Computer Science: The Ever-Expanding Sphere

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Dean's Seminar Series, McCormick School of Engineering
Northwestern University

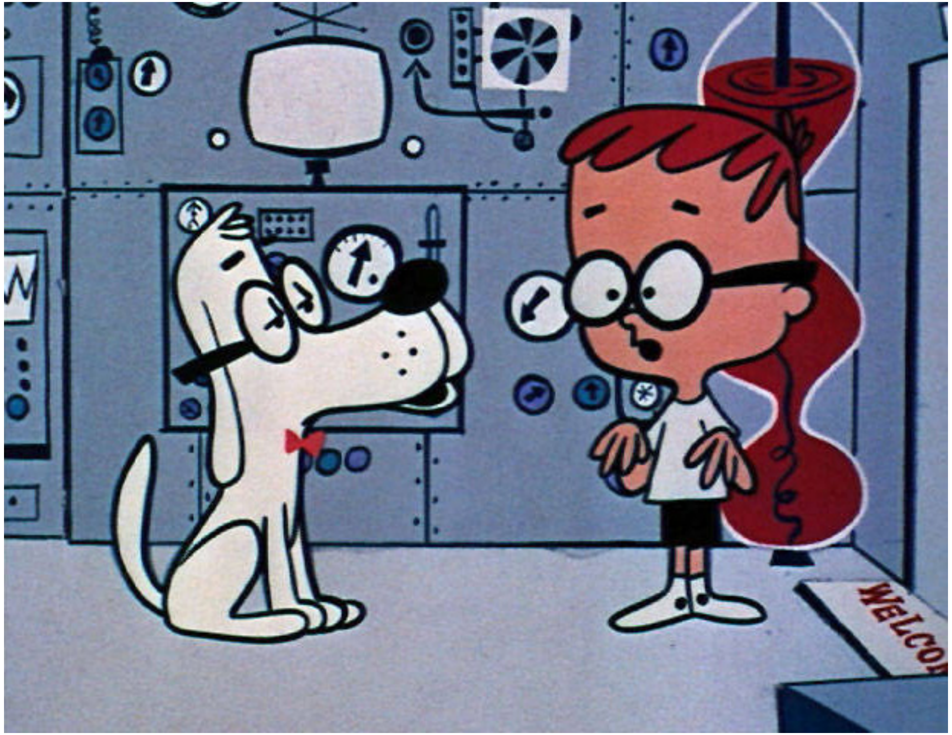
April 2016

http://lazowska.cs.washington.edu/NU.pdf, pptx

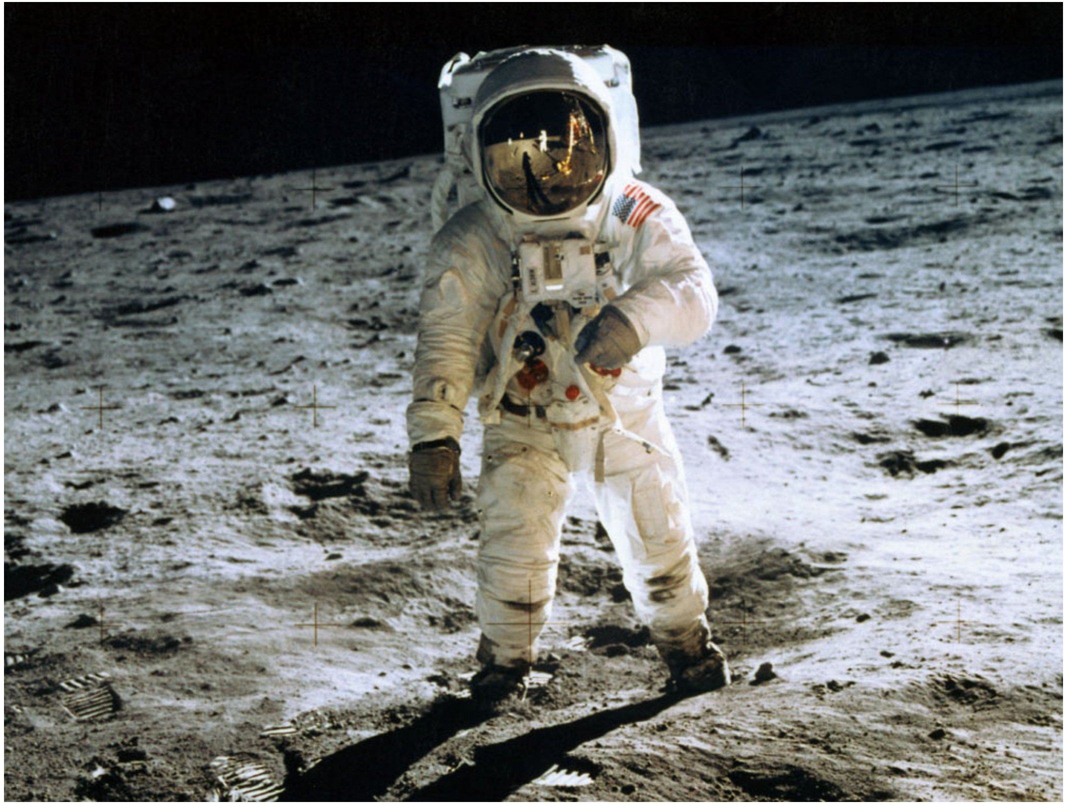
Today

- A reminder of the extraordinary progress that Computer Science has achieved
- A glimpse at what's happening today
- A 21st century view of the field
- The role of Computer Science in the modern university
  - One quick example: The University of Washington eScience Institute
- The role of Computer Science in the modern world
- Student response (enrollment trends)
- Institutional response

1969 – Forty seven years ago …



Credit: Peter Lee, Microsoft Research



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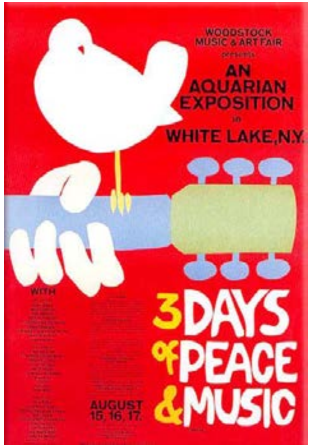

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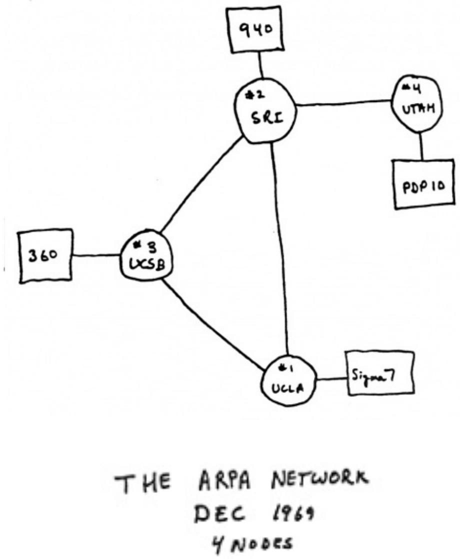
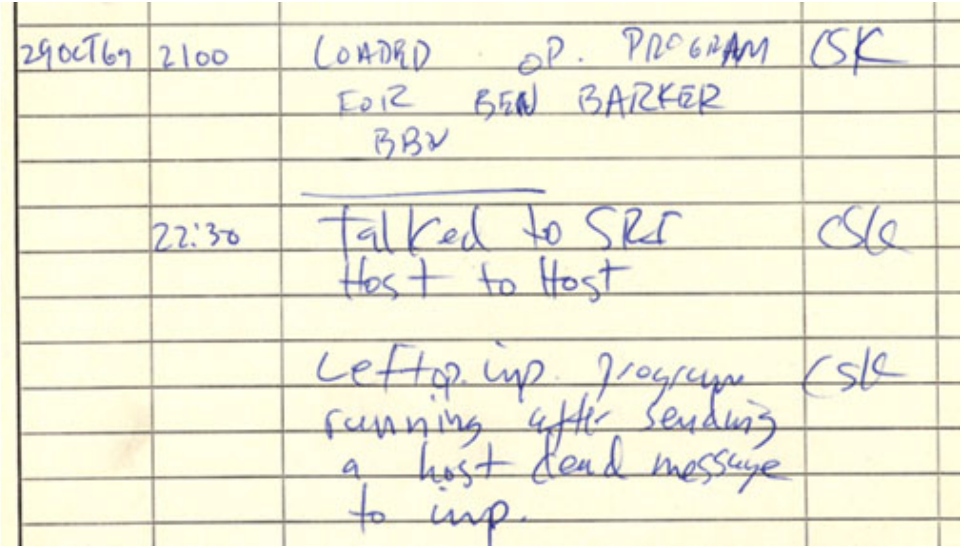




Credit: Peter Lee, Microsoft Research

With nearly 5 decades of hindsight, which had the greatest impact?

- Unless you're big into Tang* and Velcro* (or sex and drugs), the answer is clear …

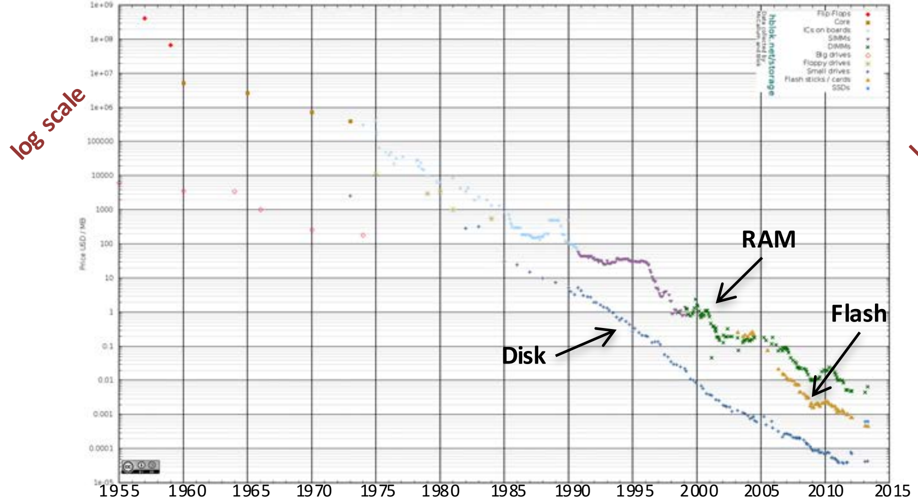
- And so is the reason …

EXPONENTIALS R US

* Commonly – although erroneously – attributed to the space program

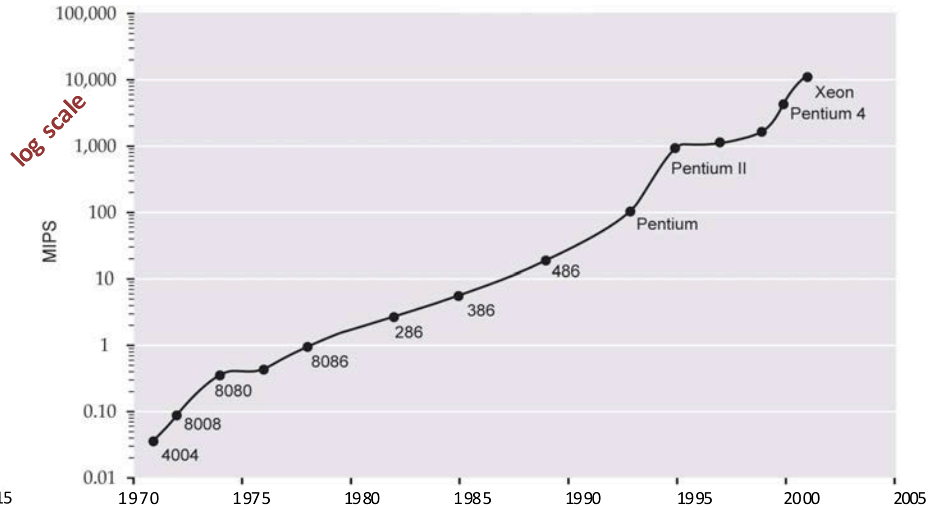
The exponential improvements that have characterized computing can be exploited in two ways

- Constant capability at exponentially decreasing cost
- Exponentially increasing capability at constant cost



Storage Price / MB, USD
(semi-log plot)

