



Computer and Information Science and Engineering (CISE)

Exploring the frontiers of computing



<http://www.nsf.gov/dir/index.jsp?org=CISE>

November 2015



CISE's Economic and Societal Context

- CISE is at the center of an ongoing, long-term societal transformation
- Advances in computing, communications, information technologies, cyberinfrastructure:
 - underpin economic prosperity, national security
 - drive U.S. competitiveness and sustainable economic growth
 - accelerate the pace of discovery and innovation
 - are crucial to achieving national and societal priorities



CISE and National Priorities



**Understanding
the Brain**



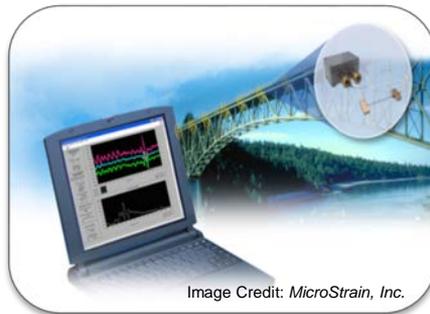
**Risk &
Resilience**



**Food-Energy-
Water Systems**



**Health &
Wellbeing**



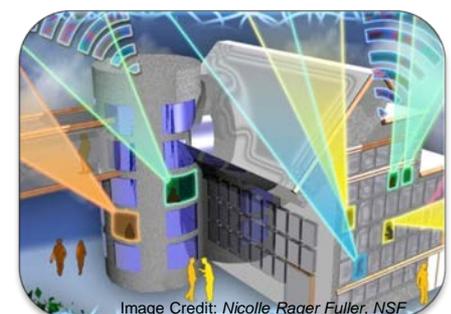
**Manufacturing,
Robotics, &
Smart Systems**



**Secure
Cyberspace**



**Education and
Workforce
Development**



**Broadband &
Universal
Connectivity**



CISE Mission

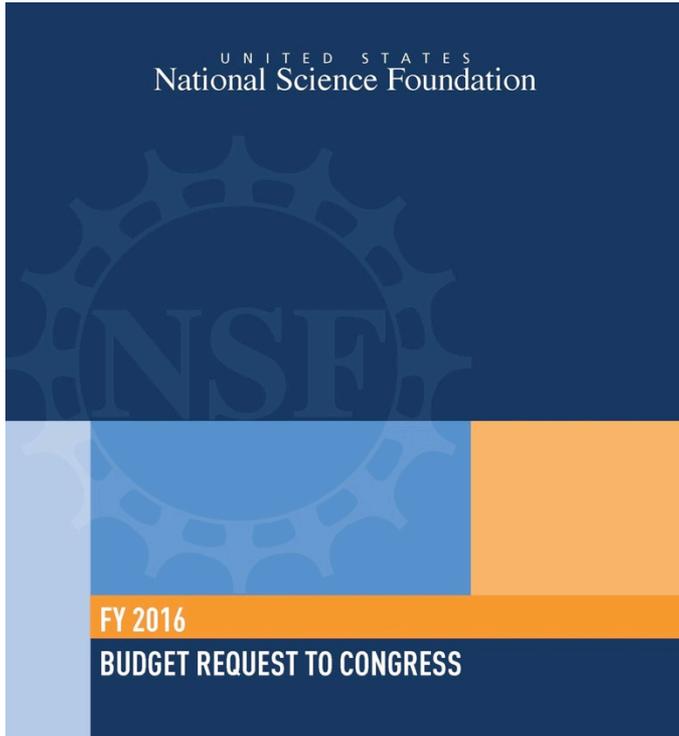
Exploring the frontiers of computing

- Promote progress of computer and information science and engineering research and education, and advance the development and use of cyberinfrastructure.
- Promote understanding of the principles and uses of advanced computer, communications, and information systems in support of societal priorities.
- Contribute to universal, transparent and affordable participation in a knowledge-based society.

These frontiers have interfaces with all the sciences, engineering, education and humanities and a strong emphasis on innovation for society.



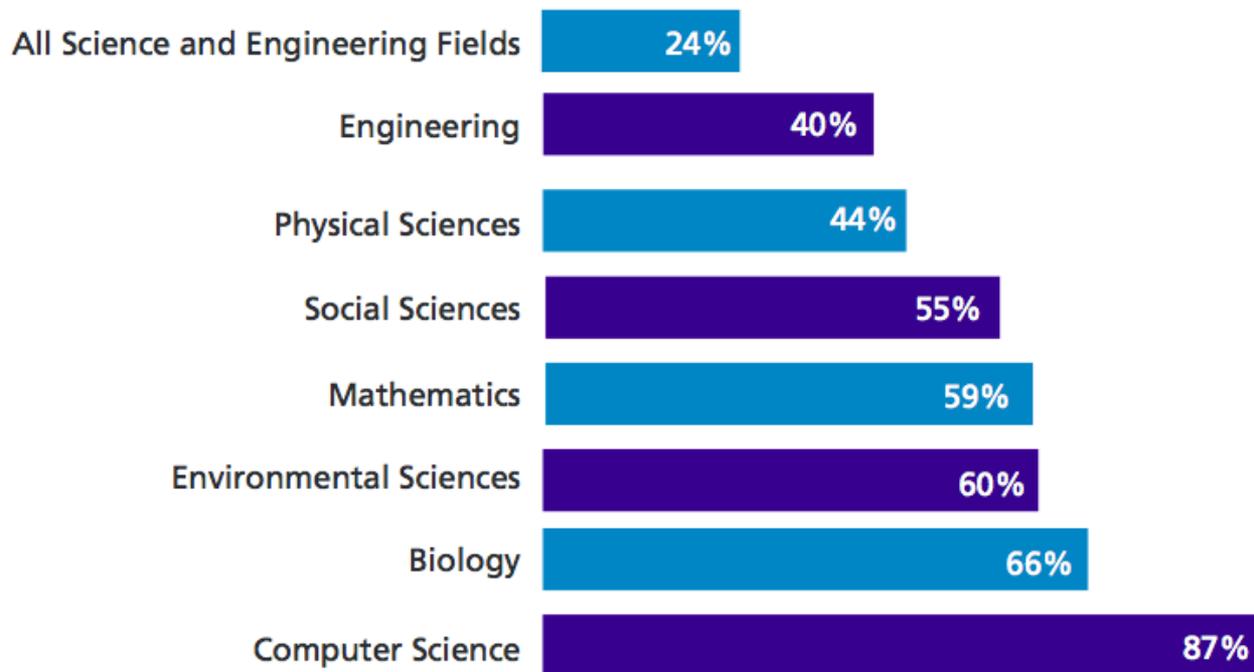
FY 2016 Budget Request



- **NSF**
 - FY 2016 Budget Request: \$7723.55 Million
 - Increase over FY 2015 Est: \$379.34 Million, +5.2%
- **CISE**
 - FY 2016 Budget Request: \$954.41 Million
 - Increase over FY 2015 Est: \$32.68 Million, +3.5%
- CISE FY 2016 request is shaped by investments in ***core research, education, and infrastructure programs*** as well as critical investments ***in NSF cross-directorate priorities and programs.***



NSF Support of Academic Basic Research in Selected Fields (as a percentage of total federal support)



Note: Biology includes Biological Sciences and Environmental Biology; excludes National Institutes of Health.

