are calling Zurich "the smallest metropolis in the world."



COMPUTER SCIENCE AT ETH - A DEPARTMENT WITH A WORLD-CLASS REPUTATION

Computer science is an exciting, fast-moving, and diverse field. It pervades many areas of research and industry, and plays a vital role in all aspects of society. No other subject of study offers so many avenues of specialization as computer science.

At its heart, the discipline is one of problem solving, and successfully fuses fundamental research with real-world engineering. In order to achieve this aspiration, ETH's Computer Science Department strives for the highest possible quality by going broad and deep in its research and teaching.

The faculty members are high-caliber experts in their domains and cover the many facets of modern computer science, from the underlying theory to the design of practical systems. The excellence of the department is demonstrated by a consistently high international ranking.

institution with the expertise to make a significant impact in their professional fields and to sustain a competitive edge throughout their careers.

Industry Partnerships

The strength and reputation of the department's research attract collaborations with business and industry from around the world. Collaborators include some of the biggest global names in information technology such as IBM, Microsoft, Intel, SAP, Google, and Credit Suisse. The department also takes pride in the foundation of the Disney Research Zurich center at ETH, the only Disney research laboratory in Europe.

To students, the various academia-industry partnerships offer access to a wealth of expert knowledge, new ideas and opportunities, cutting-edge technologies, and specialized equipment and facilities. Furthermore, students get connected with the private sector and interact with potential employers. By graduation time, students have acquired both academic and industrial experience that reflects the latest developments and career demands.

Open Doors for Career Advancement

While the curriculum challenges even the most talented students, it also rewards their efforts with superior job placement in research and industry. ETH's recognized brand and the department's prestige opens graduates coveted opportunities to take up prominent positions in leading academic institutions or global high-tech players. While major international corporations may be particularly attractive to some graduates, numerous specialized and profitable Swiss-based companies also offer excellent career prospects. The recently-published OECD Employment Outlook 2016 has pointed out that despite the impact of the global economic crisis during 2008-09 the strong demand in computer science and engineering will remain steady.



Value of an ETH Degree

Three major factors ensure the value of ETH's computer science degree: selectivity, rigor in the curriculum and close interaction with the department's faculty. The admission to the Master's program is based on a highly competitive selection process. The primary goal of the Master's program is to equip the students with advanced methodological and conceptual knowledge, which outlasts today's technology, so that they are prepared for dealing with the problems of tomorrow. To achieve this, the program combines fundamental training with hands-on projects related to cutting-edge technology. Graduates leave the



ATTRACTIVE STUDENT SERVICES AND MULTICULTURAL CAMPUS LIFE

As a top international educational and research institution, ETH has a strong commitment to providing a pleasant environment for its students and staff. The university embraces diversity, values courtesy, consideration for others, and individual responsibility. It offers a supportive and caring community, a very safe and multicultural campus environment, and a fun and inspirational learning experience.

Academic Guidance and Support

ETH and the Computer Science Department attach great importance to individual student counseling and academic advising, from study planning and focus track selection to individual mentoring and coaching. The individual experience is supported by a low student-to-faculty ratio. In addition, the personal interaction of research assistants with students ensures optimal conditions for studies and exam preparation. Moreover, the computer science student association VIS provides help to international Master's students so that they can begin their studies successfully at ETH and feel at home in their new environment.

Affordable Education and Financial Aid

ETH is committed to an affordable education for all students and, in contrast to most other top universities, keeps the tuition charge to a minimum. Furthermore, a number of scholarships are distributed selectively to top applicants. ETH assigns two types of scholarships: the Excellence Scholarship covers living and study expenses for the entire period of

the graduate program, while the Master Scholarship consists of a partial stipend for living and study expenses.

Outstanding Infrastructure

ETH offers state-of-the-art learning facilities including modern computer workstations, wireless internet access across campus, and cutting-edge computer labs. For instance, in the department's Computer Graphics Laboratory students can work with novel three-dimensional scanning technology developed at ETH. Students working on simulations can get access to the high-performance computing clusters and even to the Swiss National Supercomputing Center for large-scale projects.

Sports Facilities

Physical activity and a healthy lifestyle are part of the university culture. ETH provides state-of-the-art athletic facilities and a rich and diverse offering of over 80 different activities and sports. Besides the usual range of fitness classes, this also includes numerous fun outdoor activities in Switzerland's beautiful mountain and lake landscape.