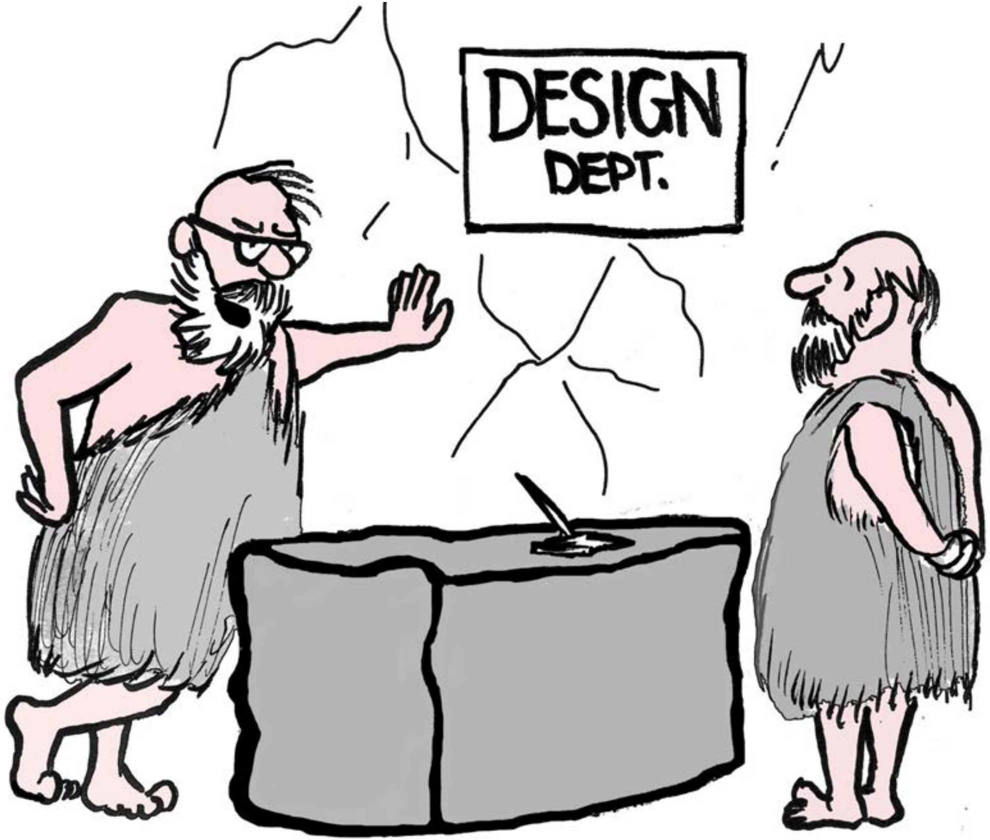
John McCallum / Havard Blok



Microprocessor Performance, MIPS
(semi-log plot)

Ray Kurzweil


UNIVAC



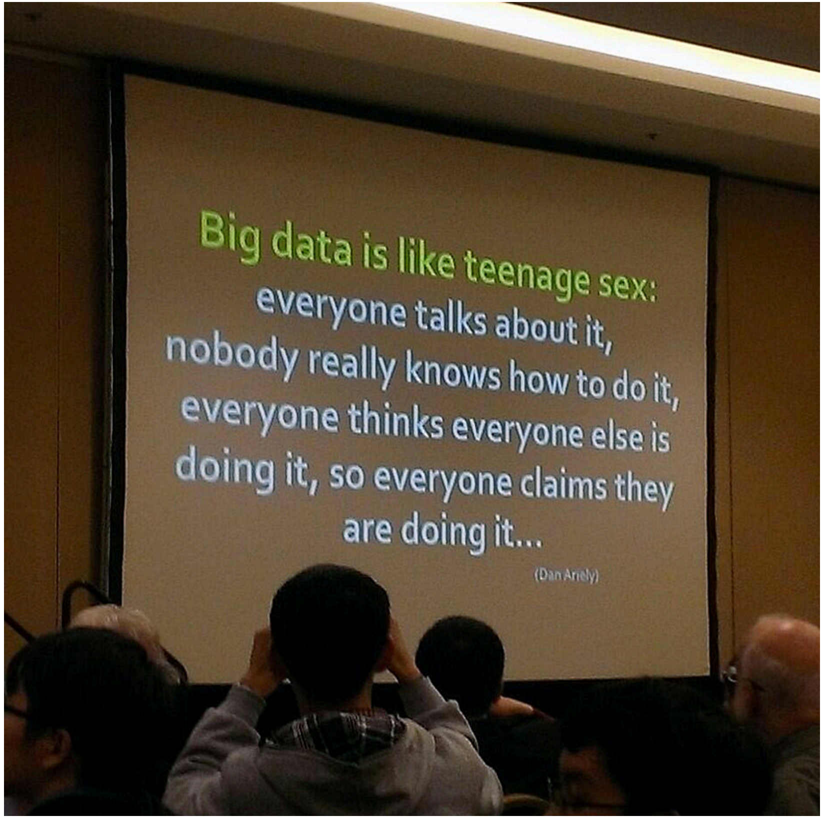
“The wheel was great.
What have you done for me lately?”

Today, these exponential improvements in technology (and also in algorithms!) are enabling a "big data" revolution

- A proliferation of sensors
  - Think about the sensors on your phone
- More generally, the creation of almost all information in digital form
  - It doesn't need to be transcribed in order to be processed
- Dramatic cost reductions in storage
  - You can afford to keep all the data
- Dramatic increases in network bandwidth
  - You can move the data to where it's needed

- Dramatic cost reductions and scalability improvements in computation
  - With Amazon Web Services, 1000 computers for 1 day costs the same as 1 computer for 1000 days
- Dramatic algorithmic breakthroughs
  - Machine learning, data mining – fundamental advances in computer science and statistics
- Ever more powerful models producing ever-increasing volumes of data that must be analyzed

So, exactly what's meant by "big data"?



Credit: Dan Ariely, Duke University

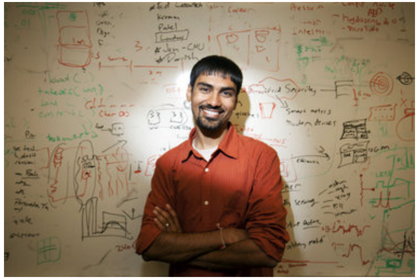
Serious answer: “big data” is enabling computer scientists to put the “smarts” into everything

- Smart homes
- Smart cars
- Smart health
- Smart robots
- Smart crowds and human-computer systems
- Smart education
- Smart interaction (virtual and augmented reality)
- Smart cities
- Smart discovery

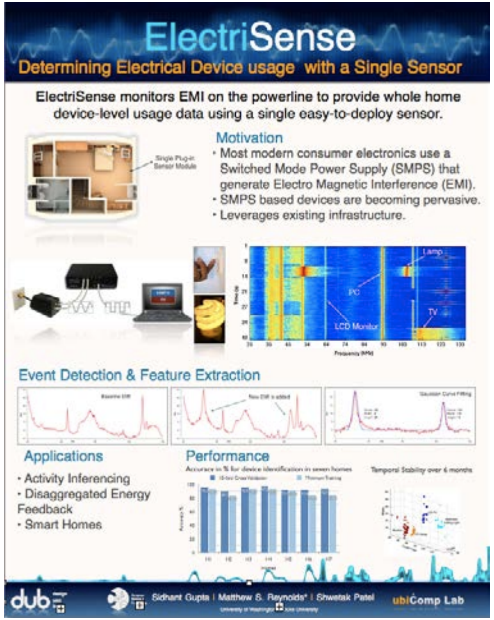
Xconomy

Business + Technology in the Exponential Economy

Smart homes (the leaf nodes of the smart grid)



Shwetak Patel,
University of Washington
2011 MacArthur Fellow



belkin echo

Smart cars

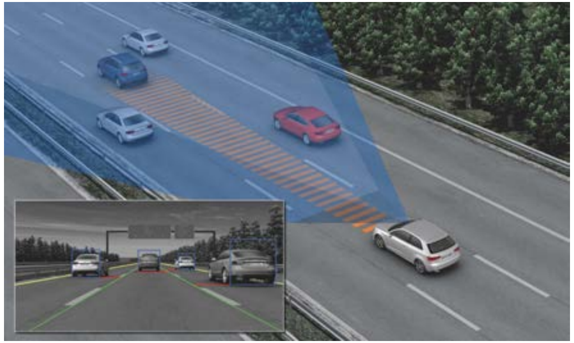
DARPA Grand Challenge

DARPA Urban Challenge

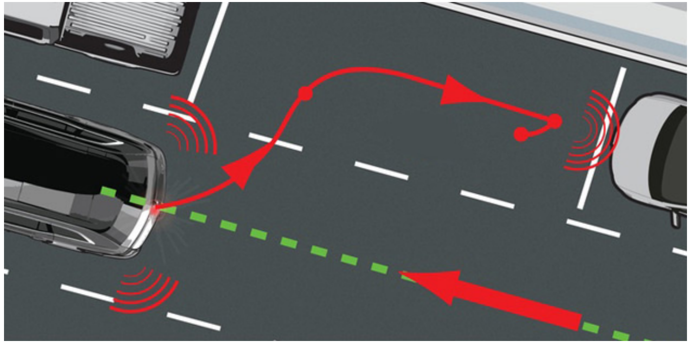
Google Self-Driving Car

Tesla Model S

Adaptive cruise control



Self-parking



Smart health

Larry Smarr – "quantified self"

Evidence-based medicine

P4 medicine

PIONEER 100
HUNDRED PERSON WELLNESS PROJECT
Institute for Systems Biology

Arivale

Smart robots

iRobot

rethink robotics

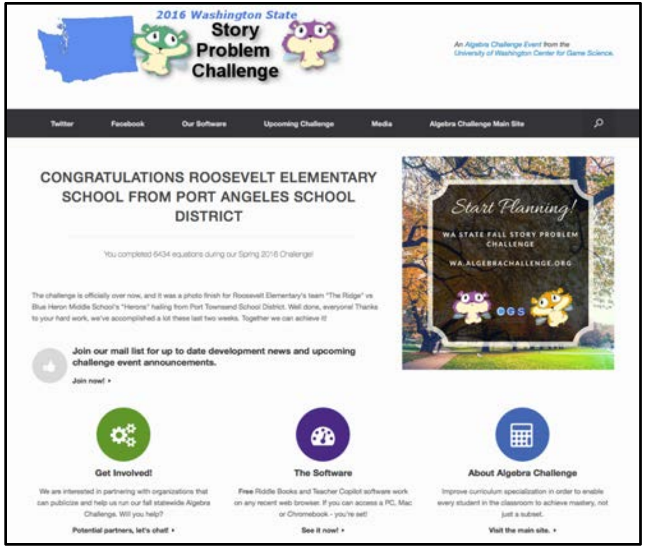
Smart crowds and human-computer systems

Zoran Popovic
UW Computer Science & Engineering

David Baker
UW Biochemistry

Smart education

Zoran Popovic
UW Computer Science & Engineering



CGS Center for Game Science

Enlearn

Smart interaction

Microsoft HoloLens

KINECT™
for XBOX 360

GOOGLE CARDBOARD

Experience virtual reality in a simple,
fun, and affordable way.

Smart interaction – content creation

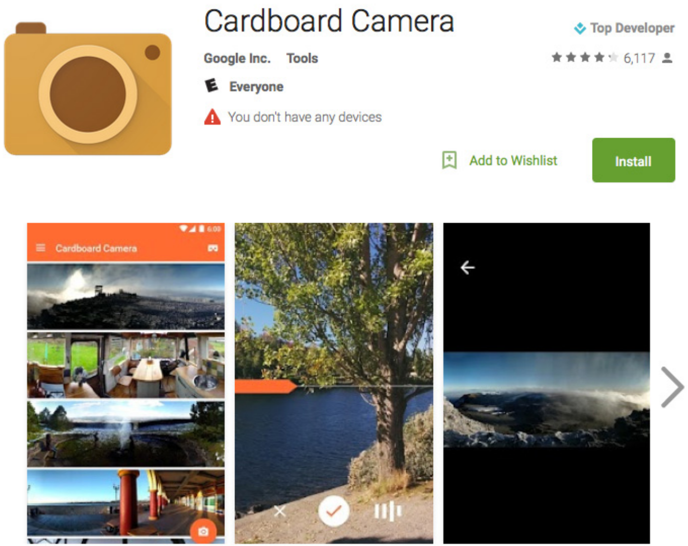
Steve Seitz
UW Computer Science & Engineering + Google Seattle

JUMP

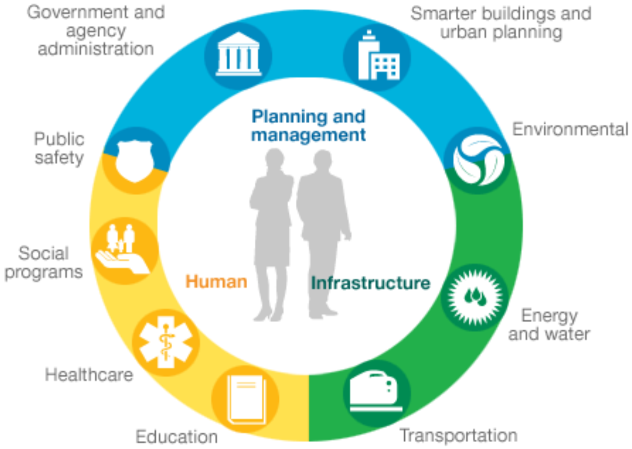
Experiences like you're actually there.

GoPro
Be a HERO.

