(Parallel) Computing Education: The Next Generation

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Important!

- All information provided here represents the opinions of an individual Program Director and not the NSF
- The only official source for NSF policy is published materials

http://nsf.gov/

Parents & Grandparents

Frances Tymann
Born 1889
11/16/2021

Parallel Computing for the Next Generation

Apollo 11
![Image](http://top-ten.readthedocs.org/en/latest/_images/flight.jpg)

First Flight: December 17, 1903
Grandmom was 14

From Kitty Hawk...
![Image](http://www.wired.com/images/article/full/2008/07/moon_landing_630px.jpg)

Moon Landing: July 20, 1969
Grandmom was 80
About 65 years

To The Moon
“I really didn't foresee the Internet. But then, neither did the computer industry. Not that that tells us very much of course—the computer industry didn't even foresee that the century was going to end.”

— Douglas Adams

1958

- Some economic facts
  - Cost of new house $12,750.00
  - Wages per year $4,600.00
  - Minimum Hourly Rate $1.00
  - Gallon of Gas 25 cents
  - 16-oz beer 23 cents
- NASA created (July 29th)
- Explorer 1 launched (Sputnik launched in 1957)
- The Microchip co-invented by Kilby and Noyce

The Altair

- The MITS Altair 8800 was a microcomputer design from 1975 based on the Intel 8080 CPU
- The Altair is widely recognized as the spark that led to the microcomputer revolution of the next few years
My First Computer...

Built in 1977
I was 19 (Senior in HS)

Total Cost...

7 Payments at $107 each
Total $749

What did it do?

Blinked the Lights!!!
When I Went to School...

[PDP-8, PDP-11, Vax]

[CM-2]
Computing has changed...

- Computers are Everywhere
- Affordable
- Powerful
- Parallel
- Mobile
- Networking is Ubiquitous
- Internet
- Cloud Computing

I am 62
About 45 years

Has Computing Education Changed at the same Pace?

No, it has not 😞
“If your students don’t listen to you, listen to them.”
— Safir Kassim Booudjelal

CS as a Service Discipline

- Entering Students
  - CE, Science, Engineers
  - Artists, Political Scientists, Journalists, …

- Developers
- Non-developers, practitioners
Parallel Computing for the Next Generation

- Introduces students to the breadth of the field of computer science
- Networking and Communication
- Parallel and Distributed Computing
- Software Development Fundamentals
- Programming Languages
- Architecture and Organization
- Computational Science
- Information Assurance and Security
- Algorithms and Complexity

The course is programming language agnostic.

Across all AP exams, Computer Science Principles (CSP) has the highest rate of participation for Black/African, Native American/Alaskan, and Native Hawaiian/Pacific Islander students. CSP has the 2nd highest rate of Hispanic/Latino/Latina student participant across STEM AP exams.

- So, Lou Russ is he going to make it?
- I don't think so
- Glenn, come on I need him
- How am I supposed to keep a kid in the band if he can't play an instrument?
- You teach him. You are telling me that you cannot teach a willing kid like Lou Russ?
- I tried and I can't
- You are a lousy teacher

Coach Meister and Glenn Opus
From Mr. Holland's Opus © Buena Vista Pictures
“I would teach how science works as much as I would teach what science knows.”

― Neil deGrasse Tyson
5. Curriculum

The curriculum requirements specify topics, but do not prescribe specific courses. These requirements are:

(a) Computer science: At least 40 semester credit hours (or equivalent) that must include:

1. Substantial coverage of algorithms and complexity, computer science theory, concepts of programming languages, and software development.
2. Substantial coverage of at least one general-purpose programming language.
3. Exposure to computer architecture and organization, information management, networking and communication, operating systems, and parallel and distributed computing.
4. The study of computing-based systems at varying levels of abstraction.
5. A major project that requires integration and application of knowledge and skills acquired in earlier coursework.

Certainly, at the undergraduate level we have been preparing computing "generalists"…

Perhaps it is time to specialize…

This morning Sandy said there was not enough HPC in our graduates.

Most curricula only have room for one or two courses in topics like HPC, AI, Data Science, …

Maybe there should be an HPC curriculum.

Began in 2010 (Sushil Prasad)

Developed PDC curriculum by 2012 that influenced ACM 2013, revised 2020

Have been involved with several curriculum committees

- ABET
- ACM/IEEE 202X
- AP Computer Science Principles
What would you say if...
EE majors still had to master designing circuits like these

Before they could learn about integrated circuits?

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"You know, sometimes kids get bad grades in school because the class moves too slow for them. Einstein got D's in school. Regardless what, I get F's!!"

— Bill Watterson

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Sage on the Stage

https://jedediyah.com/blog/2019/12/11/sage-on-the-stage/
COVID-19

Rapid Switch to online teaching

The New Classroom?
MIT App Inventor

Star Trek

We Have Communicators
Replacements

- Jimmy my tight end is... deaf
- Yeah, I know
- Well Jimmy, how am I going to coach a deaf man?
- Oh, you don't need to. Brian Murphy would've gone in the first round 5 years ago if he hadn't been born deaf. Played college ball right here in D.C., Gallaudet.
- But Jimmy, I need to communicate with him and how...?
- Learn to sign, you know...

Summary

- A goal of this talk was to make you think about how much computing has changed over the past 50 years.
- A goal of this talk was to convince you that while Computing Education has changed, is not changing fast enough.
- My goal was not to give you answers, but instead to encourage to think about answers
- Hopefully, I convinced you that we need to rethink content and pedagogy, NOW!!

"The most dangerous phrase in the language is, "We've always done it this way.""

― Grace Murray Hopper