Source: NSF/National Center for Science and Engineering Statistics, Survey of Federal Funds for Research & Development, FY 2011



Snapshot of CISE FY 2014 Activities

Description	#
Research Budget	\$893M
Number of Proposals	7,436
Number of Awards	1,682
Success Rate	~23%
Average Annualized Award	\$199K
Number of Panels Held	302
Number of People Supported	16,774

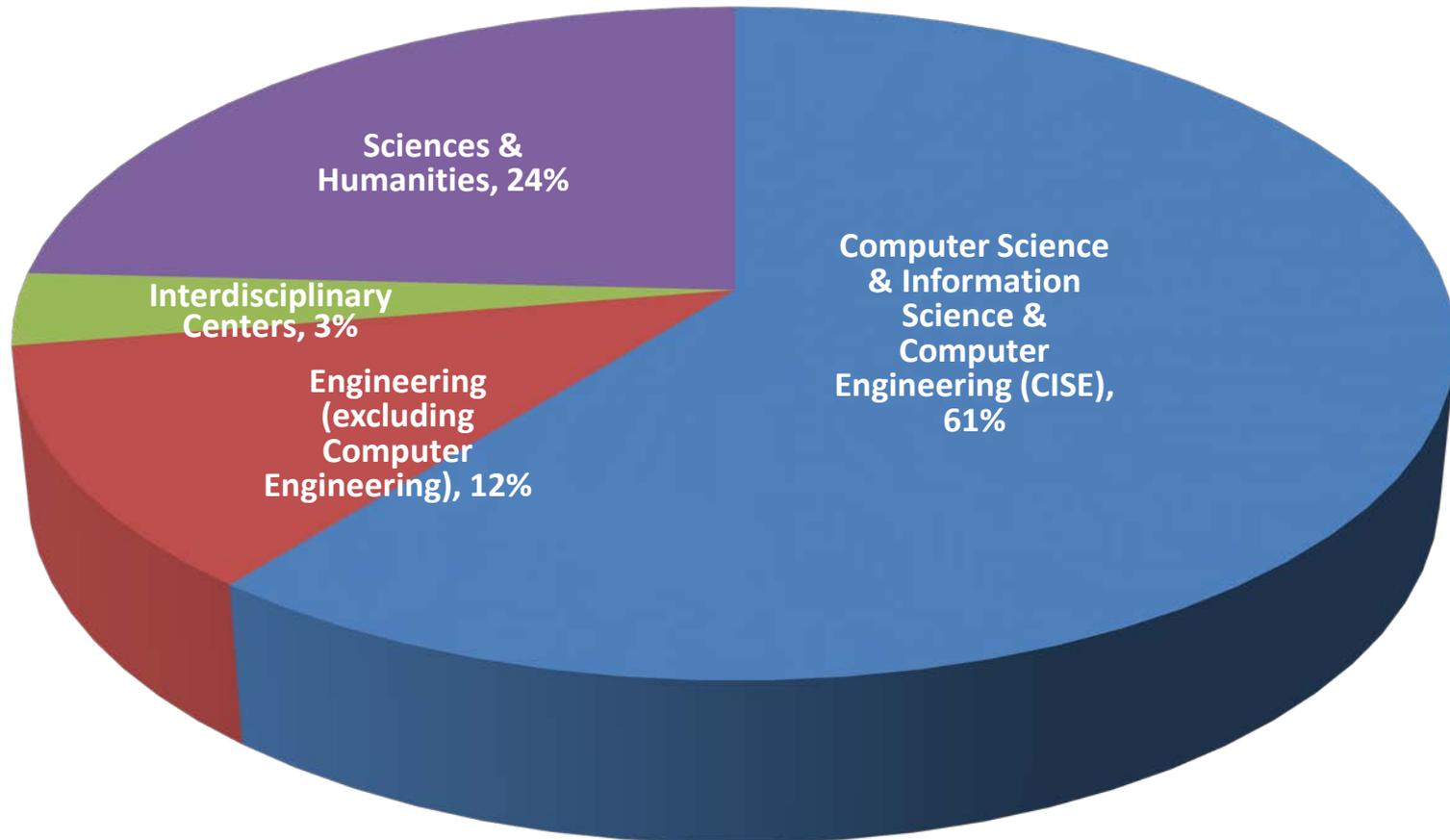


People Supported	#
Senior Researchers	6,663
Other Professionals	1,123
Postdoctoral Associates	491
Graduate Students	6,064
Undergraduate Students	2,433



Who is the CISE Community?

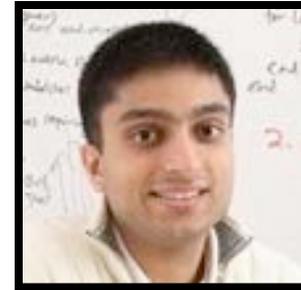
PI and Co-PI Departments for FY 2013 Awards Funded by CISE



CISE Organization



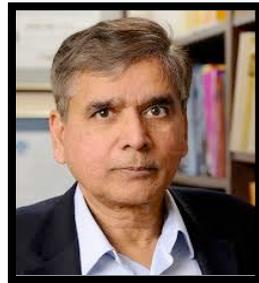
CISE Directorate
Jim Kurose, AD
Erwin Gianchandani, Acting DAD



**Advanced
Cyberinfrastructure
(ACI)**
Irene Qualters, DD



**Computing and
Communications
Foundations (CCF)**
Rao Kosaraju, DD



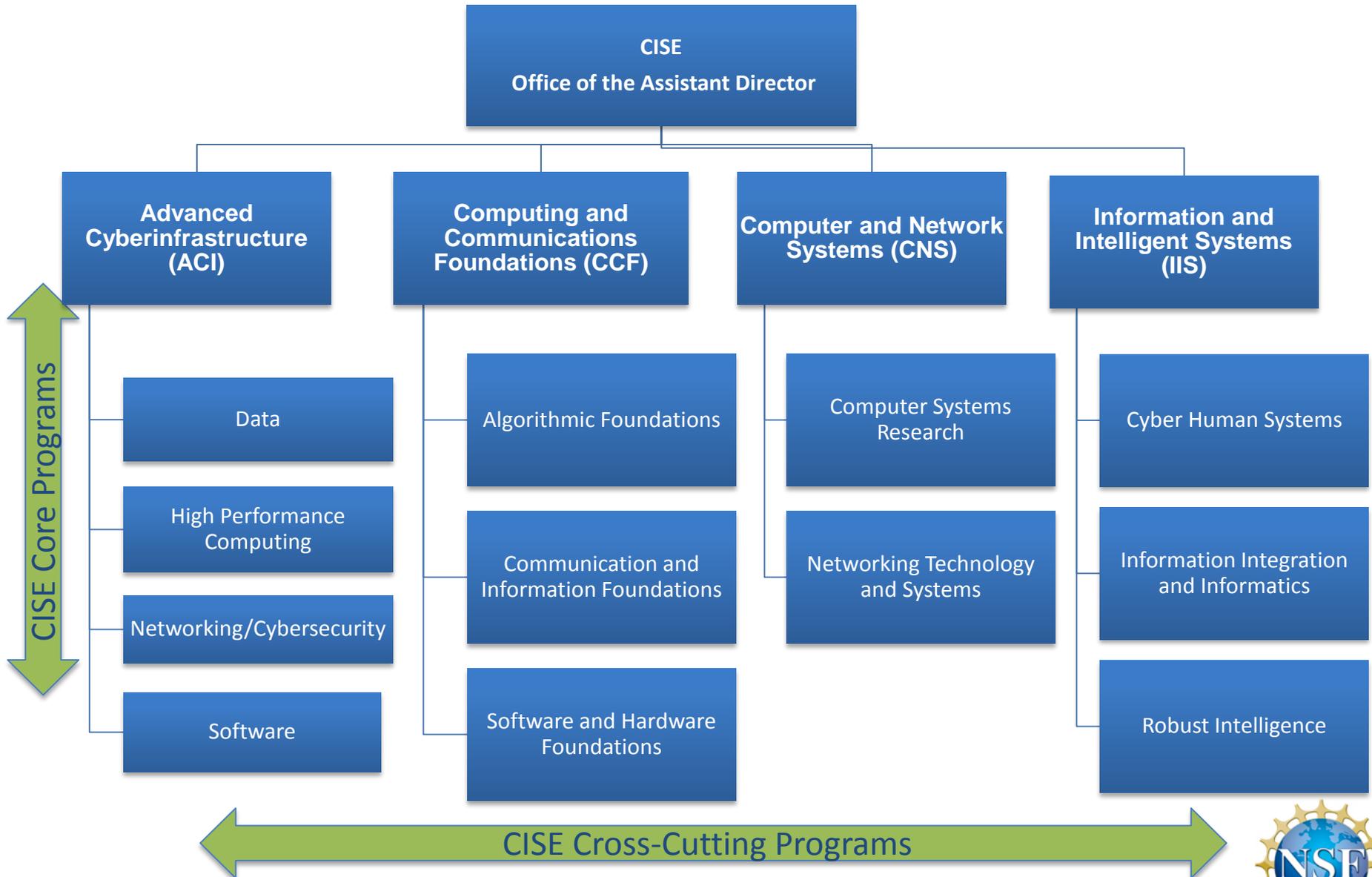
**Computer and
Network Systems
(CNS)**
*Peter Arzberger
Acting DD*



**Information and
Intelligent Systems
(IIS)**
Lynne Parker, DD



CISE Organization and Core Research Programs



Advanced Cyberinfrastructure (ACI)

<http://www.nsf.gov/div/index.jsp?div=ACI>

Supports the acquisition, development, and provision of state-of-the-art cyberinfrastructure resources, tools, and services essential to the conduct of 21st century science and engineering research and education.

