

WORKFORCE: CHALLENGES & OPPORTUNITIES

VALERIE TAYLOR
Director, MCS Division
Argonne National Laboratory

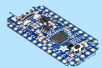


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Computing Continuum

IoT/Edge



Fog



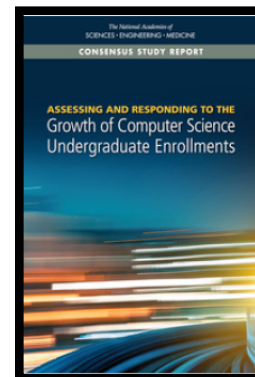
HPC/Cloud/Instrument



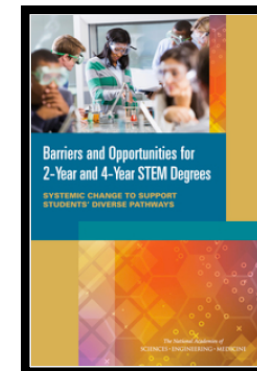
Courtesy of Pete Beckman

Critical Areas

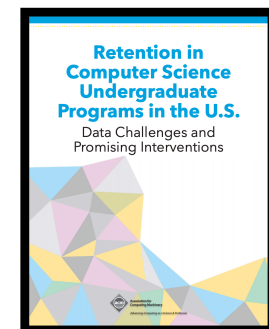
- Computer Science
- Applied Math
- Computational Science
- Data Science
- Computer Engineering
- ...



<https://doi.org/10.17226/24926>



<https://doi.org/10.17226/21739>



ACM

WORKFORCE: TO ADVANCE THE RESEARCH



Courtesy CS4All
K-12



Two-Year



Undergraduate



Graduate



**Alternative
Pathways**

IMPORTANCE OF DIVERSITY

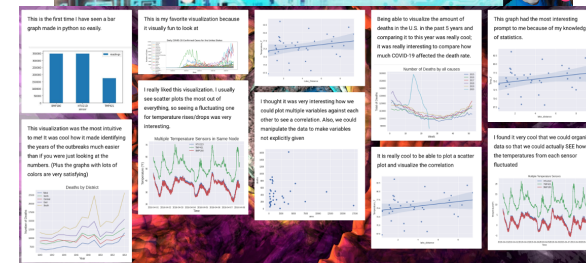
K-12 STUDENTS

- Important to engage and excite students about computing early
 - *A Blueprint for Reform: The Reauthorization of the Elementary and Secondary Education Act, released by the Obama administration in 2010*
 - Recognized the need to increase the number of students pursuing STEM degrees and careers
- By the time students start high school, CS is predominately White boys.
 - For girls and minorities, the representation is disproportionately small
- 2019 CS Advanced Placement exams (Barbara Ericson, UMich)
 - CSA: programming in Java (64,197)
 - Female: 24%
 - Black: 4%
 - Hispanic: 12%
 - CSP: broader aspects of computing (94,360)
 - Female: 33%
 - Black: 7%
 - Hispanic: 20%

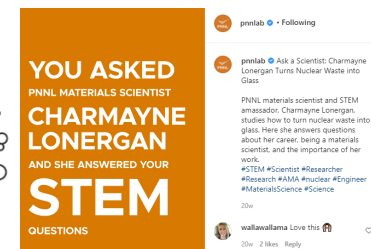
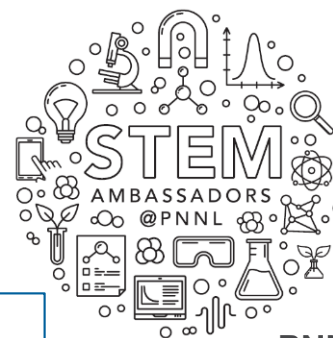
K-12 STUDENTS

- Leverage existing programs:
 - CS4ALL : engagement with students and teachers in K-12
 - Currently ~500 members (content and service providers, education, out of school)
 - CS AP, Diversity Organizations
 - Summer camps
- Challenges
 - Exposure to parallelism in some novel way
- Opportunities
 - Go beyond coding → edge computing, sensors
 - Look at problems for social good
 - Great way to bring in cultural-relevance
 - Maker spaces
 - First Robotics
 - After school programs

