

THE ROLE OF THE COMPUTING COMMUNITY CONSORTIUM IN ADVANCING AUDACIOUS COMPUTING RESEARCH

Elizabeth Mynatt

Chair

Computing Community Consortium

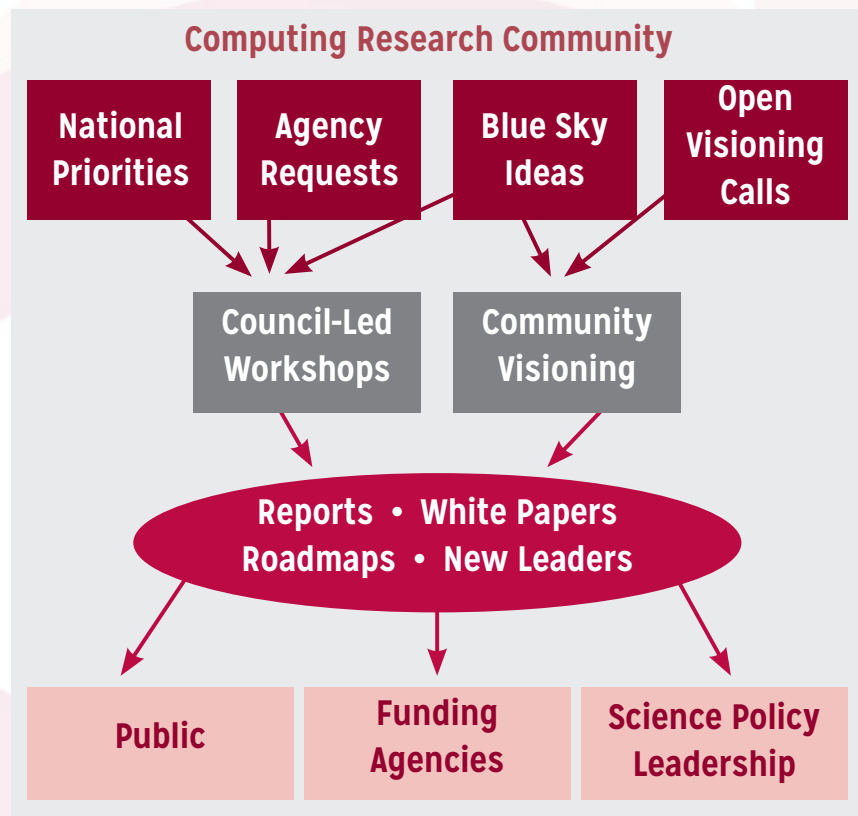


CCC

Computing Community Consortium
Catalyst

COMPUTING COMMUNITY CONSORTIUM

The **mission** of Computing Research Association's Computing Community Consortium (CCC) is to **catalyze** the computing research community and **enable** the pursuit of innovative, high-impact research.



Promote Audacious Thinking:

- Community Initiated Visioning Workshops
- Blue Sky Ideas tracks at conferences

Inform Science Policy:

- Outputs of visioning activities
- Task Forces – Health IT, Data Analytics

Communicate to the Community:

- CCC Blog - <http://cccblog.org/>
- Great Innovative Ideas
- White Papers

Promote Leadership and Service:

- Industry – Academic Collaborations
- Leadership in Science Policy Institute
- Postdoc Best Practices

THE CCC COUNCIL – EXECUTIVE COMMITTEE

- Beth Mynatt, Georgia Tech (Chair)
- Mark Hill, University of Wisconsin, Madison (Vice Chair)
- Greg Hager, Johns Hopkins Univ. (Past Chair)
- Ben Zorn, Microsoft Research
- Jennifer Rexford, Princeton
- Ann Drobnis, Director
- Andy Bernat, CRA Executive Director

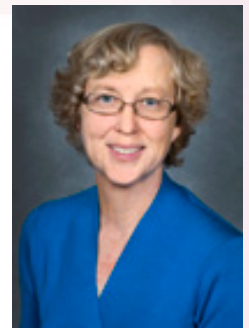


THE CCC COUNCIL



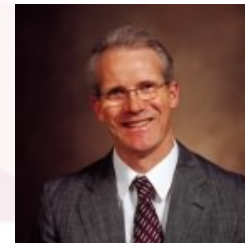
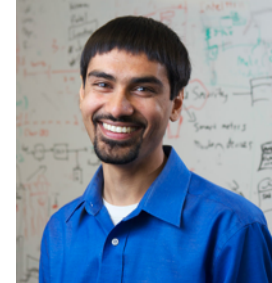
Terms ending June 2019

- Sampath Kannan, UPenn
- Maja Mataric, USC
- Nina Mishra, Amazon
- Holly Rushmeier, Yale



Terms ending June 2018

- Liz Bradley, (CU Boulder)
- Cynthia Dwork, Microsoft Research
- Kevin Fu, Univ. Michigan (Leave)
- Daniel P. Lopresti, Lehigh University
- Shwetak Patel, Univ. Washington
- Katherine Yelick, UC Berkeley

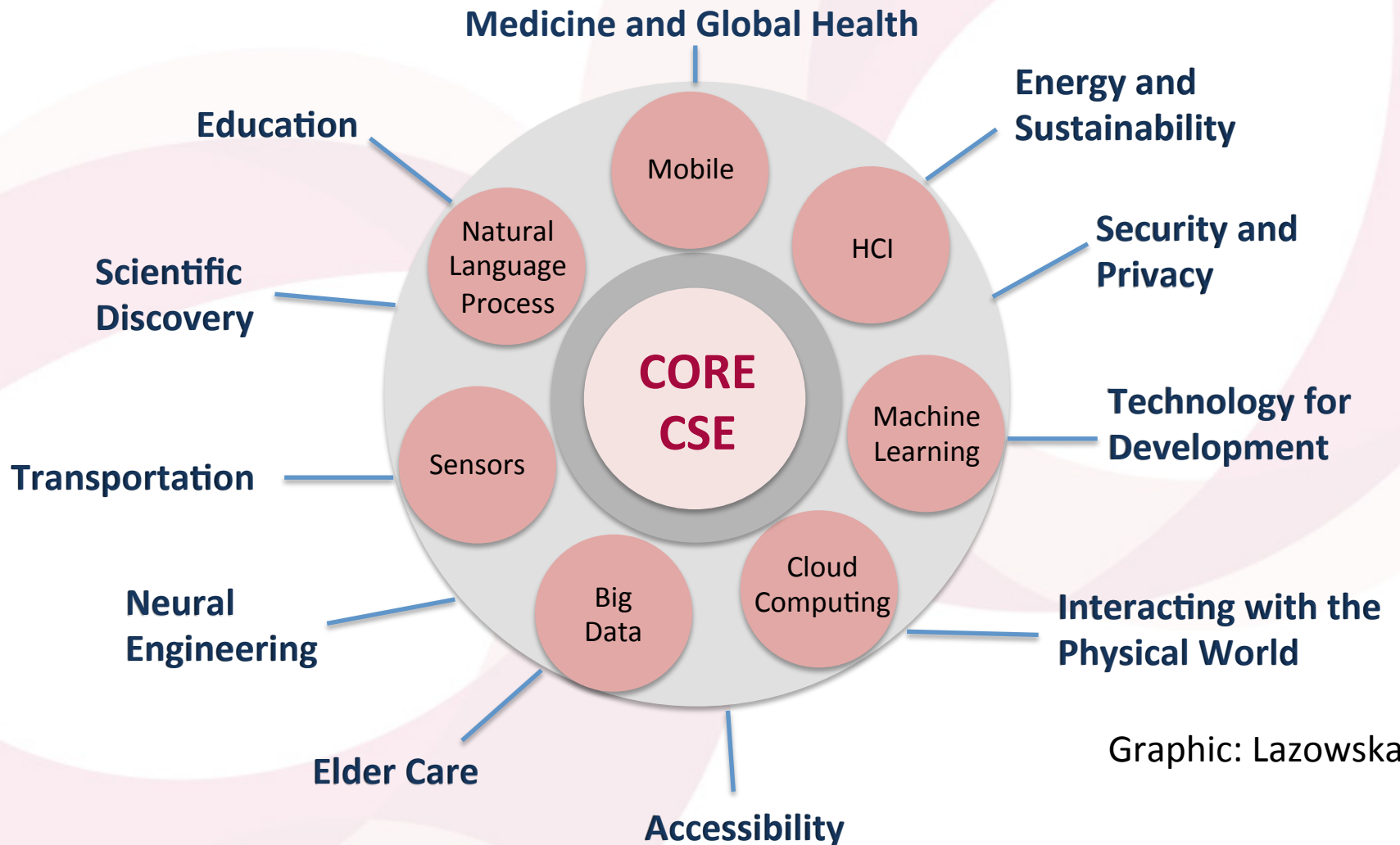


Terms ending June 2017

- Lorenzo Alvisi, Cornell
- Randy Bryant, CMU
- Vasant Honavar, Penn State
- Jennifer Rexford, Princeton
- Debra Richardson, UC Irvine
- Klara Nahrstedt, UIUC
- Ben Zorn, Microsoft Research



THE RAPIDLY EXPANDING WORLD OF COMPUTING



Graphic: Lazowska



CCC AND FEDERAL STAKEHOLDERS

OSTP: Office of Science
Technology and Policy
(Holdren, Smith, Kalil, Felten)

PCAST: President's Council of
Advisors on Science and
Technology (Holdren, Lander)

NITRD: Networking and
Information Technology R&D

CSTB: Computer Science
Telecommunications Board

Agencies: NSF, NIH, DoE, NIST,
HHS / ONC, DARPA...



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CCC AND FEDERAL STAKEHOLDERS

OSTP: Office of Science Technology and Policy
(Holdren, Smith, Kalil, Felten)

“The administration has a real commitment to evidence. ... We believe in following research where it exists and building it where it doesn’t.”