- *Data*: Support scientific communities in the sharing and archiving of, as well as computing with data by creating building blocks to address common community needs in data infrastructure.
- *High Performance Computing*: Enable petascale computing; provide open-science community with state-of-the-art HPC assets ranging from loosely coupled clusters to large scale instruments; develop an integrated scientific HPC environment.
- *Networking and Cybersecurity*: Invest in campus network improvements and re-engineering to support a range of activities in modern computational science. Support transition of cybersecurity research to practice.
- *Software*: Transform innovations in research and education into sustained software resources that are an integral part of cyberinfrastructure.



Computing & Communication Foundations (CCF)

<http://www.nsf.gov/div/index.jsp?org=CCF>

Supports research and education projects that explore the foundations of computing and communication devices.

- *Algorithmic Foundations (AF)*: Innovative research characterized by algorithmic thinking and algorithm design, accompanied by rigorous mathematical analysis.
- *Communications and Information Foundations (CIF)*: Transformative research addressing the theoretical underpinnings and current and future enabling technologies for information acquisition, transmission, and processing in communication and information networks.
- *Software and Hardware Foundations (SHF)*: Foundational research essential to advance the capability of computing systems, including software and hardware components, systems, and other artifacts.



Computer and Network Systems (CNS)

<http://www.nsf.gov/div/index.jsp?div=CNS>

Supports research and education activities inventing new computing and networking technologies and exploring new ways to make use of existing technologies.

- *Computer Systems Research (CSR)*: Transformative research on fundamental scientific and technological advances leading to the development of future generation computer systems, including new architectures; distributed real-time embedded devices; pervasive, ubiquitous and mobile computing; file and storage systems; operating systems; reliable, fault-tolerant and secure hard/middle/software.
- *Networking Technology and Systems (NeTS)*: Transformative research on fundamental scientific and technological advances leading to the understanding, development, engineering, and management of future-generation, high-performance computer networks.



Information and Intelligent Systems (IIS)

<http://www.nsf.gov/div/index.jsp?div=IIS>

Supports research and education activities that study the inter-related roles of people, computers, and information.

- *Cyber-Human Systems (CHS)*: Research to accelerate the creation and understanding of the complex and increasingly coupled relationships between humans and computing with the broad goal of advancing human capabilities: perceptual and cognitive, physical and virtual, social and societal.
- *Information Integration and Informatics (III)*: Information technology research on the processes and technologies involved in creating, managing, visualizing, and understanding diverse digital content in circumstances ranging from individuals through groups, organizations, and societies, and from individual devices to globally-distributed systems, and that can transform all stages of the knowledge life cycle.
- *Robust Intelligence (RI)*: Research that encompasses all aspects of the computational understanding and modeling of intelligence in complex, realistic contexts to advance and integrate the traditions of artificial intelligence, computer vision, human language research, robotics, machine learning, computational neuroscience, cognitive science, and related areas.



Applying to Core Programs

- Program Solicitations:
 - CCF: NSF 14-598
 - CNS: NSF 14-597
 - IIS: NSF 14-596
- } Coordinated Solicitations
- Project Types:
 - Large: \$1,200,001 to \$3,000,000; up to 5 years, collaborative teams
 - Medium: \$500,001 to \$1,200,000; up to 4 years, multi-investigator teams
 - Small: Up to \$500,000; up to 3 years, one or two investigators
 - CISE-wide Submission Windows:
 - Large: November 12 - 20
 - Medium: October 27 – November 10
 - Small: January 2 – 14
 - PI Limit:
 - Participate in no more than 2 “core” proposals/year

For a comprehensive list of CISE funding opportunities, visit:
http://www.nsf.gov/funding/pgm_list.jsp?org=CISE



Sample of CISE Cross-Cutting Programs

For a comprehensive list of CISE funding opportunities, visit:

http://www.nsf.gov/funding/pgm_list.jsp?org=CISE

- Cross-Division

- Algorithms in the Field (AitF)

- Advancing algorithmic design and the application area to which the algorithms are being deployed*

- Big Data Regional Innovation Hubs

- Hub and Spoke™— A nation-wide network for data innovation*

- Expeditions in Computing

- Exploring new frontiers in computing and information science*

- Exploiting Parallelism and Scalability (XPS)

- Supporting groundbreaking research that will lead to a new era of parallel computing*

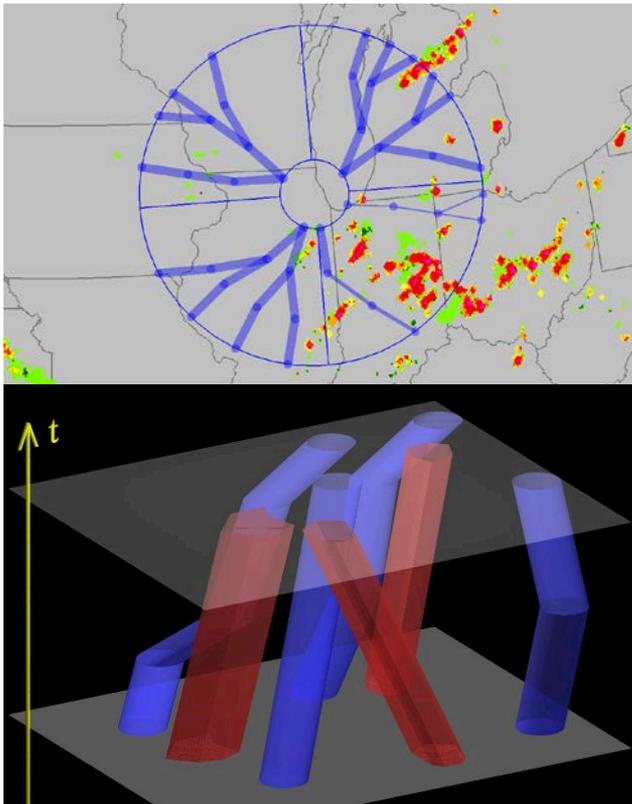
- NSFFutureCloud

- Enabling novel cloud architectures*



Algorithms in the Field (AitF)

Advancing algorithmic design and the application area to which the algorithms are being deployed



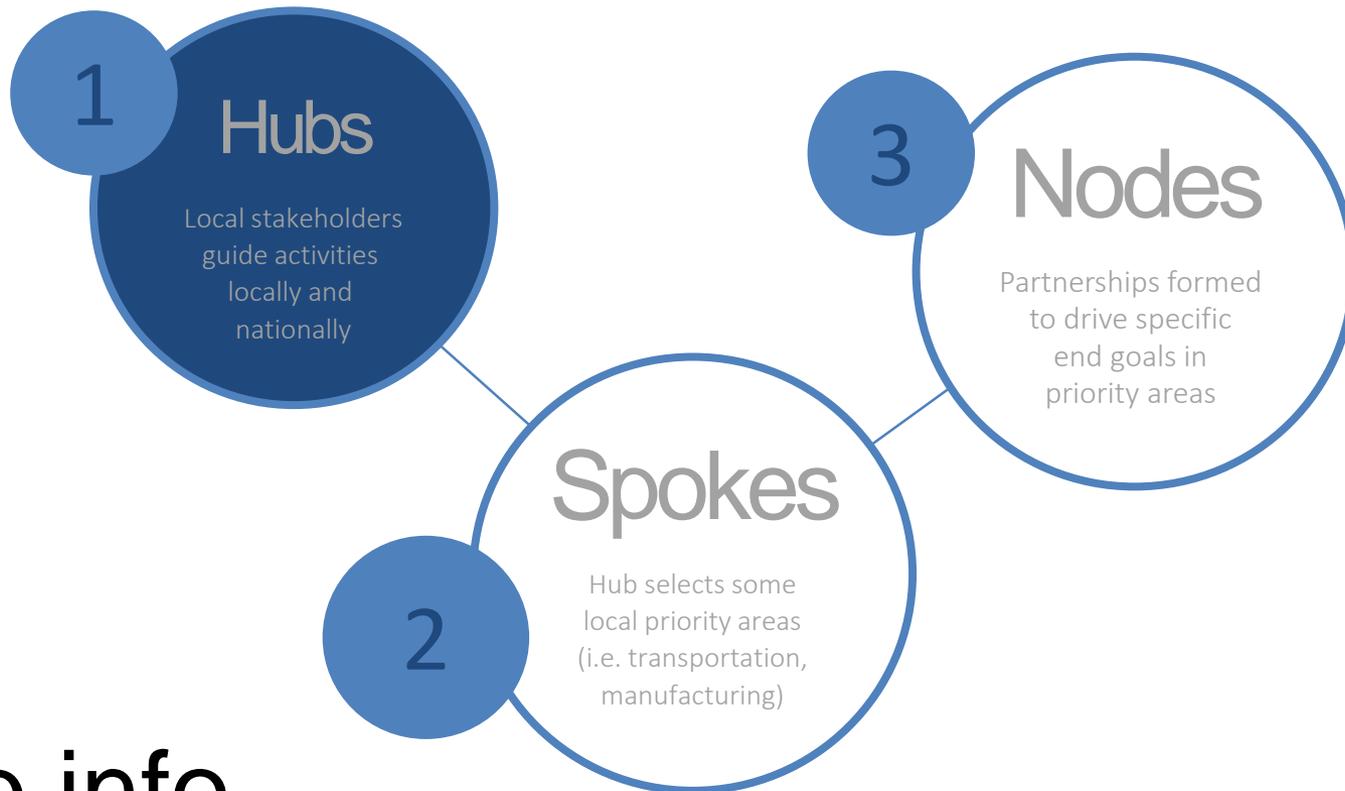
Images courtesy of Joseph Mitchell, SUNY at Stony Brook

