The State of Computing

Dr. Erwin Gianchandani
Director, Computing Community Consortium
Computing Research Association

Consortium for Computing Sciences in Colleges (CCSC)
Eastern Conference 2011
Marymount University | October 14, 2011

http://cra.org/ccc
Objective

“Future trends in computing”

- Overview of the Computing Research Association and the Computing Community Consortium

- What we’re seeing nationally

- Future directions and drivers
Mission and activities

- Strengthen research and education in the computing fields
  - Working to influence policy that impacts computing research
  - Encouraging the development of human resources
  - Contributing to the cohesiveness of the professional community

- Collect and disseminate information about the importance and state of computing research

Table 1. PhD Production by Type of Department and Rank

<table>
<thead>
<tr>
<th>Department, Rank</th>
<th>PhDs</th>
<th>Avg. per</th>
<th>PhDs</th>
<th>Avg. per</th>
</tr>
</thead>
<tbody>
<tr>
<td>US CS 1-12</td>
<td>215</td>
<td>17.9</td>
<td>265</td>
<td>20.1</td>
</tr>
<tr>
<td>US CS 13-24</td>
<td>241</td>
<td>17.9</td>
<td>206</td>
<td>17.1</td>
</tr>
<tr>
<td>US CS 25-36</td>
<td>962</td>
<td>6.4</td>
<td>1,696</td>
<td>11.3</td>
</tr>
<tr>
<td>US CS Other</td>
<td>1,501</td>
<td>10.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>US CS Total</td>
<td></td>
<td></td>
<td>1,966</td>
<td>11.3</td>
</tr>
</tbody>
</table>

http://cra.org/ccc
What is the CCC?

- Established in 2006 through a multi-year cooperative agreement between the National Science Foundation and CRA
- Provides a voice for the national computing research community
- Facilitates the development of a bold, multi-themed vision for computing research - and communicates this vision to stakeholders
A broad-based Council

Leadership:
- Ed Lazowska, U of Washington (Chair)
- Susan Graham, UC-Berkeley (Vice-Chair)
- Erwin Gianchandani, CRA (Director)

Terms ending 2014:
- Deborah Crawford, Drexel
- Gregory Hager, Johns Hopkins
- John Mitchell, Stanford
- Bob Sproull, Oracle (ret.)
- Josep Torrellas, UIUC

Terms ending 2013:
- Randy Bryant, CMU
- Lance Fortnow, Northwestern
- Eric Horvitz, Microsoft Research
- Hank Korth, Lehigh
- Beth Mynatt, Georgia Tech
- Fred Schneider, Cornell
- Margo Seltzer, Harvard

Rotated off:
- Bill Feiereisen, Intel (2011)
- Dave Kaeli, Northeastern (2011)
- Dick Karp, UC-Berkeley (2010)
- John King, U of Michigan (2011)
- Peter Lee, Microsoft Research (2009)
- Karen Sutherland, Augsburg U (2009)
- Dave Waltz, Columbia (2010)

Meets three times a year, including an annual summer meeting in Washington, DC

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A multitude of activities

- Community-initiated visioning:
  - Workshops that bring researchers together to discuss “out-of-the-box” ideas
  - Challenges & Visions tracks at conferences

- Outreach to the White House, Federal funding agencies:
  - Outputs of visioning activities
  - Short reports to inform policy makers
  - Task Forces -- Health IT, Sustainability IT, and Data Analytics

This Week’s Highlight: Fruit Fly Suggests New Solution to Computer Networking Problem
4 meetings during summer 2008
Roadmap published May 2009
Extensive discussions between visioning leaders & agencies

OSTP issues directive to all agencies to include robotics in FY 12 budgets

National Robotics Initiative is announced

Henrik Chistensen
Georgia Tech
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- Public relations efforts:
  - Library of Congress symposia
  - Research “Highlight of the Week”
  - CCC Blog [http://cccblog.org/]