- Tom Kalil

Deputy Director for Technology and Innovation
White House Office of Science and Technology Policy



CCC AND FEDERAL STAKEHOLDERS

PCAST: President's Council of Advisors on Science and Technology (Holdren, Lander)



REPORT TO THE PRESIDENT Independence, Technology, and Connection in Older Age

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

March 2016



CCC AND FEDERAL STAKEHOLDERS

NITRD: Networking and Information Technology R&D



CCC AND FEDERAL STAKEHOLDERS

NITRD: Networking and Information Technology R&D

FY 2017 Budget Requests (Dollars in Millions)

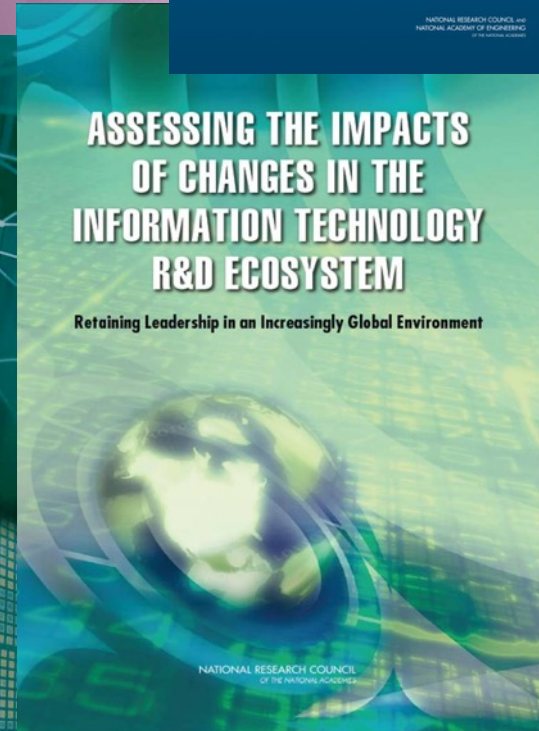
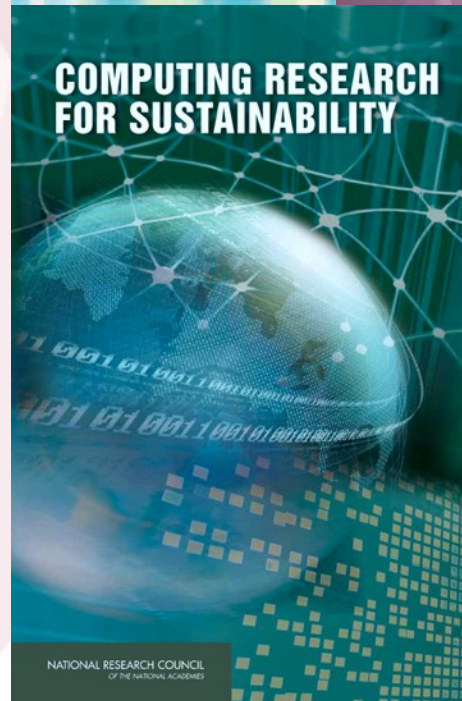
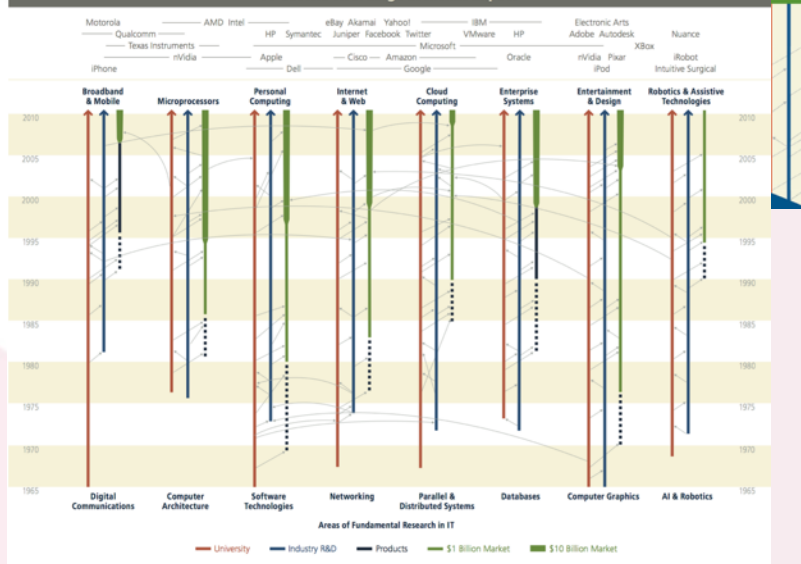
Agency/ Program Component Area	Cyber Security & Information Assurance	Enabling- R&D for High- Capability Computing Systems	Human Computer Interaction & Infor- mation Manage- ment	High- Capability Computing Systems Infrastruc- ture & Applica- tions	High Confi- dence Software & Systems	Large-Scale Data Manage- ment & Analysis	Large Scale Networking	Robotics & Intelligent Systems	Software Design & Productiv- ity	Social, Economic, & Work- force Implica- tions of IT	Total ^a
	CSIA	EHCS	HCI&IM	HCSIA	HCSS	LSDMA	LSN	RIS	SDP	SEW	
NSF	111.0	131.0	182.8	183.2	86.5	111.3	139.0	43.5	82.7	127.1	1,198.0
DoD ^b	145.1	216.4	170.0	81.9	12.9	38.2	108.0	102.9	10.2	3.1	888.7
DOE ^c	30.0	208.3		393.6	17.5		88.0	11.7		10.0	759.1
NIH ^d	3.0	23.1	313.0	194.6	30.0		8.0		129.0	54.0	754.7
DARPA	300.1	6.0				106.6	27.6				440.4
NIST	70.2	18.0	8.2	8.1	15.7	15.8	10.8	7.9	1.8	4.0	160.5
NASA		11.0	14.0	60.9	4.9	5.4	0.8	53.5	6.6		157.0
DHS	66.8		2.0			5.0					73.8
NOAA			0.2	36.0			3.3		3.7		43.2
NNSA		30.0								3.5	33.5
AHRQ			22.9								22.9
EPA		3.7	3.1								6.8
NIJ	1.5						1.0	1.0			3.5
NARA			0.2								0.2
Total ^{a, d}	727.7	647.5	716.4	958.3	167.5	282.3	386.4	220.5	234.0	201.7	4,542.4

CCC AND FEDERAL STAKEHOLDERS

CSTB: Computer Science Telecommunications Board

Continuing Innovation IN INFORMATION TECHNOLOGY

IT Sectors With Large Economic Impact



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Agencies: NSF, NIG, DoE,
NIST, HHS / ONC, DARPA...



NIST



Homeland
Security



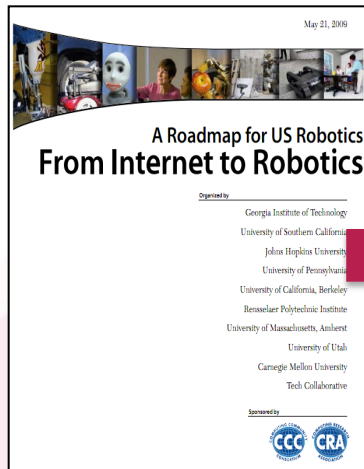
National Institutes
of Health



U.S. DEPARTMENT OF
ENERGY



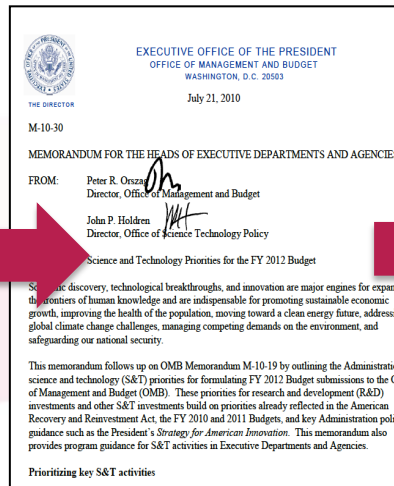
OUTREACH: ROBOTICS



4 meetings during
summer 2008

Roadmap published
May 2009

*Extensive discussions
between visioning
leaders & agencies*



OSTP issues directive to all
agencies in summer 2010
to include robotics in
FY 12 budgets