- Encourages closer collaboration between theoretical computer science and applied researchers.
- Bridges gap between theory, practice in design, analysis, implementation, evaluation of algorithms.
- Project classes:
 - FULL-SIZE up to \$800,000 for up to 4 years.
 - EXPLORATORY up to \$400,000 for up to 3 years.



Big Data Regional Innovation Hubs (BD Hubs)

“Hub and Spoke”– A nation-wide network for data innovation



bdhub.info

a virtual forum for BDHubs



Expeditions-in-Computing

Exploring scientific frontiers that promise transformative innovations in computing

- Provides the CISE community an opportunity to pursue ambitious, fundamental research agendas that promise to define the future of computing and information.
- Successful projects bring together teams of investigators with diverse expertise within or across departments or institutions to identify compelling, transformative research agendas that seek disruptive innovations in CISE.

- **Funding:**

up to \$2,000,000 per year
for up to five years

- **Limit:**

1 Expeditions Proposal per individual

- **Deadlines:**

Preliminary Proposal (required): March 9, 2016
Full Proposal: December 14, 2016



Expeditions-in-Computing

Beyond Moore's Law

- *The Molecular Programming Project*, CalTech, U Washington, 2008; & Harvard, UCSF, 2013
- *Variability-aware Software for Efficient Computing with Nanoscale Devices*, UCSD, UCLA, UIUC, Stanford, Michigan, 2010
- *Customizable Domain-Specific Computing*, UCLA, UCSB, Rice, Ohio State, 2009

Sustainability & Environment

- *Understanding Climate Change: A Data Driven Approach* – Minnesota, Northwestern, NC State, NC A&T State, 2010
- *Computational Sustainability: Computational Methods for a Sustainable Environment, Economy, and Society* – Cornell, Oregon State, Bowdoin, 2008

Wireless & Internet

- *Open Programmable Mobile Internet 2020*, Stanford, 2008

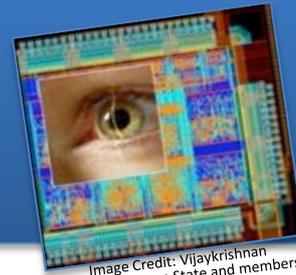


Image Credit: Vijaykrishnan Narayanan, Penn State and members of Visual Cortex on Silicon Team

Healthcare & Wellbeing

- *Socially Assistive Robots*, Yale, USC, MIT, Stanford, Willow Garage, 2011
- *Computational Behavioral Science: Modeling, Analysis, and Visualization of Social and Communicative Behavior*, Georgia Tech, MIT, Boston U, UIUC, USC, Carnegie Mellon, 2010

Robotics and Vision

- *Visual Cortex on Silicon*, Penn State, USC, Stanford, York College, UCSD, UCLA, Pitt, MIT, 2013
- *An Expedition in Computing for Compiling Printable Programmable Machines*, MIT, U Penn, Harvard, 2011
- *RoboBees: A Convergence of Body, Brain and Colony* – Harvard, Northeastern, 2009



Image Credit: Harvard University

Limits of Computation

- *Understanding, Coping with, and Benefiting from Intractability* – Princeton, Rutgers, NYU, Institute for Advanced Study, 2008



Image Credit: UC San Diego Jacobs School of Engineering

Formal Modeling and Verification

- *Expeditions in Computer Augmented Program Engineering*, U Penn, UC Berkeley, UMD, Rice, Cornell, U of Michigan, U of Illinois-UC, UCLA, MIT, 2011
- *Next-Generation Model Checking and Abstract Interpretation with a Focus on Embedded Control and Systems Biology*, Carnegie Mellon, Stony Brook, NYU, UMD, Pitt, Lehman College, JPL, 2009

Big Data

- *Algorithms, Machines, and People*, UC Berkeley, UC San Francisco, 2011
- *(Understanding Climate Change: A Data Driven Approach* – Minnesota, Northwestern, NC State, NC A&T State, 2010)



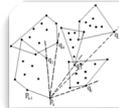
Image Credit: UC San Diego Jacobs School of Engineering



Exploiting Parallelism and Scalability (XPS)

Support groundbreaking research that will lead to a new era of parallel computing

- Aims to establish *new* collaborations combining expertise cutting across abstraction, software, hardware layers.
- Invests in foundational research advancing parallel and scalable computing, challenging validity of traditional computer hardware and software stack for heterogeneous parallel systems.
- Focuses on new principles and cross-layer approaches that integrate both software and hardware through new programming languages, models, algorithms, compilers, runtime systems, and architectures.



Foundational Principles

- New models guiding parallel algorithm design on diverse platforms
- Optimization for resources (energy, bandwidth, memory hierarchy)



Cross-layer and Cross-cutting Approaches

- Re-thinking/re-designing the hardware and software stack
- Coordination across all layers



Scalable Distributed Architectures

- Highly scalable and parallel architectures for people and things connected everywhere
- Runtime platforms and virtualization tools



Domain-specific Design

- Exploiting domain knowledge to improve programmability and performance



CISE Research Infrastructure: Mid-Scale Infrastructure - NSFFutureCloud

Enabling novel cloud architectures

- Aims to support research infrastructure that enables the academic research community to develop and experiment with novel cloud architectures and applications.
- Builds upon existing investments, recent growth in cloud computing.
- Enables exploration of:
 - Resource sharing in clustered computing.
 - Virtualization with software-defined networking technologies.
 - Interplay between application and cloud computing architectures.



Images: Logos from the NSF Cloud projects funded in FY2014

Integrates key input from CISE
AC subcommittee and CCC
whitepapers



Sample of CISE Cross-Cutting Programs

For a comprehensive list of CISE funding opportunities, visit:

http://www.nsf.gov/funding/pgm_list.jsp?org=CISE

- Cross-Directorate
 - Critical Resilient Interdependent Systems and Processes (CRISP)
Creating new approaches and engineering solutions to make interdependent critical infrastructure systems resilient
 - Critical Techniques and Technologies for Advancing Big Data Science & Engineering (BIG DATA)
Developing tools to manage and analyze data in order to extract knowledge from data
 - Science, Engineering and Education for Sustainability (SEES)
Enabling sustainability by new advances in computing
 - Cyberlearning: Transforming Education (CTE)
Designing and implementing technologies to aid and understand learning
 - Enhancing Access to the Radio Spectrum (EARS)
Enhancing access to wireless service and/or efficiency with which radio spectrum is used
 - Secure and Trustworthy Cyberspace (SaTC)
Securing our Nation's cyberspace, while preserving privacy and promoting usability
 - Software Infrastructure for Sustained Innovation (SI2)



Critical Resilient Interdependent Systems and Processes (CRISP)

Creating new approaches and engineering solutions to make interdependent critical infrastructure systems resilient

- Aims to foster an ***interdisciplinary*** research community of engineers, computer and computational scientists and social and behavioral scientists to create new approaches and engineering solutions for the design and operation of infrastructures.
- Award types:
 - Type 1 Awards: up to \$500,000 over 3 years.
 - Type 2 Awards: \$1 million to \$2.5 million over 3-4 years.
- New solicitation coming soon.



