Computing Across the Disciplines; New Data Science and Computing Center at the University of Oslo

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Why should we focus on Computational Science and Data Science?

- By 2020, it is expected that one of every two jobs in the STEM fields will be in computing (Association for Computing Machinery, 2013)
- Computation is an essential and cross-cutting element of all STEM disciplines
- Computational science has developed into a discipline of its own right
- Data Science and Computing (DSC) and the understanding of large data sets will play an even larger role in basically all disciplines of STEM fields, Medicine, the Social Sciences, the Humanities and education
- Students at both undergraduate and graduate level are unprepared to use computational modeling, data science, and high performance computing – skills valued by a very broad range of employers.
- The 3rd Industrial Revolution will alter significantly the demands on the workforce. To adapt a highly-qualified workforce to coming challenges requires strong fundamental bases in STEM fields. Computational Science can provide such bases at all stages.

Goals

- Position UiO as a leader in data science and computational science by recruiting faculty whose expertise pertains to data science, large-scale computing and mathematical foundations of data science - both generalists (algorithm/tool developers) and specialists (focused on specific disciplines).
- Develop a comprehensive set of courses and degree programs at both undergraduate and graduate levels that will give students across the university exposure to practical computational methods, understanding how to analyse data and more generally to the idea of computers as problem-solving tools. The courses and degree programs can also be tailored to external users.
- Develop an all university PhD program in Computational Science and Data Science
- Develop Bachelor and Master of Science Program in Computational Science and Data Science based on the two existing programs on Data Science and Computational Science
- Develop courses and course modules in Computational Science and Data Science for the private and the public sectors
- Develop a PhD program in Computational Science and Data Science tailored to the needs of the private and the public sectors
- Facilitate the adoption of computational tools and techniques for both research and education across campus, through education and faculty collaboration. A center and then a department will facilitate the pursuit of these goals!
- Educate the next generation of school teachers and university teachers, with a strong focus on digital competences.

Strengths, Possibilities and Synergies

- Several Centers of excellence in research where Data Science and Computational Science plays a major role
- Newly established center of excellence in education research
- Newly established Master of Science programs in Computational Science and Data Science
- Several excellent groups in STEM fiels who do Data Science and Computational Science

- Computational topics are included in most undergraduate STEM programs, possibility to develop a bachelor program in Data Science and Computational Science
- Several educational prizes and awards related to computational science
- With a center we have the possibility to really position UiO as the leading Norwegian institution within Computational Science and Data Science
- Lead in the development of computations in Life Science
- Strong links with SIMULA research lab and nearby local universities

Enhance Computational Science and Data Science across the disciplines

Data driven discovery and data driven modeling play already a central role in research. The global objective here is to strengthen and coordinate such activities by bringing together scientists and students across the disciplines. UiO has already strong computational research and education activities within Mathematics and the Natural Sciences. The aim here is to extend this to include

- Computational Science and data science in Mathematics and all of the physical sciences
- Computational biology and life science (includes medicine)
- Computational economics and data science and computing in the social science
- Data science and computing in the Humanities, Law, Medicine and other disciplines

The new center will host and coordinate research and educational programs in Computational Science and Data Science. In particular research and education that involve data analysis and machine Learning will play a central role here.

The Center

- Administratively located under the Mat-Nat college
- Composed of XXX full time equivalent positions, including some current UiO faculty and possible a larger number of new hires.
- Most of these faculty will have joint appointments with other units and/or departments at the University of Oslo and SIMULA research laboratory. As an example, one can have a 70% appointment in Mathematics and 30% at the new center.

- Faculty will focus on computational science, data science and large-scale and high-performance computation
- Faculty will be incentivized to engage in cross disciplinary and cross-department/college research collaborations
- Nurturing environment to attract these faculty and pursue large and interdisciplinary grants

Benefits

- Recruitment of new faculty who are incentivized to collaborate across the university both in terms of research and education.
- Opportunities for existing UiO faculty to expand their data science and computing related capabilities and competences, and to train students to use computational techniques.
- Broad and deep educational opportunities for both undergraduate and graduate students across the university.

Research opportunities

- Data driven discovery and data-driven modeling where machine learning plays a central role
- Research challenges that require computation-oriented multidisciplinary approaches.
- Research problems that require "bleeding edge" (e.g., multi-petaflop/petabyte) computational approaches to interpret experimental data and complex data.
- Computational and data science research and education scattered across many departments.
- Center-level funding opportunities (e.g., SFF, Marie Curie etc etc).

More research opportunities

- Simulations of complex quantum mechanical systems using novel algorithms
- Establish cross-disciplinary activity in quantun information theory
- Using machine learning to solve complicated problems, from neuroscience (our brain), physiology to complicated materials
- Computating and Data Science in Life Science

- Idem for the Social Sciences
- Data-driven discovery and modeling in the Humanities
- and much more

Timeline

1. Data Science and Computing center in 2020.
2. New Master of Science Program on Computational Science starts fall 2018
3. New Master of Science Program on Data Science starts fall 2018
4. Extend these Masters programs to become cross-college programs
5. Establish a cross-college PhD program in Computational and Data Sciences, start fall 2020. This PhD program will be a collaboration between the Natural Sciences, Humanities, Social Sciences, Medicine and Education.
6. Develop an all university Master of Science Program in Computational Science and Data Science based on the present Computational Science and Data Science programs by XXXX
   (a) Develop courses and course modules in Computational Science and Data Science for the private and the public sectors as soon as possible.
7. Develop a PhD program in Computational Science and Data Science tailored to the needs of the private and the public sectors by fall 2020
8. Develop a Bachelor program in Computational Science and Data Science? Need to strike a balance between existing programs and possible new **honors program**.
9. Submit an application called **Computing Across the Disciplines** for a Marie Curie training network by 2020, 15 PhD positions
10. Prepare first draft for an SFF application by spring 2020