LLNL – Girls Who Code

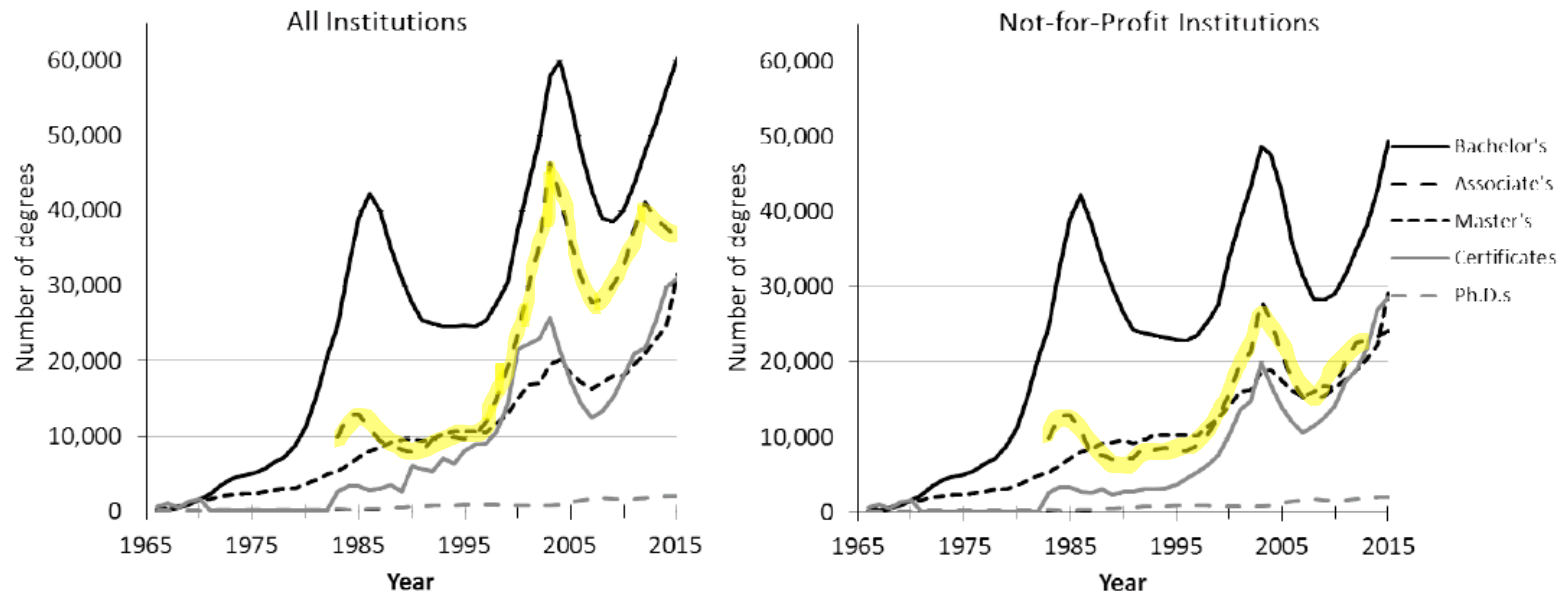


ANL Big Data Camp 2020



PNNL STEM Ambassadors

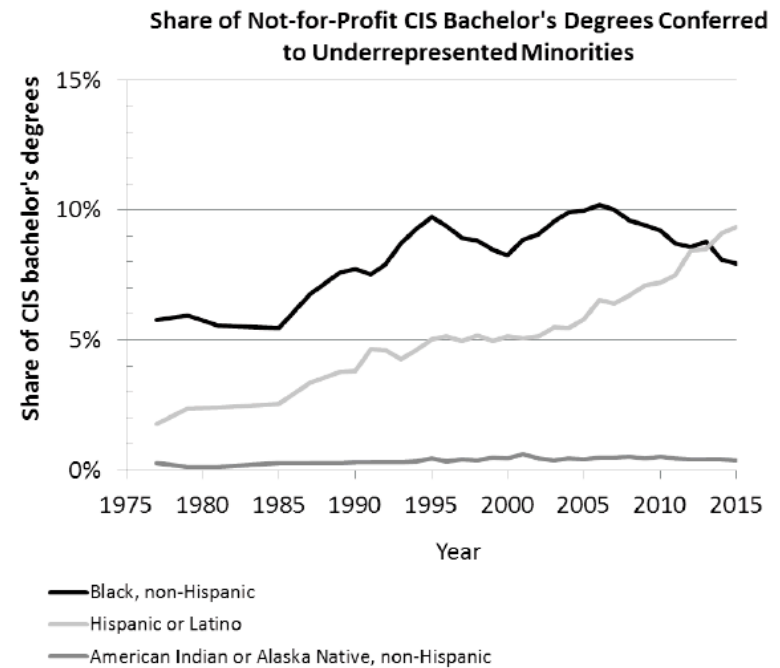
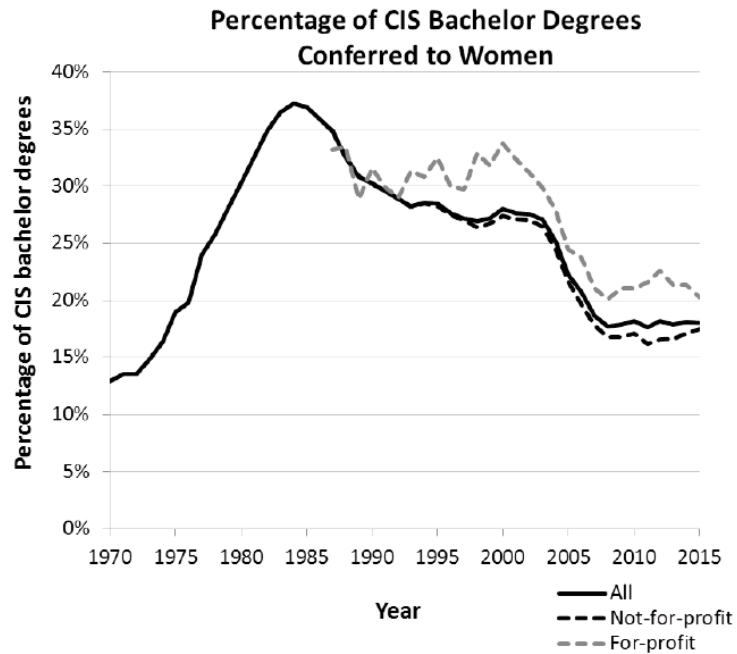
TWO-YEAR PROGRAMS



IPEDS, CS Growth Report

- Associate's degrees are important
- Students are often older, work part-time
- Provides one of several pathways to 4-year institutions; co-enrollment
- Curriculum challenge: is it possible to add components related to HPC?

UNDERGRADUATE STUDENTS



IPEDS, CS Growth Report

UNDERGRADUATE

- Challenges:
 - How much of the curriculum focuses on the full computing continuum?
- Opportunities
 - Certificates?
 - Partner to bring some of the research into the classroom
 - Requires access to computational platforms and data
 - Take advantage of summer internships & co-ops



LBLN – SHI: Sustainable Research Pathways



First Look@Argonne

GRADUATE STUDENTS

- Have strong partnerships between universities, labs, and industry with graduate students
 - Leverage research collaborations with faculty
 - Great recruiting opportunities
- Upon course completion, spend 6-9 months at a given site
- Many universities offer graduate courses in HPC
 - Opportunities for focus on full
 - Opportunities for partnership with access to computational resources and data
- Leverage internships



ATPESC: Argonne Training Program on Extreme-Scale Computing

CRLC-SH: Virtual Seminar Series



