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THE STATE OF HPC IN HIGHER EDUCATION

SPECIAL REPORT

Millions of Science, Engineering, Technology, and Mathematics (STEM) jobs go unfilled in the United States for lack of qualified candidates. As more industries look to benefit from the potential breakthroughs that HPC AI/deep learning and simulations can provide, a vibrant education pipeline for skilled HPC professionals is critical. What was once a unique area of knowledge and expertise for a select few that learned by on-the-job training is starting to go mainstream in college curricula. But where?

To meet the growing demand, higher education no longer approaches HPC as an esoteric, occasional course for computer science students. However, the demands of HPC don't directly align with any single academic department. Institutions are integrating relevant HPC courses through a variety of disciplines. Here we take a look at the higher education landscape working to educate future HPC engineers and scientists.

HOW STUDENTS EARN HPC CREDENTIALS

There are few undergraduate degrees in HPC or supercomputing. Instead, some schools offer HPC or supercomputing undergraduate certifications and minors. These formal programs often take an interdisciplinary approach and have extensive prerequisite requirements.

The more common undergraduate route is for universities to offer HPC-related courses across their computer science, mathematics, engineering, statistics, and physics departments. Students can take these individual courses as part of, or in addition to, their declared major.

This a la carte approach particularly helps students whose intention is to develop and optimize HPC applications in specific fields. Students get exposed to HPC topics while also gaining the needed subject matter expertise in another complex field. These students will ultimately become HPC professionals with degrees in disciplines such as atmospheric science, genetics, or aerospace engineering.

UNDERGRADUATES SHOULD LOOK FOR “COMPUTATIONAL” MAJORS

Undergraduate students looking for a more dedicated curriculum on HPC and supercomputing topics should look for the "computational" majors.

Stanford University's Bachelor of Science and Mathematical and Computational Science is a typical example of the interdisciplinary scope of the computational majors. Other HPC-related majors reside within specific departments, such as the University of Texas’s Bachelor of Science in Computational Engineering. The coursework of the "computational" degrees closely aligns with HPC and supercomputing concepts. Students can find a “computational” concentration in nearly all academic fields that have a connection to HPC, although not necessarily all at a single university.

There are also graduate certificate programs in high performance computing, which can be an attractive option for students eager to enter the workforce or those already there and who want to upskill. Those interested in combining HPC studies with another field may be able to find combined degree programs, like the University of Buffalo's five-year program to earn a Bachelor of Science in Computational Physics and a Master's Degree in Physics.

DID YOU KNOW?

While HPC bachelor’s degrees still lag, there’s no lack of options in higher education, including at the undergraduate level.

GAINING PRACTICAL EXPERIENCE WITH SUPERCOMPUTERS

Students have a wide range of opportunities to gain practical HPC experience outside their academic studies.

Internships

Universities that use supercomputers to conduct research may offer student research participation programs. The U.S. Department of Energy runs the Science Undergraduate Laboratory Internships (SULI) program, which provides student internships at a DOE facility. SULI provides internships in a variety of STEM fields, including the opportunity to work in HPC.

Sponsored competitions

The HPC-AI Advisory Council and ISC High Performance run an annual Student Cluster Competition. Student teams from around the world compete in various tests. In the 2020 competition, 40% of a team's score was based on how the team modified the code in HPC applications to improve their performance. Another 10% of the score depended on how innovative they were in their modifications—did they change the application in a novel way without breaking it and in a way that would be useful for researchers?

Student-led organizations are finding ways to access HPC resources

The Students for Exploration and Development of Space at the University of California at San Diego SEDS is one example. SEDS conducts research in space exploration. They've relied on HPC for many of their projects, including using the Nimbix platform to speed up and optimize the design of a 3D-printed rocket engine.

Such programs are crucial for job applicants, as requirements for HPC positions typically give preference to those who've already demonstrated some experience with supercomputers and HPC. Expanding the channels for students to gain practical experience will accelerate student-readiness in real-world operations.

POST-GRAD EDUCATION OPTIONS ARE RISING, TOO

One of the challenges to meet the HPC skills gap is how to upskill people already working in IT or HPC-adjacent fields. Some universities, like Kennesaw State University, make their HPC certification program available online to those not seeking a degree. Students and non-students can find both undergraduate and graduate-level HPC certificate courses.

One of the difficulties, however, is that there are no clear curricula or standards for HPC certifications. The HPC Certification Forum (HPC-CF) is working to change that. The HPC-CF is a member-driven, HPC educational resource with a mission to provide HPC training to those already working in HPC and those who aspire to do so. One of their goals is to be a resource for HPC education for people from "non-traditional HPC disciplines."