National Robotics
Initiative announced
in summer 2011



2 meetings in Spring, 2016

Report and
Congressional Briefing in
June, 2016



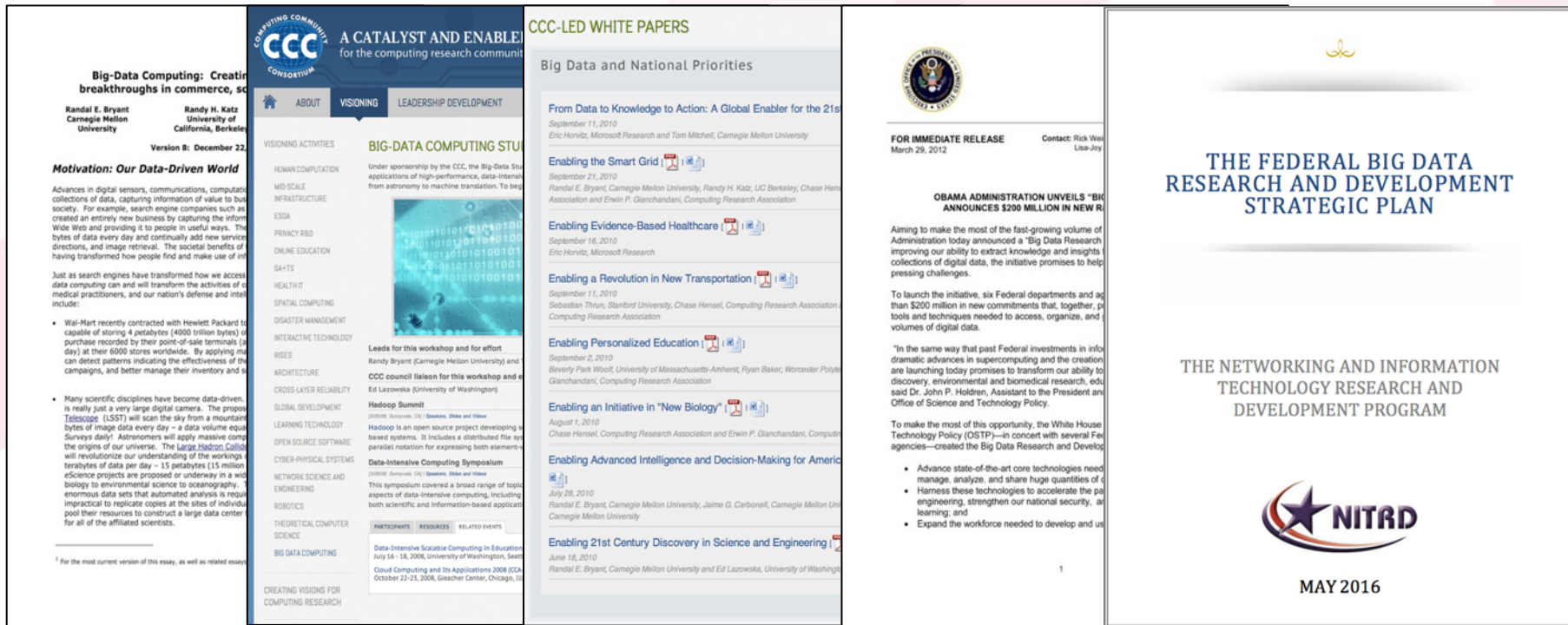
Henrik Chistensen



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OUTREACH: BIG DATA



2008

2008

2010

2012

2016



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OUTREACH: ARCHITECTURE

Workshop on Advancing Computer Architecture Research (ACAR-I)

Failure is not an Option: Popular Parallel Programming

Organizers: Josep Torrellas (University of Illinois) and Mark Oskin (University of Washington).

Steering Committee: Chita Das (NSF and Pennsylvania State University), William Harrod (DARPA), Mark Hill (University of Wisconsin), James Larus (Microsoft Research), Margart Marstoni (Princeton University), Jose Moreira (IBM Research), and Oluokun (Stanford University).

Written by: Josep Torrellas, Mark Almadena Chinchellano, Chita Das, Jon Hiller, Sampath Kannan, Krishnakumar Murphy, Omer Mutlu, Satish Nadimbram, Kevin Skadron, Karin Strauss, Steven Swanson, and Dean Tullsen.

Funded by the Computing Research Association's (CRA) Computing Consortium (CCC) as a "visioning exercise" meant to promote forward thinking in computing research and then bring these ideas to a funded program.

Held on February 21-23, 2010 in San Diego, California
Contact: torrella@illinois.edu; oskin@cs.washington.edu
Websites: <http://www.cra.org/cc/acar.php>; <http://iacoma.cs.uiuc.edu/acar>

August 2010

21st Century Computer Architecture

A community white paper

May 25, 2012

Workshop on Advancing Computer Architecture Research (ACAR-II)

Laying a New Foundation for IT: Computer Architecture for 2025 and Beyond

Organizers: Mark Oskin (University of Washington) and Josep Torrellas (University of Illinois).

Steering Committee: Chita Das (Pennsylvania State University), Margart Marstoni (Princeton University), Jose Moreira (IBM Research), and Oluokun (Stanford University).

Written by: Mark Oskin, Josep Torrellas, Chita Das, John Davis, S. Dwarakadas, Lieven Eeckhout, Bill Ferenstein, Daniel Jimenez, Mark Kim, James Larus, Margaret Marstoni, Omer Mutlu, K. Ravi Andrew Putnam, Tim Sherwood, James Smith, David Wood, and others.

Funded by the Computer Research Association's (CRA) Computing Consortium (CCC) as a "visioning exercise" meant to promote forward thinking in computer research and then bring these ideas to a funded program.

Held on September 20-21, 2010 in Seattle, Washington
Contact: oskin@cs.washington.edu; torrella@illinois.edu
Website: <http://www.cra.org/cc/acar.php>

1. Introduction and Summary

Information and communication technology (ICT) is transforming our world healthcare, education, science, commerce, government, defense, and entertainment to remember that 20 years ago the first step in information science involved a trip to the library. Today's information science is mostly physical, and 5 years ago "tweets" cartoon characters.

Importantly, much evidence suggests that ICT innovation is accelerating with many visions moving from science fiction toward reality. Appendix A both touches upon the need and seeks to distill their attributes. Future visions include: personalized medicine and drugs to an individual, sophisticated social network analysis of potential threats and homeland security, and sophisticated to reduce the greenhouse gases spent on data. Future applications will increasingly require processing on large, heterogeneous "Data", using distributed designs, working within factor constraints, and on deployment with efficient operation.

Two key—but often invisible—enablers of this technology and computer architecture. See Moore's Law (Moore's Law) for roughly of Computer architects took these rapid techniques to scale processor performance and mitigate memory system losses. effect of technology and architecture has provided ICT innovations with exponential growth at near constant cost.

Because most technology and computer architecture innovations were (intentionally) higher layers, application and other software developers could reap the benefits of it without engaging in it. Higher performance has both made more computationally applications feasible (e.g., virtual assistants, computer vision) and made less applications easier to develop by enabling higher-level programming abstractions (e.g., languages and reusable components). Improvements in computer system cost enabled value creation that could never have been imagined by the field's four distributed web search sufficiently inexpensive so as to be covered by advertising levies.

21st Century Computer Architecture

A community white paper

May 25, 2012

2. Exploiting Parallelism and Scalability (XPS)

PROGRAM SOLTICATION
NSF 13-507

National Science Foundation
Division of Computer & Information Science & Engineering
Division of Computing and Communications Foundations
Division of Information & Intelligent Systems
Division of Computer and Network Systems
Office of Cyberinfrastructure

Full Proposal Deadline(s): (due by 5 p.m. proposer's local time)
February 20, 2013

IMPORTANT INFORMATION AND REVISION NOTES

A revised version of the *NSF Proposal & Award Policies & Procedures Guide (PAPPG)*, NSF 12-5, was issued on February 15, 2013. The revised version of the PAPPG is available at <http://www.nsf.gov/pubs/papapg/>. Please note that the guidelines contained in NSF 12-5 apply to proposals submitted in response to this funding opportunity who opt to submit prior to January 14, 2013, must also follow the guidelines contained in NSF 12-5.

Please be aware that significant changes have been made to the PAPPG to implement recent NSF review efforts based on the National Science Foundation's (NSF) mission, vision, and strategic plan. These changes include, but are not limited to, the following: the focus of the review. Changes will affect the proposal summary and proposal description sections of proposals. Annual and final reports will be affected.

A chapter summary of the full and other significant changes is provided at the beginning of both the *NSF Proposal Guide* and the *NSF Award & Administration Guide*.

Please note that this information may contain applicable proposed preparation guidance and/or guidance that deviates from the guidelines established in the *NSF Proposal Guide*.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:
Exploiting Parallelism and Scalability (XPS)

Synopsis of Program:
Computing systems have undergone a fundamental transformation from the single processor device of the turn of the century to today's ubiquitous and networked devices and supercomputers. The proliferation of multi-processor, multi-core, and many-core processors, ever-increasing numbers of interconnected high performance and data intensive edge devices, and the data centers servicing them, is enabling a new set of global applications with large scientific and social impact. At the same time, the exponential growth in being bandwidth performance limits and single domain performance has prevented the realization of the ability to achieve performance improvements through improved processing techniques.

The Expanding Parallelism and Scalability (XPS) program aims to support groundbreaking research leading to a new era of parallel computing. XPS seeks research re-evaluating, and possibly re-designing, the traditional computer hardware and software stack to today's heterogeneous parallel and distributed systems and exploring new architectures and applications that are scalable and sustainable. XPS encourages collaborative effort among researchers representing all areas—from the application layer down to the micro-processor—and will be built on new computing paradigms that are scalable and sustainable. XPS will support scalable performance and usability: new abstract models and algorithms, programming models and languages, hardware architectures, compilers, operating systems and run-time systems, and related services and application-specific knowledge. Research should also focus on energy- and communication-efficiency and on enabling the division of effort between edge devices and clouds.

Consistent Program Officer(s):

Please note that the following information is current at the time of publishing. See program website for any updates to the points of

2010

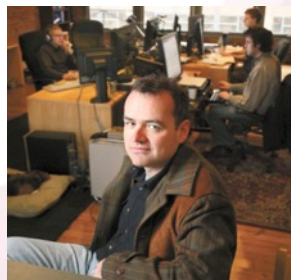
2010

2012

2013



Josep Torrellas
UIUC



Mark Oskin
Washington



Mark Hill
Wisconsin

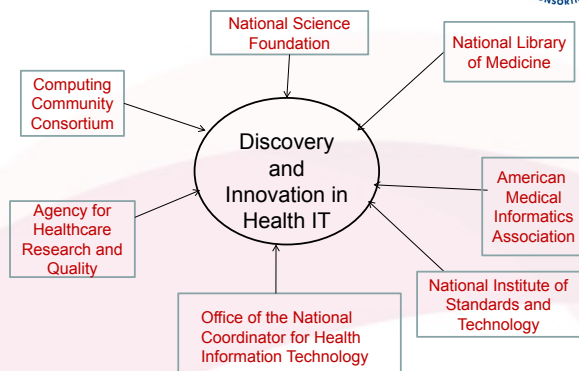


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OUTREACH: HEALTH IT

October 2009 Workshop



National Science Foundation
WHERE DISCOVERIES BEGIN

Directorate for Computer & Information Science & Engineering

SMART HEALTH AND WELLBEING (SHW)

CONTACTS

See program guidelines for contact information.

