UMBC High Performance Computing Facility (HPCF)

Complete information at the HPCF webpage hpcf.umbc.edu:
- Research including public relations: list of projects, publications, outcomes, posters
- Resources for users: system description with schematics and photos, tutorials and sample code, link to consulting support, supporting material, account request form
- Point of contact: Matthias K. Gobbert, Mathematics and Statistics, *gobbert@umbc.edu*

HPCF is the community-based, interdisciplinary core facility for scientific computing and research on parallel algorithms at UMBC. HPCF currently consists of two machines, taki and ada, and both are comprised of several types of nodes:
- The CPU cluster consists of 18 compute nodes with two 24-core Intel Cascade Lake CPUs and 196 GB of memory each and 50 compute nodes with two 18-core Intel Skylake CPUs and 384 GB of memory each. This cluster also includes 2 nodes in a develop.
- The taki GPU cluster contains a node with four NVIDIA Tesla V100 GPUs connected by NVLink.
- The ada GPU cluster is comprised of 13 nodes which each have two 24-core Intel Cascade Lake CPUs and 384 GB of memory. Four of these nodes have eight 2080 Ti GPUs; seven of these nodes have eight RTX 6000 GPUs; and two of these nodes have eight RTX 8000 GPUs with an extra 384 GB of memory each. This brings the total number of GPUs to 104.

The HPCF initiative originated in 2008 with an MRI proposal to the National Science Foundation (NSF) by over 20 faculty from more than 10 departments and research centers from all three colleges at UMBC. It built on the experience with a partnership between the Department of Mathematics and Statistics and the Division of Information Technology (DoIT) in jointly operating the 33-node cluster **kali** (purchased in 2003 with funds from an NSF SCREMS grant and UMBC) that had also been used by researchers from several other departments, notably in the College of Natural and Mathematical Sciences. The initial machine **hpc** in HPCF with 35 nodes was funded jointly by several participating faculty, the administration, and DoIT in 2008 and extended the partnership with DoIT to the entire UMBC community. Its complete replacement and significant expansion to the 86-node **tara** in 2009 was supported by NSF grants from the MRI and SCREMS programs, plus funding from individual researchers. The dramatic expansion to **maya** with over 300 nodes in 2013 used a second NSF MRI grant, UMBC funds, individual researchers' funds, and a gift from NASA, the first-ever significant gift of computing equipment to UMBC. The latest expansion of **taki** in 2021 was again funded by 10 individual researchers on campus. Also in 2021, the GPU cluster **ada** with 104 GPUs became available to the campus community funded by an NSF MRI grant to a group of researchers centered in Computer Science.

Unique features of HPCF:
- Integration with education: Math 447/627 Introduction to Parallel Computing for most general and community building, computational chemistry classes, computer science / information systems classes on machine learning and others. *REU Site: Interdisciplinary Program in High Performance Computing* (hpcreu.umbc.edu) funded by NSF, NSA, and DOD as summer program 2010-2017. Resource for other grants, e.g., NSF-funded Biology-Mathematics UBM@UMBC program (ubm.umbc.edu), and NSF-funded CyberTraining (cybertraining.umbc.edu), REU Site: Online Interdisciplinary Big Data Analytics in Science and Engineering bigdatareu.umbc.edu funded by the NSF as summer program 2021-2026.
- Individual user support available by RAs hosted by the Department of Mathematics and Statistics and via consulting through the *Center for Interdisciplinary Research and Consulting* (circ.umbc.edu).
- Committee comprised of members of the user community. Regular meetings for the user community and of the user support team with DoIT staff on system management.
- Scientific and parallel computing research across all colleges visible on campus (more than 400 users over time; over 40 faculty research groups)
- Interdisciplinary research opportunities among departments and with research centers (JCET, CUERE, IRC, etc.)
- Over 400 publications, including over 150 papers in peer-reviewed journals (including Nature, Science, and other top-tier journals in their fields), 50 refereed conference papers, and 50 theses.