ODYSSEY



Smart cities

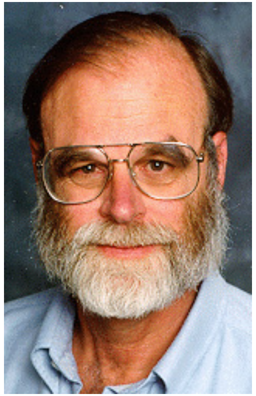


Urban @UW

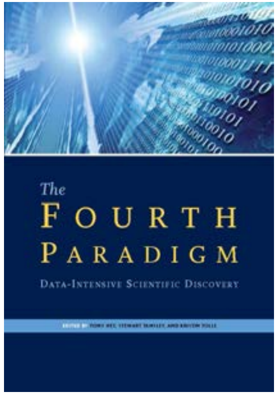
METROLAB NETWORK

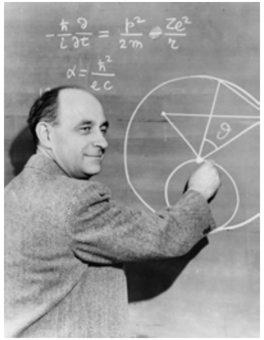
Smart discovery: “The Fourth Paradigm”

1. Empirical + experimental
2. Theoretical
3. Computational
4. Data-Intensive



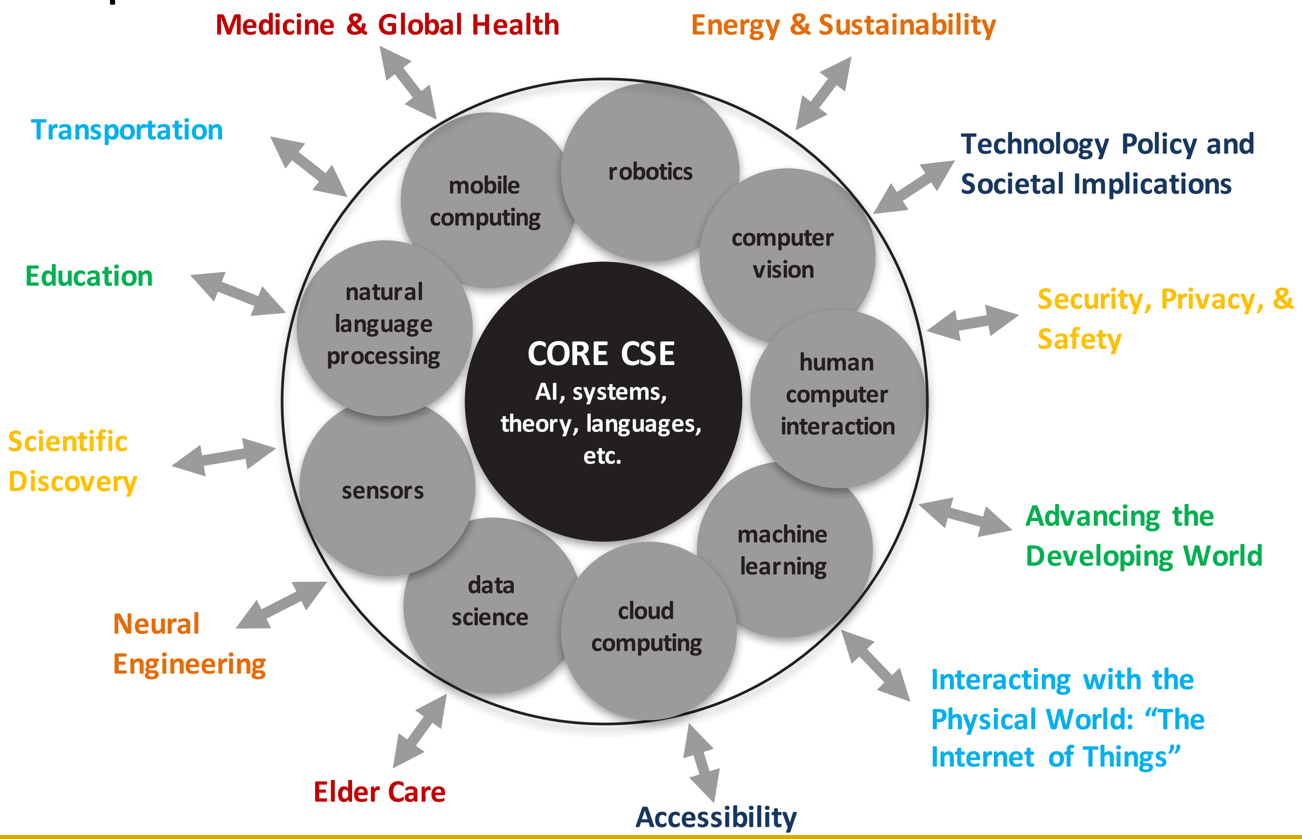
Jim Gray





Each augments, vs. supplants, its predecessors – “another arrow in the quiver”

A 21st century view of Computer Science: A field unique in its societal impact



Is this stuff computer science?

Medicine & Global Health

Energy & Sustainability

Transportation

Technology Policy and Societal Implications

Education

Security, Privacy, & Safety

Scientific Discovery

Advancing the Developing World

Neural Engineering

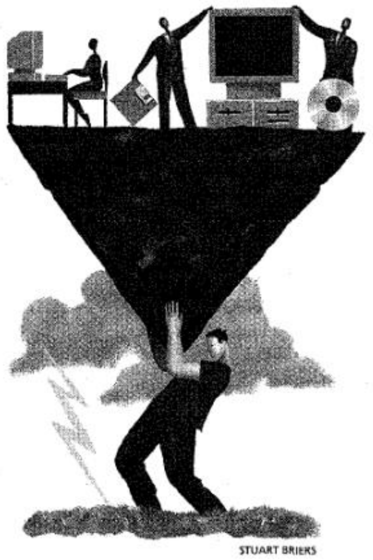
Interacting with the Physical World: “The Internet of Things”

Elder Care

Accessibility

"The last electrical engineer"

"I am worried about the future of our profession. … I see the world as an inverted pyramid. It balances precariously on the narrow point at the bottom. … This point is being impressed into the ground by the heavy weight at the wide top of the inverted pyramid where all the applications reside. … Electrical engineering will be in danger of shrinking into a neutron star of infinite weight and importance, but invisible to the known universe. … Somewhere in the basement of Intel or its successor … the last electrical engineer will sit."

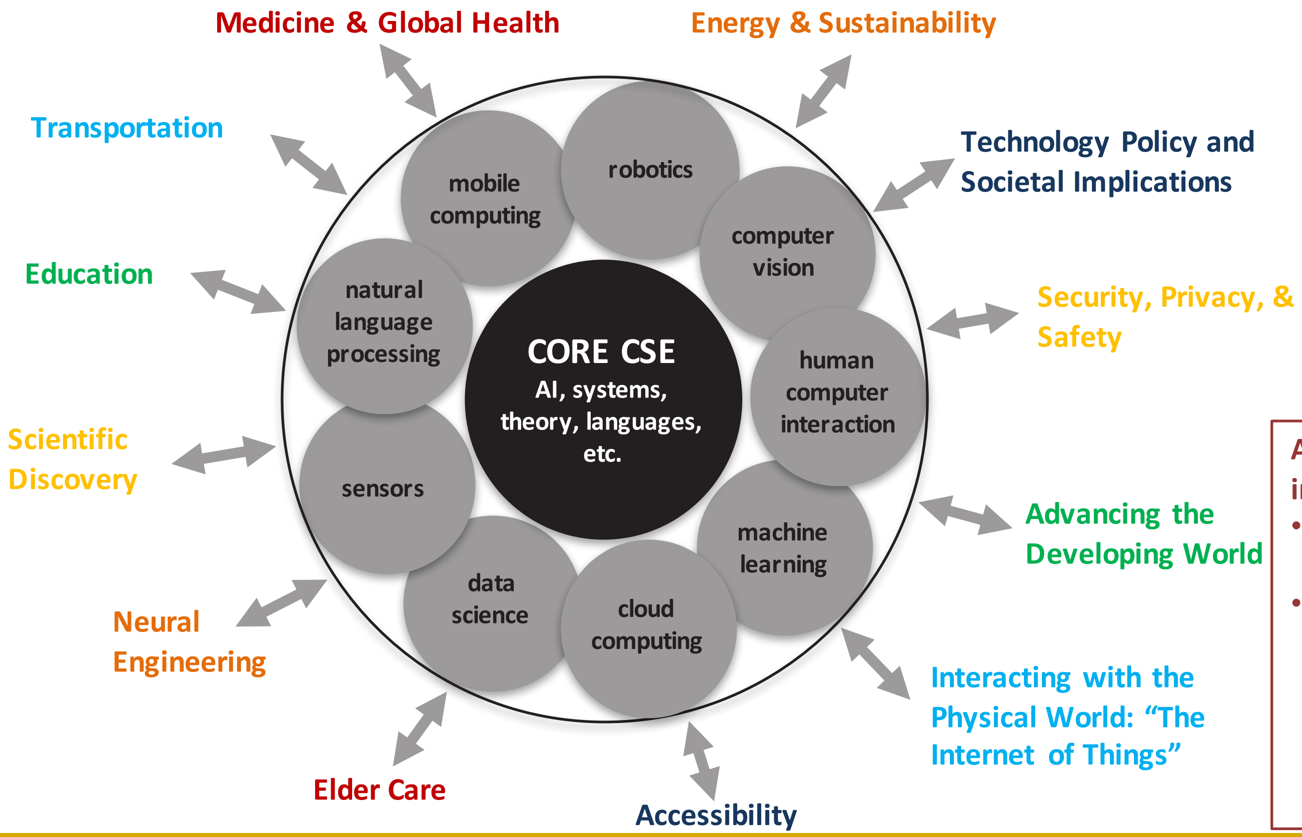


Bob Lucky
IEEE Spectrum
May 1998

"Computer Science: The ever-expanding sphere"

Credit: Alfred Spector, Google (ret.)

"Computer Science: The ever-expanding sphere"



At UW, we've been investing in all areas:

- We've augmented the core
- We have a serious story in all areas of the "connections" ring and nearly all of the societal challenge areas

The role of Computer Science in the modern university

- The **Center for Sensorimotor Neural Engineering**, an NSF Engineering Research Center
- The **Center for Game Science**, funded by the Gates Foundation and DARPA to create revolutionary games for scientific discovery and for learning
- The **eScience Institute**, funded by the Moore, Sloan, Washington Research, and National Science Foundations to bring advances in data-intensive discovery to researchers campus-wide
- **dub** – "design-use-build" – a campus-wide collaboration that has made UW one of the top institutions in the nation in human-computer interaction

TCAT The Taskar Center for Accessible Technology

TECH POLICY LAB

- **Urban@UW**, a campus-wide urban science collaboration
- The **Taskar Center for Accessible Technology** develops and deploys technologies that increase independence and improve quality of life for individuals with motor and speech impairments
- **Change**, a campus-wide collaboration exploring how technology can improve the lives of underserved populations in low-income regions
- The **Tech Policy Lab**, a joint effort of CSE, the School of Law, and the Information School, funded by Microsoft

- **GIX** – the Global Innovation Exchange – a new kind of education that is global, project-based, and integrates technology, design, and entrepreneurship
- The **Intel Science and Technology Center for Pervasive Computing**, led by UW, with researchers from Cornell, Georgia Tech, Rochester, Stanford, and UCLA

One quick example: The University of Washington eScience Institute

"All across our campus, the process of discovery will increasingly rely on researchers' ability to extract knowledge from vast amounts of data... In order to remain at the forefront, UW must be a leader in advancing these techniques and technologies, and in making [them] accessible to researchers in the broadest imaginable range of fields." [2007 concept paper]

UNIVERSITY of WASHINGTON

eScience Institute

ADVANCING DATA-INTENSIVE DISCOVERY IN ALL FIELDS

Major sources of support for our "core effort"

- University of Washington
  - $725,000/year for staff support
  - $600,000/year for faculty support
- National Science Foundation
  - $2.8 million over 5 years for graduate program development and Ph.D. student funding (IGERT)
- Gordon and Betty Moore Foundation and Alfred P. Sloan Foundation
  - $37.8 million over 5 years to UW, Berkeley, NYU
- Washington Research Foundation
  - $9.3 million over 5 years for faculty recruiting packages, postdocs
    - Also $7.1 million to the closely-aligned Institute for Neuroengineering

Genesis of the Moore/Sloan "Data Science Environments" effort

- The Foundations have a focus on novel advances in the physical, life, environmental, and social sciences
- They recognized the emergence of data-intensive discovery as an important new approach that would lead to new advances
- They perceived a number of impediments to success
- They sought partners who were prepared to work together in a <u>distributed</u> <u>collaborative</u> <u>experiment</u> focused on tackling these impediments