SYNOPSIS

Smart and Connected Health (SCH)

PROGRAM SOLICITATION

NSF 13-543

REPLACES DOCUMENT(S):

NSF 12-512



National Science Foundation

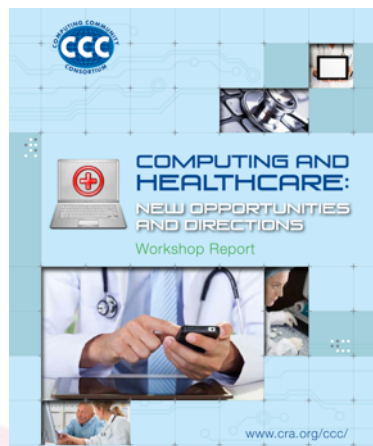
Directorate for Computer & Information Science & Engineering
Division of Computing and Communication Foundations
Division of Computer and Network Systems
Division of Information & Intelligent Systems

Directorate for Engineering

Directorate for Social, Behavioral & Economic Sciences



National Institutes of Health



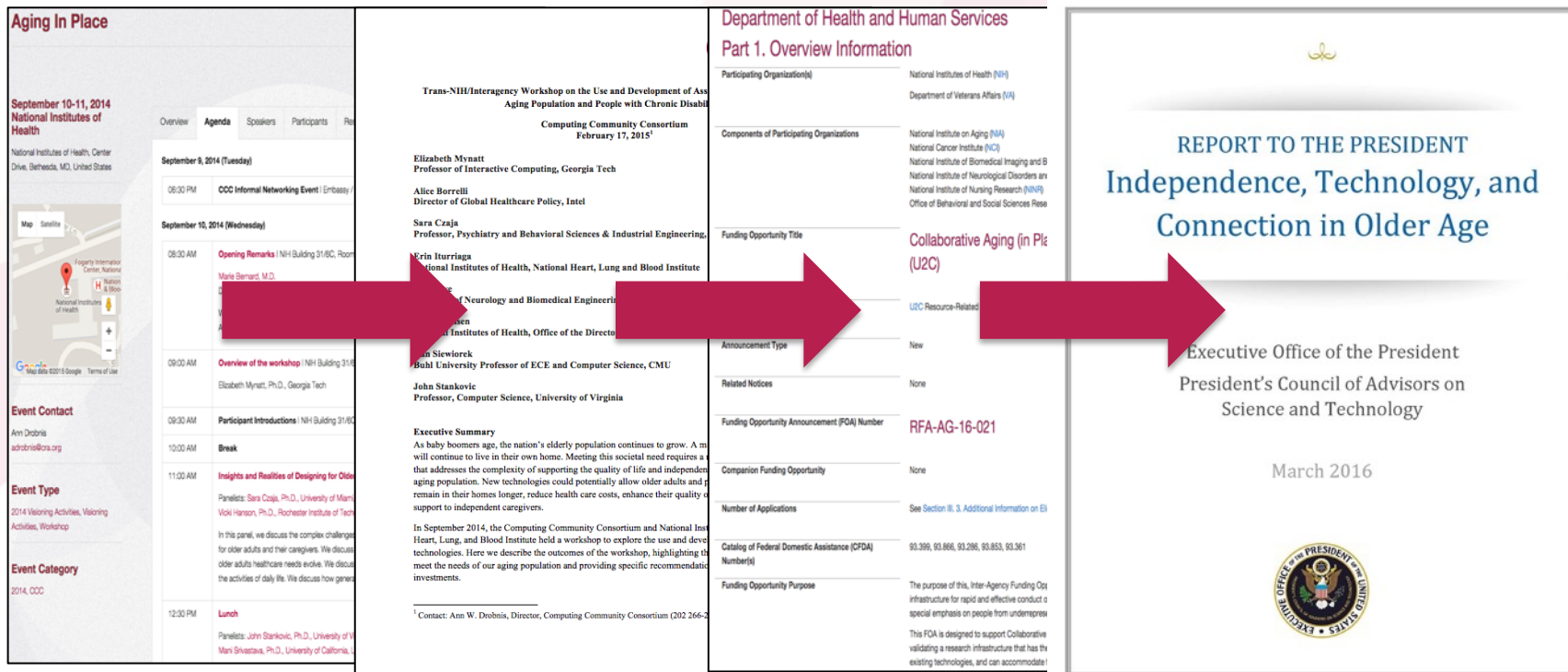
October 2012 Workshop



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OUTREACH: AGING IN PLACE



Joint NIH/CCC
Meeting
September
2014

Produced
Workshop
Report
February
2015

NIH released
new RFP
informed by
AIP Workshop
October 2015

PCAST Report
March 2016



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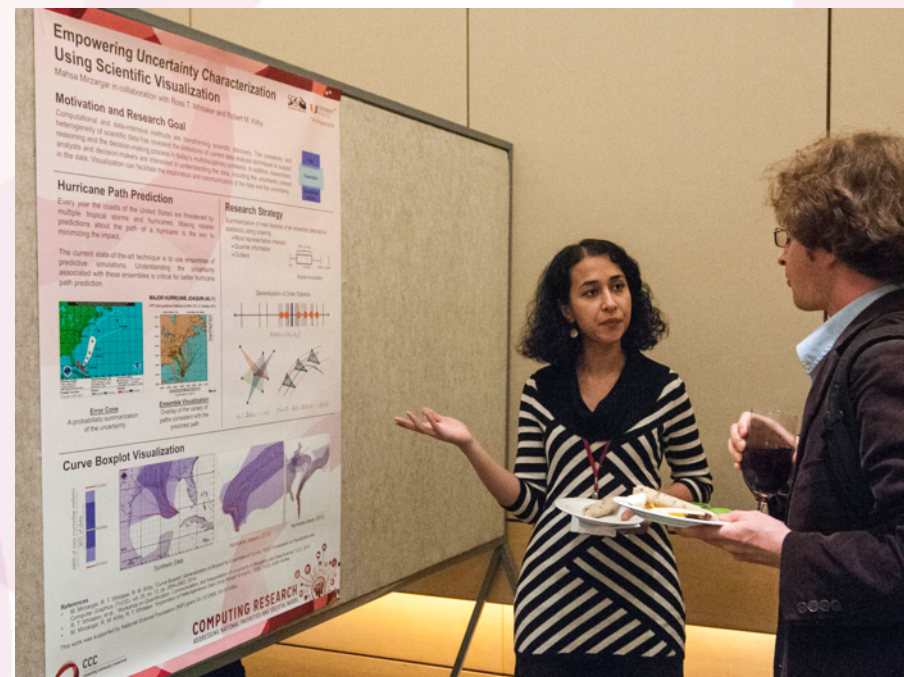
COMPUTING RESEARCH

ADDRESSING NATIONAL PRIORITIES AND SOCIETAL NEEDS



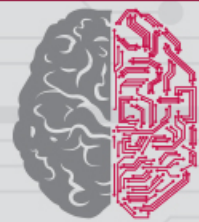
National Symposium to Highlight the Impact of Computing Research:

- Seven panels, two plenaries, and an early career poster session covering four main themes:
 - The Impact of Computing in Our Physical World
 - Computing Enhancing Our Lives
 - Controlling Our Data
 - Partnerships for the Future
- 130 in-person participants; over 1000 online viewers



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ARTIFICIAL INTELLIGENCE

FOR SOCIAL GOOD

- June 7, 2016 in Washington, DC
- Co-sponsored by OSTP, AAI, CCC to discuss the successful deployments and the potential use of AI in various topics that are essential for social good
- One of four workshops the OSTP co-sponsored to identify challenges and opportunities around AI
- Over 400 participants in-person; over 3,500 participants online



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WHAT'S ON THE HORIZON?