- Nurturing the next generation of leaders:
  - Computing Innovation Fellows Project
  - “Landmark Contributions by Students”
  - Leadership in Science Policy Institute

http://cra.org/ccc
Established in 2009 with NSF/CISE funding
Provides recent CS Ph.D.s one- to two-year postdoctoral positions
Goal is to retain new Ph.D.s in research & teaching during difficult economic times
60 CIFellows funded in 2009
  19 left the program after year 1
  39 have now found tenure-track faculty or industrial research positions
Another 47 CIFellows funded in 2010, 21 in 2011
A research project in and of itself...
Welcome! This website is intended to help undergraduates in computing fields find summer research opportunities and resources for applying to graduate school.
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The CS Job Market
“As the rest of the country fights stubbornly high unemployment, the shortage of qualified engineers has grown acute in the last six months, tech executives and recruiters say, as the flow of personal or venture capital investing has picked up. In Silicon Valley, along the southern portion of the San Francisco Bay in California, and other tech hubs like New York, Seattle and Austin, Tex., start-ups are sprouting by the dozen, competing with well-established companies for the best engineers, programmers and designers. At the same time, all the companies are seeking ever more specialized skills.”

-- “Silicon Valley Hiring Perks,”
March 25, 2011
Where the jobs are

Projected S&E Job Openings
(new jobs + net replacements, 2006-2016)

- Computer Specialists: 62%
- Engineers: 21%
- Life Scientists: 7%
- Physical Scientists: 4%
- Mathematical Scientists: 4%
- Social Scientists: 2%

Projected S&E Job Creation
(new jobs, 2006-2016)

- Computer Specialists: 70%
- Engineers: 14%
- Life Scientists: 8%
- Physical Scientists: 3%
- Mathematical Scientists: 4%
- Social Scientists: 1%


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Where the jobs are II

Contribution to Total Growth in S&E Occupations, 2008-18

- Life, physical, and social science technicians: 57%
- Social scientists and related: 3%
- Physical scientists: 9%
- Life scientists: 3%
- Drafters, engineers, and mapping technicians: 6%
- Engineers: 4%
- Architects, surveyors, and cartographers: 13%
- Mathematical science: 2%
- Computer specialists: 2%


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Where in computing the jobs are

Actual, Projected IT Occupational Employment, 2006-2016

Computer and information scientists, research
Computer programmers
Computer software engineers, applications
Computer software engineers, systems
Computer support specialists
Computer systems analysts
Database Administrators
Network and computer systems administrators
Network systems and data communications analysts
Computer specialists, all other

(in thousands)


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By the numbers perks

* Extraordinary competition for CS majors right now

* Starting salaries as high as $105,000

* Weekly lessons about entrepreneurship

* Free meals, haircuts, iPads, shuttle busses, and stock options
Promising signs: Tale of four cities

CMU (applicants)

Stanford (enrollments)
- Previous record in 1999-2000: 762 students
- Bottomed out in 2006-07
- New record in 2010-11: 1,087
  - Year-to-year growth of 51%
  - Spring enrollment up 120%

UW (enrollments)

MIT (enrollments)
- Introductory CS course is single most popular course (out of 2,000+ MIT courses in a broad range of fields)
“It’s become glamorous to become the next Mark Zuckerberg, and everyone likes to think they have some great idea.”

--Keila Fong, Yale University undergraduate
Just about every field is becoming an information field

“NIT is arguably unique among all fields of science and engineering in the breadth of its impact ... Recent technological and societal trends place the further advancement and application of NIT squarely at the center of our Nation’s ability to achieve essentially all of our priorities and to address essentially all of our challenges ... All indicators - all historical data, and all projections - argue that NIT is the dominant factor in America’s science and technology employment.