GORDON AND BETTY MOORE FOUNDATION

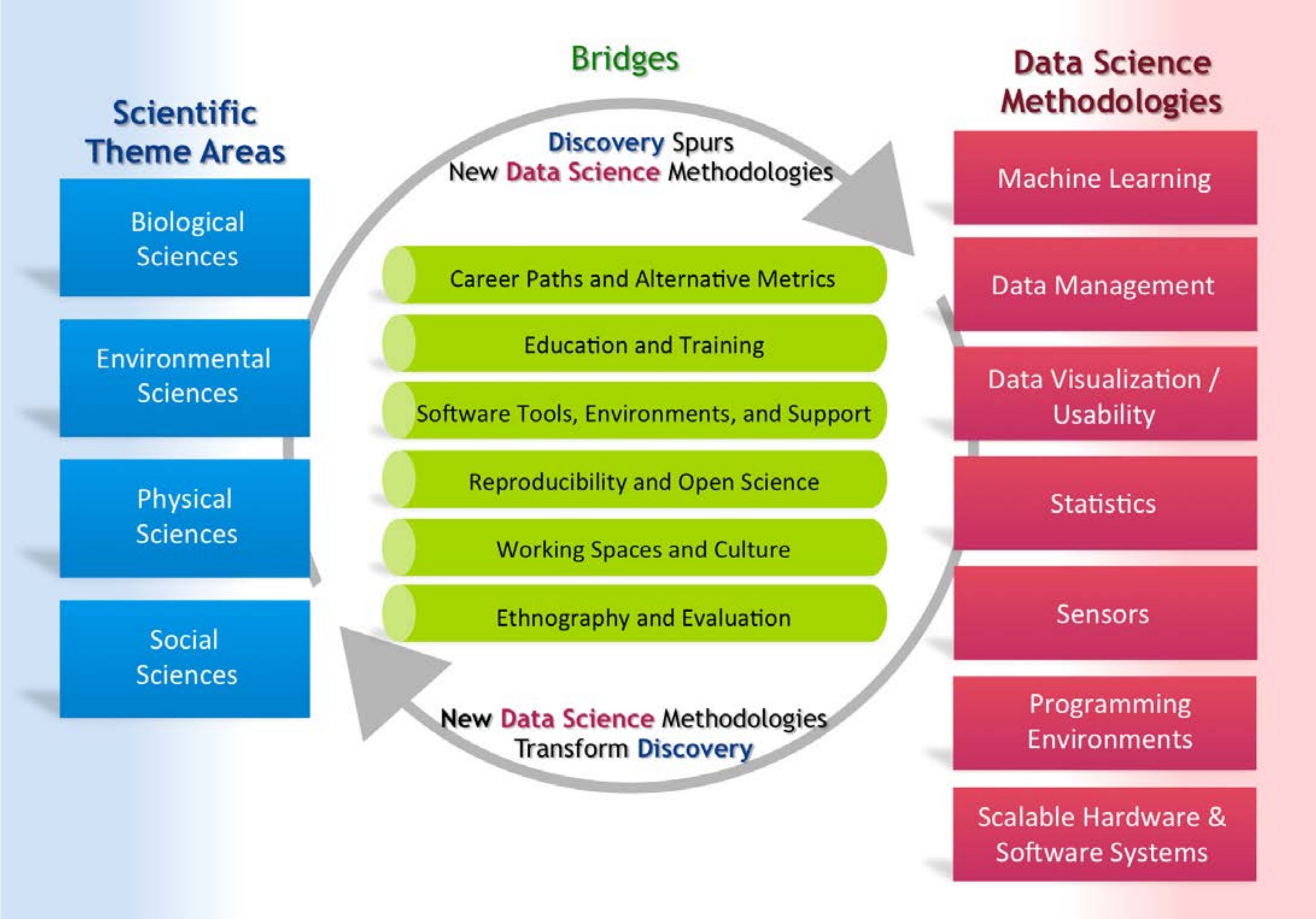
ALFRED P. SLOAN FOUNDATION 1934

NYU

Berkeley UNIVERSITY OF CALIFORNIA

UNIVERSITY of WASHINGTON

Vision


Bridges
Data Science Methodologies
Scientific Theme Areas
Biological Sciences
Environmental Sciences
Physical Sciences
Social Sciences
Discovery Spurs New Data Science Methodologies
Career Paths and Alternative Metrics
Education and Training
Software Tools, Environments, and Support
Reproducibility and Open Science
Working Spaces and Culture
Ethnography and Evaluation
New Data Science Methodologies Transform Discovery
Machine Learning
Data Management
Data Visualization / Usability
Statistics
Sensors
Programming Environments
Scalable Hardware & Software Systems

Our original core faculty team (much expanded now)

Data science methodology


Cecilia Aragon
Human Centered Design & Engr.


Magda Balazinska
Computer Science & Engineering


Emily Fox
Statistics


Carlos Guestrin
CSE


Bill Howe
CSE


Jeff Heer
CSE


Ed Lazowska
CSE


Randy LeVeque
Applied Mathematics


Thomas Richardson
Statistics, CSSS


Werner Stuetzle
Statistics

Life sciences


David Beck
Chemical Engr.


Tom Daniel
Biology


Bill Noble
Genome Sciences

Environmental sciences


Ginger Armbrust
Oceanography

Social sciences


Josh Blumenstock
iSchool


Mark Ellis
Geography


Tyler McCormick
Sociology, Statistics, CSSS

Physical sciences


Andy Connolly
Astronomy


John Vidale
Earth & Space Sciences

Our original core faculty team (much expanded now)

13 Departments
5 Schools / Colleges

Data science methodology


Cecilia Aragon
Human Centered Design & Engr.


Magda Balazinska
Computer Science & Engineering


Emily Fox
Statistics


Carlos Guestrin
CSE


Bill Howe
CSE


Jeff Heer
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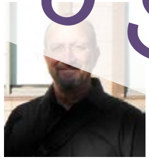
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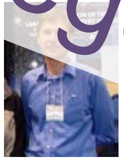
Physical sciences


Andy Connolly
Astronomy


John Vidale
Earth & Space Sciences

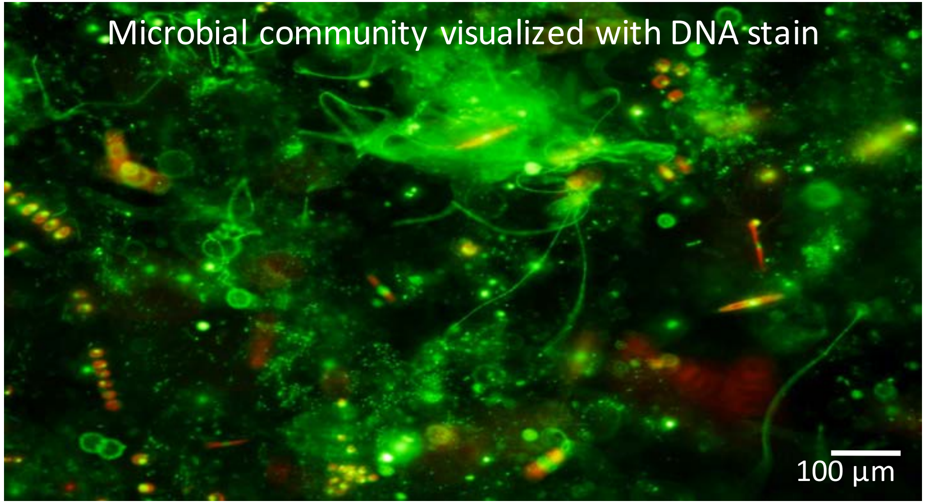
Among our activities

- Educational initiatives at the Bachelors, Masters, and Doctoral levels, plus professional education certificate programs and Coursera MOOCs
- Hires of “pi-shaped” faculty (facilitated by the Provost and the Washington Research Foundation)
- A vibrant program of dual-mentored postdocs and graduate students
- A permanent staff of superb Ph.D.-level Data Scientists spanning disciplines
- A collaboratory: the WRF Data Science Studio
- Myriad training and mentoring activities: short-courses, workshops, office hours
- Deep partnerships, plus an “incubation program” for data-intensive research projects

One example of a deep partnership

Role of microbes in marine ecosystems

- Ginger Armbrust (Oceanography), Bill Howe (CSE + eScience Institute)



Credit: Ginger Armbrust, University of Washington

UNIVERSITY of WASHINGTON

UNIVERSITY of WASHINGTON

eScience Institute

ADVANCING DATA-INTENSIVE DISCOVERY IN ALL FIELDS

SQLShare: Database-as-a-Service for Science

Try SQLShare | Tutorial | Publications | Developers | How to Cite SQLShare

Python API | R API | REST API

SQLShare: Upload Data, Get Answers, Share Results

SQLShare is a database service aimed at removing the obstacles to using relational databases: installation, configuration, schema design, tuning, data ingest, and even application design. You simply upload your data and immediately start querying it.

Credit: Ginger Armbrust, University of Washington

Integrating across physics, biology, and chemistry

Query across data sets in real-time: “not just faster…different!”

Dan Halperin,
Research Scientist, eScience Institute

Konstantin Weitz
Graduate student, CSE

Credit: Ginger Armbrust, University of Washington

Connecting across distributed labs

SeaFlow instrument

↓

Ship computer

↓

Processed data

↓ *automated*

Cloud – SQLShare ← Other ship data streams

↓

Web display – collaborator computers

Completely automated

Credit: Ginger Armbrust, University of Washington

One of dozens of incubation projects

UNIVERSITY of WASHINGTON
eScience Institute
DATA SCIENCE FOR SOCIAL GOOD

Predictors of Permanent Housing for Homeless Families

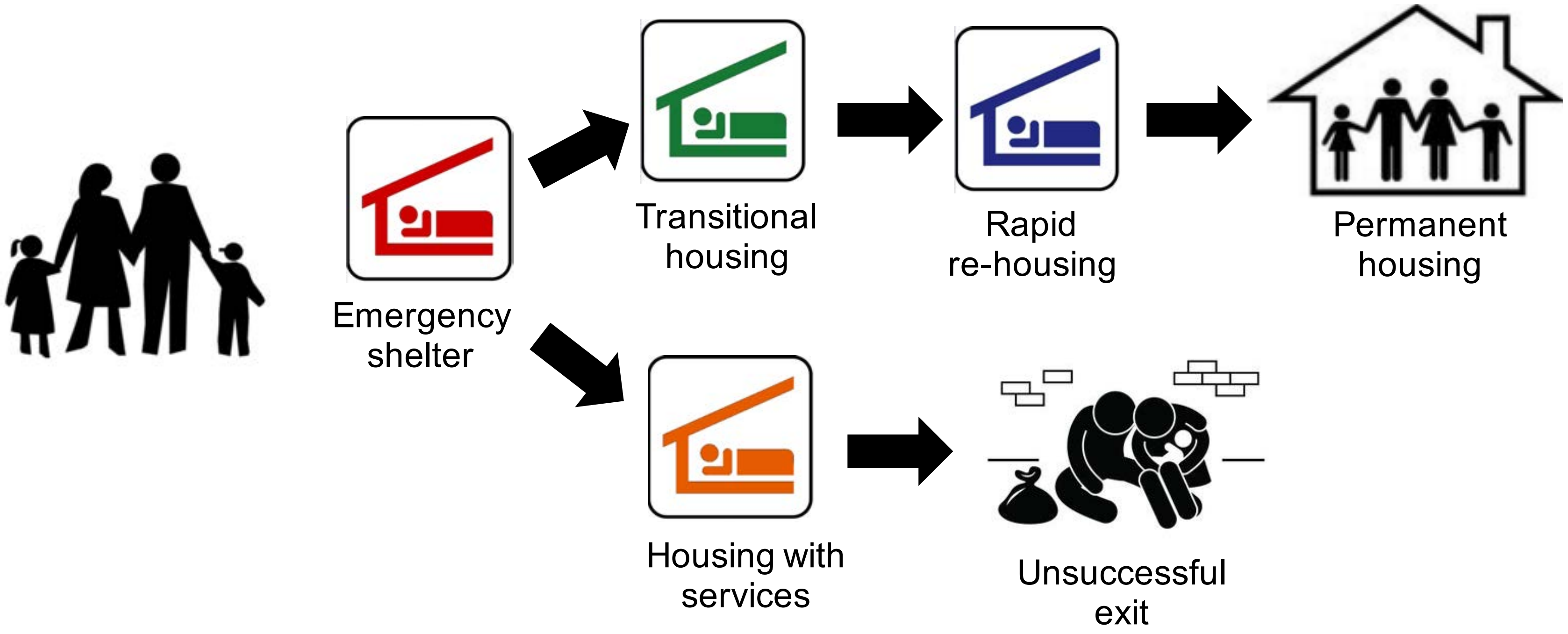
- Project leads: Neil Roche and Anjana Sundaram, The Bill and Melinda Gates Foundation
- DSSG Fellows: Fablina Ibnat, Jason Portenoy, Chris Suberlak, Joan Wang
- ALVA students: Cameron Holt, Xilalit Sanchez
- Data Scientist Mentors: Ariel Rokem, Bryna Hazelton

In Snohomish, Pierce, and King counties

- There are over **4,000** homeless families in the Tri-county area every year
- Families spend on average **8 months** moving from shelter to shelter
- Goal of the Bill & Melinda Gates Foundation and Building Changes: Cut family homelessness **in half** by 2020 and reduce the time a family spends homeless to **1 month**

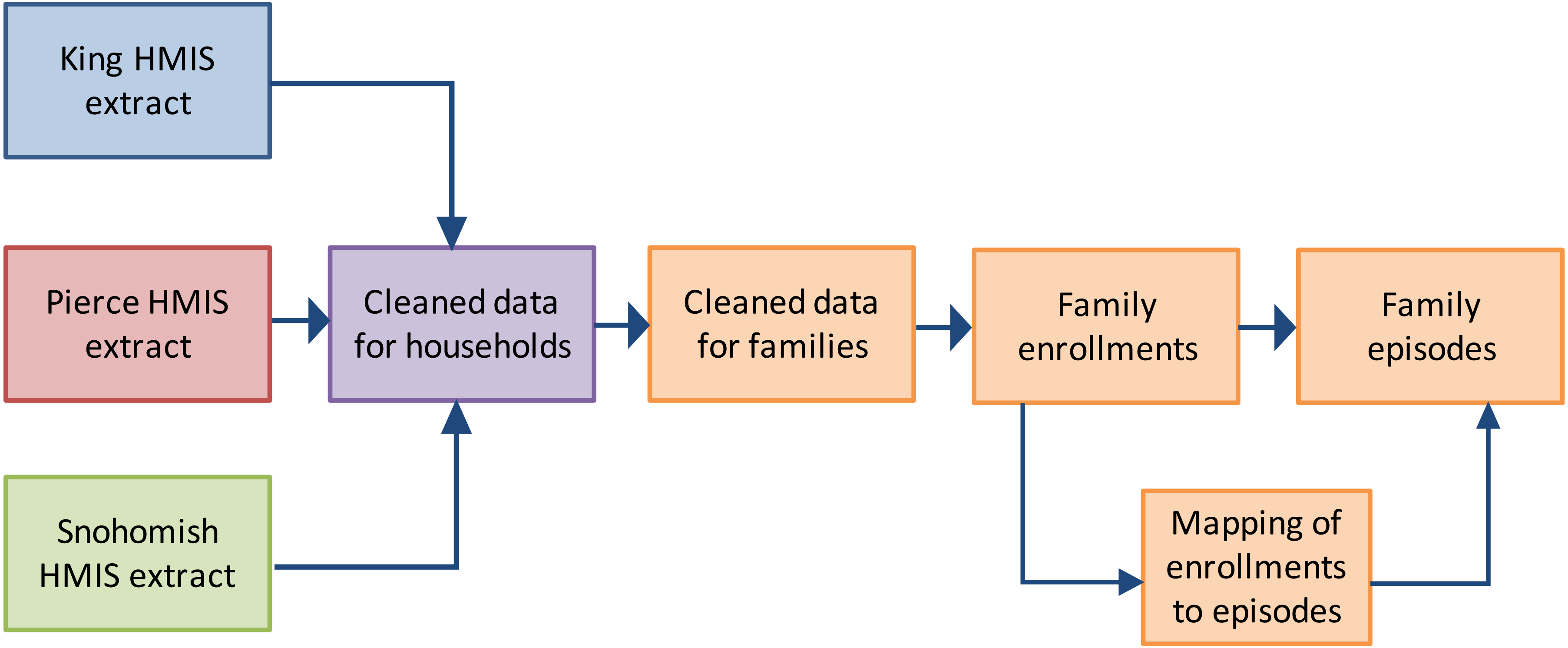
Credit: Fablina Ibnat, University of Washington