Vibrant Community Culture

From athletics to politics, from art to poetry, from film-making to theater, from volunteering to active citizenship, the cultural and leisure facilities encompass a vast array of activities. Students have extraordinary opportunities here for growth and learning outside the classroom. This kind of rich and dynamic atmosphere makes ETH a great place to work, study, and grow.



MASTER'S PROGRAM

The Master's program is tailored to the students' specific interests, needs, and goals. Its objective is to help students become practiced, creative, and efficient problem solvers in the general domain of computer science and information technology. The program guides each individual student in taking a meaningful path through the variety of course offers and designing a profile that matches both personal inclinations and prospective career opportunities.

Specialization or Generalization

The Master's program combines theory and hands-on practice to provide students with a well-rounded education. Students have the choice between the General Computer Science track, which allows a combination of courses from different areas and grants a maximum freedom of choice, or 7 more specialized tracks to prepare for a particular career route.

The Master's degree program offers the following 8 tracks:

- Theoretical Computer Science
- Information Security
- Software Engineering
- Information Systems
- Distributed Systems
- Visual Computing
- Computational Science
- General Computer Science

Curriculum Structure

Duration: 3 semesters (90 ECTS credits)

Language: English

Admission: Bachelor of Science ETH in Computer Science, Computer Science related fields or equivalent degree from a different university (minimum requirement: 6 semesters, 180 credits)

Thanks to the wide range of courses and to the flexible structure of the curriculum, students in all tracks enjoy a large degree of freedom to customize their study plan. Each student, regardless of track, graduates with the degree "Master of Science ETH in Computer Science".

Direct Doctorate: The Direct Doctorate in computer science comprises course work and original research. Furthermore, it allows exceptionally qualified students holding a Bachelor's degree to join the doctorate program at the Department of Computer Science. The program is also ideal for students who wish to pursue a career in academia or industrial research. Students in this program are entitled to financial support and tuition waivers.

Master of Science ETH in Computer Science 90 CP

1.5 years

MASTER THESIS 30 CP

FOCUS COURSES IN COMPUTER SCIENCE min. 26 CP

choose 1 of 8 possible tracks:

- Theoretical Computer Science
- Information Security
- Software Engineering
- Information Systems
- Distributed Systems
- Visual Computing
- Computational Science
- General Computer Science

INTER FOCUS COURSES COMPUTER SCIENCE min. 12 CP

Selection of CS topics of general importance

ELECTIVE COURSES COMPUTER SCIENCE min. 8 CP

Free choice out of a wide range of CS topics

ELECTIVE COURSES min. 0 CP

Optional multidisciplinary courses

GESS COURSES min. 2 CP

Humanities, Social and Political Sciences

SPECIALIZATION TRACKS

Research guides all efforts of the department. Its faculty members cover a broad spectrum of research areas within computer science. Seven areas have specialization tracks allowing the students a high degree of versatility and ensuring that they find the study track that suits them best. The educational objective of the specialization tracks is that the students develop in-depth skills in a chosen domain, obtain specialized knowledge, and are prepared for professional practice.



Theoretical Computer Science

The goals of theoretical computer science are to understand the fundamental concepts of computation and information – comparable in spirit to the goals of physics: understanding fundamental concepts like matter and energy.

Research fields in theoretical computer science span a wide variety of topics, including models of computation (from automata theory to quantum computers), algorithms and data structures, computability and computational complexity theory, infor-

mation theory, and cryptography. Methods are often mathematical and abstract, but the motivation comes from understanding practical, real-world problems.

Key teaching areas

- Algorithms and data structures
- Combinatorial and geometric algorithms
- Randomized algorithms and probabilistic methods
- Complexity theory
- Cryptography

Information Security



The electronic representation and exchange of information differ radically from traditional approaches; for instance, electronic data can be copied without cost, erased without leaving traces, and communicated without effort over large distances. However, protecting information has become increasingly difficult. Research in information security

strives 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 specialization track is offered in collaboration with the Department of Information Technology and Electrical Engineering.

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.

