

## **Template Facilities, Equipment, and Other Resources Document for Michigan State University Institute for Cyber-Enabled Research (ICER)**

Michigan State University (MSU) participants in this project (including faculty, research staff, graduate, and undergraduate students) will have access to the resources provided by MSU's Institute for Cyber-Enabled Research (ICER).

ICER manages MSU's High Performance Computing Center (HPCC), which maintains four clusters that are available to MSU researchers as a free, shared resource. These clusters comprise a total of 1,047 nodes, which collectively have 56,236 CPU cores, 614 GPUs (including NVidia K20, K80, V100, and V100S models), and 317 TB of memory. The theoretical peak speed of the entire system is approximately 3.9 Petaflops (for double precision floating-point operations; for single precision workloads the number is approximately twice that value). The nodes are connected via low-latency InfiniBand FDR (56 Gbit), EDR/HDR100 (100 Gbit), and HDR (200 Gbit) and share high-speed parallel file systems based on Lustre and GPFS with a total capacity over 8 petabytes for persistent and temporary storage with aggregate performance above 100 gigabytes/sec. Supporting infrastructure including high speed networking, firewalls, data transfer nodes, job scheduling, commonly used software, and interactive services are also provided as part of the overall system. MSU researchers have access to this machine and its supporting infrastructure as a shared resource at no cost; however, users may purchase one or more computational nodes to receive priority access to them. These purchased nodes are operated and maintained by ICER at no additional cost to the user for the duration of the machine's service contract (currently 5 years), and will continue to be available after that on a "best effort" basis.

Opportunities to purchase hardware occur periodically, with the details of the hardware and node cost varying depending on current market conditions. For reference, information about the most recent hardware buy-in opportunity is available at <https://icer.msu.edu/users/buy-options> .

In addition to its computational assets, the Institute for Cyber-Enabled Research supports users through several mechanisms. The HPCC has an electronic help desk system to deal with user requests and system issues. ICER employs several research consultants (RCs), who are PhD scientists that provide one-on-one consulting to individuals and research groups for advanced research computing. The RCs have extensive experience in complex workflows, leveraging numerical libraries, and are familiar with many different parallel-programming paradigms. Finally, ICER offers user training in a variety of computing-related subjects through online course modules and through live interactive workshops.