Computer Science - Facts and Fantasies

Ed Lazowska
Bill & Melinda Gates Chair in Computer Science & Engineering
University of Washington
UW Computer Science & Engineering

- Ranked among the top 10 programs in the nation
  - MIT, Stanford, Berkeley, Carnegie Mellon, Cornell, Illinois, Washington, Texas, Princeton, Caltech, ...

- Two undergraduate programs
  - Computer Science (College of Arts & Sciences)
  - Computer Engineering (College of Engineering)

- 160 Bachelors students per year
  - We also grant ~70 Masters and ~20 Ph.D. degrees annually
“Direct Admission” program for top high school students

- Offered in the spring, coordinated with the UW Admissions Office and the UW Honors Program

- A deep commitment to providing a top-tier undergraduate education

  - Winner of 4 UW Distinguished Teaching Awards
  - Winner of the inaugural UW Brotman Award for Instructional Excellence
Housed in the spectacular new Paul G. Allen Center for Computer Science & Engineering
Message #1

- There are various reasons to go out of state for college
- Getting the best computer science or computer engineering education in the nation is not one of them
Today

- UW Computer Science & Engineering
- Education for the 21st century
- Why computer science?
- Why a research university?
- What your students will experience in UW Computer Science & Engineering
Education for the 21st century

Once upon a time, the “content” of the goods we produced was largely physical
Then we transitioned to goods whose “content” was a balance of physical and intellectual
In the “innovation economy,” the content of goods is almost entirely intellectual rather than physical.
What kind of education is needed to produce "innovation economy" goods?

National and regional studies conclude the $\frac{3}{4}$ths of the jobs in software require a Bachelors degree or greater (and it’s highly competitive among those with this credential!)
Average Earnings as a Proportion of High School Graduates’ Earnings, 1975 to 1999

Washington State: Percent unemployed, March 2004
(Age 25 or greater)

US Census Bureau
Washington State: Percent describing health as "good" or better
(Age 25 or greater, surveyed March 2004)

US Census Bureau
Washington State: Percent describing health as "good" or better
(Age 25 or greater, surveyed March 2004)
Washington State: Percent who reported ever volunteering through an organization
(Age 25 or greater, surveyed September 2004)
Washington State: Percent who voted in the November 2000 election
(Age 25 or greater)

US Census Bureau
### Washington's ranking among the states

<table>
<thead>
<tr>
<th>Category</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineers employed / 10,000 workers</td>
<td>1</td>
</tr>
<tr>
<td>Computer specialists employed / 10,000 workers</td>
<td>6</td>
</tr>
<tr>
<td>Life and physical scientists employed / 10,000 workers</td>
<td>9</td>
</tr>
<tr>
<td>Persons with recent science &amp; engineering Bachelors degrees / 10,000 workers</td>
<td>6</td>
</tr>
<tr>
<td>Recent science &amp; engineering Ph.D. degrees / 10,000 workers</td>
<td>9</td>
</tr>
<tr>
<td>Percent of employment in high-technology NAICS codes</td>
<td>5</td>
</tr>
<tr>
<td>Percent of payroll in high-technology NAICS codes</td>
<td>1</td>
</tr>
</tbody>
</table>

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**US Department of Commerce**

**The Dynamics of Technology-based Economic Development**

State Science and Technology Indicators

Fourth Edition

OFFICE OF TECHNOLOGY POLICY
Engineers employed / 10,000 workers: 1
Computer specialists employed / 10,000 workers: 6
Life and physical scientists employed / 10,000 workers: 9
Persons with recent science & engineering Bachelors degrees / 10,000 workers: 6
Recent science & engineering Ph.D. degrees / 10,000 workers: 9
Percent of employment in high-technology NAICS codes: 5
Percent of payroll in high-technology NAICS codes: 1
Bachelors degrees granted (all institutions, public and private) / population of 18-24 year olds: 35
Percent of Bachelors degrees granted in science & engineering: 38
Science & engineering graduate students / population of 18-24 year olds: 42
Washington State is all geared up to fight the last war!
Message #2

- The vanguard of our economy is the production of goods whose content is almost entirely intellectual.
- It takes a Bachelor's education to produce these goods.
- If you steer a capable student towards a 2-year program, you are doing that student an incalculable disservice.
- Shame on the Workforce Board for protesting the HEC Board's attempt to require 4 years of math for college entrance.
  - "Honors, AP, and IB English, math, and science"
Why Computer Science?