Homeless families may take many pathways through programs



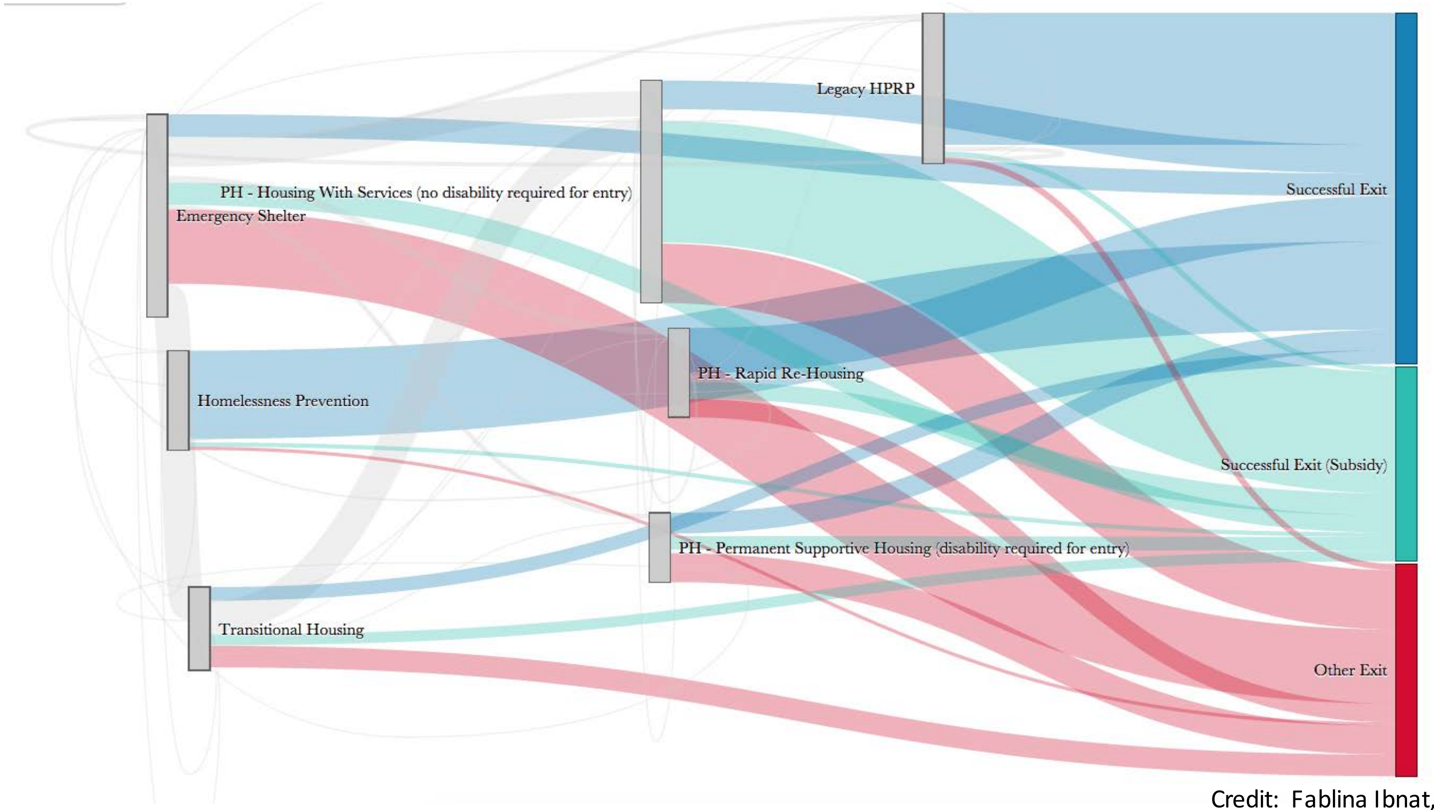
Credit: Fablina Ibnat, University of Washington

Create data cleaning pipeline for messy Homeless Management Information Systems data



Credit: Fablina Ibnat, University of Washington

Develop visualizations to show how homeless families move through programs

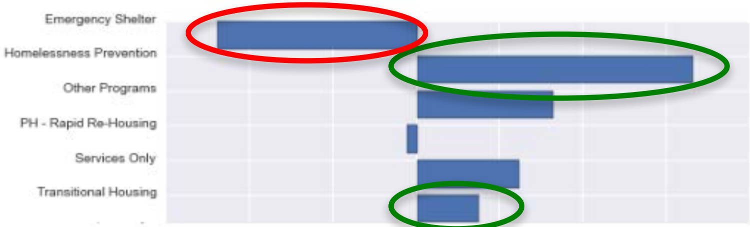


Credit: Fablina Ibnat, University of Washington

Conduct analysis to identify predictors of permanent housing

Emergency Shelter use tends to be associated with unsuccessful outcomes (unsurprising!)

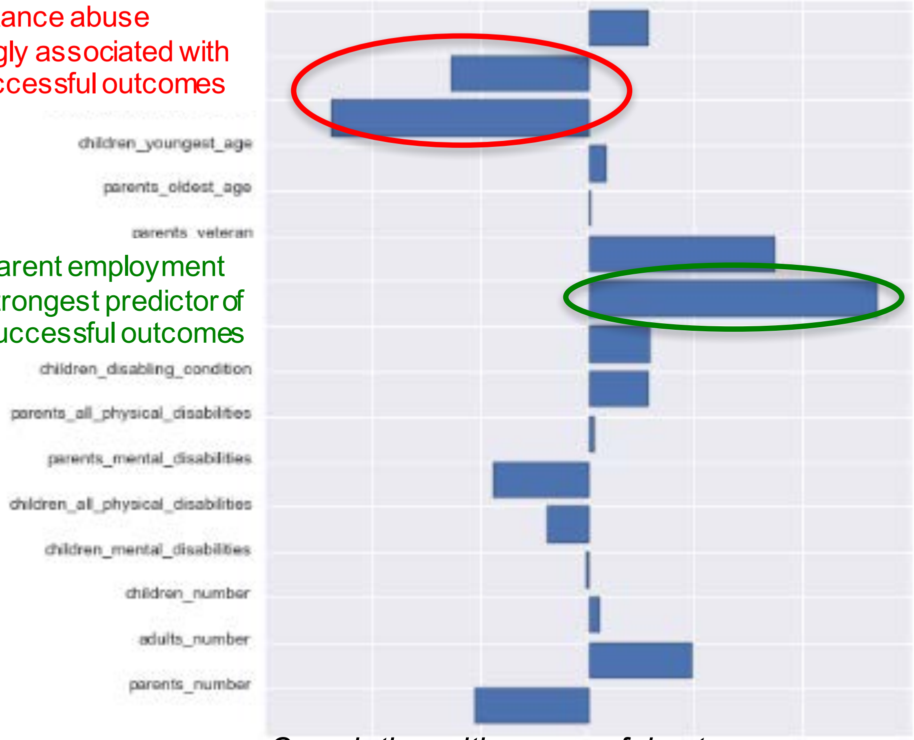
Homelessness Prevention programs more strongly associated with positive outcomes than transitional housing



Correlation with successful outcome, by homelessness program

Substance abuse strongly associated with unsuccessful outcomes

Parent employment strongest predictor of successful outcomes



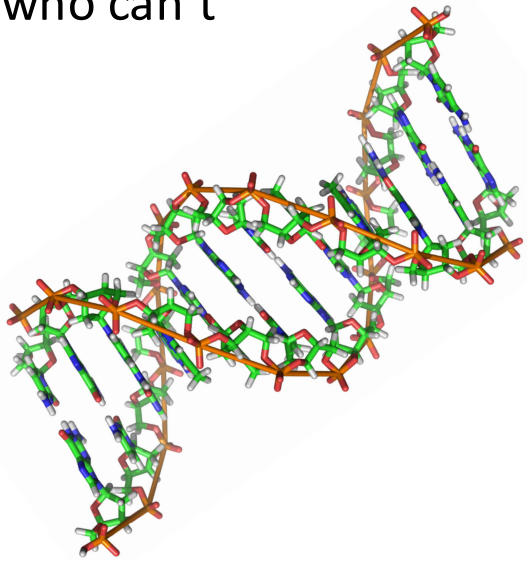
Correlation with successful outcome, by family characteristics

Credit: Fablina Ibnat, University of Washington

The role of Computer Science in the modern world

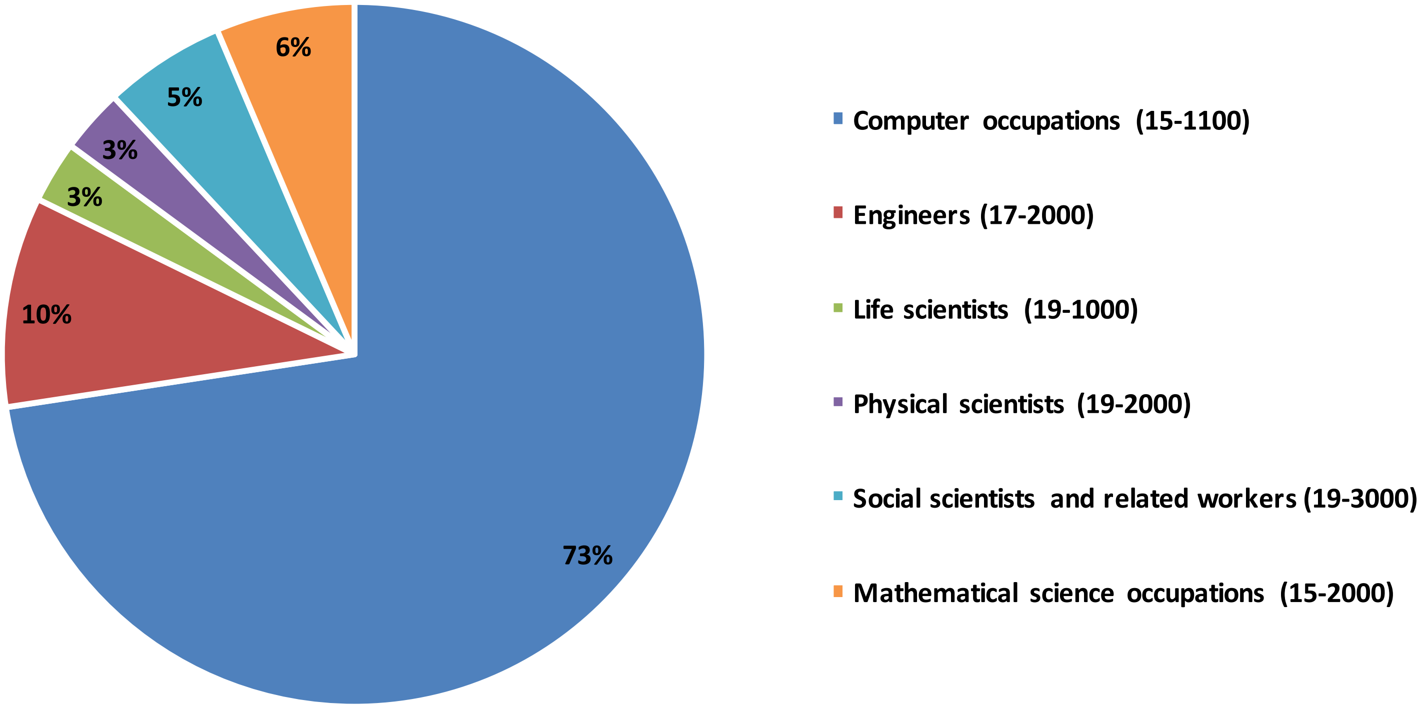
1. Every 21st century citizen needs to have facility with "computational thinking" – problem analysis and decomposition (stepwise refinement), abstraction, algorithmic thinking, algorithmic expression, stepwise fault isolation (debugging), modeling
   - Computational thinking is not "this particular operating system" or "that particular programming language"
   - Computational thinking is not even programming. It's a mode of thought – a way of approaching the world
   - Programming is the hands-on, inquiry-based way that we teach computational thinking and the principles of computer science