Key teaching areas

- Cryptographic systems, algorithms, and proofs
- Quality assurance methods for security-critical systems
- Vulnerability analysis
- Wireless network security

Software Engineering

Large software systems are among the most complex artifacts mankind has ever built. Software engineering is concerned with the methods, techniques, and tools that allow computer scientists to develop software systems that satisfy high quality standards: systems that are reliable, efficient, and flexible.

The continuous evolution of novel computing platforms such as the recent proliferation of multicore processors, mobile devices, and cloud computing, as well as new demands from users such as social computing constantly provide opportunities and challenges for software engineering. The software engineering group at ETH is at the forefront of software engineering research.

It covers a wide area of topics, from the design and implementation of programming languages to correctness proofs for critical systems.

Members of the department have developed several programming languages (Pascal, Modula-2, Oberon, Eiffel) that achieved world-wide recognition and impact.

Key teaching areas

- Compiler design
- Object technology
- Parallel and high-performance programming
- Programming language design and implementation
- Software testing and verification



Information Systems

We are in the information age. Companies require information, for instance, in order to do market research for the development of new products and to process the demands of their customers.



Personal information includes the telephone numbers of friends as well as pictures, e-mails, and videos. The goal of information systems is to provide the right tools to store, search, and update information on modern computer systems in a secure and robust way.

A modern computer system can be a mobile phone, a PC, or a data center with thousands of servers. Information systems also coordinate the flow of information between such computer systems at different scales.

Key teaching areas

- Databases
- Cloud computing
- Big data, Web 2.0
- Information interaction
- Data stream processing

Distributed Systems

The internet, smartphones, social networks, on-line games, and web shopping are just a few of the many practical applications of modern distributed computing.

For those interested in “serious” business, consider airline reservation systems, cloud computing, search engines, or e-banking – none of which would be possible without distributed algorithms, networking protocols, and distributed systems.

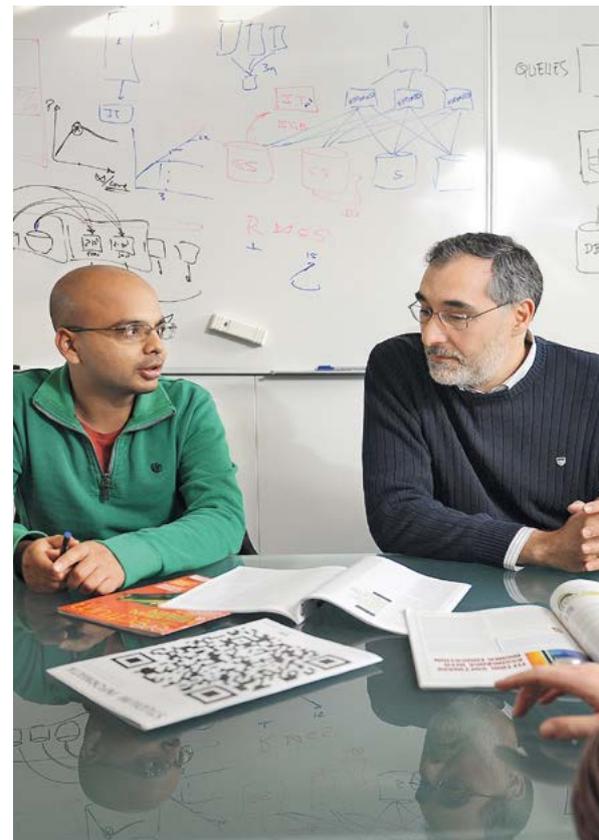
It is fair to say that most computing today is distributed computing and that all of these applications have been made possible by the techniques, methods, and platforms that emerge as part of research on distributed systems.

At the Department of Computer Science, the group is working in many areas of distributed systems with the goal of developing practical systems that can be used in real settings. The projects range from how to program mobile devices and invent new applications for smartphones, to the architecture of large data centers with thousands of computers, not forgetting work on, for instance, sensor

networks, distributed databases, and the new architectures of the internet. As distributed systems become an even more essential part of today’s computers and networks, the group is leading the effort into breaking the traditional barriers between areas of computer science, and exploring how to build future generations of computers: cloud-based, with hundreds or thousands of cores, highly interconnected, and using specialized hardware to speed up operations.