- It’s creative, it’s challenging, it’s exciting
- It’s increasingly fundamental to many other fields
  - And thus it’s great preparation for these fields
- There are tons of jobs
  - Although this is not a reason to choose a major!
### Top 15 occupations in WA requiring Bachelors education or greater

**Figure 6.6**
Top 15 Occupations Requiring a Bachelor’s Degree or Higher
Washington State and Seattle-King County Comparison

**Source:** Employment Security Department/LMEA

<table>
<thead>
<tr>
<th>Washington State</th>
<th>Seattle-King County</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rank</td>
<td>SOC</td>
</tr>
<tr>
<td>1</td>
<td>151031</td>
</tr>
<tr>
<td>2</td>
<td>151021</td>
</tr>
<tr>
<td>3</td>
<td>151032</td>
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<tr>
<td>4</td>
<td>193021</td>
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<td>5</td>
<td>172011</td>
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<td>6</td>
<td>172051</td>
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<td>191042</td>
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<tr>
<td>15</td>
<td>113021</td>
</tr>
</tbody>
</table>
Highest demand occupations in WA (next 10 years)

**Figure 6.7**
Bachelor’s Degree or Higher
Source: Employment Security Department/LMEA; Occupational Projections

<table>
<thead>
<tr>
<th>WDA Title</th>
<th>SOC Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>State</td>
<td>Computer Software Engineers, Applications</td>
</tr>
<tr>
<td>Olympic Consortium</td>
<td>Computer Programmers</td>
</tr>
<tr>
<td>Pacific Mountain</td>
<td>Rehabilitation Counselors</td>
</tr>
<tr>
<td>Northwest</td>
<td>Accountants and Auditors</td>
</tr>
<tr>
<td>Snohomish</td>
<td>Aerospace Engineers</td>
</tr>
<tr>
<td>Seattle-King</td>
<td>Computer Software Engineers, Applications</td>
</tr>
<tr>
<td>Pierce County</td>
<td>Accountants and Auditors</td>
</tr>
<tr>
<td>Southwest</td>
<td>Writers and Authors\textsuperscript{18}</td>
</tr>
<tr>
<td>North Central</td>
<td>Rehabilitation Counselors</td>
</tr>
<tr>
<td>South Central</td>
<td>Substance Abuse and Behavioral Disorder Counselors</td>
</tr>
<tr>
<td>Eastern Washington</td>
<td>Electrical Engineers</td>
</tr>
<tr>
<td>Benton-Franklin</td>
<td>Computer and Information Scientists, Research</td>
</tr>
<tr>
<td>Spokane</td>
<td>General and Operations Managers</td>
</tr>
</tbody>
</table>
Annual job growth rate in WA (regardless of education required)
Message #3

- Computer science is an incredible field
- There are tons of jobs
- But a Bachelors-level education is not about vocational training – it’s about preparation for lifelong learning, and preparation for citizenship
  - There are many “direct” entries to the IT field
  - And there are even more “indirect” entries
Why a research university?
What can we uniquely do?

- Get students into the lab
- Make them our partners in discovery
- Prepare them for life-long learning at the forefront of knowledge and society
Eliana Hechter  
UW Early Entrance Pgm.  
2004 Goldwater Scholars

Jon Su  
Newport HS

Erin Earl  
UW Early Entrance Pgm.  
2003 Dean’s Medal for the Arts  
Rhodes Finalist  
Marshall Finalist

Terri Moore  
Redmond HS  
2004 Dean’s Medal for the Sciences
Thomas Carlson  
UW Early Entrance Pgm.  
2002 Dean's Medal for the Sciences

Simon Pai  
Sam Coskey  
Taiwan  
Garfield HS  
2003 “Outstanding Winners”  
Mathematical Contest in Modeling  
(11 of 638 teams)
Emma Brunskill
UW Early Entrance Pgm.
2001 Rhodes Scholar

