"There is nowhere else in the world we could have run this simulation."

Loukas Petridis,
Staff Scientist

Oak Ridge Leadership Computing Facility

Breakthrough Science at Every Scale

Researchers from around the world use the Oak Ridge Leadership Computing Facility (OLCF) to solve problems so challenging they require the nation's most powerful computers. OLCF's high-performance computing systems—supercomputers—coupled with the expertise of OLCF technical staff help solve challenges in diverse fields. These challenges include improving the safety and performance of nuclear power plants, designing new materials that can revolutionize industries, and modeling the origins of the universe. Supercomputers allow researchers to study subatomic particle interactions that only exist for fractions of a second and to simulate the volatile conditions inside a combustion or turbine engine, enabling a level of detailed analysis unavailable through traditional experimental means.

Supercomputers for Solving Problems

The OLCF is home to the nation's fastest supercomputer, Summit, an IBM AC922 system that debuted in June 2018. Summit has a theoretical peak performance of 200 petaflops, which makes it possible for scientists to solve problems faster than ever before. Summit is at least eight times more powerful than its predecessor, Titan, which will remain active through FY 2019. Titan came online in November 2012 and has a theoretical peak performance of 27 petaflops.

With Summit, Titan, and other OLCF high-performance computing resources, scientists are developing increasingly complex models to address questions about who we are, how we live, and how our universe works with even greater complexity and higher fidelity. In 2018, researchers broke the exascale barrier on Summit with a genomics algorithm, achieving a peak throughput of 2.36 exaops—or 2.36 billion billion calculations per second, the fastest science application ever reported.

250 petabytes
Storage capacity of OLCF's disk system

49
Unique OLCF computing projects in 2018

429
Average OLCF publications per year from 2012–2018 by OLCF staff and users

56,855
OLCF publication citations since 2012

1,444
Researchers who worked with the OLCF in 2018

194
US institutions that used the OLCF in FY 2018, including universities, companies, and government agencies

Recent Impacts

Industrial competitiveness: General Electric uses Titan to simulate combustion in gas-powered turbines. By using computer simulations, researchers get more designs to evaluate, which means they can make leaps in turbine efficiency that translate to millions of dollars in saved fuel and millions of tons of reduced carbon pollution.

Inner Earth mapping: A Princeton University team is mapping the Earth's interior using earthquake data to create an ultrasound of the Earth. The team's first model, completed in 2015, brings prominent subsurface features such as tectonic plates, magma plumes, and subsurface hotspots into focus and adds context to ongoing debates related to Earth's geologic history and dynamics.

Deep learning for cancer research: In collaboration with the National Cancer Institute, an ORNL team is using large volumes of data to train computers to read medical documents and extract important information, which can be used to help doctors determine the best treatment for each patient. The team is leveraging Summit's fast compute cores, vast amounts of memory (important for data-intensive applications), and efficient communication among cores to enable automated and accurate capture of important cancer surveillance data elements from clinical text documents.

Summit by the Numbers

200 petaflops	If everyone on Earth made one calculation per second, it would take 305 days to do what Summit can do in 1 second.
8.8 megawatts	Summit is very efficient, demonstrating a sustained performance of 122.3 petaflops using just 8.8 megawatts of power.
4,000 gallons	The amount of chilled water circulated through Summit every minute.
5,600 square feet	Summit's footprint is about as big as two tennis courts.

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