# ALCF Computing Resources

The Argonne Leadership Computing Facility operates supercomputing resources that support large-scale computing projects aimed at solving some of the world’s most complex problems in science and engineering.

## Polaris

Polaris is an HPE Apollo Gen10+ system equipped with AMD EPYC processors and NVIDIA A100 GPUs. The 44-petaflops system provides researchers with a platform to test and optimize applications and workloads for ALCF’s upcoming exascale supercomputer, Aurora.

- **HPE Apollo 6500 Gen10+ architecture**
- **44 petaflops**
- **1 AMD EPYC Milan processor per node**
- **4 NVIDIA A100 Tensor Core GPUs per node**
- **280 TB of DDR4 memory**
- **560 nodes**
- **17,920 cores**
- **87.5 TB of high-bandwidth memory**
- **HPE Slingshot 11 with Dragonfly configuration**

## Theta/ThetaGPU

Theta is an 11.7 petaflops Cray XC40 supercomputer powered by second-generation Intel Xeon Phi processors, also known as Knights Landing (KNL) processors. ThetaGPU, an NVIDIA DGX A100 GPU-based platform, is an extension of Theta that brings 3.9 petaflops of compute power and enhanced capabilities for AI and data-intensive research.

- **Theta KNL Nodes**
  - **Cray XC40 architecture**
  - **11.7 petaflops**
  - **64-core, 1.3-GHz Intel Xeon Phi 7230 processor per node**
  - **4,392 nodes**
  - **281,088 cores**
  - **843 TB of memory**
  - **70 TB of high-bandwidth memory**
  - **Aries network with Dragonfly configuration**

- **ThetaGPU Nodes**
  - **NVIDIA DGX A100 architecture**
  - **3.9 petaflops**
  - **2 AMD EPYC 7742 processors per node**
  - **8 NVIDIA A100 Tensor Core GPUs per node**
  - **24 nodes**
  - **576 cores**
  - **26 TB of DDR4 memory**
  - **8.32 TB of GPU memory**
  - **NVIDIA QM8700 HDR InfiniBand**

## Cooley

Cooley is an Intel platform that serves as the ALCF’s data analysis and visualization cluster.

- **Intel Haswell architecture**
- **293 teraflops**
- **2 6-core, 2.4-GHz Intel E5-2620 processors per node**
- **1 NVIDIA Tesla K80 with dual GPUs per node**
- **126 nodes**
- **1,512 cores**
- **47 TB of memory**
- **3 TB of GPU memory**
- **FDR InfiniBand**

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*Argonne National Laboratory is a U.S. Department of Energy laboratory managed by UChicago Argonne, LLC.*

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Data Storage Systems
ALCF disk storage systems provide intermediate-term storage for users to access, analyze, and share computational and experimental data. Tape storage is used to archive data from completed projects.

<table>
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<tr>
<th>FEATURE</th>
<th>EAGLE</th>
<th>GRAND</th>
<th>THETA-50</th>
<th>SWIFT</th>
<th>TAPE STORAGE</th>
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<tbody>
<tr>
<td>File System</td>
<td>Lustre</td>
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<td>Lustre</td>
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<tr>
<td>Storage System</td>
<td>HPE ClusterStor E1000</td>
<td>HPE ClusterStor E1000</td>
<td>HPE Sonexion L300</td>
<td>All NVMe Flash Storage Array</td>
<td>LTO6 and LTO8 Tape Technology</td>
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<tr>
<td>Usable Capacity</td>
<td>100 PB</td>
<td>100 PB</td>
<td>9 PB</td>
<td>123 TB</td>
<td>300 PB</td>
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<td>Sustained Data Transfer Rate</td>
<td>650 GB/s</td>
<td>650 GB/s</td>
<td>240 GB/s</td>
<td>48 GB/s</td>
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<tr>
<td>Disk Drives</td>
<td>8,480</td>
<td>8,480</td>
<td>2,300</td>
<td>24</td>
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</tbody>
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ALCF AI Testbed
The ALCF AI Testbed provides an infrastructure of next-generation AI-accelerator machines that allows researchers to evaluate the usability and performance of machine learning-based applications running on the systems. AI testbeds include:

**Grove**
- Tensor Streaming Processor
  - >26 billion transistors, 14 nm

**SambaNova DataScale**
- Reconfigurable Dataflow Unit
  - >40 billion transistors, 7 nm

**Habana Gaudi**
- Tensor processing cores
  - 7nm
  - Integrated 100 GbE-based interconnect
  - Synapse AI Software, PyTorch, Tensorflow

**Graphcore MK1**
- Intelligent Processing Unit (IPU)
  - 1216 IPU tiles, 14 nm
  - >23 billion transistors

**Cerebras CS-2**
- Wafer-Scale Engine
  - >800,000 processing cores
  - 2.6 trillion transistors, 7 nm

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Joint Laboratory for System Evaluation
Through Argonne's Joint Laboratory for System Evaluation (JLSE), the ALCF provides access to leading-edge testbeds for exploratory research aimed at evaluating future extreme-scale computing systems, technologies, and capabilities. JLSE testbeds include:

**Arcticus, DevEP, Iris:** Intel discrete and integrated GPU testbeds to support the development, optimization, and scaling of applications and software for Aurora

**Aurora Software Development Kit:** Frequently updated version of the publicly available Intel oneAPI toolkit for Aurora development

**Arm Ecosystem:** Apollo 80 Fujitsu A64FX Arm system, NVIDIA Ampere Arm and A100 test kits, and an HPE Comanche with Marvell ARM64 CPU platform provide an ecosystem for porting applications and measuring performance on next-generation systems

**Presque:** Intel DAOS nodes for testing the Aurora storage system

**Edge Testbed:** NVIDIA Jetson Xavier and Jetson Nano platforms provide a resource for testing and developing edge computing applications.

**Intel Xeon Clusters:** Cascade Lake, Skylake, and Cooper Lake Xeon clusters enable a variety of research activities, including testing AI and learning applications

**NVIDIA and AMD GPUs:** Clusters of NVIDIA V100, A100, and A40 GPUs, and AMD MI50 and MI100 GPUs for preparing applications for heterogeneous computing architectures

**Atos Quantum Learning Machine:** Platform for testing and developing quantum algorithms and applications

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