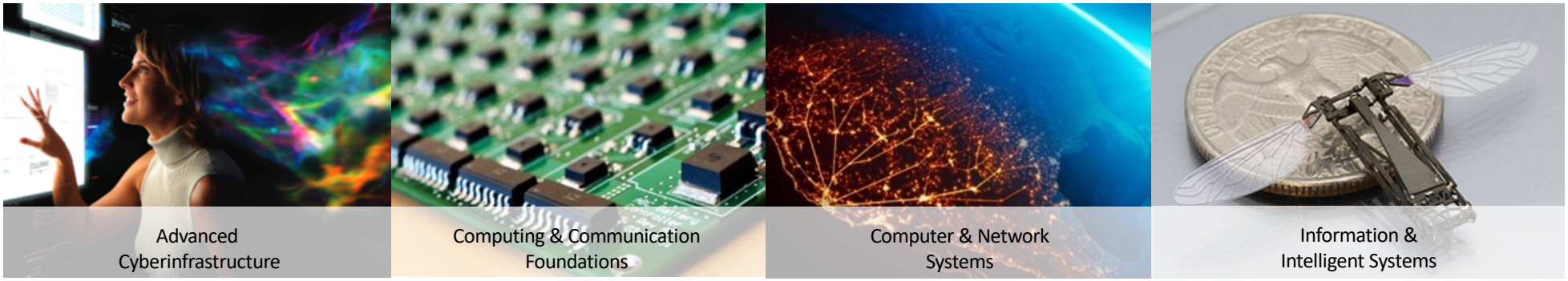
NSF/CISE:
An Update



Erwin Gianchandani
Acting Assistant Director, Computer and Information Science and Engineering (CISE)

CCC Council Meeting
November 20, 2019

Outline

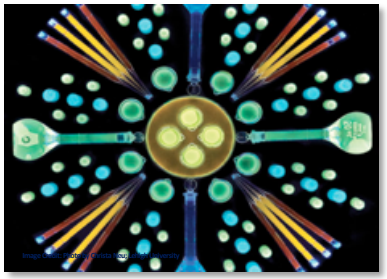

NSF/CISE Overview
Selected Programmatics
Looking Forward

CISE programs address national priorities…

AI, Big Data, & Robotics

Cybersecurity

Manufacturing & Microelectronics



Quantum Information Sciences

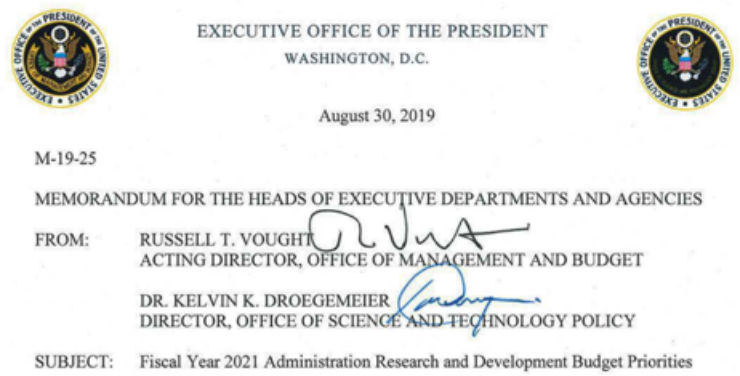
Future Computing Systems

Smart Communities

Computer Science Education

Advanced Wireless Research

…in alignment with Administration, Congress



EXECUTIVE OFFICE OF THE PRESIDENT
WASHINGTON, D.C.

August 30, 2019

M-19-25

MEMORANDUM FOR THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

FROM: RUSSELL T. VOUGHT
ACTING DIRECTOR, OFFICE OF MANAGEMENT AND BUDGET

DR. KELVIN K. DROEGEMEIER
DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY POLICY

SUBJECT: Fiscal Year 2021 Administration Research and Development Budget Priorities

FY 2021 R&D Budget Priorities Memo

"Artificial Intelligence, Quantum Information Science, and Computing: … prioritize basic and applied research investments that are consistent with the 2019 *Executive Order on Maintaining American Leadership in Artificial Intelligence* and the … 2019 update of the *National Artificial Intelligence Research and Development Strategic Plan*… In terms of computing, departments and agencies should work together to explore new applications in and support R&D for high performance future computing paradigms, fabrication, devices, and architectures alongside sustainable and interoperable software; data maintenance and curation; and appropriate security.