2. Fields from Anthropology to Zoology are becoming *information* fields, and that those who can bend the power of the computer to their will – computational thinking, but also computer science in greater depth – will be positioned for greater success than those who can't
   - Data science is a perfect example



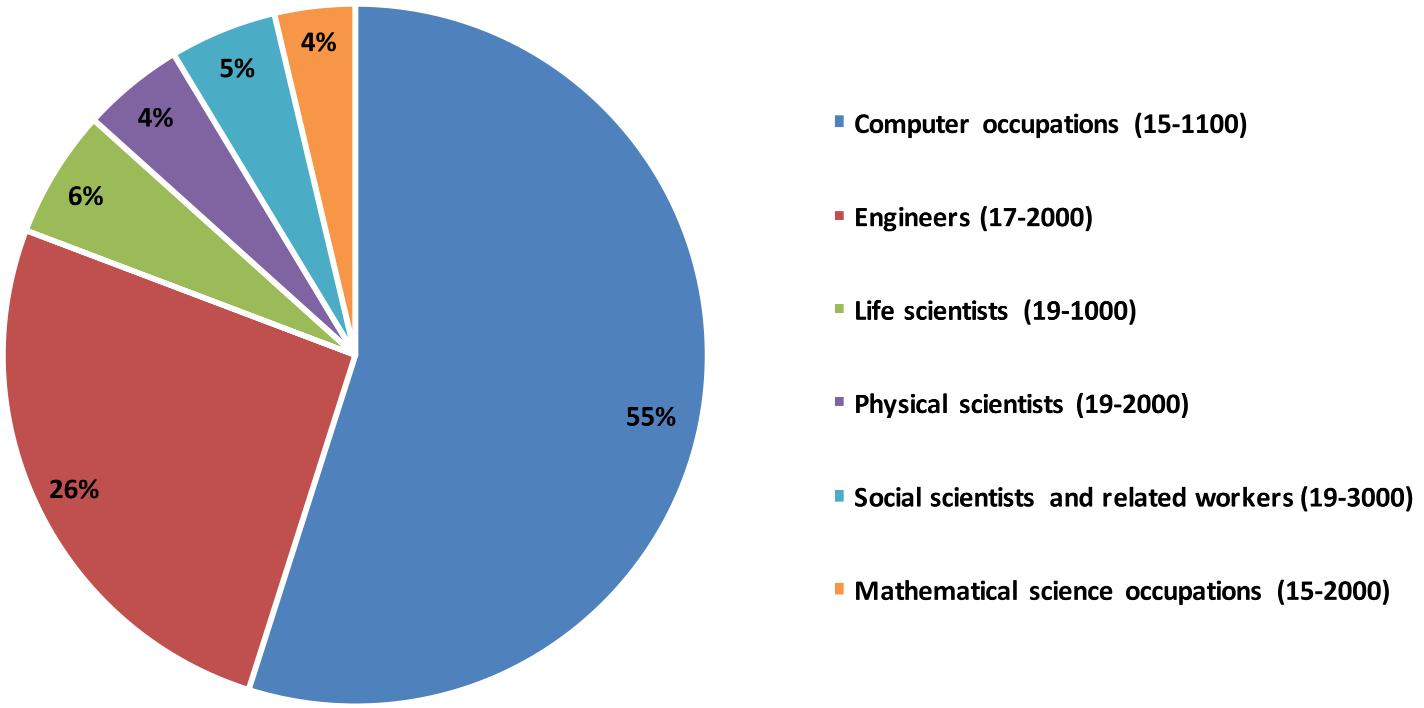
3. Pretty much all of the STEM jobs are in computer science
   - In the computing industry, which is not Dilbert – it's an intellectually exciting, highly creative and interactive, "power to change the world" field
   - In all sorts of other fields where people educated as computer scientists – not merely people with some computer science background – are essential

STEM job growth, 2014-24 (US Bureau of Labor Statistics)



Data from the spreadsheet at http://www.bls.gov/emp/ind-occ-matrix/occupation.xlsx

STEM job openings (growth + replacement), 2014-24 (US BLS)



Data from the spreadsheet at http://www.bls.gov/emp/ind-occ-matrix/occupation.xlsx

16% of *all* new wages, across *all* fields

CODE.ORG ASK A QUESTION STUDENT OF THE MONTH TEACHER OF THE MONTH

16% of all new wages in the U.S. are in computer science

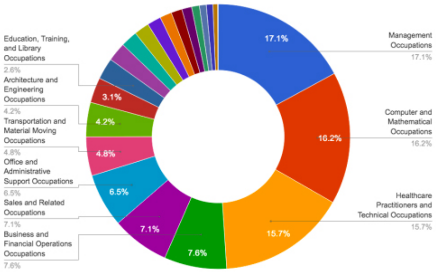
11% of all job openings in the U.S. are in computing categories, and these jobs account for 16% of all new wages. Computing is the second largest occupation category in the U.S. when it comes to total ***new*** wages, just behind Management Occupations (which include software management positions) and just ahead of Healthcare and Practitioner Occupations.

Here's how we calculated this:

First, we looked at the average count of **new** jobs per occupational category over the past 6 months. According to the **Conference Board**, there were 5,130,483 help wanted online ads in March of 2016. Of these job openings, 566,466 or 11% were in the SOC-15 computer and mathematical science categories* in the Standard Occupational Classification system.

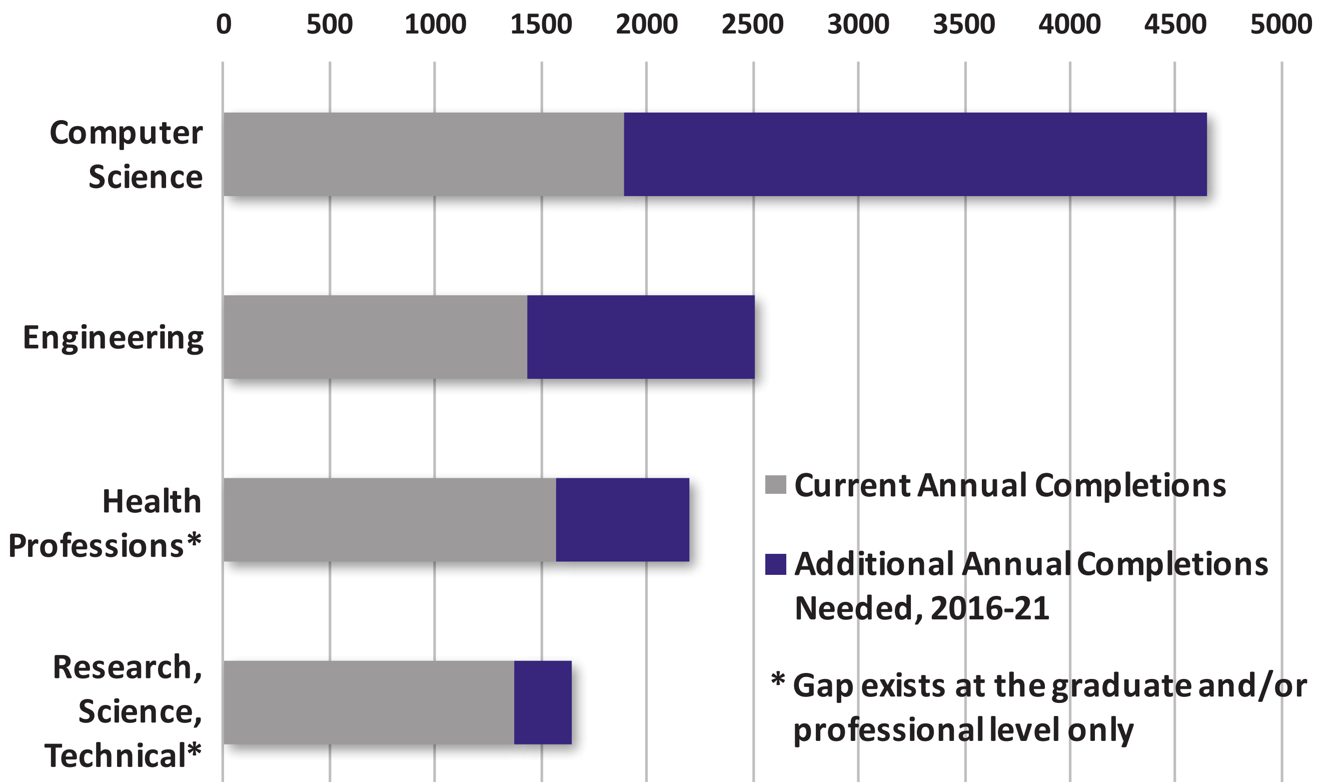
Next, we looked at the **Bureau of Labor Statistics** data on mean salaries. For example, the average salary across all occupations is $48,320. The average salary across computing jobs (the SOC 15 category) is $86,170.

For each category, we multiplied the number of job openings times the average salary for the category to estimate the total new wages in that category. Looking at 6 months worth of data, 16.2% of all new wages are in the computing fields.



Credit: Code.org

Fields with workforce gaps in Washington State (Baccalaureate level and above)



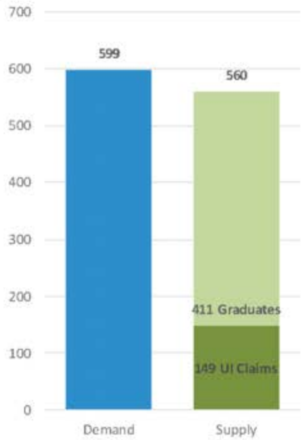
Data from Table 2 at http://www.wsac.wa.gov/sites/default/files/2013.11.16.Skills.Report.pdf

King County WA’s Aerospace Workforce

KING COUNTY AEROSPACE TALENT PIPELINE DRAFT

Bachelor's Degree

Annual Average Demand and Supply
All Occupations by Education



Occupation (Ranked by Annual Openings (2018-2023))	Employment 2013	Employment 2023	CAGR 2013-2023	Annual Demand and Supply, 2018-2023 (Scale: 0 - 162 annual openings in sector)		Gap
1 Computer systems analysts	11,311	15,459	3.2%	Demand	135	(113)
				Supply	22	
2 Industrial engineers	3,175	3,289	0.4%	Demand	77	(67)
				Supply	10	
3 Aerospace engineers	2,942	2,899	-0.1%	Demand	65	61
				Supply	126	
4 Computer network architects	2,611	3,027	1.5%	Demand	38	25
				Supply	62	
5 Budget analysts	1,162	1,247	0.7%	Demand	37	20
				Supply	57	
6 Mechanical engineers	2,472	2,846	1.4%	Demand	34	(19)
				Supply	15	
7 Logisticians	2,730	2,673	-0.2%	Demand	30	(17)
				Supply	14	
8 Electrical engineers	2,521	2,963	1.6%	Demand	28	(12)
				Supply	16	
9 Operations research analysts	1,305	1,546	1.7%	Demand	25	(14)
				Supply	10	
10 Engineers, all other	2,039	2,356	1.5%	Demand	23	(13)
				Supply	10	

cai community attributes inc

February 2, 2016

WORKFORCE DEVELOPMENT COUNCIL OF SEATTLE – KING COUNTY

Q: What field has the largest total number of current employees in King County’s aerospace industry?

Q: What field has the greatest predicted number of new employees needed by King County’s aerospace industry from 2013-2023?

Q: What field has the greatest predicted compound annual growth rate for King County’s aerospace industry from 2013-2023?

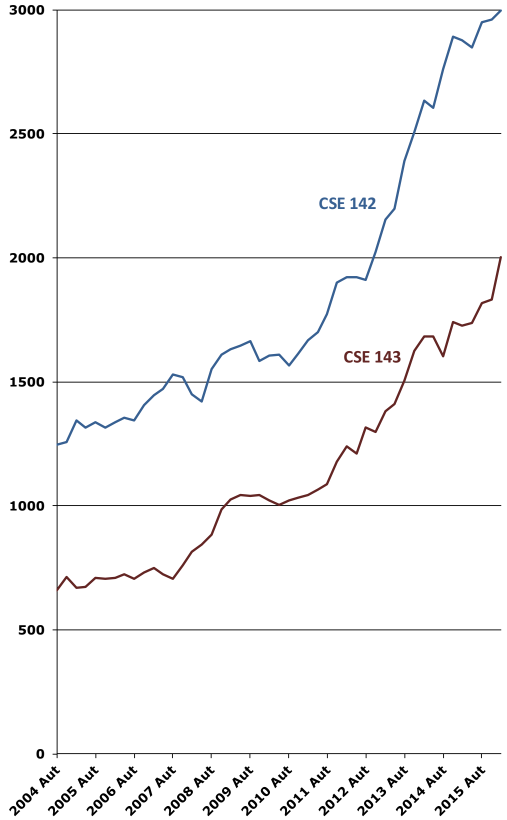
Q: What field has the greatest predicted annual gap between supply and demand for King County’s aerospace industry from 2013-2023 (where “supply” is not “degrees granted” but rather the industry’s current ability to hire)?