CISE Research: Addressing National Priorities



Big Data R&D



National Robotics Initiative



Understanding the Brain



White House Initiatives



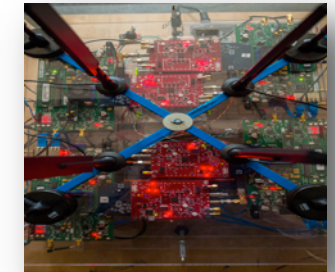
National Strategic Computing Initiative



Smart Cities



CS for All

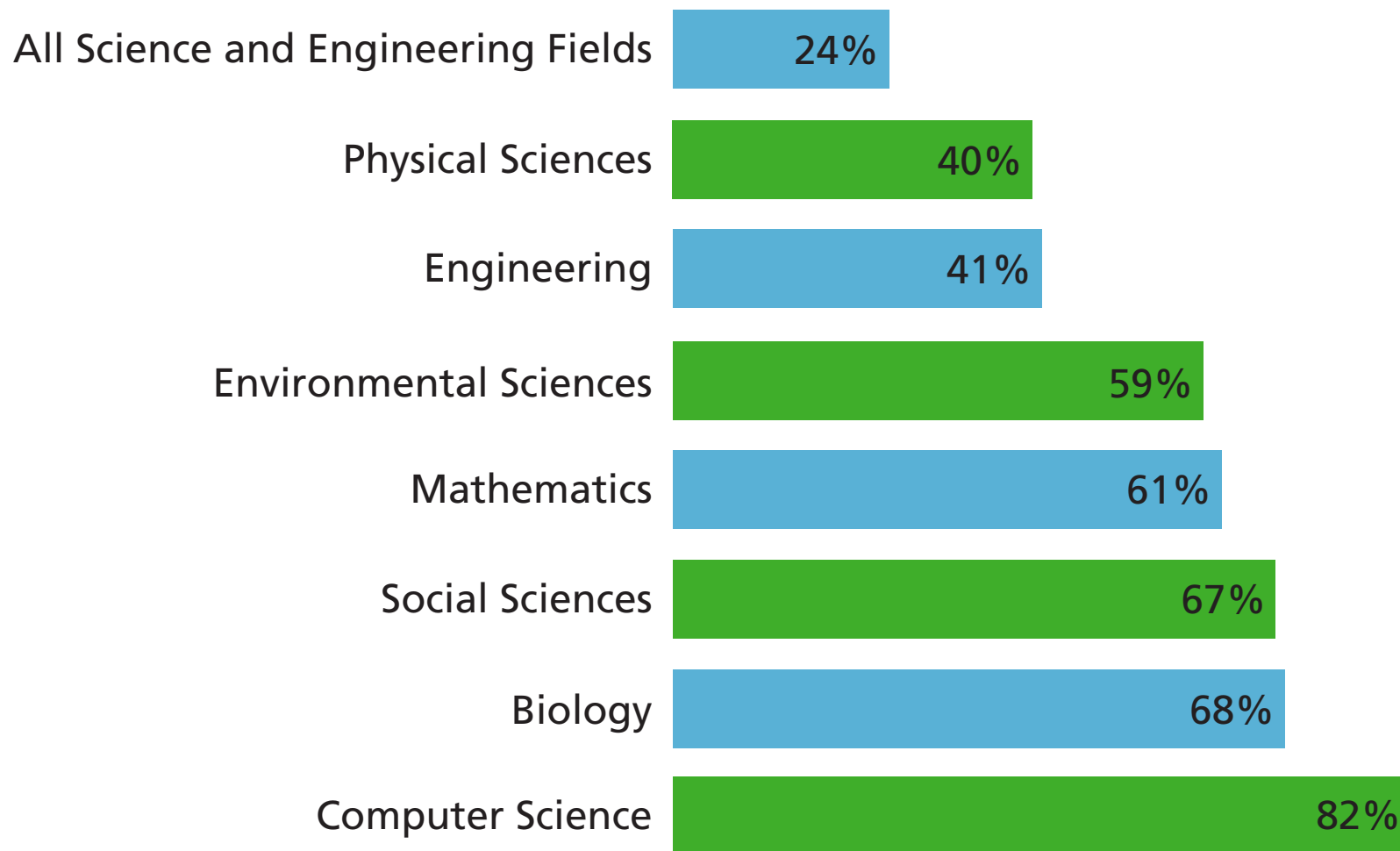


Advanced Wireless Initiative



NSF Support of Academic Basic Research

(as a percentage of total federal support)

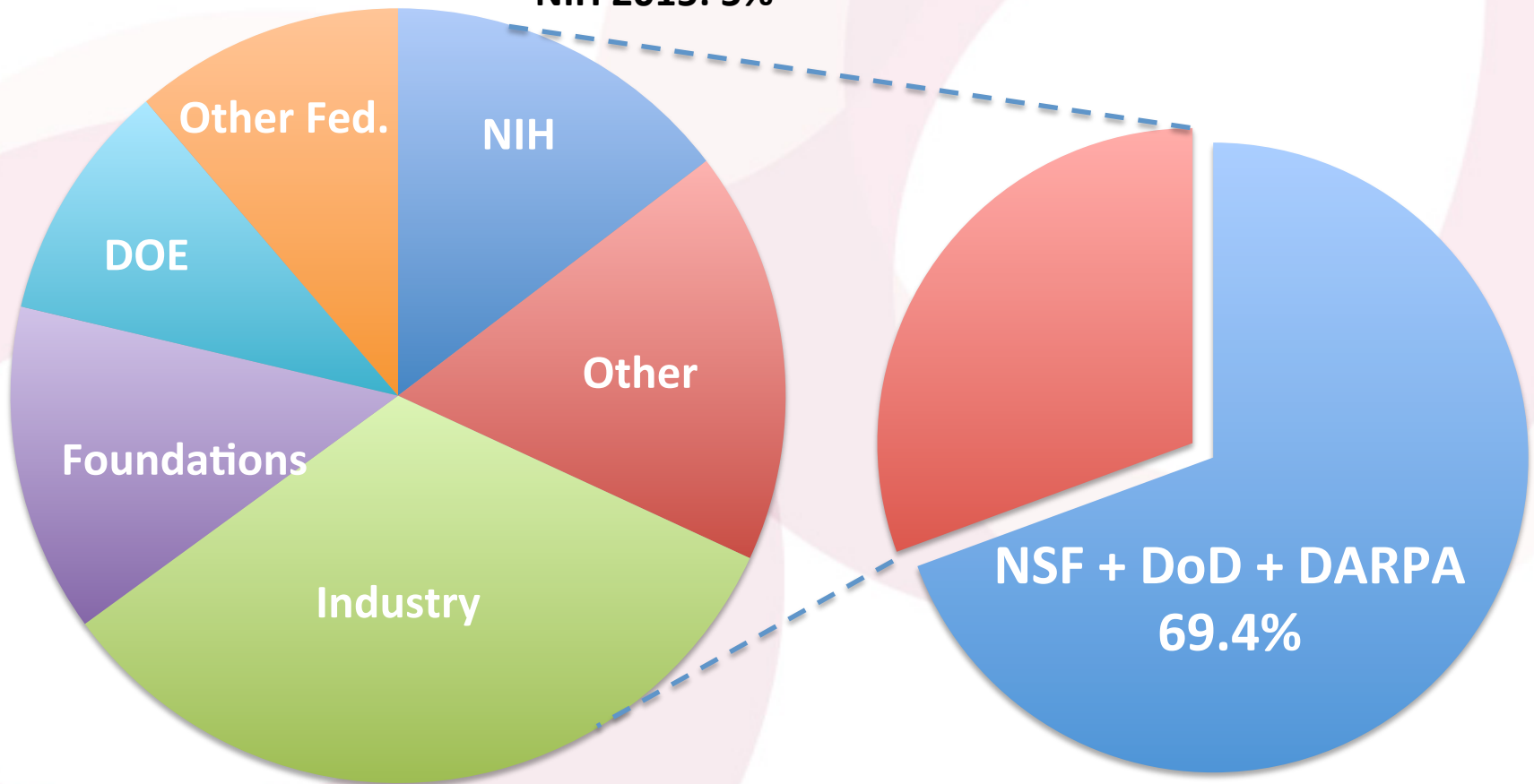


Source: NSF/NCSES, Survey of Federal Funds for Research & Development, FY 2014



CS RESEARCH FUNDING PORTFOLIO

NIH 2003: 2%
NIH 2015: 5%



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Source: 2015 Taulbee Survey, Table R2; slide courtesy of G. Hager.

Wireless, virtualization: recent announcements



PAWR: *Platforms for Advanced Wireless Research*

- at-scale experimental exploration of robust new wireless devices, communication techniques, networks, systems
 - dynamic spectrum, mmWave, network architecture, wide-area wireless backhaul, metrology
- public-private partnership: \$50M NSF/CISE investment, > \$40M in industry consortium investment (7 years)
- Up to 4 wireless research testbeds
- Program solicitation NSF 16-585 seeking a project office



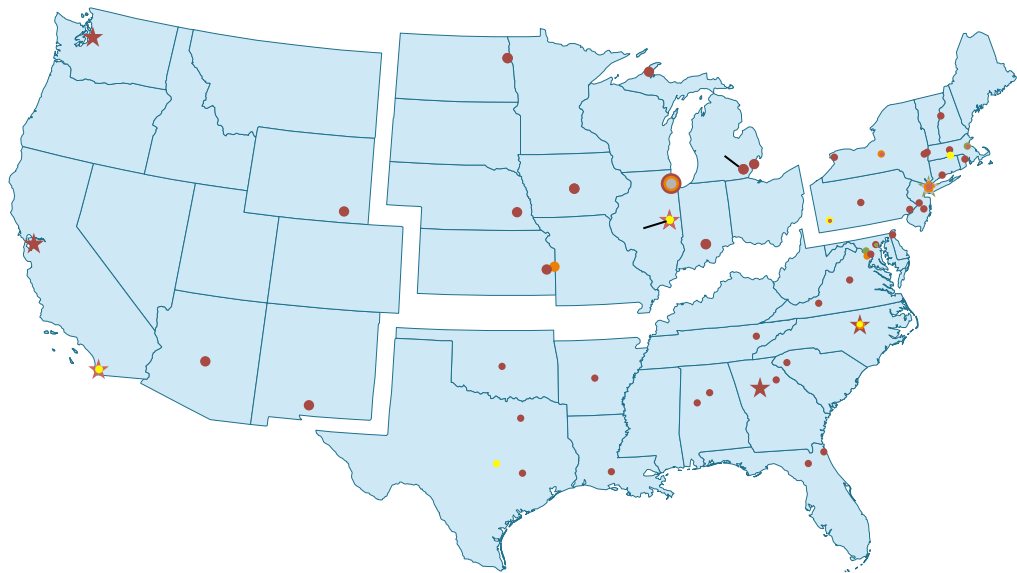


Platforms for Advanced Wireless Research (PAWR)