National Security Strategy

National Defense Strategy

National Quantum Initiative Act

One Hundred Fifteenth Congress
of the
United States of America

AT THE SECOND SESSION

An Act

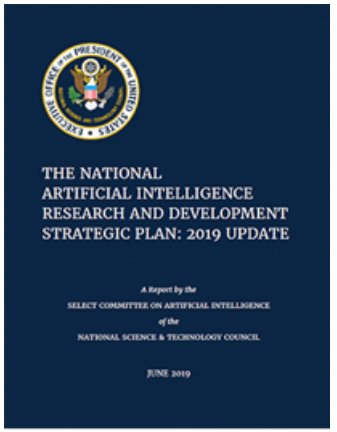
To provide for a coordinated Federal program to accelerate quantum research and development for the economic and national security of the United States.

AI Executive Order

EXECUTIVE ORDERS

Executive Order on Maintaining American Leadership in Artificial Intelligence

INFRASTRUCTURE & TECHNOLOGY | Issued on: February 11, 2019



AI R&D Strategic Plan

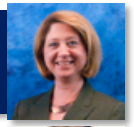
CISE divisions/office

CISE Directorate

Erwin Gianchandani, Acting AD

Thyaga Nandagopal, Acting DAD

Gracie Narcho
Senior Advisor,
Strategic Engagements
(detail)



Peter Arzberger
Senior Advisor

Office of Advanced Cyberinfrastructure (OAC)

Manish Parashar, OD

- Data
- Leadership and Advanced Computing
- Networking/ Cybersecurity
- Software
- Learning and Workforce

Computing and Communication Foundations (CCF)

Rance Cleaveland, DD

- Algorithmic Foundations
- Communication and Information Foundations
- Software and Hardware Foundations
- Foundations of Emerging Technologies

Computer and Network Systems (CNS)

Ken Calvert, DD

- Computer and Network Systems
- Education and Workforce Development

Information and Intelligent Systems (IIS)

Henry Kautz, DD

- Cyber Human Systems
- Information Integration and Informatics
- Robust Intelligence