Critical Techniques and Technologies for Advancing Foundations and Applications of Big Data Science & Engineering (BIGDATA)

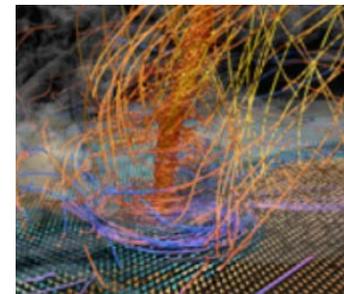
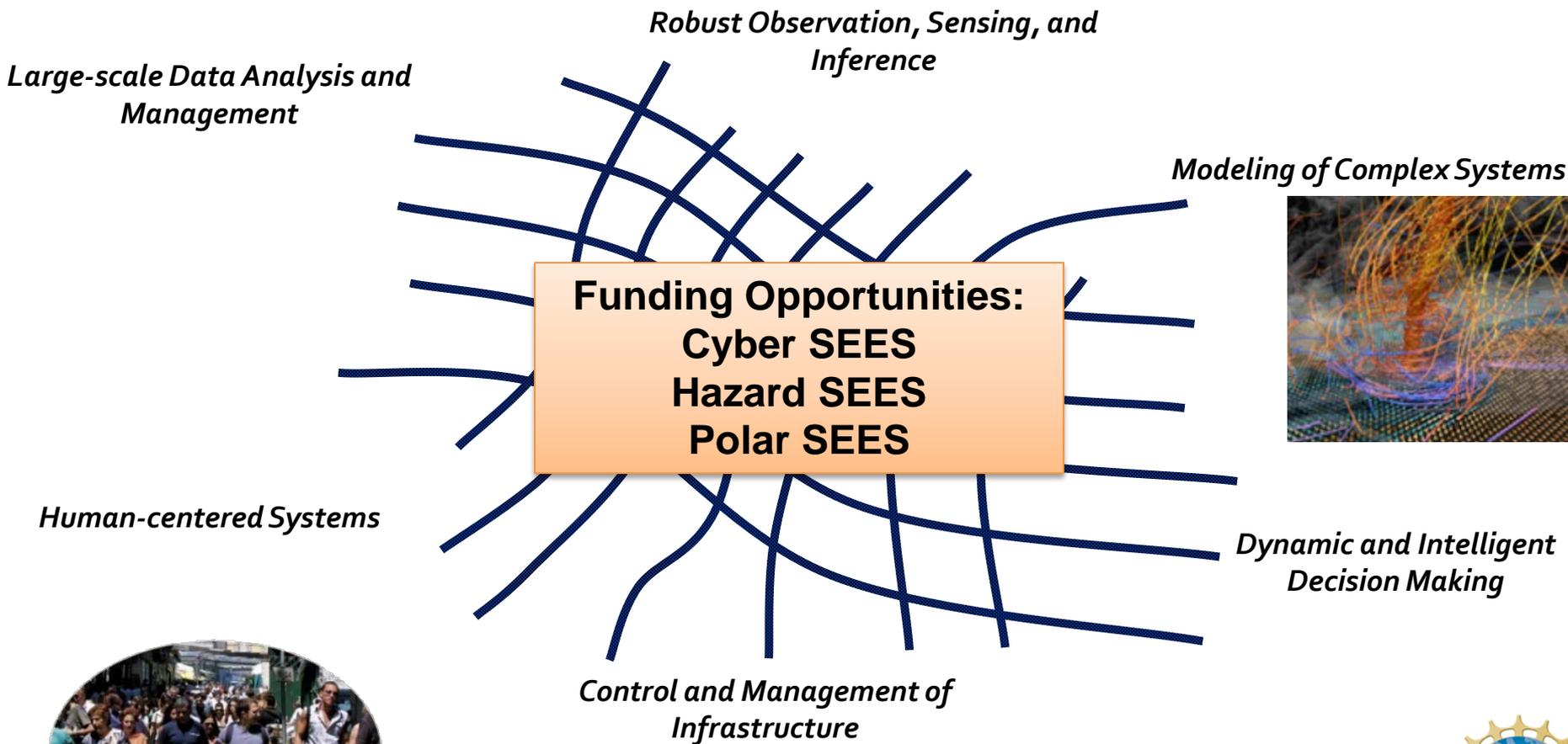
Developing techniques to manage and analyze data

- Two categories for submission:
 - **Foundations:** Encourages fundamental techniques, theories, methodologies and technologies of broad applicability.
 - **Innovative Applications:** Encourages novel techniques, methodologies, and technologies of interest to at least one specific application (special requirements).
- Awards: up to \$500K per year for up to 4 year.



Science, Engineering and Education for Sustainability (SEES)

Enabling sustainability by new advances in computing



Cyberlearning and Future Learning Technologies

Improving learning by integrating emerging technologies with knowledge from research about how people learn

- Computer science is both the **enabling discipline** for the development of technologies that enhance learning and a discipline with an **immediate and critical need** for cyberlearning technologies as it aims to scale K-16 educational transformations at the national scale.
- Four types of awards: CAP, EXP, DIP, INT

Research Thrusts:

- **Innovation:** Identifying new means of using technology for fostering and assessing learning;
- **Advancing understanding of how people learn in technology-rich learning environments:** Enhancing understanding of how people learn and how to better foster and assess learning; and
- **Promoting broad use and transferability of genres:** Extracting lessons from experiences with these technologies that can inform design and use.



Enhancing Access to the Radio Spectrum (EARS)

Enhancing access to wireless service and/or efficiency with which radio spectrum is used



Credit: Nicolle Rager Fuller, National Science Foundation

- Aims to strengthen U.S. leadership in the global wireless technology marketplace.
- Support for research in wireless communication, spectrum sharing, and mobile computing, as well as development of wireless and spectrum testbeds.
- Advance spectrum sensing techniques, explore machine learning and game theory for dynamic spectrum management, and understand incentive mechanisms.

Cross-Directorate Solicitation: CISE, ENG, and MPS



Secure and Trustworthy Cyberspace (SaTC)

Securing our Nation's cyberspace

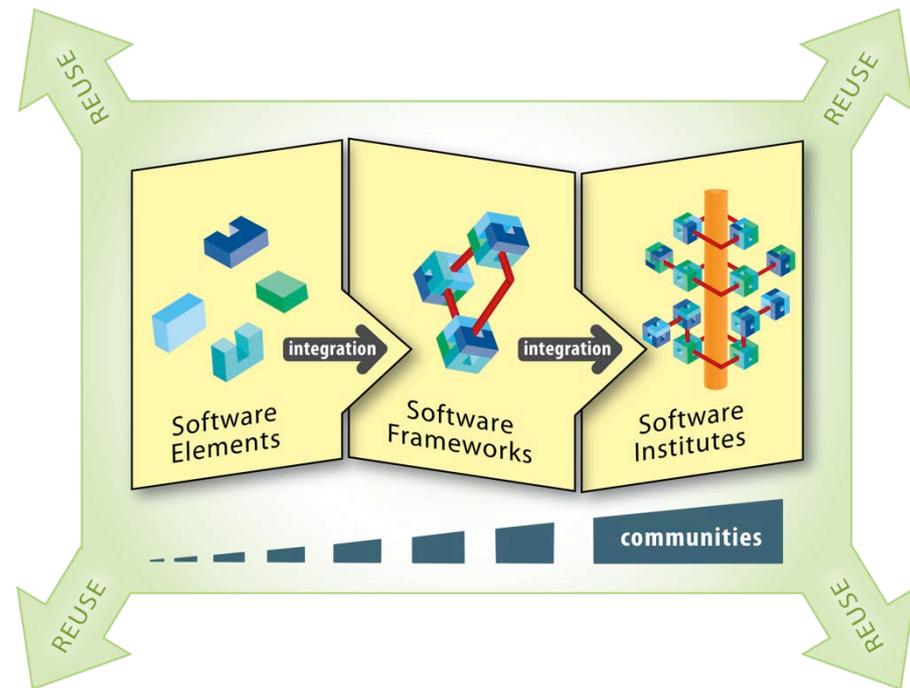
- Aims to support fundamental scientific advances and technologies to protect cyber-systems from malicious behavior, while preserving privacy and promoting usability.
- Proposals must address cybersecurity from one or more perspectives:
 - Trustworthy Computing Systems.
 - Social, Behavioral and Economic Sciences.
 - Secure, Trustworthy, Assured and Resilient Semiconductors and Systems (STARSS), jointly offered with the Semiconductor Research Corporation (special requirements).
 - Cybersecurity Education (special requirements).
- Transition to Practice option.