ALTERNATIVE PATHWAYS

- Coding Bootcamps
 - Flatiron, Hack Reactor, WTIA...over 500 code camps
 - Vary in duration, several weeks to several months
 - Vary in organization, and focus areas
- Opportunity to have a focus on the computing continuum
 - Include curriculum on parallel programming, AI, data analysis, ...
 - Need some way to evaluate the rigor of the camps
- Allow for retooling

PARTNERSHIPS

- Industry, Academia, Government Labs, Government Agencies
- Opportunities to bring the real world into the classroom
 - Leverage project-based courses
- Providing instruction via guest lectures or course development/delivery
 - Modules that can be easily disseminated
 - Computational platforms and data infrastructure for the classroom
 - Consider possible certificates
- Diversity:
 - Leverage partnerships with Minority Serving Institutions and organizations (BPCnet)
- Leverage research opportunities for students
- Consider opportunities for co-curricular activities

SUMMARY & RECOMMENDATIONS

- Important to consider all levels of the educational enterprise
- Multiple paths to degree completion
 - Reward experience, tinkering, curiosity
- Opportunities to work in partnership to inject the computing continuum into the curricular
- Work in partnership with diversity efforts
- *Important for DOE ASCR to continue supporting training and outreach efforts at the undergraduate and graduate student levels*

