DELL Technologies NVIDIA

Teamed for success

Working closely with Dell Technologies, the University of Alabama at Birmingham builds a world-class supercomputer to accelerate scientific research.

UAB THE UNIVERSITY OF ALABAMA AT BIRMINGHAM

Scientific Research | United States

Needs

The University of Alabama at Birmingham needs leading-edge high performance computing systems to accelerate computational research.

Solutions at a glance

- NVIDIA® DGX™ A100 systems with 2nd Gen AMD® EPYC™ processors
- Dell EMC PowerSwitch networking
- Dell EMC PowerVault storage systems
- OpenStack® private cloud

Results

- Supporting groundbreaking scientific discoveries
- Accelerating time to results for research workloads
- Making high performance computing more accessible
- Raising UAB's stature as a world-class research university

From 2016 to 2020, UAB's Cheaha supercomputer grew from 10 teraflops to

7 petaflops

Among the supercomputers in the state of Alabama, Cheaha ranks as the

largest & fastest

A research powerhouse

The University of Alabama at Birmingham is an internationally renowned research university and academic medical center known for its innovative and interdisciplinary approach to education.

Scientific research is a huge part of the UAB mission. The university brings in more than $600 million per year in research funding, which is more than the combined research budgets of all other universities in Alabama.[1] Currently, more than 1,200 UAB faculty are engaged in sponsored research fueled by funding from federal, state and local agencies, industry, nonprofits and foundations.

For universities around the world, a great deal of this scientific research now depends on the power of high performance computing (HPC) systems that can churn through massive amounts of data to accelerate discovery and innovation. And when it comes to delivering this HPC power to academic researchers, UAB is at the head of the class.

Delivering the power of HPC

Back in 2005, UAB launched its first general-access HPC cluster for the UAB research community. That system — named Cheaha, after Alabama's highest peak — featured 64 nodes with a total of 128 cores. In the years since, the UAB research computing team has been on quest to make computational resources larger, faster and more accessible to the University's research community.

A few highlights from this ongoing journey:

- In 2012, UAB IT invested in the foundational hardware to expand long-term storage and virtual machine capabilities with the acquisition of 12 PowerEdge R720xd systems, creating a 192-core and 432-terabyte virtual compute and storage fabric.
- In 2013, UAB IT acquired an OpenStack cloud and Ceph storage software fabric, through a partnership between Dell and Inktank, to extend cloud computing solutions to the researchers at UAB and enhance interfacing capabilities for HPC.
- In 2016, the Cheaha supercomputer grew from 10 o 110 teraflops, to become the fastest supercomputer in Alabama. In the same year, the UAB IT team launched a 100Gbps network, one of the fastest in the state.
- In 2017, UAB added 72 NVIDIA GPUs, to boost the Cheaha supercomputer's power to 450 teraflops. At that point in time, this expansion made Cheaha far and away the fastest supercomputer in Alabama and one of the five fastest supercomputers at academic institutions in the Southeast.

Today, this pursuit of HPC excellence continues as the UAB research computing team pushes forward with additional enhancements to the Cheaha cluster. Working closely with HPC specialists from Dell Technologies and NVIDIA, the UAB team recently added a new accelerated computing cluster built with new NVIDIA DGX A100 systems.

The DGX A100 system harnesses the power of 8 accelerators — the NVIDIA A100 Tensor Core GPU, interconnected with NVIDIA NVSwitch and NVLink technology. Each system has eight 200Gbps NVIDIA networking interfaces, integrated PCIe 4 support and dual 2nd Gen AMD EPYC processors. Delivering five petaflops of AI performance, the NVIDIA DGX A100 enables organizations to accelerate diverse AI workloads, such as data analytics, training and inference.

The UAB installation incorporates four DGX A100 systems and each DGX system can allocate up to 56 GPU instances using NVIDIA multi-instance GPU (MIG) technology. Each server can be allocated to different virtual machines via an OpenStack cloud layer.

"It gives us a solution for machine learning, both the training and inference aspects, as well as exploratory uses for data analysis," says Ralph Zottola, Ph.D. and Assistant Vice President for Research Computing at UAB. "It lets us give our users virtual machines with GPUs enabled inside of them, if that's what they need. These are systems that allow us to spin up virtual machines that have GPUs and that don't have GPUs. We can choose the configuration on the fly."

Fueling discovery and innovation

In its latest iteration, the Cheaha supercomputer delivers seven petaflops of computational power, according to UAB Vice President and Chief Information Officer Curtis A. Carver Jr., Ph.D. In mathematical terms, that equates to the ability to perform seven quadrillion floating point operations per second. That kind of HPC horsepower allows researchers to tackle bigger and harder problems in the scientific discovery process.

1 UAB news release, "UAB tops $600 million in research funding for first time," November 18, 2019. UAB Research Computing, accessed November 3, 2020.

"Technology underlies the innovation and research here at UAB," Dr. Carver says. "The supercomputer powers lifesaving research that can help UAB change the world."

Here are a few examples of the breakthrough research showcased on the UAB IT Research Computing site:

- **Kristina Visscher, Ph.D.**, assistant professor of neurobiology, studies visual processing, analyzing huge amounts of data per subject. Her work studies how the brain adapts after long-term changes in visual input, such as macular degeneration.
- **Dr. Hassan Fathallah-Shaykh**, a professor of neurology, works to detect cancer in MRI images using new mathematical models and techniques. Using the new technology implemented by this project, Dr. Hassan, working with an engineering student, won the 2016 Worldwide Multimodal Brain Tumor Image Segmentation Challenge by analyzing 118,000 MRI images to detect cancer in less than 12 hours. "The supercomputer worked like magic, without any glitches. It is evident that I would not have been able to compete without the supercomputer resource," he says.
- **David Crossman, Ph.D.**, bioinformatics director in UAB's Heflin Center for Genomic Science, deciphers the sequences of human genomes for patients seeking a diagnosis in UAB's Undiagnosed Diseases Program. The expanded computer cluster allows him to get answers in hours as opposed to weeks. Speeding the processing time to crunch genome sequencing data means faster diagnoses — and faster treatment and better health outcomes — for his patients.
- **Ryoichi Kawai, Ph.D.**, associate professor of physics, uses the supercomputer for what may be the largest calculation on campus — determining the electronic structure for a cube made up of just 216 atoms of zinc sulfide doped with chromium or iron. His research is laying the groundwork for a better infrared laser, which could be used for a variety of treatments, from shrinking tumors to removing kidney stones.

Working with Dell Technologies

In its work to deliver leading-edge HPC resources to the University's researchers, the UAB research computing team works closely with Dell Technologies.

"We have made giant strides. The collaboration is leading to research that changes the world," says Carver.

"It really is a partnership," he says. "It's not always even Dell equipment. Dell has the ability to work holistically, to take a big-picture engineering approach. It's not just about the hardware. They work to identify the right type of resources, connections and services that we will need. But most importantly, they are a partner who helps us think through problems, and find ideal solutions."

"In today's world, no one person is an island," he says. "You need a team to get things done."