Sasha Aravkin
Inglemore HS
2004 “Outstanding Winner”
Mathematical Contest in Modeling
(6 of 599 teams)

Hakim Weatherspoon
Evergreen HS
2002 Rhodes Finalist
Computing Research Association “Outstanding Undergraduates” 2005

Cary Cherng
Redmond HS

Beau Crawford
Shorewood HS

Jenny Yuen
Mexico

Mandy Askew
Tonasket HS

Chris Bradley
Evergreen HS

David Dewey
Port Townsend HS

Crystal Hoyer
Sehome HS
Computing Research Association “Outstanding Undergraduates” 2003

Youngji Kim
Bellevue HS

Colin Bleckner
Lake Washington HS

Samson Kwong
Franklin HS

Tom Anderl
Mountlake Terrace HS
Paul Javid  
Kamiak HS

Micah Brodsky  
Lakeside School

Ilya Maykov  
Shorewood HS

Tessa MacDuff  
Issaquah HS  
(Google)

Christophe Bisciglia  
Gig Harbor HS  
(Google)

(Corporate trip to Burning Man)
BS in Computer Science + BS in Applied and Computational Mathematical Science, 2004

Now working at Sony Online Entertainment
Job title: AI Programmer

“My primary responsibility is architecture and implementation of the artificial intelligence systems we are using in the game we are currently developing for the PC and PS3. In addition to that, I maintain our code integration with the latest versions of Epic's Unreal Engine and interview potential job candidates.”

“I like my job because it is a rewarding mixture of high level architectural problem solving, low level code optimization, and game design.”

How CSE helped you prepare?
“CSE showed me the big picture in computer science, everything from low level hardware details to abstract computational theory. I firmly believe this helped me be open minded, curious, and humble about the continual learning process of being an engineer.”

Hobbies: Kickboxing, Snowboarding, Learning Japanese, Motorcycles, Reading, Video Games
Now working at Varolii Corporation (formerly PAR3 Communications)  
Job title: Senior Professional Services Engineer

“I integrate Varolii’s product with customer systems. I spend my days developing solutions by integrating directly with backend customer systems, writing applications to process files, implementing business logic, testing solutions, and working with customers.”

“Every customer solution is a new challenge, so my job is always interesting. I also feel like my work has a direct impact on the success of Varolii.”

“The CSE department gave me a good foundation in many areas – programming, design, databases, project management, and teamwork. I also learned how to learn new things, which is vital in field that changes as much as CSE.”

“I love hiking and camping in the mountains, biking around Seattle, baking pies and cookies, geocaching, and going to see outdoor movies.”
Now works at Microsoft, after an internship at Honeywell
Job title: Software Design Engineer in Test

“I develop tools and frameworks for the quality
assurance of Microsoft Windows SDK for Windows
Vista Client and Windows Server 2008.”

“I like the fact that I'm involved with bringing next
generation development tools to my peers and the
fact that I get a chance to work on emerging
technology of current and future versions of leading
operating systems.”

“I've come to realize that almost everything that I
learned throughout the CS program at UW, even the
most theoretical topics, has an impact on my day to
day activities at work. The variety of subject matter
and the quality at which they were taught provided me
with the necessary tools and skill set in order to excel
in virtually any field of Computer Science.”

Hobbies: Soccer and Swimming
Elizabeth Arrowsmith
BS in Computer Engineering, 2006

Now studying Software Engineering
at the University of California San Diego

“I am interested in finding ways to create software tools that lower the barriers to programming. Most of the code written today is written by people who have never taken a programming course, so finding ways to allow novice programmers to create quality usable code can make a big impact.”

What you like best about UC San Diego?
“Thinking up new ideas that no one has ever done before.”

“UW CSE gave me a great start by providing me with a solid foundation from which to start my graduate study.”

Hobbies: “When I'm not at school I enjoy going to the beach, yo-yoing, and dancing.”
“I am part of a three-man team that demonstrates Unmanned Areal Systems capabilities to potential customers around the country. This includes operating aircraft, maintaining Mobile Ground Control System, integrating emerging technology, support of research and development, flight testing, software development and analysis, aircraft maintenance and general engineering support.”

“My favorite part of the job is the variety, I do something different every day. The people with whom I am fortunate enough to work are a big benefit as well.”

