

Mathematics in Computing Section Overview and Opportunities

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ORNL is one of the *basic sciences* DOE laboratories

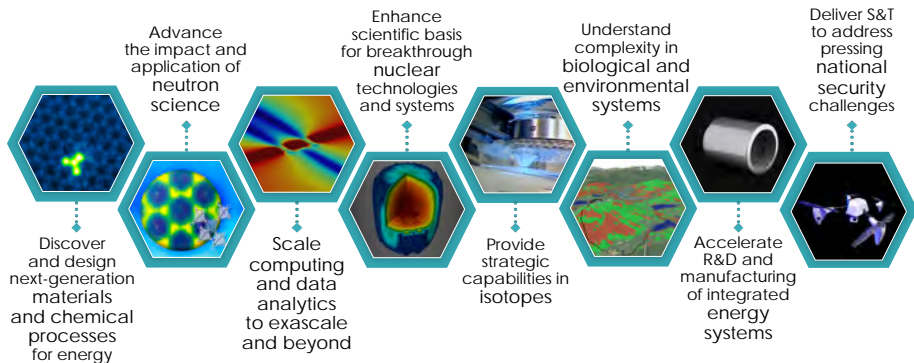
Oak Ridge National Laboratory evolved from the Manhattan Project







Delivering advances in science and technology



Computing at ORNL

Summit is being replaced by Frontier:

- ▶ 10^{18} fps (takes 7.7 billion people, each executing 1 instruction in 1 second 7 years).
- ▶ can 'read' 100K HD movies per second (about 2.8M times faster than your home internet).
- ▶ 90 miles of cable.
- ▶ Requires 30 MW of power, 6000 gal/min water cooling.
- ▶ Weighs the equivalent of 35 school buses.
- ▶ 7300 sq ft footprint.
- ▶ \$700M.



About the Section

Sections' mission statement

Scientific discovery & decisions sciences

Our mission

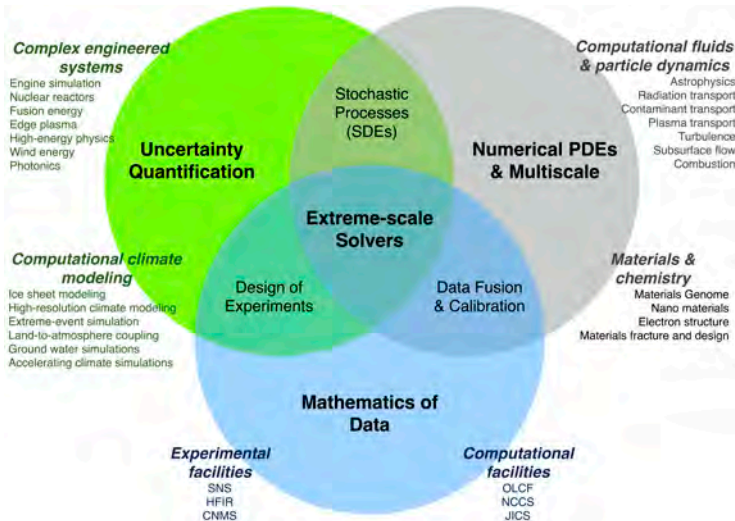
To create the mathematics and architecture-aware algorithms that make progress in the sciences and engineering possible.

1. **Discrete Algorithms (DA)**
2. **Dynamics and Multi-Scale Processes (DMM)**
3. **Data Science and Machine Learning (DML)**
4. **Systems and Decision-sciences (SDS)**

Who do we work for?

- ▶ Our main funding source is the Department of Energy, Office of Advanced Scientific Computing Research (ASCR)
 - ▶ Applied Mathematics Program
 - ▶ Scientific Discovery through Advanced Computing (SciDAC)
- ▶ We also receive funding from
 - ▶ Other DOE Office of Science and Nuclear Energy Programs
 - ▶ National Science Foundation (U Tenn)
 - ▶ Department of Defense
 - ▶ Defense Advanced Research Projects Agency (DARPA)
 - ▶ Air Force Office of Scientific Research
 - ▶ Office of Naval Research
 - ▶ Internal laboratory funding

What we do



What kind of applications do we work on?

- ▶ Combustion and Fluids
- ▶ Climate modeling
- ▶ Astrophysics
- ▶ Fusion plasmas
- ▶ Machine learning and artificial intelligence
- ▶ Material Science and chemical physics
- ▶ Nuclear and electronic structure
- ▶ Neutron Tomography
- ▶ Quantum computing
- ▶ Reactor design

Information for students

Opportunities for students

▶ Internships

- ▶ DOE Computational Sciences Graduate Fellowship (CSGF)
- ▶ DOE Office of Science Graduate Fellowship (SCGF)
- ▶ NSF Mathematical Science Graduate Internship (MSGI)
- ▶ Internal internships, administered by Oak Ridge Institute for Science and Education (ORISE)

▶ Education

- ▶ ORNL staff can serve on graduate committees
- ▶ Joint Faculty can advise students
- ▶ Research assistantships

- ▶ We're hiring:
 - ▶ Go to jobs.ornl.gov and put in key words 'mathematics in computing'

What skills do we look for?

- ▶ Training:
 - ▶ Analysis, ODE, PDE
 - ▶ Numerical analysis
 - ▶ Numerical methods
 - ▶ Optimization
 - ▶ Probability and Statistics
 - ▶ Graph Theory and Combinatorics
 - ▶ Theory of Computing
 - ▶ AI/ML
- ▶ Programming experience
 - ▶ MATLAB, Python, Julia
 - ▶ C, C++, Fortran
 - ▶ Parallel computing
 - ▶ .ML and Statistical Packages
- ▶ Science / engineering applications

For further information:

<https://www.ornl.gov/section/mathematics-computation>

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