Over **20 companies** have partnered to establish a new **Industry Consortium**



Big Data Regional Innovation Hubs



Northeast: Columbia University

West: UCSD, UC Berkeley, UW

South: NC Chapel Hill, Georgia Tech

MidWest: UIUC

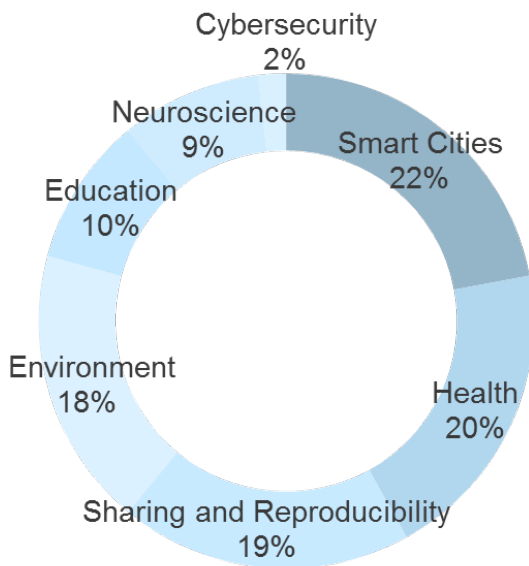
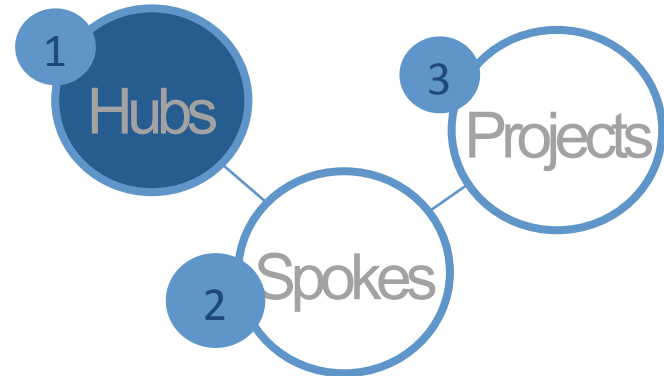
- Goal: ignite new **Big Data public-private partnerships** across the Nation
- Hub:
 - Consortium from academia, industry, gov't
 - focus on Big Data challenges, opportunities for region
- Support breadth of local stakeholders, *achieve common Big Data goals not be possible alone*



Big Data Spokes of the BDHubs

Each Hub supports subcommittees on **topical areas of interest** (“Spokes”)

BDSpokes solicitation aims to support **collaborative projects** surfaced or developed by the Hubs and Spokes



- Two award categories: **Planning Grants** (100K for 1 year) and **Spokes** (\$1M total over 3 years)
- Total anticipated funding: \$10M
- 10 Spokes, 10 Planning Grants anticipated

INDUSTRY – ACADEMIC COLLABORATIONS

With Big Data Regional Innovation Hubs

- *Northeast:* Young Innovator Internships, Knowledge Exchange Lecture Series, Data Science Best Practices Workshop
- *South:* Data Start Internships, PEPI Early Career Exchange Visits
- *Midwest:* Early Career Big Data Summit, Data Quality and Informal Data-An Oxymoron Workshop, Travel Grants
- *West:* Collaboratory Faire, Workshop on Data Hackathon Best Practices, Tools of the Data Journalism Trade Workshop



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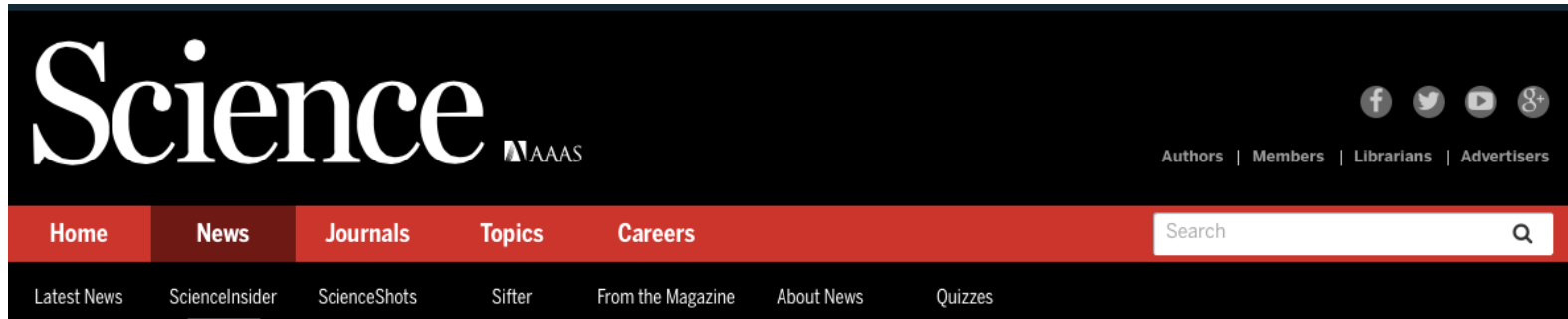
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Smart and Connected Communities

- WH Initiative announced Sept. 2015
- Cross-Foundation DCL issued
- *Synergies*: Cyber-Physical Systems, Urban Science, Risk & Resilience, Smart and Connected Health, US Ignite, Advanced Wireless Research Initiative/PAWR, Human-Technology Frontier, ...
- Multiple community Workshops
- Recent RFP announced



NSF “Big Ideas”



Better understanding the changing Arctic is one item on a new list of big ideas that should shape the National Science Foundation's work.

NASA/Kathryn Hansen

NSF director unveils big ideas, with an eye on the next president and Congress

By **Jeffrey Mervis** | May. 10, 2016 , 3:30 PM



NSF: BIG IDEAS

NSF Ideas for Future Investment

RESEARCH IDEAS

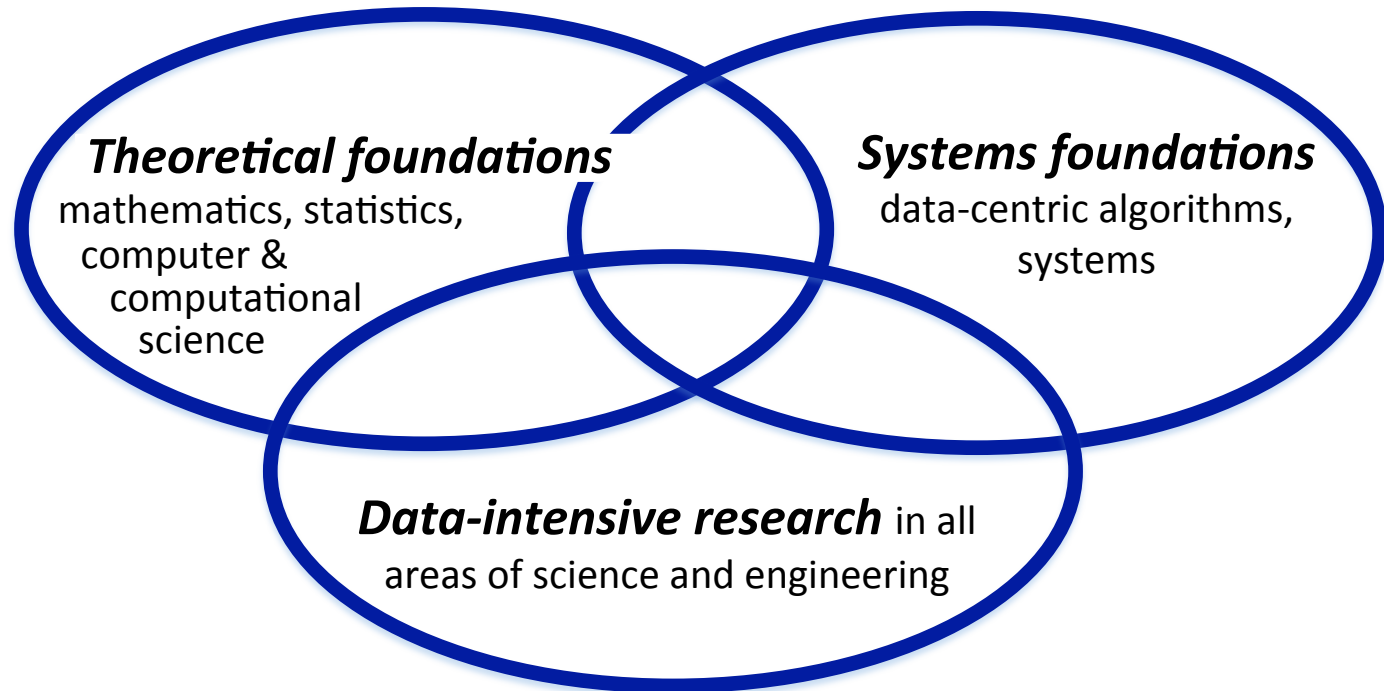
- Harnessing Data for 21st Century Science and Engineering
- Shaping the New Human – Technology Frontier
- Understanding the Rules of Life: Predicting Phenotype
- The Quantum Leap: Leading the Next Quantum Revolution
- Navigating the New Arctic
- Windows on the Universe: The Era of Multi-messenger Astrophysics

PROCESS IDEAS

- Growing Convergent Research at NSF
- Mid-scale Research Infrastructure
- NSF 2050



Harnessing the Data Revolution



- + **Advanced cyberinfrastructure ecosystem** for accelerating data-intensive research, including large-scale facilities
- + **Innovative educational pathways**, grounded in an education-research-based framework

NSF: Shaping the new Human-Technology Frontier

We envision a world in which technologies – sensors, communication, computation, and intelligence – are embedded around, on, and in us. *We propose a bold initiative to catalyze the interdisciplinary science and engineering needed to shape that future and the human centered engineered and social systems that those technologies will enable.*

- Machine intelligence
- Energy efficiency of sensing, communications and computing
- Human-centered engineered systems with cognitive and adaptive capacities, best matched to collaboration with people
- Understand how technologies affect human behavior and social organizations
- Improve and extend learning
- Address technical and social research challenges in privacy and security



The Human-Technology Frontier

Computing will be embedded around, on, and in us. These engineered systems will be more pervasive, more personal, more intimate.



