Why Computer Science?
Why UW CSE?

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Forty five years ago ...
THE ARPA NETWORK
DEC 1969
4 NODES

29 OCT 69 2100
LOADED OP PROGRAM CSK
FOR BEN BARKER
BBV

22:30 TALKED TO SRC CSLE
HOST TO HOST

LEFT IMP PROGRAM (CSLE)
RUNNING AFTER SENDING
A HOST DEAD MESSAGE
TO IMP.
With 4+ 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 ...

EXPO\text{\textcenterline{NENTIAL}} US
Exponentials are rare – we’re not used to them, so they catch us unaware.
Every aspect of computing has experienced exponential improvement

- Processing capacity
- Storage capacity
- Network bandwidth
- Sensors
- Astonishingly, even algorithms in some cases!
You can exploit these improvements in two ways

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

Storage Price / MB, USD

Microprocessor Performance, MIPS
The 1970s to today

1970 Ford Mustang

2014 Ford Mustang

Size: roughly comparable
Speed: roughly comparable
Efficiency (MPG): roughly comparable
Value (cost relative to performance): roughly comparable
The 1970s to today

1971 Intel 4004
(2,300 transistors)

2014 Intel Xeon
(4,300,000,000 transistors)

Size: area occupied by a transistor reduced by 1,000,000x
Speed: operations per second increased by 100,000x
Efficiency (operations per watt): improved by 6,750x
Value (dollars per instruction): improved by 2,700x
The 1970s to today

What if cars had improved as rapidly as microprocessors?
The 1970s to today

Size: A car would be smaller than an ant! (About 1/5\textsuperscript{th} of an inch long!)
The 1970s to today

Speed: A car would go 6,000,000 miles per hour! (San Francisco to New York in 1.7 seconds!)
The 1970s to today

Efficiency: A car would get 100,000 miles per gallon!
(San Francisco to New York on 1/2 cup of fuel!)
The 1970s to today

Cost: A car would cost less than $10!
During the decade of the 2000’s …

• Search
• Scalability
• Digital media
• Mobility
• eCommerce
• The Cloud
• Social networking and crowd-sourcing
During the current decade ...

• 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
Smart homes (the leaf nodes of the smart grid)

Shwetak Patel,
University of Washington
2011 MacArthur Fellow
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, “scientific wellness”
Smart robots
Smart crowds and human-computer systems

Zoran Popovic, UW Computer Science & Engineering

David Baker, UW Biochemistry
Smart education

Zoran Popovic,
UW Computer Science & Engineering

Enlearn

For English Language Arts
We're proud to be powering Velocity®, the revolutionary K-5 Digital Learning Solution for ELA from Voyager Sopris

Press Release
Watch the Video
Smart interaction
Smart cities
Smart discovery (data-intensive discovery, or eScience)

Nearly every field of discovery is transitioning from “data poor” to “data rich”

Astronomy: LSST
Oceanography: OOI
Physics: LHC
Biology: Sequencing
Sociology: The Web
Economics: POS terminals
Neuroscience: EEG, fMRI
A 21st century view of Computer Science:
A field that’s unique in its societal impact
Computer Science: The ever-expanding sphere
Students are figuring this out!

- Demand is booming at colleges and universities nationwide
  - For introductory courses
  - For the major
  - For upper-division and graduate courses by non-majors
Demand for introductory courses: Students are realizing that 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.
Demand for upper-division and graduate courses by non-majors: Students are realizing that computer science is great preparation for anything! 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
Demand for the major: Students are realizing that computer science is not Dilbert – it’s an intellectually exciting, highly creative and interactive, “power to change the world” field.
• Students are also realizing that pretty much all of the STEM jobs are in computer science
  – While fluency with computational thinking and with computer science are important to all fields, the job prospects in the field of computer science itself are extraordinary
    • The U.S. Bureau of Labor Statistics recently released its job projections for the decade 2014-2024. Computer occupations will be responsible for 73% of all the job growth in all fields of STEM (Science, Technology, Engineering, and Mathematics) – the many dozens of fields that comprise the life sciences, the physical sciences, the social sciences, engineering, and the mathematical sciences – and for 55% of all available jobs, whether newly-created or available due to replacement
    • In Washington State, the workforce gap in computer science is greater than the workforce gap in all other fields (not just STEM fields!) combined
National STEM Job Creation and Job Availability, 2016-26

STEM Job Growth, 2016-26
U.S. Bureau of Labor Statistics

- Computer occupations (15-1100) 66%
- Engineers (17-2000) 17%
- Life scientists (19-1000) 4%
- Physical scientists (19-2000) 4%
- Social scientists and related workers (19-3000) 3%
- Mathematical science occupations (15-2000) 6%
High-Demand Fields in Washington State, Baccalaureate Level
(Washington Student Achievement Council / State Board for Community & Technical Colleges / Workforce Training & Education Coordinating Board, 2017)

Projected Bachelor's Supply/Demand Gaps, 2020-2025

- Computing
- Education
- Engineering
- Human Services
- Life Sciences & Agriculture
- Physical Sciences

■ Annual Supply
■ Additional Degrees Needed to Fill Projected Openings
Every high school should offer computer science, and every student should take it!

• Not because programming is a valuable skill (although it certainly is that)
• Rather, because every field is becoming an information field
• And because “computational thinking” is an essential 21st century capability
Is this a great time or what?