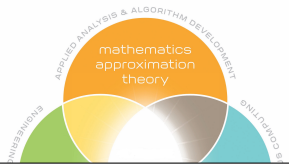
Computing Across the Disciplines (CAD); a new Center/Department at the University of Oslo

A proposal to the board of the MN-fak of the University of Oslo

Establish a center by fall 2018 and as a new department by fall 2020

Why?

- Computation is an essential and cross-cutting element of all STEM disciplines.
- Computational science has developed into a discipline of its own right.
- Students at both undergraduate and graduate level are unprepared to use computational modeling, data science, and high performance computing – skills valued by a broad range of employers.



Goals

- Position UiO as a leader in computational science by recruiting faculty whose expertise pertains to 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 the undergraduate and graduate levels, including minors and graduate certificates, that will give students across the university exposure to practical computational methods, and more generally to the idea of computers as problem-solving tools.
- 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 facilitate the pursuit of these goals!

The Center/Department

- Administratively located under the MN-college
- Composed of 25-30 FTEs, including some current MSU faculty and a larger number of new hires (most from ACI).
- Most of these faculty will have joint appointments with other units and/or Department at the University of Oslo and SIMULA
- Faculty will focus on data science and large-scale and high-performance computation
- Faculty will be incentivized to engage in cross-discipline and cross-college research collaborations
- Nurturing environment to attract these faculty and pursue large and interdisciplinary grants
- Close ties to SIMULA research laboratory and the HPC center at USIT

Benefits

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

New research opportunities

- Research challenges that require computation-oriented multidisciplinary and interdisciplinary approaches.
- Research problems that require "bleeding edge" (e.g., multi-petaflop/petabyte) computational approaches to interpret experimental data and complex data..
- Center-level funding opportunities (e.g., SFF, Marie Curie etc etc).

Why Computational Science in four points

- This program aims at educating the next generation of cross-disciplinary science students with the knowledge, skills, and values needed to pose and solve current and new scientific, technological and societal challenges.
- Complex systems involving many scales pose a great challenge to our present understanding of problems in Science. This program allows you explore the theory needed to understand complex systems with the tools of the 21st century.
- All disciplines in the Sciences are represented in this program and you can thereby explore and design thesis projects that cover a large range of topics and own interests, from Mathematics and Computational Science to the Physical Sciences and Life Sciences.
- Combining machine learning and data analysis with quantum computing is an exciting topic which can change totally the future of computer simulations and the way we study physical systems.

Possible thesis topics

- Simulations of complex quantum mechanical systems using novel algorithms, with applications spanning from quantumchromodynamics on the lattice and subatomic physics, via materials to the equation of state of stars.
- Exploring algorithms from quantum computing in order to solve complicated quantum mechanical problems
- Study complex materials or the DNA using large-scale molecular dynamics simulations
- Using machine learning to solve complicated problems, from neuroscience (our brain), physiology to strongly interacting quantum mechanical systems
- Using machine learning to develop new tools for learning physics

Special topics

- Only program where you learn how to use machine learning to study complex physical systems
- Emphasis on the tools and knowledge which will prepare you for the scientific challenges of the 21st century
- Several exchange possibilities with leading universities and laboratories in Europe, Asia and Northern America.