A: Computer Science

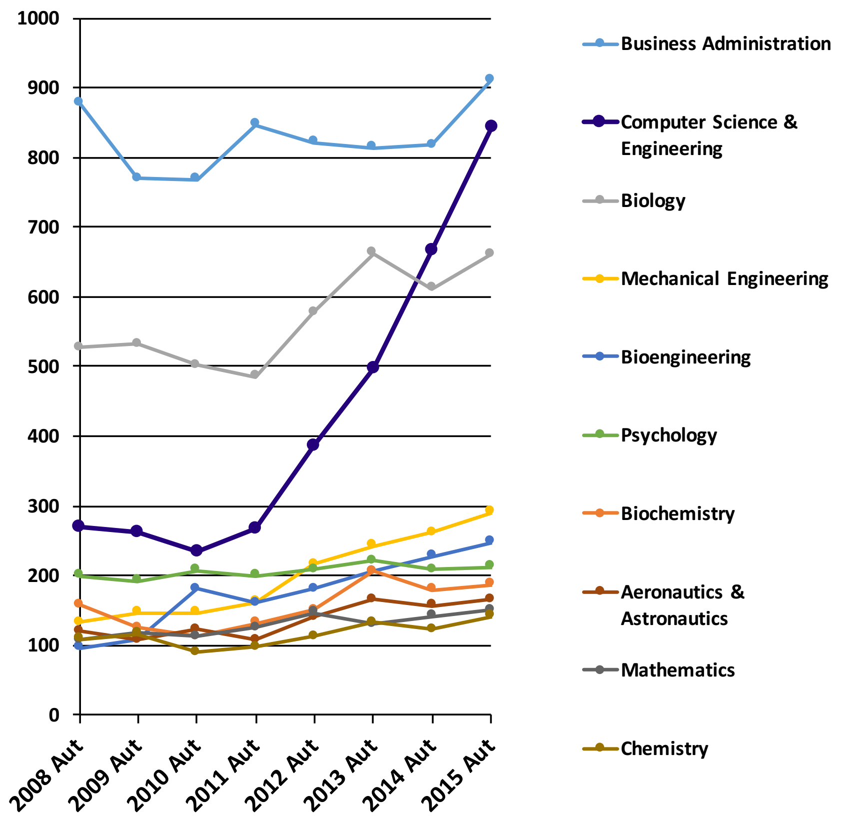
Students are responding to all three imperatives

1. Demand for introductory courses is booming
2. Demand for upper-division and graduate courses by non-majors is booming
3. Demand for the major is booming

UW CSE introductory course enrollment (1-year rolling average)



Top 10 first-choice majors of UW confirmed incoming freshmen

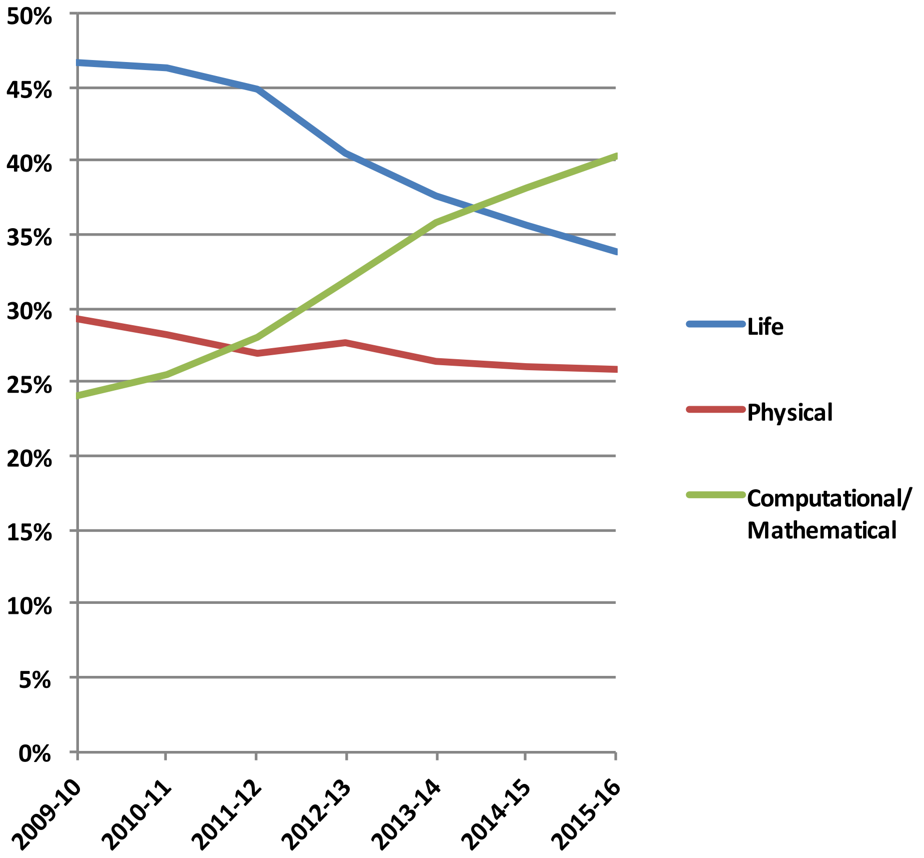


Top 25 concentrations at Harvard

2007-08	2015-16
Economics	Economics
Government	Government
Social Studies	Computer Science
Psychology	Applied Mathematics
English & American Literature & Language	Psychology
History	Social Studies
Anthropology	Neurobiology
History & Literature	Statistics
Biochemical Sciences	Human Developmental & Regenerative Biology
Applied Mathematics	English
Molecular & Cellular Biology	History
Human Evolutionary Biology	Sociology
Neurobiology	History & Literature
Biology	Integrative Biology
Mathematics	Molecular & Cellular Biology
Sociology	Mathematics
Chemistry	Physics
Physics	Chemistry
Visual & Environmental Studies	Human Evolutionary Biology
History & Science	History & Science
Computer Science	Engineering & Applied Science (SB)
Engineering & Applied Science (AB)	Biomedical Engineering
Chemical & Physical Biology	Anthropology
Environmental Science & Public Policy	Philosophy
Fine Arts / History of Art & Architecture	Visual & Environmental Studies

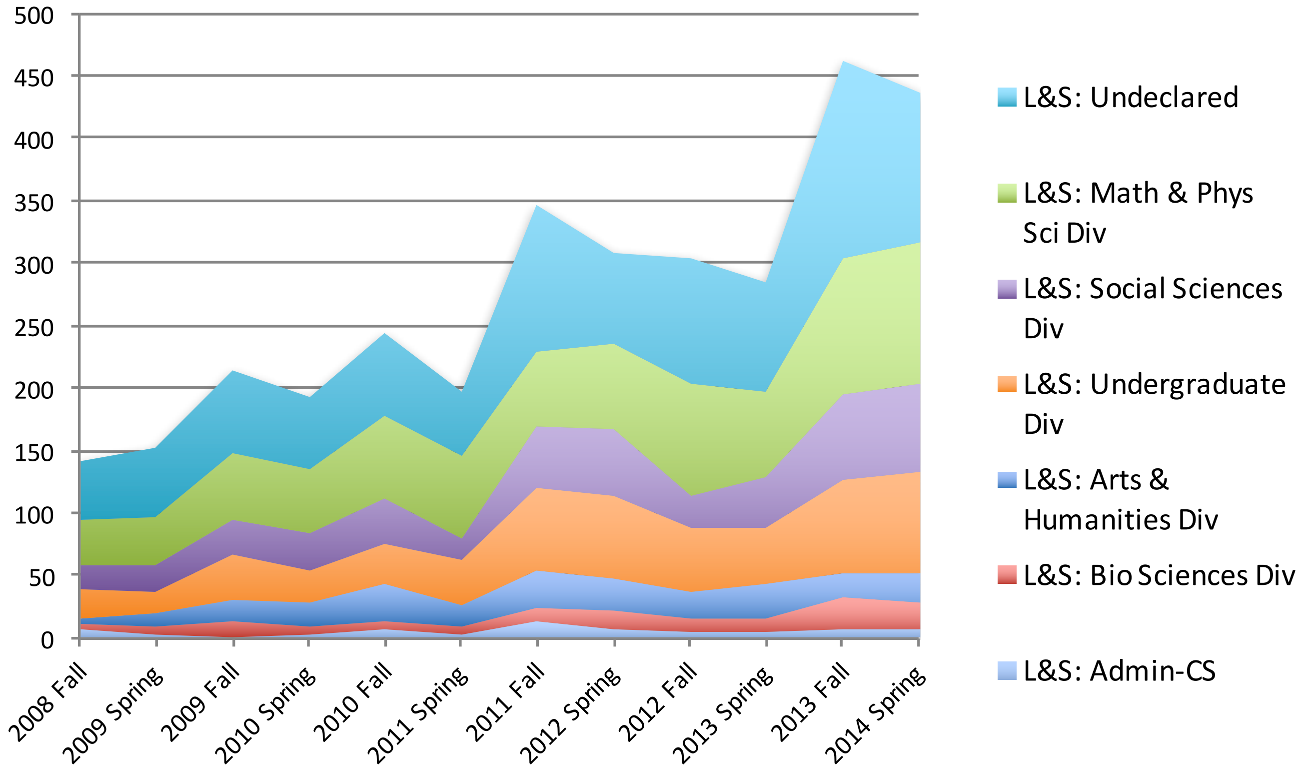
Credit: Harry Lewis

Distribution of science majors at Harvard

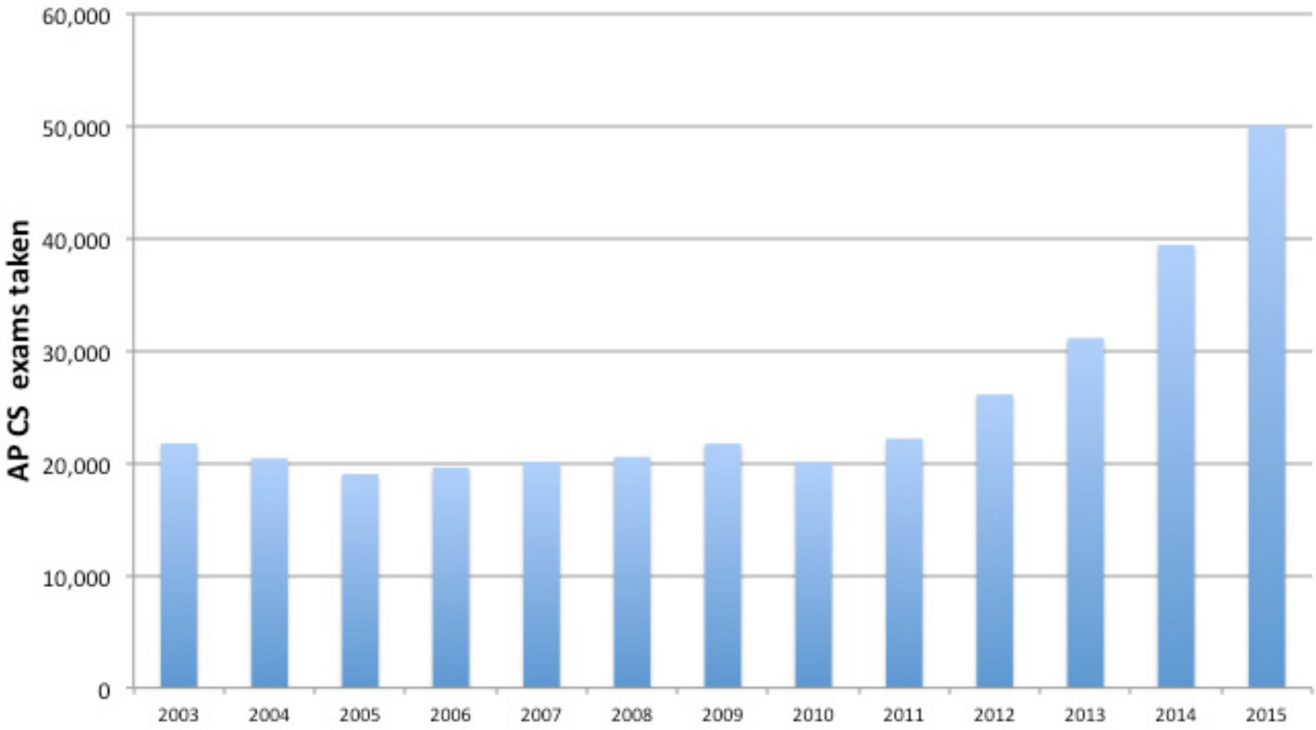


Credit: Harry Lewis

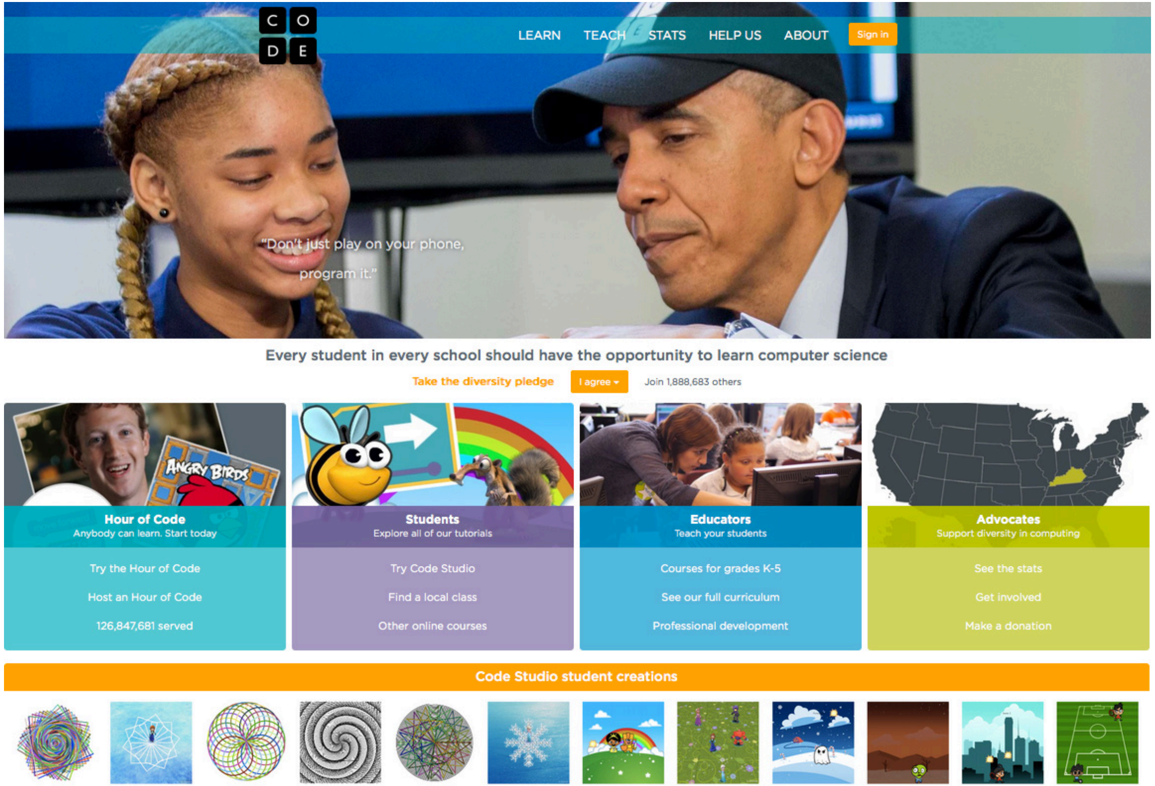
Berkeley upper-division CS enrollment from L&S outside of CS



K-12 too: CS AP participation, while still pathetic, is now growing



Code.org will cause all of this to accelerate



Hadi Partovi
Code.org

Institutional response: K-12

1983

A Nation At Risk

Our Nation is at risk. Our once unchallenged preeminence in commerce, industry, science, and technological innovation is being overtaken by competitors throughout the world. This report is concerned with only one of the many causes and dimensions of the problem, but it is the one that undergirds American prosperity, security, and civility.