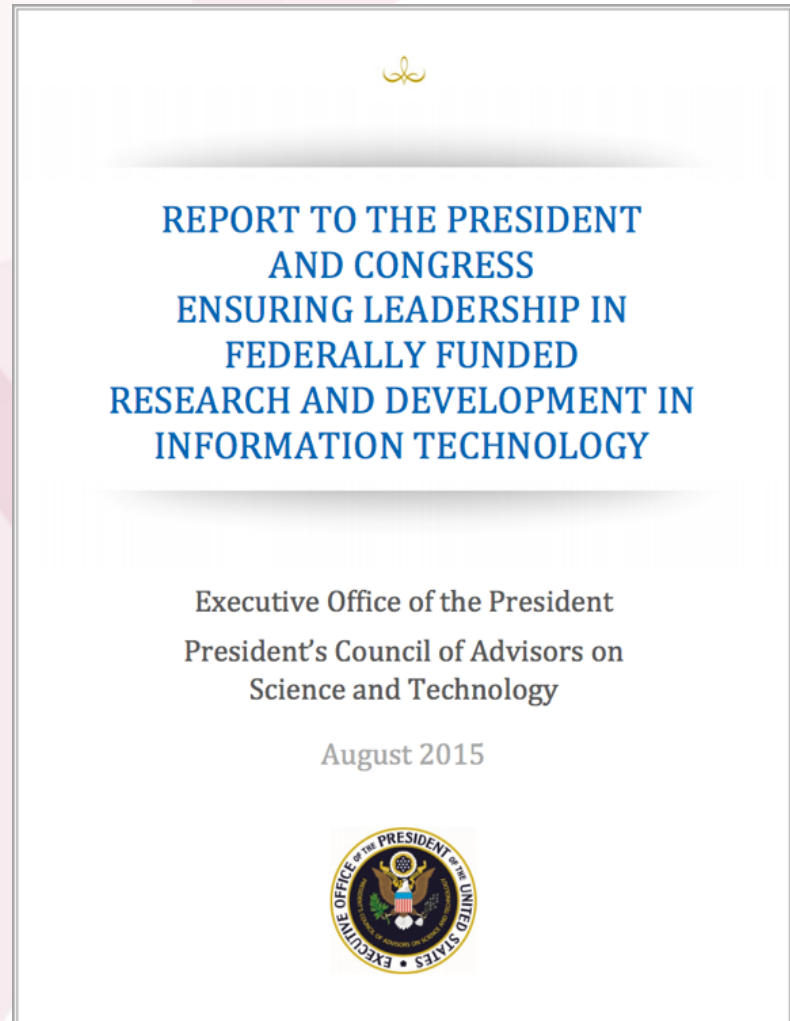
Understanding how constantly evolving technologies are actively shaping our lives and how we in turn can shape those technologies, especially in the world of work

- understand benefits, risks of new technologies: efficiency, quality, productivity, human dynamics
- science and engineering: creating technologies that promise to enhance work lives
- **Education:** changing workplace demands changing workforce

2015 PCAST NITRD REPORT

Critical Areas:

- Cybersecurity
- Health
- Big Data and Data Intensive Computing
- Interaction with the Physical World
- Privacy
- Cyber-Human Systems
- Foundational Research
- High-Capability Computing



BETH'S SPECULATION

- Tension between augmentation and automation
- AI for Social Good
- Smart Cities and Communities (PCAST, White House / OSTP)
- Aging
- STEM / CS for all
- Increased role of public-private partnership
(see new wireless initiative)
- Socio-technical systems demand different research programs and infrastructure
- Funding capability doesn't match demand on computing academic units

CCC IMPLEMENTATION PLAN: 2016-2017

1. Expanding Investments in Computing Research

- Agencies; Initial focus on transition papers
- Industry
 - Collaborative investments

2. Cross-Cutting Visioning

- Research Infrastructure / Testbeds
- Socio-Technical Systems

3. Assessment

4. Outreach and Communication

- Academic Depts
- Industry (including “non CS”)
- Engagement with ACM / IEEE / NITRD / CSTB ...
- Media: Trusted Voice

5. Scalability

- Task Forces
- Tap CCC Alumni Network

6. Leadership Development

7. Sustainability



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TASK FORCES

- Computing in the Physical World
- Convergence of Data and Computing
- Healthcare
- Privacy
- Artificial Intelligence



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CURRENT VISIONING WORKSHOPS

Nanotechnology-Inspired Systems Workshop Processing Systems Workshop

- Naresh Shanbhag (UIUC)

August 31 – Sept. 1

Cyber Social Learning Systems

- Kevin Sullivan (UVA)
- Chuck Friedman (Mich)

August 29-30, 2016

November 2-3, 2016

January 2017

Symposium on Accelerating Science A Grand Challenge for AI

- Joint with AAI

Nov 17-19, 2016

Smart Health and Health IT

- Mynatt, Hager, ...

Dec 5-6, 2016

Sociotechnical Cybersecurity

- Tim Summers (UMD)
- Susan Winter (UMD)

Dec 12-13, 2016

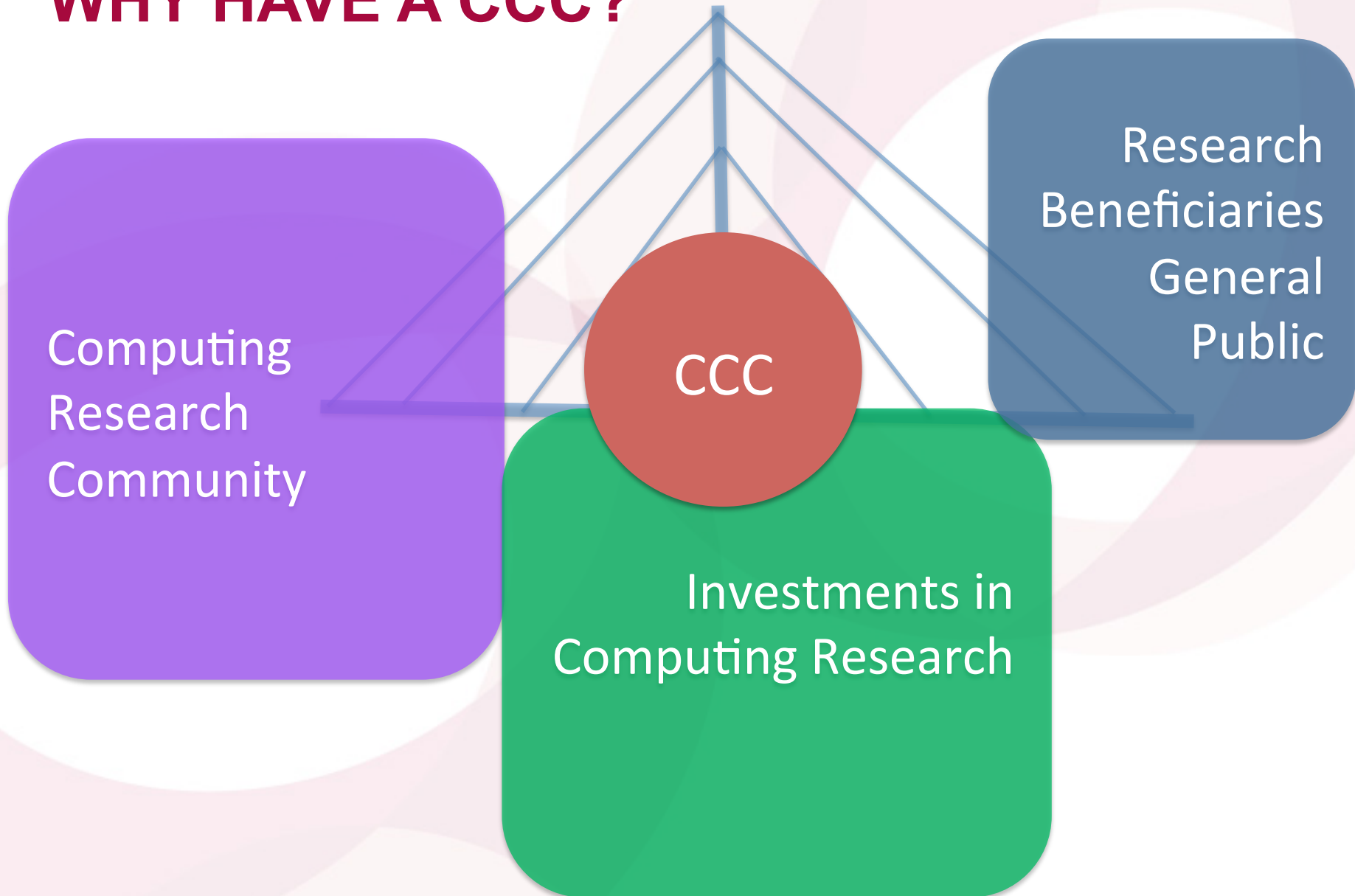
WHY HAVE A CCC?

