Computational Facilities

The Advanced Research Computing Center (ARCC) located at the University of Wyoming (UW) is the university's primary research computing facility. All ARCC operations promote the growth of UW's research and educational activities. Resources provided by the department include high performance computing (HPC), large research data storage, and user training and consultation. Specialized ARCC staff members perform on-site administration, maintenance and support for all ARCC hosted HPC systems and research support resources. This includes UW's primary campus HPC cluster, Beartooth. Beartooth is a heterogeneous condominium cluster open to all facets of research. ARCC also supports several specialty clusters and research services used by several UW research organizations.

HPC hardware is housed in liquid-cooled enclosures in UW IT's 6,000 sqft data center which includes highly redundant infrastructure for power, cooling, and security. Hardware is interconnected utilizing Mellanox InfiniBand and high-speed internet. Beartooth's condo-style heterogeneous environment hosts specialty nodes to address a wide array of compute requirements including mass memory (4TB RAM) nodes, and a variety of GPU nodes.

Beartooth HPC System Configuration

Beartooth is a x86_64 based HPC running RHEL 8. Job scheduling configuration based on the condo model encourages researchers to purchase nodes for use in our HPC environment granting them priority and predictable access times. We also leverage fair-share mechanisms to distribute computational workloads between various research projects as well as weighted scheduling parameters (job size, age, etc.) to maximize efficient cluster utilization. Beartooth is backed by a VAST performance data storage filesystem hosting over 3PB of high-performance storage. Beartooth (currently consisting of over 375 nodes) is largely an Intel x86_64 core HPC system. Environment hardware is heterogenous, comprised of several specialty partitions to address a wide variety of scientific pipelines and workloads. The system utilizes SLURM workload manager and LMOD environment modules to provide a robust and flexible user experience. Beartooth supports a wide range of compilers (GNU, Intel oneAPI, and NVIDIA HPC SDK) as well as containerization frameworks.

Beartooth hardware specifications are summarized below:

Beartooth	# of Nodes	Cores	RAM (GB)	GPU (mixed)	GPUs / Node
Hardware Specs	384	15468	84504	52	Up to 8

Facilities Expansion: Thunderer

Thunderer, an upgrade to ARCC's primary HPC environment, is made possible by a generous $5 million appropriation from the State of Wyoming. This expansion adds an additional 25 AMD EPYC Nodes, 8 A30 GPU Nodes, 5 L40S GPU Nodes, and 6 H100 GPU Nodes. Hardware specifications for the addition are listed in the following table:

Allocations	# of Nodes	Cores / Node	RAM	GPU	GPUs / Node	Processor	TensorCores/GPU & CUDACores/GPU
Standard Nodes	25		1024GB/Node	N/A	N/A		N/A
A30 GPU Nodes	8	96 CPU Cores per Node	24GB/GPU	Nvidia A30	8	2x 48-Core/96-Thread 4th Gen AMD EPYC 9454	224 TC/GPU 3804 FP32 CUDA/GPU
L40S GPU Nodes	5		48GB/GPU	Nvidia L40S	8		568 TC/GPU
H100 GPU Nodes	6		80GB/GPU	Nvidia SXM5 H100	8		528 TC/GPU 16896 FP32 CUDA/GPU

High Performance Data Storage

Our facility houses two primary research storage resources in addition to housing data for direct use on Beartooth. Both are available to all researchers at UW for both short- and long-term archive data storage. The first named Alcova. This service is a peta-scale capable filesystem. Both Beartooth and Alcova file storage use VAST data platform, a highly scalable, in-line, block-based data storage that is built for performance. Connected to the UWyo network, Alcova offers blazing-fast transfer speeds starting at 100 GB/s. In addition to hosting a variety of research data, Alcova storage also facilitates the publication of datasets curated by UW Libraries. Pathfinder, ARCC's other primary research storage resource, uses the S3 protocol on object storage through Ceph to provide a low-cost storage option with added functionality facilitating a wide scale of large datasets for web-based applications. All ARCC hosted data storage services support GridFTP via Globus data transfer servers connected to the UW Science DMZ (100 Gbps Internet2 link). Alcova and Beartooth storage also allow for SMB/CIFS and NFS making it easy for researchers to transfer data from their daily work environment.

In addition to computational resources, our department assists researchers by offering guidance, consultation and training for any users - both new and experienced – who may seek help incorporating HPC technologies in their research pipeline. Our team works in collaboration with the UW Libraries Digital Scholarship Center to host training towards the growth in understanding and use of HPC across UW and throughout our state.