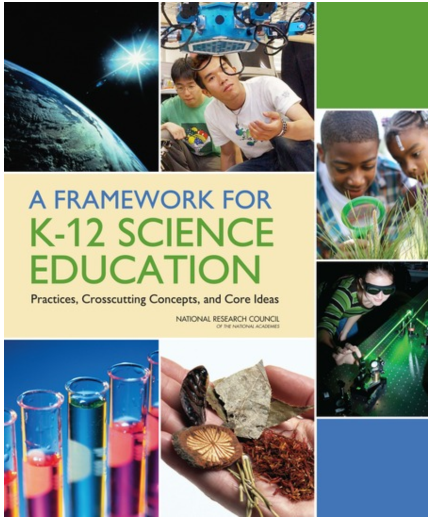
If an unfriendly foreign power had attempted to impose on America the mediocre educational performance that exists today, we might well have viewed it as an act of war. As it stands, we have allowed this to happen to ourselves.

Recommendation A: Content

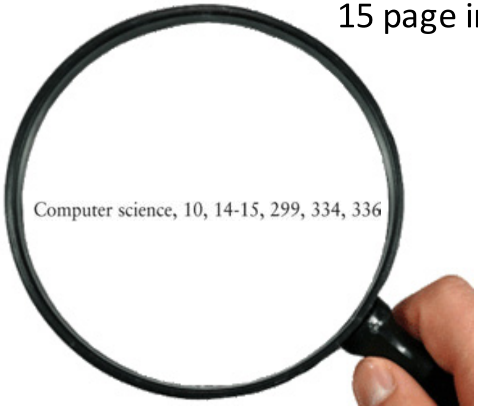
We recommend *that State and local high school graduation requirements be strengthened and that,* at a minimum, all *students seeking a diploma be required to lay the foundations in the Five New Basics by taking the following curriculum during their 4 years of high school: (a) 4 years of English; (b) 3 years of mathematics; (c) 3 years of science; (d) 3 years of social studies; and (e) one-half year of computer science.*

IBM PC XT
4.77 MHz 8088
128 KB RAM
PC DOS 2.0

Scroll forward 30 years, to 2013



401 page report
15 page index



Which begat the Next Generation Science Standards …

NEXT GENERATION SCIENCE STANDARDS

Elementary (K–5)

Storylines: K–2 3–5 PDFs: K 1 2 3 4 5

- K. Forces and Interactions: Pushes and Pulls
- K. Interdependent Relationships in Ecosystems: Animals, Plants, and Their Environment
- K. Weather and Climate
- 1. Waves: Light and Sound
- 1. Structure, Function and Information Processing
- 1. Space Systems: Patterns and Cycles
- 2. Structure and Properties of Matter
- 2. Interdependent Relationships in Ecosystems
- 2. Earth's Systems: Processes that Shape the Earth
- K-2. Engineering Design
- 3. Forces and Interactions
- 3. Interdependent Relationships in Ecosystems
- 3. Inheritance and Variation of Traits
- 3. Weather and Climate
- 4. Energy
- 4. Waves
- 4. Structure, Function, and Information Processing
- 4. Earth's Systems: Processes that Shape the Earth
- 5. Structure and Properties of Matter
- 5. Matter and Energy in Organisms and Ecosystems
- 5. Earth's Systems
- 5. Space Systems: Stars and the Solar System
- 3-5. Engineering Design

PS: Physical Sciences

Middle School (6–8) Storyline PDF	High School (9–12) Storyline PDF
MS. Structure and Properties of Matter	HS. Structure and Properties of Matter
MS. Chemical Reactions	HS. Chemical Reactions
MS. Forces and Interactions	HS. Forces and Interactions
MS. Energy	HS. Energy
MS. Waves and Electromagnetic Radiation	HS. Waves and Electromagnetic Radiation

LS: Life Sciences

Middle School (6–8) Storyline PDF	High School (9–12) Storyline PDF
MS. Structure, Function, and Information Processing	HS. Structure and Function
MS. Matter and Energy in Organisms and Ecosystems	HS. Matter and Energy in Organisms and Ecosystems
MS. Interdependent Relationships in Ecosystems	HS. Interdependent Relationships in Ecosystems
MS. Growth, Development, and Reproduction of Organisms	HS. Inheritance and Variation of Traits
MS. Natural Selection and Adaptations	HS. Natural Selection and Evolution

ESS: Earth and Space Sciences

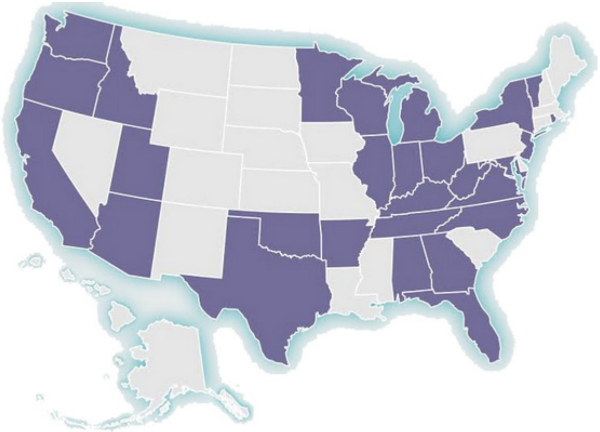
Middle School (6–8) Storyline PDF	High School (9–12) Storyline PDF
MS. Space Systems	HS. Space Systems
MS. History of Earth	HS. History of Earth
MS. Earth's Systems	HS. Earth's Systems
MS. Weather and Climate	HS. Weather and Climate
MS. Human Impacts	HS. Human Sustainability

ETS: Engineering, Technology, and Applications of Science

Middle School (6–8) Storyline PDF	High School (9–12) Storyline PDF
MS. Engineering Design	HS. Engineering Design

Pathetic … but despite all, progress is being made

- In 3 out of 4 high schools nationwide, computer science that includes programming is not offered
  - But that's far better than just a year or two ago!
- In 22 of the 50 states, computer science does not count towards the math or science graduation requirement
  - But that's far better than just a year or two ago!



Credit: Code.org

FORTUNE SUBSCRIBE

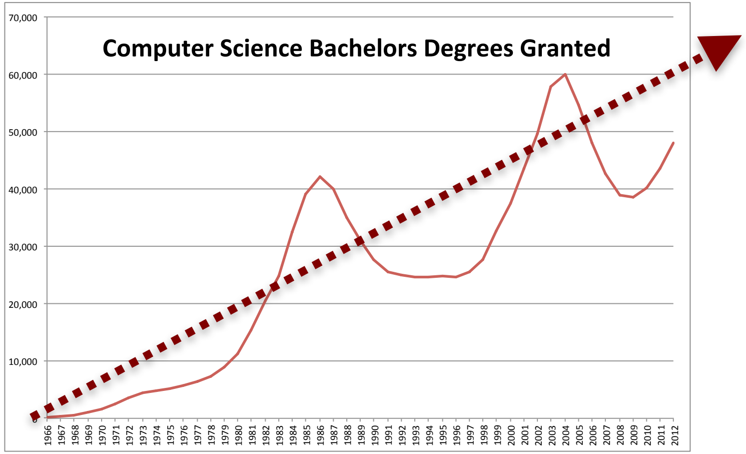
LEADERSHIP PRESIDENT OBAMA

Obama Is Putting $4 Billion into Computer Science Education

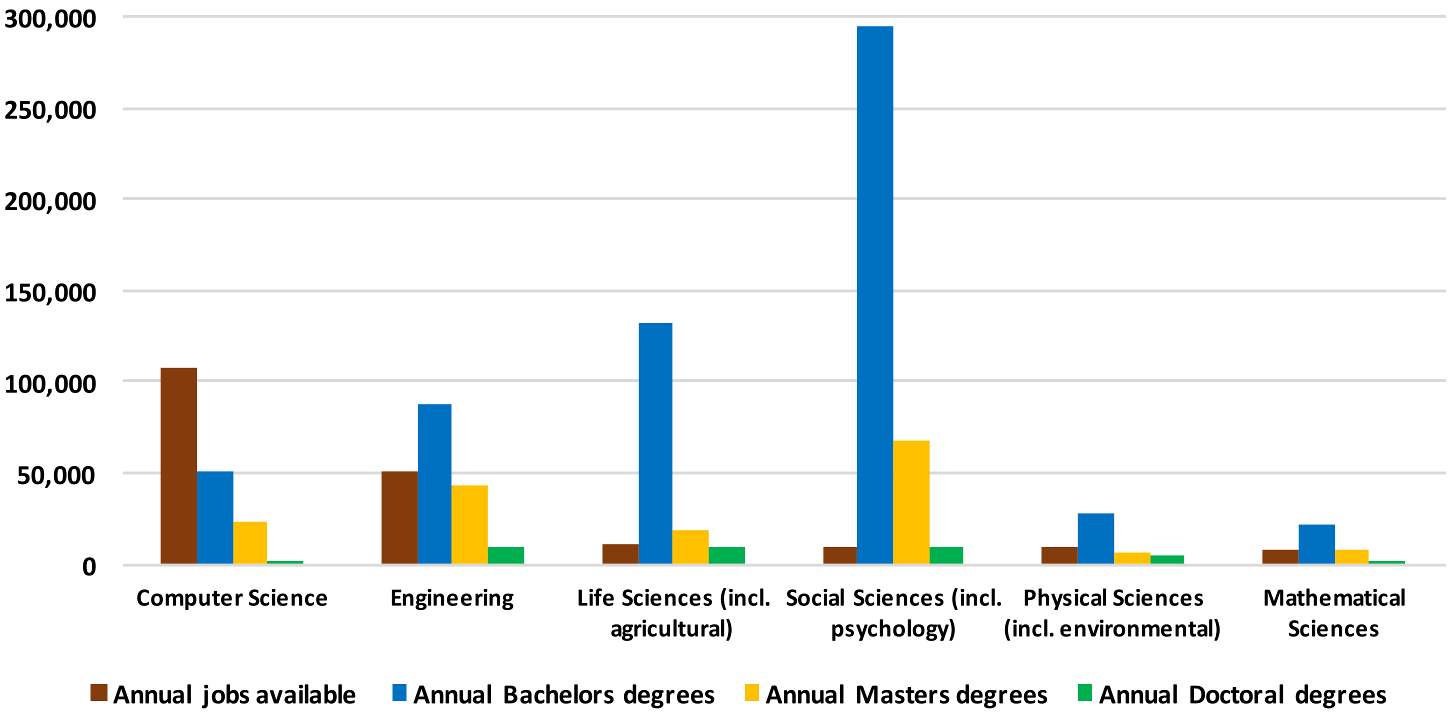
by Michal Addady @michal_addady JANUARY 31, 2016, 11:35 AM EDT

Institutional response: higher education

- Many positive signs
  - “Schools of Computer Science” are proliferating
  - Whatever the prefix, the key thing is that Computer Science be viewed as a unit of the entire university
    - Computer science programs need to <u>act</u> this way
- However
  - Some tendency to view current situation as a transient
    - E.g., hire lecturers; usefaculty from other fields
  - Facilities are a huge problem
    - Must accommodate scale
    - Must respond to evolving nature of the field



Room for growth: Annual STEM job openings (BLS) vs. degrees granted (NSF)



BLS job projection data: http://www.bls.gov/emp/ind-occ-matrix/occupation.xlsx
S&E Indicators degree data: http://www.nsf.gov/statistics/2016/nsb20161/uploads/1/12/at02-01.xlsx

Is this a great time or what?

http://lazowska.cs.washington.edu/NU.pdf, pptx