Project type	Submission window	Award size
Small	January 2-14 annually	up to \$500,000 Up to 3 years
Medium	September 2-19 annually	\$500,001 to \$1,200,000 Up to 4 years
Large	November 4-19 annually	\$1,200,001 to \$3,000,000 Up to 5 years
Cybersecurity Education	December 4-19 annually	Up to \$300,000 Up to 2 years



Software Infrastructure for Sustained Innovation (SI2) Program

- Aims to catalyze and nurture the interdisciplinary processes required to support the entire software lifecycle, resulting in sustainable community software elements and reusable components at all levels of the software stack.
- Addresses software in all aspects of cyberinfrastructure, from embedded sensor systems and instruments, to desktops and high-end data and computing systems, to major instruments and facilities.
- Supports projects at 3 levels from **elements to framework to institutes**



Cross-Directorate Solicitation: CISE, BIO, EHR, ENG, GEO, and MPS



Sample of CISE Cross-Cutting Programs

For a comprehensive list of CISE funding opportunities, visit:

http://www.nsf.gov/funding/pgm_list.jsp?org=CISE

- Cross-Agency Programs and Initiatives

- BRAIN

Improving understanding of the brain

- National Big Data Research & Development Initiative

- Cyber-Physical Systems

Deeply integrating computation, communication, and control into physical systems

- Materials Genome Initiative

Decreasing the time-to-market by 50%

- National Robotics Initiative (NRI)

Developing and using robots that work alongside, or cooperatively with, people

- National Strategic Computing Initiative (NSCI)

- Smart and Connected Health (SCH)

Transforming healthcare knowledge and delivery, and improving quality of life through IT



BRAIN: Brain Research through Advancing Innovative Neurotechnologies

Improving understanding of the brain

- White House BRAIN Initiative launched in April 2013 (NSF, NIH, DARPA).
- Addresses critical challenge of research integration across multiple scales ranging from molecular to behavioral levels with the ultimate goal of understanding the brain.
- Builds on ongoing NSF investments:
 - Collaborative Research in Computational Neuroscience (CRCNS) in collaboration with NIH, Germany, France, and Israel;
 - Integrative Strategies for Understanding Neural and Cognitive Systems;
 - Robust Intelligence Core Research; and
 - MIT STC: Center for Brains, Minds and Machines: The Science and the Technology for Intelligence.



More at:

http://www.nsf.gov/news/special_reports/brain/



National Big Data R&D Initiative

- **Cross-agency “Big Data” Senior Steering Group** – chartered in spring 2011 by OSTP:
 - Co-chaired by NSF and NIH
 - Significant research community input
- **Launched** by OSTP on March 29, 2012
 - **Major Announcements:** NSF, NIH, USGS, DoD, DARPA, DOE
- **Data to Knowledge to Action** event hosted by OSTP November 12, 2013
 - Encouraging **public-private partnerships** across the country



Cyber-Physical Systems (CPS)

Deeply integrating computation, communication, and control into physical systems

- Aims to develop the core system science needed to engineer complex “smart” cyber-physical systems.
- Serves multiple key national priorities.

Project Types:

- **Breakthrough Projects**
up to \$500,000
up to 3 years
- **Synergy Projects**
\$500,001 to \$1,000,000
over 3-4 years
- **Frontiers Projects**
\$1,000,001 to \$7,000,000
over 4-5 years



Transportation

- Faster and safer aircraft
- Improved use of airspace
- Safer, more efficient cars



Energy and Industrial Automation

- Homes and offices that are more energy efficient and cheaper to operate
- Distributed micro-generation for the grid



Healthcare and Biomedical

- Increased use of effective in-home care
- More capable devices for diagnosis
- New internal and external prosthetics



Critical Infrastructure

- More reliable power grid
- Highways that allow denser traffic with increased safety

Cross-Directorate Solicitation: CISE and ENG

Multi-agency Commitment: NSF, DHS, DoT, NASA, and NIH



Materials Genome Initiative

Aiming to decrease the time-to-market by 50%



To help businesses discover, develop, and deploy new materials twice as fast, we're launching what we call the Materials Genome Initiative. The invention of silicon circuits and lithium ion batteries made computers and iPods and iPads possible, but it took years to get those technologies from the drawing board to the market place. We can do it faster.

-President Obama, Carnegie Mellon University, June 2011

Goals:

- Develop a Materials Innovation Infrastructure
- Achieve National goals in energy, security, and human welfare with advanced materials
- Equip the next generation materials workforce

Themes

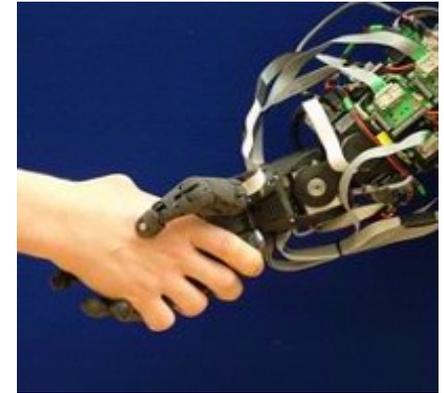
- Incentivizing open paradigms of sharing & access of tools
- Facilitating the development of innovation ecosystems & access to all stakeholders
- Driving innovative techniques across computation, informatics & experimentation
- Catalyzing shift in culture across the entire materials continuum & scaling the movement



National Robotics Initiative (NRI)

Developing the next generation of collaborative robots to enhance personal safety, health, and productivity

- A nationally concerted cross-agency program to provide U.S. leadership in science and engineering research and education aimed at the development and use of cooperative robots that work alongside people across many sectors.



Credit: Bristol Robotics Lab

Research Thrusts

- **Fundamental research in robotics science & engineering**
- **Understanding the long term social, behavioral, and economic implications across all areas of human activity**
- **Use of robotics to facilitate and motivate STEM learning across the K-16 continuum**

Cross-Directorate Solicitation: CISE, EHR, ENG, and SBE

Multi-agency Commitment: NSF, DOD/DARPA, NASA, NIH, and USDA



National Strategic Computing Initiative (NSCI)

- Executive Order, July 29, 2015 orders the creation of a national strategic computing initiative.
- Motivation: HPC essential to U.S. scientific discovery and economic competitiveness
- NSF co-lead with DOE and DOD
 - “NSF will play a central role in scientific discovery advances, the broader HPC ecosystem for scientific discovery, and workforce development.”



Smart & Connected Health (SCH)

Transforming healthcare knowledge, delivery, and quality of life through IT

- Address fundamental technical and scientific issues to support the transformation of healthcare from reactive and hospital-centered to preventive, proactive, evidence-based, person-centered and focused on wellbeing rather than disease.
- Must relate to a key health problem and must make a fundamental contribution to ENG, CISE, or SBE domains.

Project Types:

- **Type I: Exploratory**
Up to \$250,000 / year
for 1-3 years
- **Type II: Integrative**
Up to \$500,000 / year
for up to 4 years

Research Thrusts

**Digital Health
Information
Infrastructure**

*Informatics and
Infrastructure*

**Data to Knowledge to
Decision**

*Reasoning under
uncertainty*

Empowering Individuals

*Energized, enabled,
educated*

**Sensors, Devices, and
Robotics**

Sensor-based actuation

Cross-Directorate Solicitation: CISE, ENG, and SBE

Multi-agency Commitment: NSF and NIH



Sample of Programs to Support CS Students, Teachers, and Early-Career Researchers

For a comprehensive list of CISE funding opportunities, visit:

