

# MSI Facilities Statement

Established in 1983, the Minnesota Supercomputing Institute (MSI) is the University of Minnesota's principal center for computational and data intensive research. MSI provides services to over 900 active groups that sponsor more than 4,500 unique users from 19 different university colleges, maintaining an array of systems dedicated to the computational and data intensive research needs of investigators in the state of Minnesota's higher education institutions and their collaborators.

## High Performance Computing

MSI's High Performance Computing (HPC) systems are designed with high speed networks, high performance storage, GPUs, and large amounts of memory to support some of the most compute and memory intensive programs developed today. MSI's HPC systems are composed of over 90,000 x86 64-bit compute cores and 500 TB of RAM, which can support over 6 double-precision PFLOPS of peak performance. HPC nodes are equipped with between 64 GB and 2 TB of RAM to support applications that require small and large amounts of memory, all nodes have local scratch drives, and 83 nodes include various configurations of the NVIDIA general purpose GPU accelerators (V100, A100), from 2- to 8-way.

## Interactive Computing and Scientific Visualization

In collaboration with the Laboratory of Computational Science and Engineering, MSI supports a visualization laboratory. The Lab can accommodate up to 24 people and is located in the same building as MSI. MSI also supports Open OnDemand for web-based interfaces and hardware for remote visualization and interactive computing. Interactive HPC systems allow real-time user inputs to facilitate code development, real-time data exploration, and visualizations. Interactive HPC systems are used when data are too large to download to a desktop or laptop, software is difficult or impossible to install on a personal machine, or specialized hardware resources (e.g.; GPUs) are needed to visualize large datasets.

## Cloud Computing

MSI supports an on-premise cloud computing platform built on OpenStack to support special data use agreements and to allow quick deployment of web, database, and other non-High Performance Computing systems. The virtual instances in this environment are available for a fee in a variety of sizes depending on the number of processors and the amount of memory and disk space required for the project.

## Data Storage

All MSI researchers have access to two high-performance storage systems to support their research: a high-performance all-flash storage platform (2 PB), and a hybrid ssd/hdd high-performance parallel storage platform (9 PB) with sustained read and write speeds of up to

48 GB/sec. The integrity of the data is protected by daily snapshots and tape backups. High value datasets are backed up to an off-site facility as a part of the Institute's disaster recovery plan. MSI also supports a second-tier storage solution (12 PB) designed to address the growing need for resources that support data-intensive research. The system is tightly integrated with other MSI storage and computing resources in order to support a wide variety of research data life cycles and data analysis workflows and uses the standard S3 interface, so that researchers can better manage their data, more seamlessly share data with other researchers, and migrate entire data analysis pipelines to cloud-based platforms. Finally, MSI partners with other campus providers to support disaster recovery and cold storage using a SpectraLogic Tfinity tape library with expansion capabilities for over 100 PB of storage.

## Data Centers, Network Connectivity, and Office Facilities

MSI enables interdisciplinary research through its robust data center facilities with over 1 MW of IT capacity to support leading edge computational and data storage systems. MSI supports two data centers, both of which are connected to the campus network with speeds up to 100 Gbps. Campus networks connect to our regional optical network and Internet2 at 100 Gbps giving our researchers the network capacity and capability needed to collaborate with researchers from around the world. Located in the Walter Library building, MSI office and data center space (~18,000 sq. ft) are centrally located on the Twin Cities campus in Minneapolis. MSI also maintains office spaces on the Twin Cities campus in St. Paul, where additional researchers are located. MSI also provides computer and teaching laboratories, which are primarily used for outreach and teaching workshops.

## Research Informatics

MSI is home to 31 research informatics staff (25 Ph.D. level) who work to foster and accelerate computational research across the University of Minnesota System in all scholarly pursuits by providing informatics services and consultations. Some consultation services are conducted in close collaboration with U of M-based high-throughput core facilities including genomics, metagenomics, optical and electron microscopy, small animal imaging, neuroimaging, material science, and mass spectrometry. Informatics staff also provide consulting services and tutorials in the areas of high-performance computing, high-throughput computing, data management, and specific application support. In addition to the general support, many of the informatics staff are associated with long-term partnerships to provide dedicated informatics consulting services to specific departments.