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Super Education for Supercomputers

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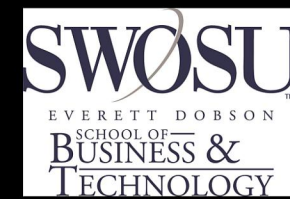


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Super Education for Supercomputers

Southwestern Oklahoma State University



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Abstract

Supercomputing (100X more powerful than a desktop) allows organizations to solve complex problems that are not easily studied in any other way (ex. Blue Waters to simulate the known universe since the beginning of time for the design of the James Webb telescope). Producing qualified individuals to take advantage of the growing number of supercomputing jobs is a constant struggle. This poster provides an overview of education in supercomputing, explains how training occurs, and describes some of the key players working to educate a taskforce to deal with these highly complex machines.

Why learn High Performance Computing?

Infinite opportunities...for all disciplines!

- Applications of supercomputing reach far and wide, from medicine to astrophysics!
 - Even the humanities, arts, and social sciences.
- Supercomputing used to be special to government agencies, research institutions, weather prediction centers and other industries that deal with large amounts of numbers. While this is still applicable, now, many different organizations in many industries not normally identified with supercomputing are seeking a competitive edge, by "providing a window into the future of technology" (H. Neeman, personal communication, March 1, 2020). However, the supply of qualified people to program, run and maintain supercomputers is not enough to meet the increasing demand. Few organizations know how to implement HPC systems and use them effectively (Prosysis, 2016).

Actual Usage by Discipline

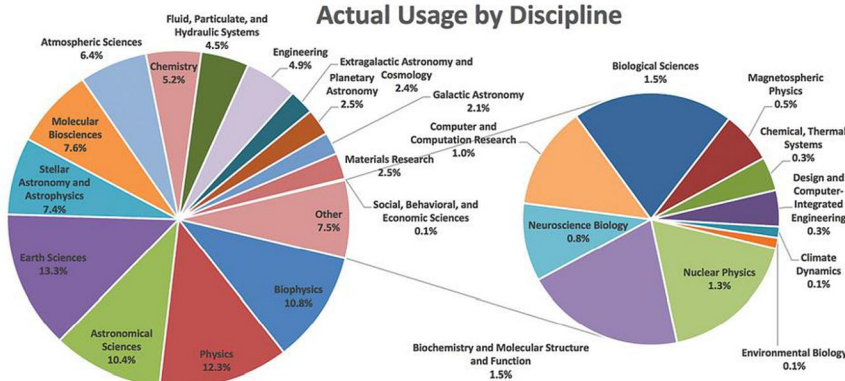


Fig. 1: Actual usage by discipline of the Blue Waters petascale supercomputer

References

- Figure 1 National Center for Supercomputing Applications University of Illinois at Urbana-Champaign. (2017). Retrieved from http://www.ncsa.uiuc.edu/news/stories/ncsa_releases_2017_blue_waters_project_annual_report_detailing_innovative_r
- Figure 2 Business Wire. (2017). Retrieved from <https://www.businesswire.com/news/home/20170120005015/en/Supercomputer-Market-Driven-Development-Smart-Cities-2021>
- Joiner, D., Peck, C., Murphy, T., Gray, P. (2008). Education, Outreach, and Training for High-Performance Computing. *Computing in Science & Engineering*, 10, 40 - 45. 10.1109/MCSE.2008.129
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How to educate and train?

- Universities and other research institution are among the most important users of high-performance computing systems. Their support, along with government agencies (Department of Energy, National Science Foundation, and NASA, to name a few) and IT companies are crucial for educating and training qualified individuals (See Fig. 2).
- Provide easy access to supercomputing resources (HPCUniversity.org)
- Recruitment and long-term engagement through training workshops (XSEDE EMPOWER)
- A standard curriculum should be established; necessary to teach a wide range of computer science subjects such as:
 - Programming
 - Algorithms
 - Parallel computing systems
 - Complexity analysis
 (Joiner, Peck, Murphy, & Gray, 2008)

GLOBAL SUPERCOMPUTER MARKET BY END USER

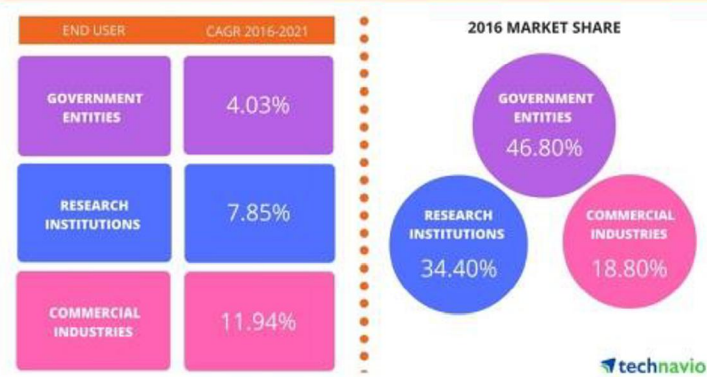


Fig. 2: Compound Annual Growth Rate 2016-2021 and 2016 Supercomputer Market Share

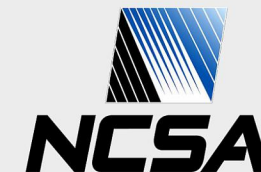
How to learn supercomputing?

- ✓ Massive Open Online Courses (MOOCs)
 - University of Edinburgh via FutureLearn
 - Georgia Institute of Technology via Udacity
 - Learn coding languages (Python, Java, C)
- ✓ Get an account on Oklahoma's own supercomputers:
 - OSU High Performance Computing Center- Cowboy
 - OU Supercomputing Center for Education and Research (OSCER)- Schooner
- ✓ Explore ways in which you can utilize supercomputers in your discipline; ask faculty in your department and in computer science that utilize supercomputing resources.
- ✓ Attend workshops, training programs, or conferences, such as the ACM/IEEE Supercomputing Conference.

Resources



Yale Center for Research Computing



How the experts got started in HPC?

Dr. Henry Neeman, Director of the OU Supercomputing Center for Education & Research (OSCER)



Scientific visualization → research assistantship at University of Illinois at Urbana-Champaign (UIUC) Center for Supercomputing Research and Development (CSR) on scientific visualization → UIUC National Center for Supercomputing Applications PhD research → University of Oklahoma

(H. Neeman, personal communication, March 1, 2020)

Dr. Andrew Sherman, Senior Research Scientist, Center for Research Computing at Yale University



Ph.D. on sparse numerical linear algebra research at computer science departments → Scientific Computing Associates (work on language Linda) → HPC Linux clusters at Yale, research computing support for the Arts and Sciences at Yale

(A. Sherman, personal communication, March 2, 2020)