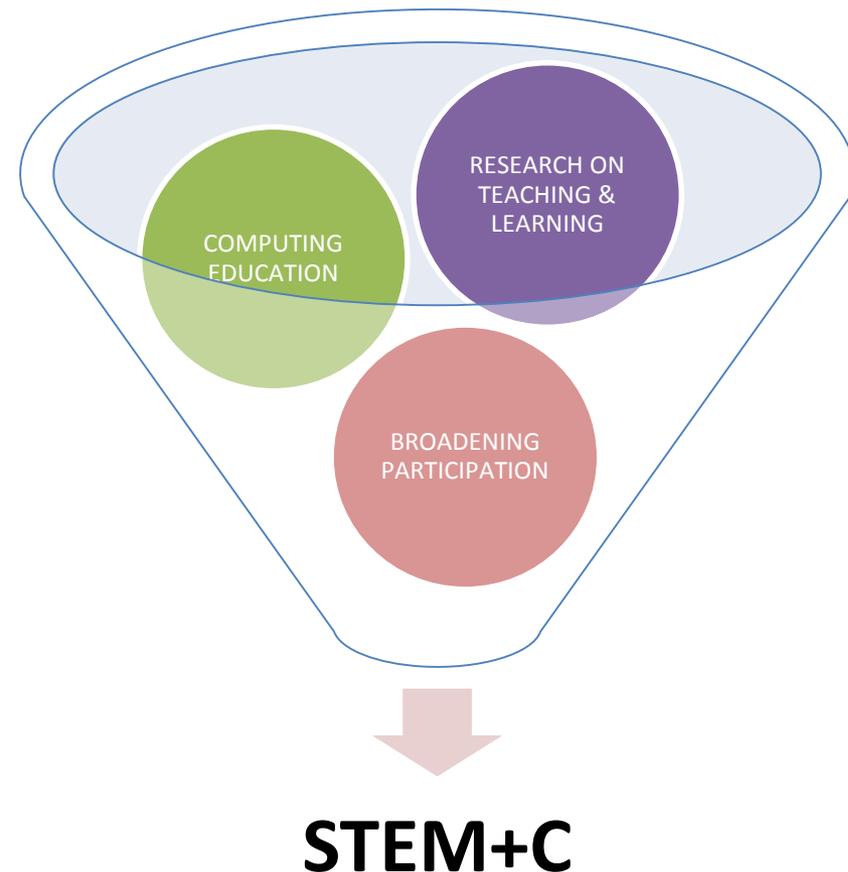
http://www.nsf.gov/funding/pgm_list.jsp?org=CISE

- STEM + Computing (STEM+C) Partnerships
Integrating computing into STEM
- NSF Research Traineeship (NRT)
Preparing professionals in emerging STEM fields vital to the nation
- Computing Research Initiation Initiative (CRII)
Enabling early research independence
- Faculty Early Career Development (CAREER) Program
- Graduate Research Fellowship Program (GRF)
- Research Experiences for Undergraduates (REU)



STEM + Computing (STEM+C) Partnerships

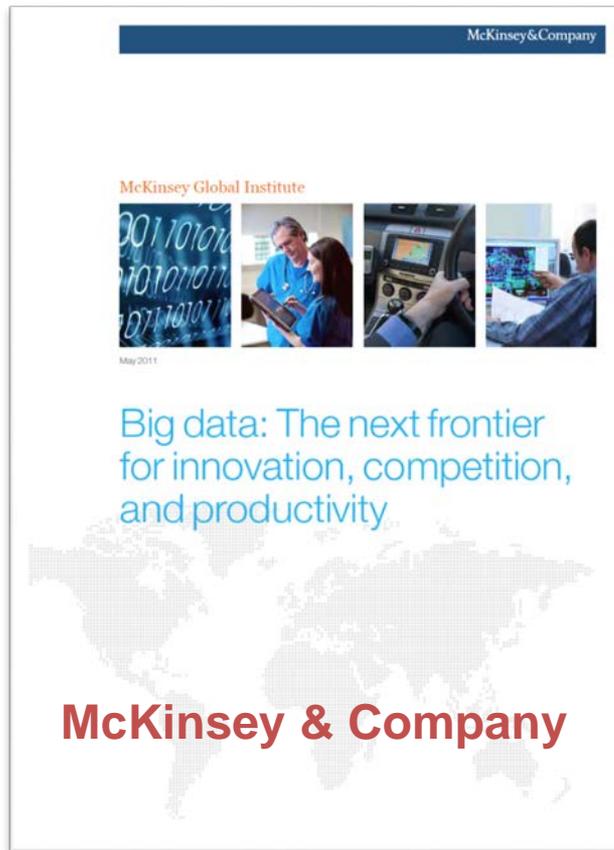
Integrating computing into STEM



- Integrates computing into STEM disciplines and builds capacity in K-12 computing education.
- Deep community partnerships.
- Transforms the computing education pipeline through CS10K.
- Combines and replaces two earlier solicitations that focused on Science, Technology, Engineering and Mathematics (STEM), including Computing Partnerships: Math and Science Partnerships (STEM-CP: MSP) and STEM-CP: Computing Education for the 21st Century (STEM-CP: CE21).



Education, Learning, Workforce Development, Computational and Data-enabled Science



“By 2018 the United States alone faces a shortage of 140,000 to 190,000 people with analytical expertise and 1.5 million managers and analysts with the skills to understand and make decisions based on the analysis of big data.”¹

¹McKinsey&Company (May 2011), “Big data: The next frontier for innovation, competition, and productivity.” Available at: http://www.mckinsey.com/Insights/MGI/Research/Technology_and_Innovation/Big_data_The_next_frontier_for_innovation



NSF Research Traineeship (NRT)

Preparing professionals in emerging STEM fields vital to the nation

Priority research theme: Data-enabled science and engineering

- Aims to create and promote new, innovative, effective, and scalable models for STEM graduate student training and prepare scientists and engineers of the future, particularly in emerging STEM fields vital to the nation.
- A new NSF graduate education initiative to replace the Integrated Graduate Research Traineeship (IGERT) program.
- Award tracks:
 - NRT Traineeship: up to \$3M up to 5 years.
 - NRT Innovations in Graduate Education: \$300K-\$500K over 2-3 years.
- Proposal deadlines: February 22, 2016



Computing Research Initiation Initiative (CRII)

Enabling early research independence

- Aims to contribute to the growth and development of future generations of scientists and engineers who will dedicate their careers to advancing CISE research and education.
- Provides the opportunity for individuals who are in their first academic position post-PhD to recruit and mentor their first graduate students.
 - Allows for a full budget for grad student salary only (and some travel, equipment) but no PI salary.
- Deadline: Fourth Wed in Sept Annually



Faculty Early Career Development (CAREER) Program

- The National Science Foundation's most prestigious awards in support of junior faculty who exemplify the role of teacher-scholars through:
 - outstanding research,
 - excellent education, and
 - the **integration of education and research** within the context of the mission of their organizations.
- Since its inception in 1996:
 - More than **200 programs** have reviewed CAREER proposals.
 - More than **7,000 awards**.
- PIs are allowed only one submission per competition.

CISE CAREER Proposal Writing Workshops

- 2015 Workshop in Arlington, VA: March 16
- Presentations from March 2014 available at <http://cs.gmu.edu/events/nsfcisecareer2014/>



Support for Graduate and Undergraduate Students

- ***Graduate Research Fellowship Program (GRF)***
 - Foundation-wide programs with substantial CISE participation.
 - Deadlines in mid-Nov but differ for each Directorate.
- ***Research Experiences for Undergraduates (REU)***
 - **REU Sites**
 - Typically in summer.
 - 8-10 students in a cohort environment.
 - Deadline in August.
 - **REU Supplements**
 - Support for 1-2 students to work on existing project.
 - Best to submit request by March but no strict deadline.



Other NSF-wide Opportunities for the CISE Community

- Innovation Corps (I-Corps)
- Grants for Rapid Response Research (RAPID)
- EARly-concept Grants for Exploratory Research (EAGER)
- Conferences, Summer Schools, and Workshops
- International Collaborations

For a comprehensive list of NSF funding opportunities, visit:

<http://www.nsf.gov/funding/>



Innovation Corps (I-Corps)

Accelerating innovations from the laboratory to the market

- Aims to develop and nurture a national innovation ecosystem that builds upon fundamental research to guide the output of scientific discoveries to the development of technologies, products and processes that benefit society.
- NSF-funded researchers are eligible to receive additional support in the form of mentoring and funding through I-Corps.
- **Must consult with a program director before submission.**



NSF-wide Initiative



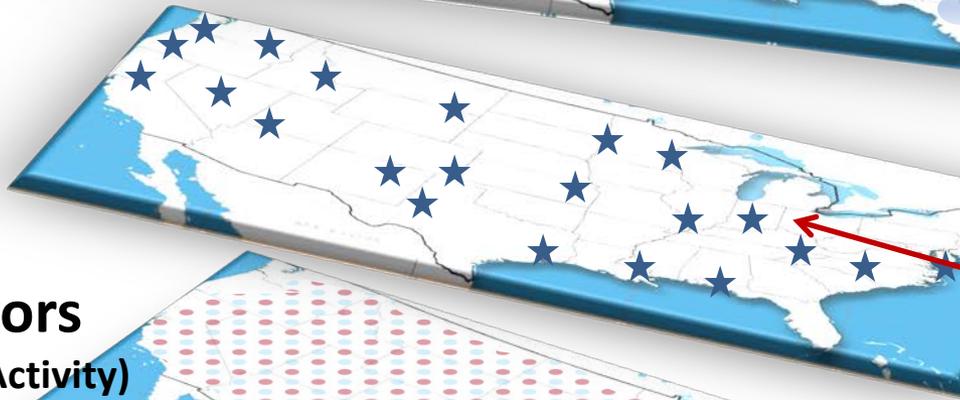
Building the Nation's I-Corps "Fabric"

