Master program in Computational Science at the University of Oslo

Program Structure

Planned start: Fall 2018

Thesis directions

The program has the following study directions/options

- Computational Science: Applied Mathematics and Risk Analysis
- Computational Science: Astrophysics
- Computational Science: Bioinformatics
- Computational Science: Biology
- Computational Science: Chemistry
- Computational Science: Geoscience
- Computational Science: Imaging and Biomedical Computing
- Computational Science: Materials science
- Computational Science: Mechanics
- Computational Science: Physics

Structure and courses

The table here is an example of a suggested path for a Master of Science project, with course work the first year and thesis work the last year.

	10 ECTS	10 ECTS	10 ECTS
4th semester	Master thesis	Master Thesis	Master Thesis
3rd semester	Master thesis	Master Thesis	Master Thesis
2nd semester	Master courses	Master courses	Master courses
1st semester	Master courses	Master courses	Master courses

The program is very flexible in its structure and students may opt for starting with their thesis work from the first semester and scatter the respective course load across all four semesters. Depending on interests and specializations, there are many courses on computational science which can make up the required curriculum of course work. Furthermore, courses may be broken up in smaller modules, avoding thereby the limitation of 10 ECTS per course only. Some of these courses are listed below.

Presently available courses at UiO and NMBU

- FYS4150 Computational Physics I
- FYS4411 Computational Physics II
- FYS4460 Computational Physics III
- INF5620 Numerical Methods for Partial Differential Equations
- INF5631 Project on Numerical Methods for Partial Differential Equations
- FYS388 Computational Neuroscience
- STK4520 Laboratory for Finance and Insurance Mathematics
- STK4021 Applied Bayesian Analysis and Numerical Methods
- MAT-INF4130 Numerical Linear Algebra
- MAT-INF4110 Mathematical Optimization
- ECON4240 Equilibrium, welfare and information
- MEK4470 Computational Fluid Mechanics
- MEK4250 Finite Element Methods in Computational Mechanics
- GEO4310 - Stochastic methods in hydrology
- AST5210 Stellar Atmospheres I
- AST9110 Numerical Modeling

New courses

In order to build a common study program and identity as a Computational Science student, there will be two compulsory courses that aim at providing topics of common and broad interest. Both courses have a workload of 10 ECTS each. The courses are

- **CS-MATH1**: *Data analysis and machine learning*, 10 ECTS (Existing STK2100, GEO4310)

1. Monte Carlo methods and statistical data analysis
2. Optimization of data and handling of large data sets
3. Machine learning and neural networks

- **CS-INF1**: *High-Performance Computing and Numerical projects*, 10 ECTS (Existing INF3380)

  1. This course teaches you to develop and structure large numerical projects, from code writing to finalizing a report
  2. Topics which are included are parallelization and vectorization
  3. Machine architecture and GPU-CPU programming
  4. Optimization of code and benchmarking
  5. Numerical methods from linear algebra will be discussed as well as examples from life science.

Possible new courses

Some of these courses could incorporate (or base themselves upon) existing ones. The courses here are organized according to their corresponding disciplines. They should, for search ease, contain the word **Computational**

- Mathematics

  1. **CS-MATH1**: Data analysis and machine learning (Existing GEO4330, STK2100)
  2. **CS-MATH2**: Basic methods in computational modeling (new? do we need it?)
  3. **CS-MATH3**: Mathematical Foundations of data science (based on MAT-INF4110 and STK4021)
  4. **CS-MATH4**: Computational Linear Algebra (based on MAT-INF4130)
  5. **CS-MATH5**: Computational differential equations (Based on INF5620)
  6. **CS-MATH6**: Computational finance (based on STK4520)
  7. **CS-MATH7**: Advanced data science (new)

- Physical sciences (Astrophysics, geoscience, physics, chemistry and materials science)

  1. **CS-PHYS1**: Computational Physics
  2. **CS-PHYS2**: Computational Molecular dynamics in life science and materials science (new)
  3. **CS-PHYS3**: Computational Astrophysics
  4. **CS-PHYS4**: Computational quantum mechanics

5. **CS-PHYS5**: Computational statistical mechanics
6. **CS-PHYS6**: Computational Materials Science (based on FYS-MENA4111)

- Bioscience
  1. **CS-BIO1**: Computational Bioinformatics (Based on INF5380)
  2. **CS-BIO2**: Advanced Computational bioinformatics (new)
  3. **CS-PHYS2**: Computational Molecular dynamics in life science and materials science (new)

- Computer science
  1. **CS-INF1**: High-Performance Computing and Numerical projects (parts of inf3380, else new)
  2. **CS-INF2**: Advanced optimization of numerical code (new)

- Mechanics
  1. **CS-MECH1**: Computational Mechanics (based on MEK4470 and MEK4250?)
  2. **CS-MECH2**: Advanced Computational Mechanics (new?)

Graduate Certificates

The program plans to offer graduate certificates in

- Three of the courses with label CS-MATH gives a certificate in Computational Mathematics
- Three of the courses with label CS-PHYS gives a certificate in Computational Physics, Astrophysics, Chemistry, Materials Science and Geoscience
- Three of the courses with label CS-BIO gives a certificate in Computational life science.
- Three of the courses with label CS-INF gives a certificate in High-performance computing.

Dual Degrees

The program plans to offer dual degrees (more text to come)