-- PCAST report, December 2010
...Postdocs in computing

Numbers of New Ph.D.s Hired


Categories: PostDocs, Tenure-track faculty, Teaching faculty, Research faculty

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Future directions
A report on the future of the field

- Issued by the President’s Council of Advisors on Science and Technology
- About the nationwide Networking & Information Technology R&D initiative
- An excellent roadmap for the field

REPORT TO THE PRESIDENT AND CONGRESS
DESIGNING A DIGITAL FUTURE: FEDERALLY FUNDED RESEARCH AND DEVELOPMENT IN NETWORKING AND INFORMATION TECHNOLOGY

Executive Office of the President
President’s Council of Advisors on Science and Technology

DECEMBER 2010

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Affecting national priorities

- Improving health care
- Enabling the smart grid
- Revolutionizing transportation
- Delivering personalized education
- Empowering the developing world
- Ensuring our national defense
- Enabling the future of networking
- Driving advances in all fields of science & engineering
Some examples from PCAST

- Health information technology
  - “Go well beyond the current national program to adopt electronic health records”
  - “Make possible comprehensive lifelong multi-source health records for individuals; enable both professionals and the public to obtain and act on health knowledge from diverse and varied sources as part of an interoperable health IT ecosystem; and provide appropriate information, tools, and assistive technologies that empower individuals to take charge of their own health and reduce costs.”

- Energy and transportation
  - “dynamic power management broadly; interoperable standards for real-time control; low-power systems and devices; and improved surface and air transportation.”

- Security and robustness of cyber-infrastructure:
  - “more effective ways to build trustworthy computing and communications systems; better defense mechanisms for today’s infrastructure; and fundamentally new approaches for making cyber-infrastructure truly resilient to cyber-attack, natural disaster, and inadvertent failure.”
The shift toward interdisciplinary

numbers of new PhDs


- Artificial Intelligence/Robotics
- Hardware/Architecture
- Numerical Analysis/Scientific
- Programming Languages/Compilers
- Operating Systems/Networks
- Software Engineering
- Theory & Algorithms
- Graphics/Human Interfaces
- Database/Information Systems
- Other/Unknown

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Federal investment

- Health information technology
  - Workshop held in San Francisco in October 2009
  - NSF/CISE initiative on Smart Health & Wellbeing (SHB) announced in FY 2011

- Role of information sciences & engineering in sustainability
  - Workshop in Washington, DC, on Feb. 3-4, 2011
  - Several NSF SEES solicitations in recent weeks for FY 2012

- “Big Data”/Data analytics
  - Series of white papers written for policy makers in summer 2010
  - Anticipating a new initiative in FY 2013

- Education (learning) technologies
  - Roadmap produced in summer 2010
  - Digital Promise and ARPA-ED
Others

- Hack-a-thons
- Crowdsourcing
- Prize-based (challenge) competitions
The topics are ordered roughly by increasing date of $1 B industry.

From Internet:
- Berkeley, Wisconsin
- IBM
- Oracle, IBM, Sybase
- Tokyo, Wisconsin, UCLA
- IBM, ICL
- ICL, Teradata, Tandem
- Wisconsin, Stanford
- IBM, Arbor
- IRI, Arbor, Plato
- Illiac 4, CMU, Caltech, HPC
- IBM, Intel
- CM-S, Teradata, Cray T3D
- Berkeley
- Striping/Datamesh, Petal
- many
- Berkeley, Purdue (CDMA)
- Linkabit, Hughes
- Qualcomm
- CERN, Illinois (Mosaic)
- Alta Vista
- Netscape, Yahoo, Google
- CMU, SRI, MIT
- Bell, IBM, Dragon
- Dragon, IBM
- Stanford, UCLA
- Bellcore (Telcordia)
- Amati, Alcatel, Broadcom

University:
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Industry R&D Products:
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A community effort

- Propose visioning activities, white papers, Challenges & Visions tracks at research conferences
- Put together short videos for undergraduates
- Contribute to the CCC Blog
- Send us a research highlight for the Highlight of the Week

Get involved today:

erwin@cra.org or 202-266-2936
http://cra.org/ccc or http://cccblog.org/

http://cra.org/ccc