Computing
Research
Community

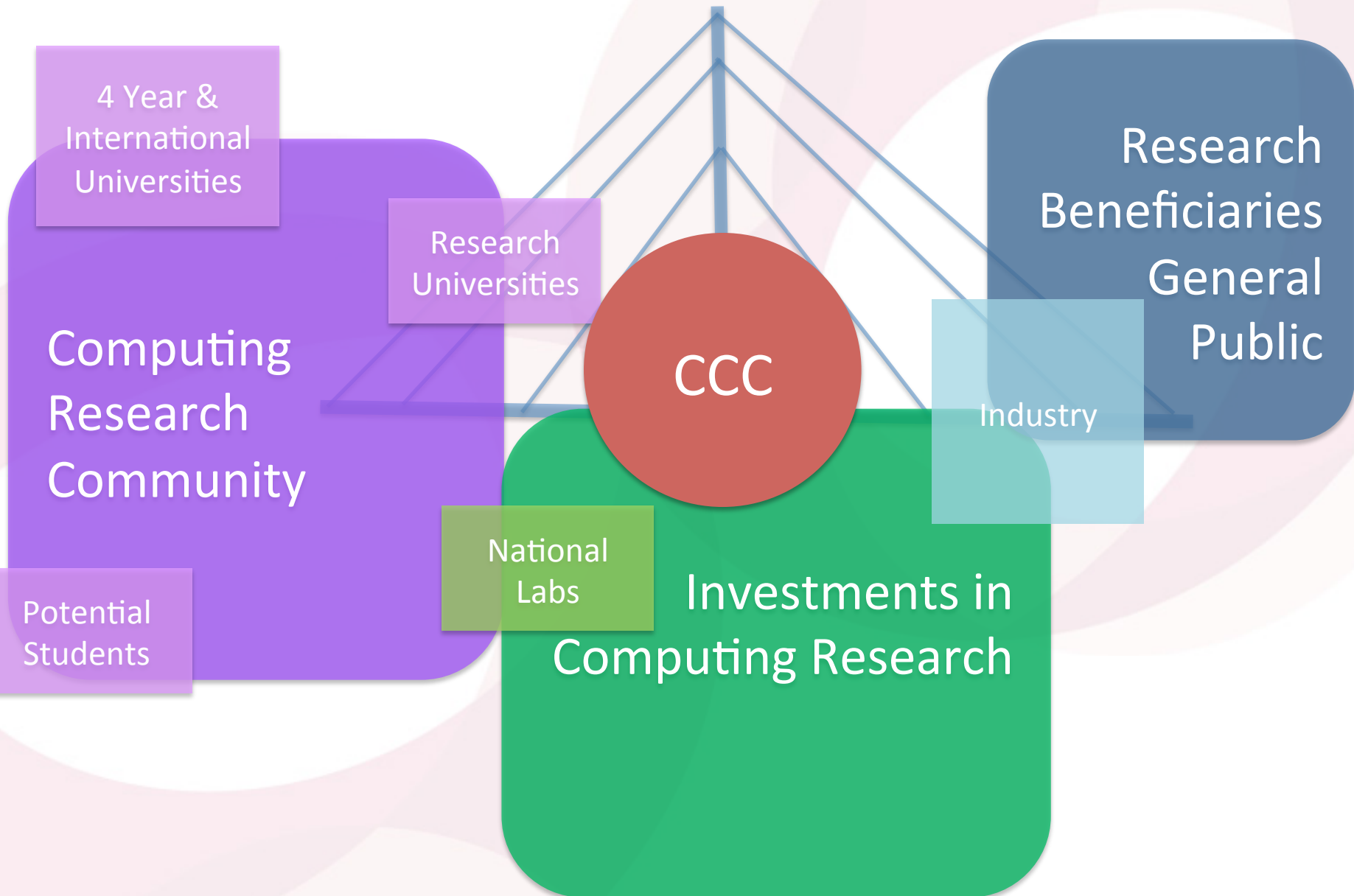
Investments in
Computing Research

Research
Beneficiaries
General
Public

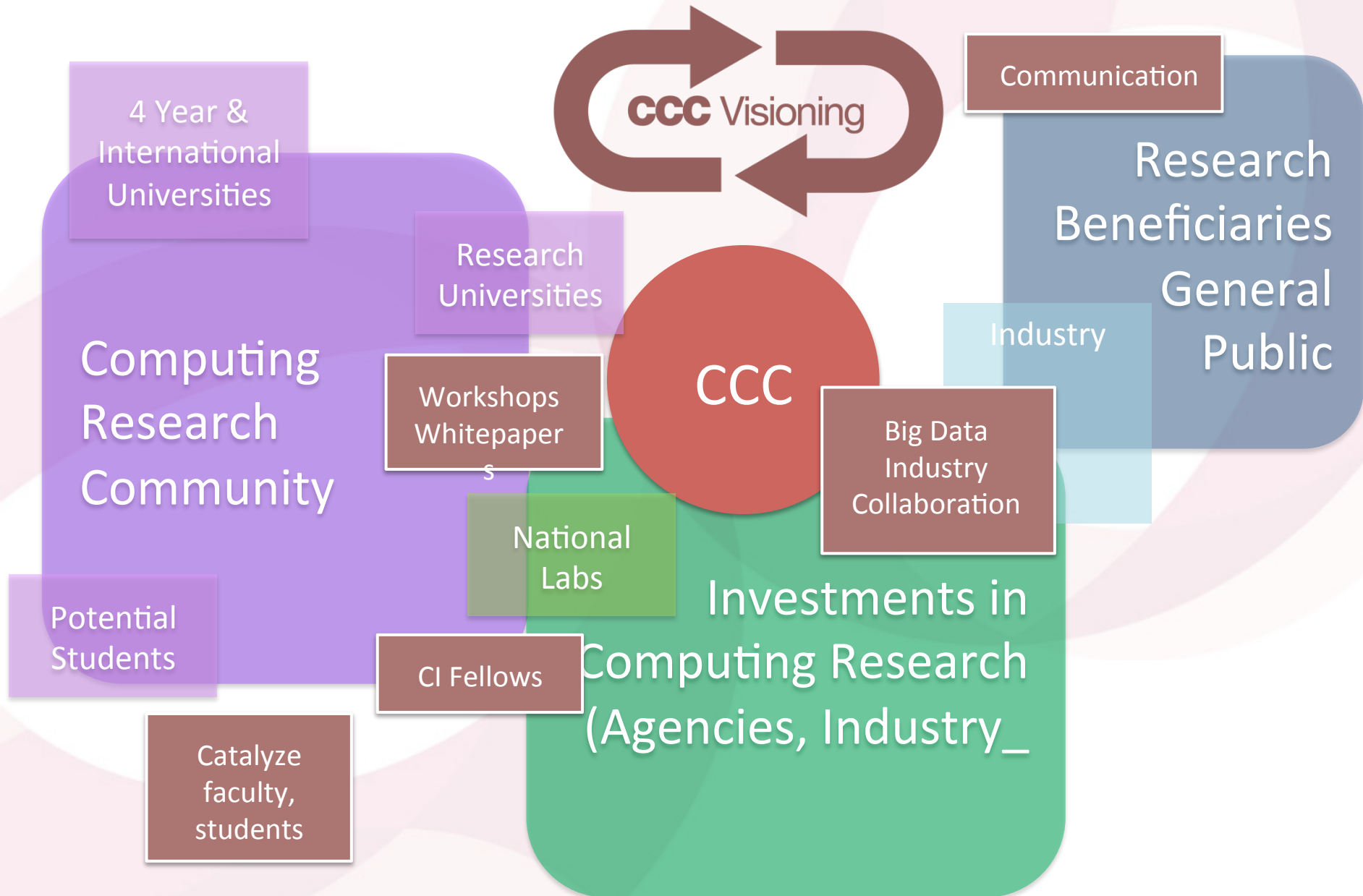
WHY HAVE A CCC?



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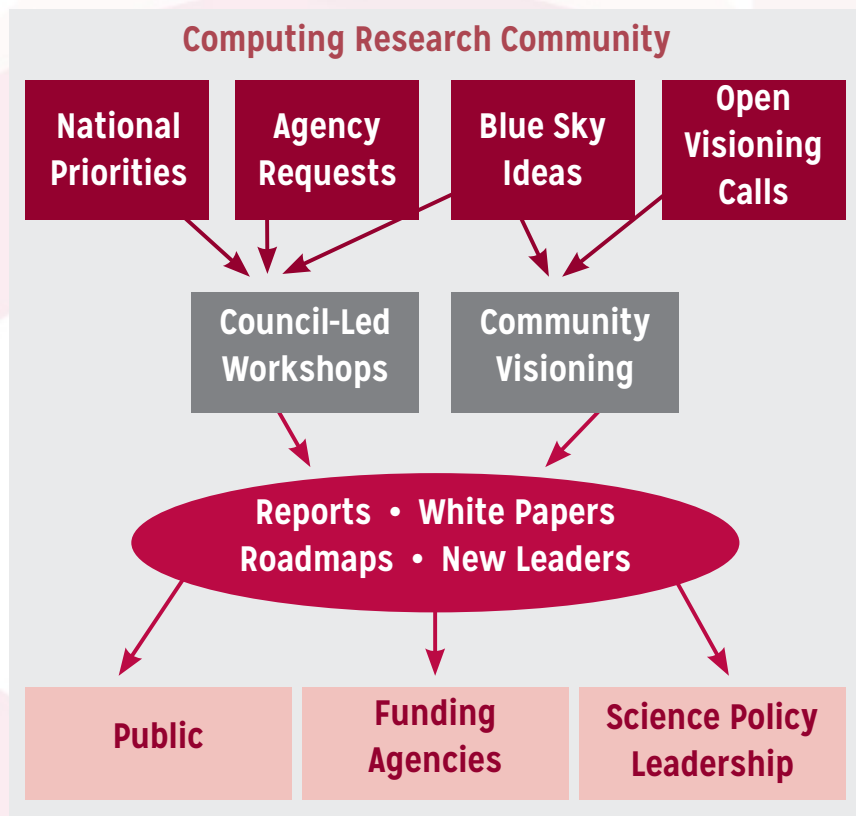


WHY HAVE A CCC?



COMPUTING COMMUNITY CONSORTIUM

The **mission** of Computing Research Association's Computing Community Consortium (CCC) is to **catalyze** the computing research community and **enable** the pursuit of innovative, high-impact research.



Promote Audacious Thinking:

- Community Initiated Visioning Workshops
- Blue Sky Ideas tracks at conferences

Inform Science Policy:

- Outputs of visioning activities
- Task Forces – Health IT, Data Analytics

Communicate to the Community:

- CCC Blog - <http://cccblog.org/>
- Great Innovative Ideas
- White Papers

Promote Leadership and Service:

- Industry – Academic Collaborations
- Leadership in Science Policy Institute
- Postdoc Best Practices

THE ROLE OF THE COMPUTING COMMUNITY CONSORTIUM IN ADVANCING AUDACIOUS COMPUTING RESEARCH

Elizabeth Mynatt

Chair

Computing Community Consortium



CCC

Computing Community Consortium
Catalyst