Computational Science

A specialized Master’s program in applying computation and the principles of dynamical systems to a broad range of problems in the sciences.
COMPUTATIONAL SCIENCE PROGRAM

Science is undergoing a major paradigm shift comparable to the move from tabletop experiments to large facilities that began at the beginning of the last century. Theoretical work requires high quality simulation and our shared experimental facilities are producing Peta-byte to Exabyte datasets that must be designed and mined for maximal scientific return. Experimental detectors and computers have both become millions of times more powerful owing to the same technology leaps — the current technology that puts billions of transistors on computer chips and networks them with fiber optics also enables multiplexed detectors with billions of pixels. The main change that will result from further advances in computing technology will not be faster processing of data, but greater quantities of data that outstrip the gain in processing speed if one is looking for relationships in the data (hence, doing operations that might scale like the data volume squared or an even higher power).

Sciences that once used very little information technology are now becoming dominated by the powerful results that can be extracted using it. Biology is being revolutionized by the realization that it is based on a digital code. The Computational Science Program at the University of Zurich is new and evolving. Our program aims to have the full breadth of the scientific fields of the University and to allow the students the flexibility to work in new and emerging areas.

GOALS OF THE PROGRAM

The Computational Science Program at the University of Zurich is a Master’s program designed to prepare students either for careers in industry or for a variety of Ph.D. degree programs at the University. With so many directions that students might take, we make the program very flexible. The program encourages the acquisition of a broad range of skills and knowledge. There is sufficient flexibility for students to spend enough coursework in a single discipline if they want to move toward a Ph.D. program in an applications area such as Computational Physics and Chemistry. For those students aiming at a more professional Master’s with a career as an analyst, they will be encouraged to explore a wide range of techniques and develop some familiarity with multiple application areas.

In cooperation with many other institutes within the University of Zurich and ETH Zurich, the program tries to support students who might concentrate in any of a number of optional threads:

- Scientific Simulation
- Scientific Analysis and Visualization
- Datamining
- Optimization and Control
- Biological Modeling
- Pervasive/Ubiquitous Computing
- Specific Scientific Applications
  (Astrophysics, Chemistry, Physics ...)

Not all of these threads have been pursued and we can imagine many more being created in individualized programs, so we encourage students who are interested in any of these or others to discuss their desired program.

We do not aim to be the only stop for computational science. We encourage prospective students to look carefully at other degree offerings at UZH, particularly those in Computer Science, Bioinformatics, and Neural Systems and Computation. If your interests are better represented by those programs, we will encourage you to join those program.
The key elements of most programs pursued by students are:

- High Performance Computing
- Applied Math and Computational Methods
- Simulation and Modeling
- Visualization
- Applications in Science and Engineering

In these areas, there are many courses at the University of Zurich and ETH. We guide students through these for their elective options.

While we wish to serve students flexibly, we have no desire to be inscrutable. Hence, our website provides guidance for several options that students may pursue with different backgrounds and goals. Students should note that the “core program” is very flexible.

**ADMISSION REQUIREMENTS**

Students may enter the program by either applying for admission or by possessing a Bachelor’s degree in Physics, Chemistry, Computer Science, Computational Science, Astronomy, Astrophysics, Mathematics or Applied Mathematics from an accredited Swiss University. We welcome students to apply from other backgrounds. One reason for applications outside of these degrees is that there might be more appropriate programs at the University of Zurich such as the Master’s Program in Computational Biology and Bioinformatics.

**THE PROGRAM OF STUDY**

The core courses of the program are Computational Science I and II (QGD 411 and 412). Students in other degree programs also take these courses as an elective module. Students will do their Master’s thesis in a wide range of areas. To facilitate connection with a research group and advisor, they are required to attend a research seminar or journal club in the area of their interest. They are also encouraged to engage in projects where they assist other students as consultants on computational aspects of the other students work. As with other Master’s programs, the thesis and the associated exam are an important part of a Master’s program as gateway to individual research.