Transitions

Jim Kurose

Jan. 5, 2015-Sept. 6, 2019

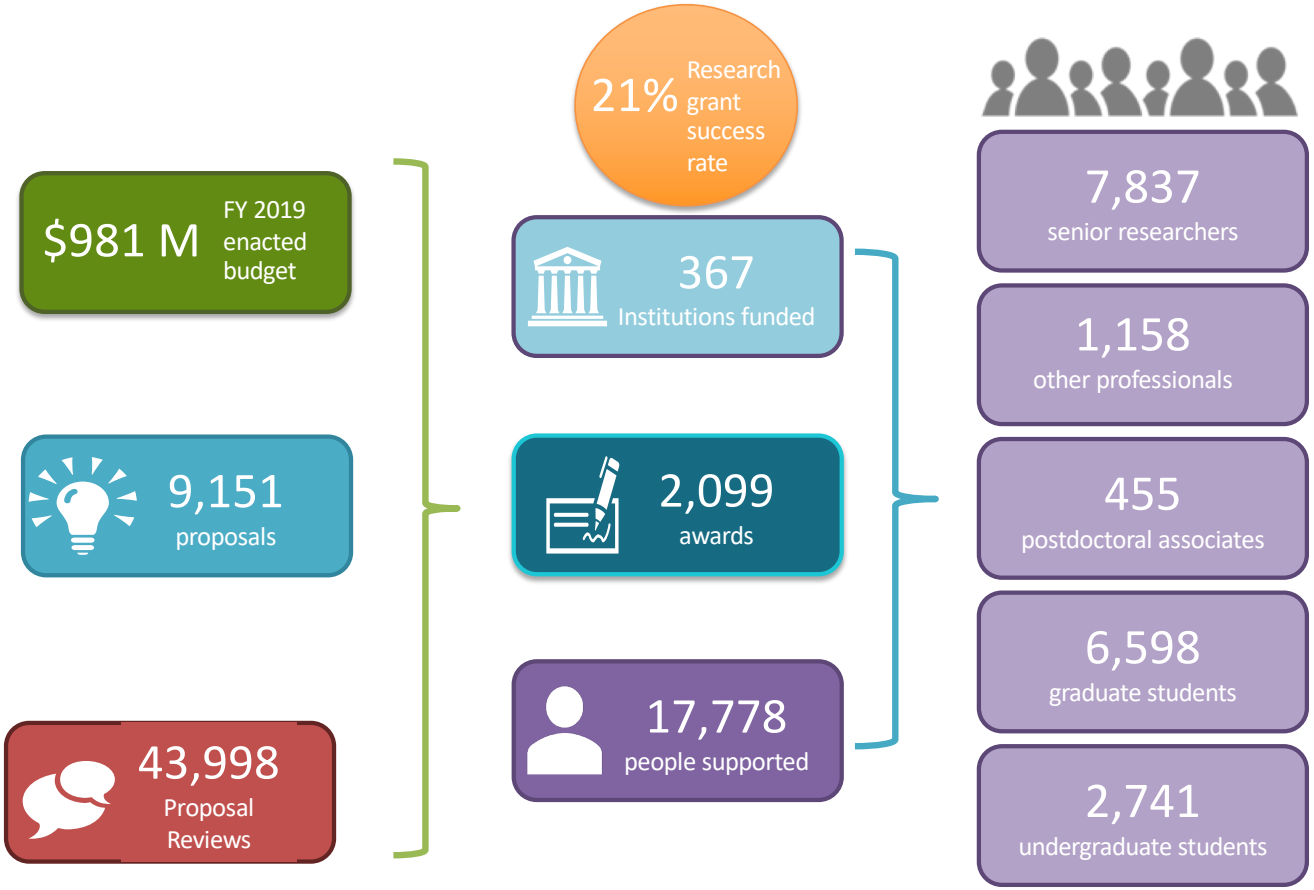
Margaret Martonosi

Feb. 1, 2020 –

Thank you to the CISE AD search committee!

Dr. Vinton C. Cerf, Committee Chair
Dr. Charles Isbell
Dr. Ed Lazowska
Dr. Padma Raghavan
Dr. Jennifer Rexford
Dr. Daniela Rus
Dr. Fred Schneider

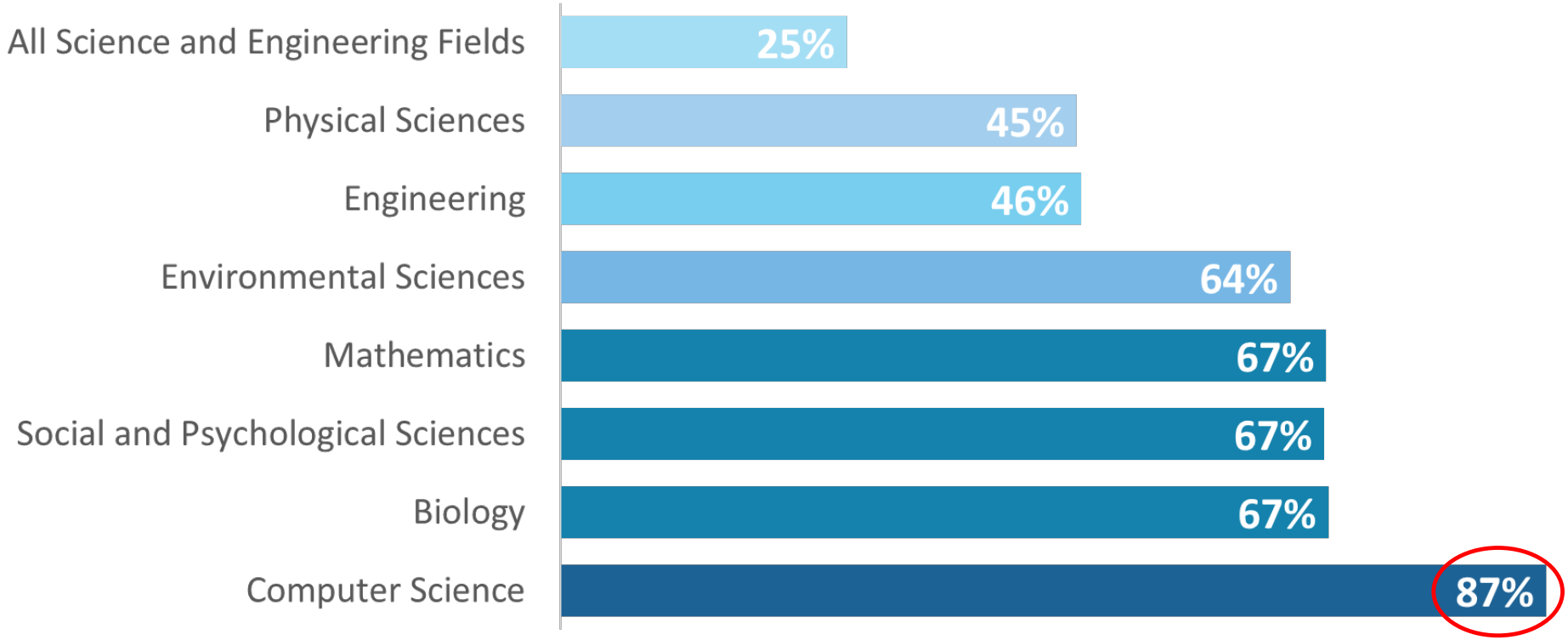
CISE by the numbers



Most numbers based on FY 2018 activities.