Key teaching areas

- Mobile computing, mobile devices
- Distributed data processing
- Architecture of enterprise data centers
- Multi-core architectures
- Distributed algorithms and network protocols
- Internet of things



Visual Computing

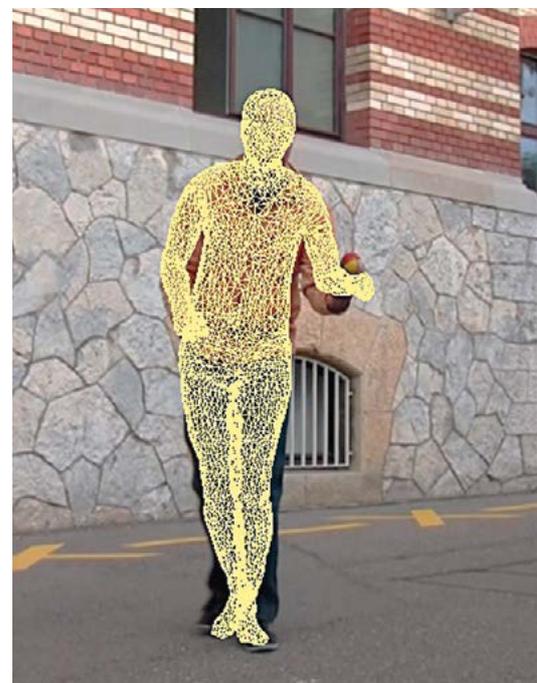
Visual computing connects the areas of computer graphics, computer vision, and geometry processing to classical disciplines such as optics, robotics, human-machine interaction, and many more fields in computer science, physics, mathematics, and engineering.

While in the early years visual representations were mostly restricted 2D drawings, nowadays computers can automatically reconstruct 3D city models from video camera input and generate synthetic imagery that is difficult to distinguish from photographs.

Visual computing is an exciting, dynamic discipline that has applications in everyday life and impact on scenarios in robotics, mobile communication, medical imaging, driver assistance, physical simulations, film and game industries, and many more.

Key teaching areas

- Computer graphics
- Computer vision
- Geometric modelling
- Physically-based animation
- 3D modeling for images/video
- Digital geometry processing
- Image and video processing
- Display and multi-modal interaction technology
- Machine learning
- Data mining



Computational Science

Today's advances in computer science and mathematics provide us with unprecedented capabilities for revolutionary progress in scientific and engineering challenges. Computational science synthesizes these advances leading to validated, verifiable, and efficient simulation, analysis, and optimization of real-world problems. It has joined experiments and theory as a third pillar of scientific investigation.

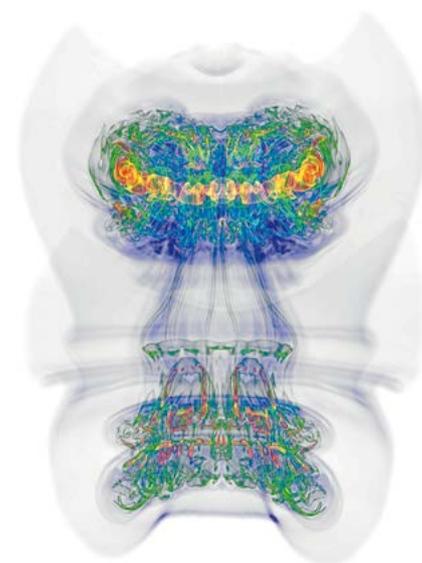
Computational scientists tackle problems by integrating fundamental mathematical and algorithmic concepts with software and systems engineering, leading to simulation and analysis tools that make efficient use of today's computer architectures. Computational science is a rapidly growing field and is fundamentally interdisciplinary.

It facilitates the interaction of seemingly diverse fields such as computer science and social sciences, engineering and biology, materials science, and medicine. While computers have changed society, computing is now also transforming the scientific and engineering world. Computational science aims to accelerate this process

and to materialize the potential of computers for scientific discovery and engineering innovation.

Key teaching areas

- High performance computing
- Scientific visualization
- Computational biology
- Bioinformatics
- Machine learning



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Student Life

Computer Science Library
www.library.inf.ethz.ch

Umbrella organization of ETH student associations
www.vseth.ethz.ch

Expertise and research areas of ETH Zurich's professors
www.ethz.ch/de/die-eth-zuerich/organisation/who-is-who.html

Doctoral Studies at ETH
www.phd.ethz.ch

Canteens at ETH
www.gastro.ethz.ch

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