I-Corps Nodes
(NSF Program)



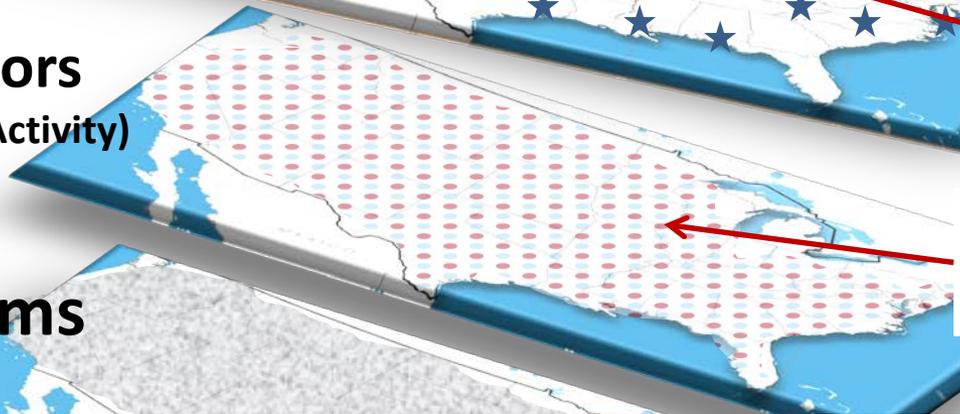
National Network of university collaborators – offer immersion curriculum and engage in research about commercialization

I-Corps Sites
(NSF Program)



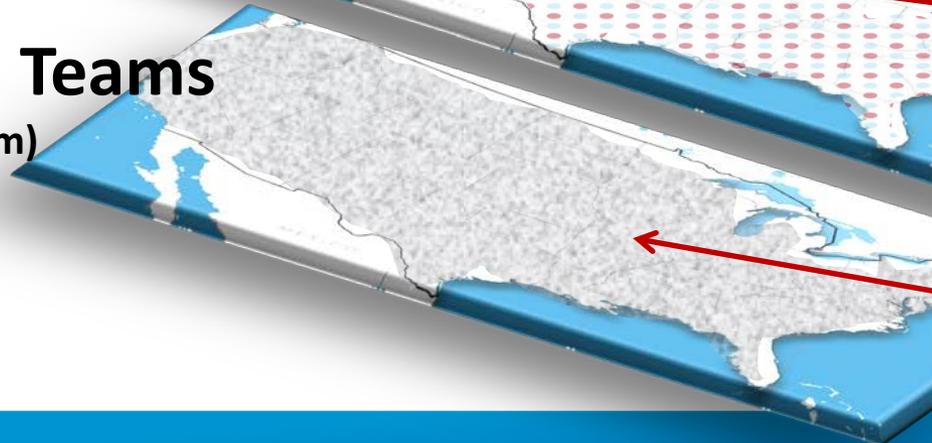
National network of universities that can enable their local teams

I-Corps Mentors
(External Partners Activity)



National network of serial-entrepreneurs who Mentor I-Corps Teams

I-Corps Teams
(NSF Program)



National network of "Grass-Roots" activities by NSF PIs – individual teams pursue I-Corps Curriculum and commercialization



RAPID and EAGER Proposals

- ***Grants for Rapid Response Research (RAPID):***
 - Supports quick-response research on natural or anthropogenic disasters and similar unanticipated events.
 - Up to \$200K and one year duration.
 - Project descriptions are expected to be brief (two to five pages) and include clear statements as to why the proposed research is of an urgent nature.
- ***EARLY-concept Grants for Exploratory Research (EAGER):***
 - Supports high-risk, exploratory and potentially transformative research.
 - Up to \$300K and two years duration.
 - Project description is expected to be brief (five to eight pages) and include clear statements as to why this project is appropriate for EAGER funding.



Conferences, Summer Schools, and Workshops

- ***Conferences***
 - Student Travel Support
 - Doctoral Consortia
- ***Summer Schools***
 - Intensive program for doctoral students on emerging research topics.
 - Require faculty expertise not available at any single institution.
- ***Workshops***
 - Bring the community together to reflect on, and identify emerging research opportunities and challenges.

Must consult with a program director before submission.



International Collaborations

- ***Supplements*** to existing projects to allow US researchers to engage in collaborative activities with international partners:
 - True intellectual collaboration with foreign research partner;
 - New international collaborations;
 - Clear benefit to U.S. science/engineering community from expertise, facilities, or resources of the foreign collaborator; and
 - Active research engagement of U.S. students and junior researchers at the foreign site.
- ***East Asia and Pacific Summer Institutes for U.S. Graduate Students (EAPSI)***
- ***Pan-American Advanced Studies Institutes Program (PASI)***
- ***International Research Fellowship Program (IRFP)***
- If what you have in mind does not fit one of the existing programs, get in touch with the PD responsible for the country, or region of interest in the NSF Office of International Science and Engineering.



Commitment to Research and Education in CISE

- As a field of inquiry, computer, communication and information science and engineering has a **rich intellectual agenda** – highly creative, highly interactive, with enormous possibilities for changing the world!
- A thriving basic research community is the foundation for long-term **discovery** and **innovation, economic prosperity, and national security.**
- Our investments in **research and education** have returned exceptional dividends to our nation.



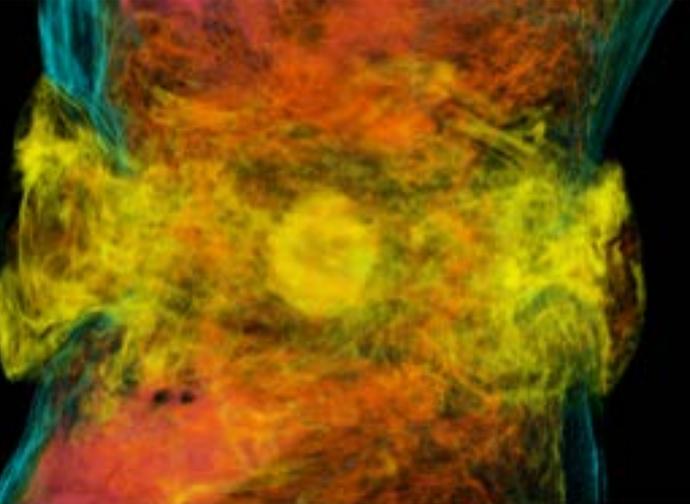
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- Talk to Program Directors: http://www.nsf.gov/staff/staff_list.jsp?org=CISE&from_org=CISE.
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The image shows a screenshot of the National Science Foundation (NSF) website. At the top, the NSF logo and the tagline "WHERE DISCOVERIES BEGIN" are visible. Below the logo is a search bar and a navigation menu with links for HOME, FUNDING, AWARDS, DISCOVERIES, NEWS, PUBLICATIONS, STATISTICS, ABOUT NSF, and FASTLANE. A large banner image features a colorful abstract pattern with the text "Why stars born in same cluster look alike" and a "FULL STORY" button. Below the banner is a secondary navigation bar with links for "Advancing the Sciences", "Funding & Supporting", and "Inspiring & Educating", along with a "SHOW" button. The main content area is titled "NSF Funding & Research Community" and includes sections for "SPECIAL NOTICES" (with links to NSF Strategic Plan, Proposal & Award Policies, and American Recovery and Reinvestment Act), "EVENT CALENDAR" (with dates for Advisory Committee Meeting, Large Facilities Workshop, and Smart Vehicles Concepts Meeting), and "FUNDING OPPORTUNITIES" (with a search bar and a "VIEW ALL FUNDING OPPORTUNITIES" button). At the bottom of the page, there is a footer with various links and a "Feedback" button. A red arrow points to the "STATISTICS" link in the top navigation bar. A yellow box at the bottom right contains the text "Get NSF Updates by Email".

Thanks!

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