“CSE helped me to develop a work ethic that is unmatched in industry. It taught me to approach challenges methodically with an open mind and to think like a scientist.”

Hobbies: Mountain biking, sailing, rock climbing and travel
Viet Nguyen
BS in Computer Science, 2004

Now studying at the UW Medical School as a 4th year Medical Student

Job description: Working in hospital, caring for patients.

Best part about the UW Medical School: The intellectual stimulation of the work, and the ability to help people.

How did CSE prepare you for medical school?

“[The program provided] a good basis for problem solving.”

Hobbies:
Spanish guitar,
Broadway musicals,
Cooking/eating
Now works at Rhythm & Hues
Job title: Animator

“[I] animate CG characters to be placed into live action film. Animators use the CG model to create a performance through motion.”

“I love working in feature film because I’m encouraged to continue learning and pushing my work to a higher level of polish.”

“CSE taught me excellent problem solving skills and prepared me to work in a team environment. The animation capstone was a great introduction to what it's like to work on a real production. My programming skills have also come in handy for writing scripts to customize or streamline my workflow.”

Hobbies: Drawing and collecting music memorabilia
Now working at Knowledge Mosaic  
Job title: Systems Analyst

“Knowledge Mosaic is an internet-based company that provides a research tool for legal professionals. I work on both backend (data parsing) and front end of web development. It’s an opportunity to apply what I learned in CSE (problem solving skills), and also at the same time learn new skills continuously.”

“CSE imparted in me the skills, the knowledge, and the confidence to approach and solve complex problems. It also taught me how to work independently as well as in teams. I appreciate the opportunity of being able to work with great minds on class projects. CSE taught me the value of continuous learning. Everyday, I find myself applying to my work what I learned in CSE.”

“I was a Gurkha for several years before I attended CSE. I still live a little bit of Gurkha life by remaining very active in outdoor activities. I also enjoy helping people in the Himalayas. I collect computers and their parts to send to the people in the village. During my free time, I also develop applications that I think will be useful for these people. I will likely find myself more involved in such voluntary projects that benefit poor people in the Himalayas. I would like to start a club of volunteers who work together as a team to help poor kids there by collecting and sending computers and books, teaching computer programming, building online resources, etc. I am really thankful to the CSE family for the great experience I had throughout the program.”
“I work on the 2011 Xeon server; we'll be using a core designed by another team [and] my job is to make sure that team designs their part in a way that will make our part as great as possible. Since the other team is located in Israel, I also do a lot of international travel.”

“I've always wanted to do architecture, and now I'm influencing a real product that thousands of people will use in their server farms one day. I consider the travel opportunities to be the biggest perk: I never dreamed I'd go to India or Israel, all paid for by Intel. Finally, my team is bursting with fun, intelligent people, and they're a great social circle both for geeking out with or taking in a baseball game or putting together a camping trip.”

“CSE gave me a breadth of exposure so that I knew which aspect of computer science really appealed to me. My decision to pursue architecture by going on to graduate school was very last minute but the faculty was both responsive and supportive. I didn't leave UW an expert in architecture, but I had acquired the skills that let me catch up with relative ease.”
Darby Wong

B.S. Computer Science, 2004

Now studies at Harvard Law School as a Law Student

Brief description of what you do: Reading cases to prepare for class, studying class notes to prepare for final exams

“As an intern in the Silicon Valley office of Orrick, Herrington & Sutcliffe this summer, I'm working on various legal issues for start-up companies, mostly related to financings and acquisitions.”

What you like best about law school: “Getting to know bright, friendly classmates with a wide variety of interests and ambitions.”

How CSE helped you prepare?
- Training me to think analytically
- Experience working closely with others, on group projects
- Conditioning my work ethic through all-nighters

Hobbies: Ruby on Rails, cooking, snowboarding, and bowling.
Message #4

Bright, well-prepared, well-motivated students from all across this state get a mind-blowingly great education at UW
What your students will experience in UW Computer Science & Engineering

- “Capstone Design Courses”
  - Robot soccer => robot blimps
  - “Software system design”
  - Computer animation
  - Digital design
  - “Google-scale computing”
Message #5

We are in “the opportunity business”