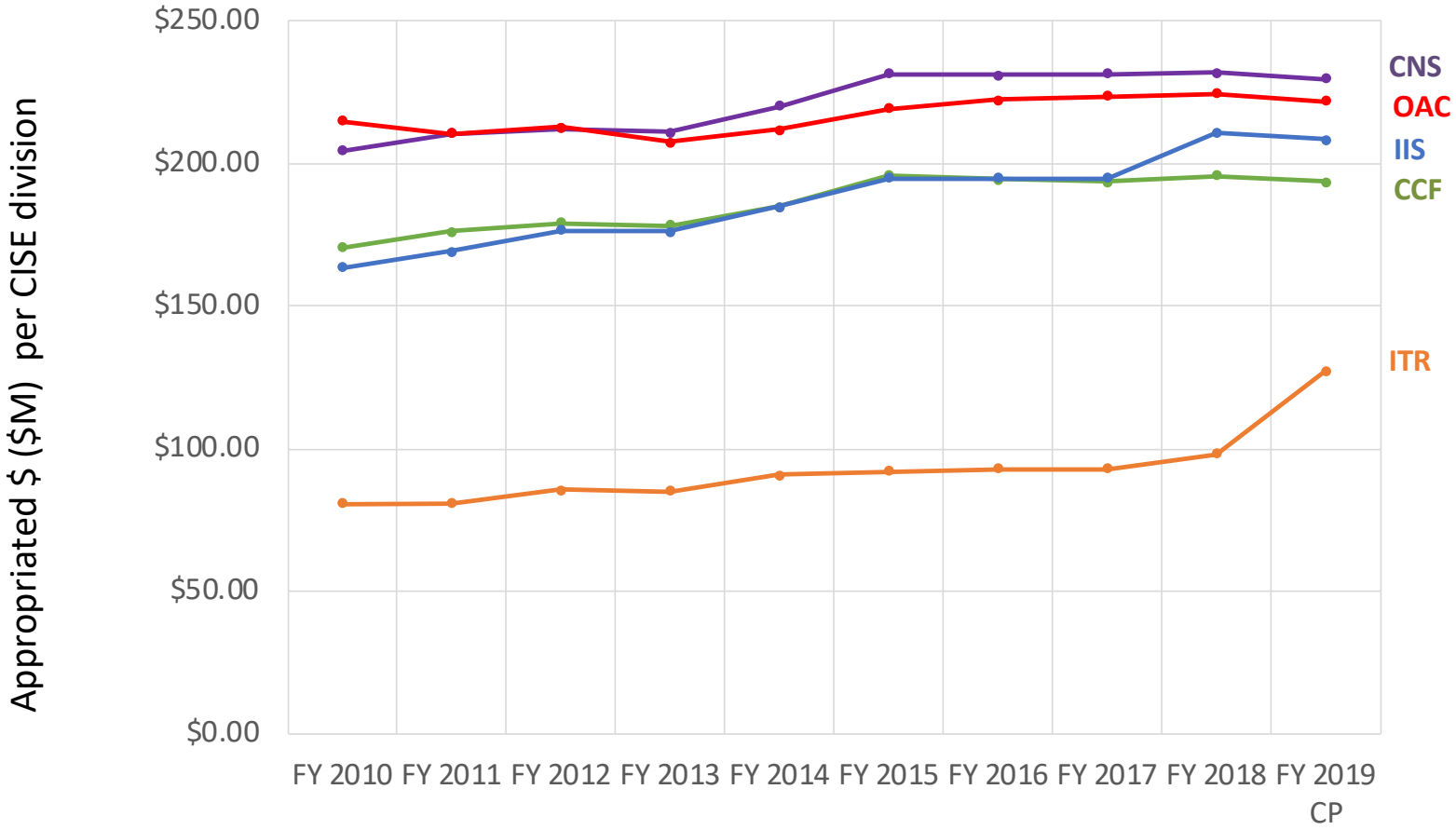
NSF supports all areas of fundamental research

NSF support as a percentage of total federal support for basic academic research



Source: NSF/NCSES, "Survey of Federal Funds for Research and Development." In FY 2020 NSF Budget Request to Congress.

Ten years of NSF/CISE budgets



Budget process: reminder

Markup, reconciliation of appropriation bills

THE WHITE HOUSE
WASHINGTON

BUDGET

Request

U.S. HOUSE OF REPRESENTATIVES

House Budget Resolution

UNITED STATES SENATE

Senate Budget Resolution

BUDGET

NSF

Budget process: FY 2020

FY 2019 enacted budget

- $8.075B (+4% over FY 2018, which was +5% over FY 2017)

FY 2020 TBD

- $7.100B (R&RA: -13.2% wrt FY 2019)
- CISE: -8.1% wrt FY 2018
- House, Senate Resolutions: $8.6B, $8.3B (up to +7% wrt FY 2019)

Markup, reconciliation of appropriation bills

TBD

THE WHITE HOUSE WASHINGTON

BUDGET

NSF

BUDGET

Request

March 18, 2019

U.S. HOUSE OF REPRESENTATIVES

June 25, 2019

House Budget Resolution

UNITED STATES SENATE

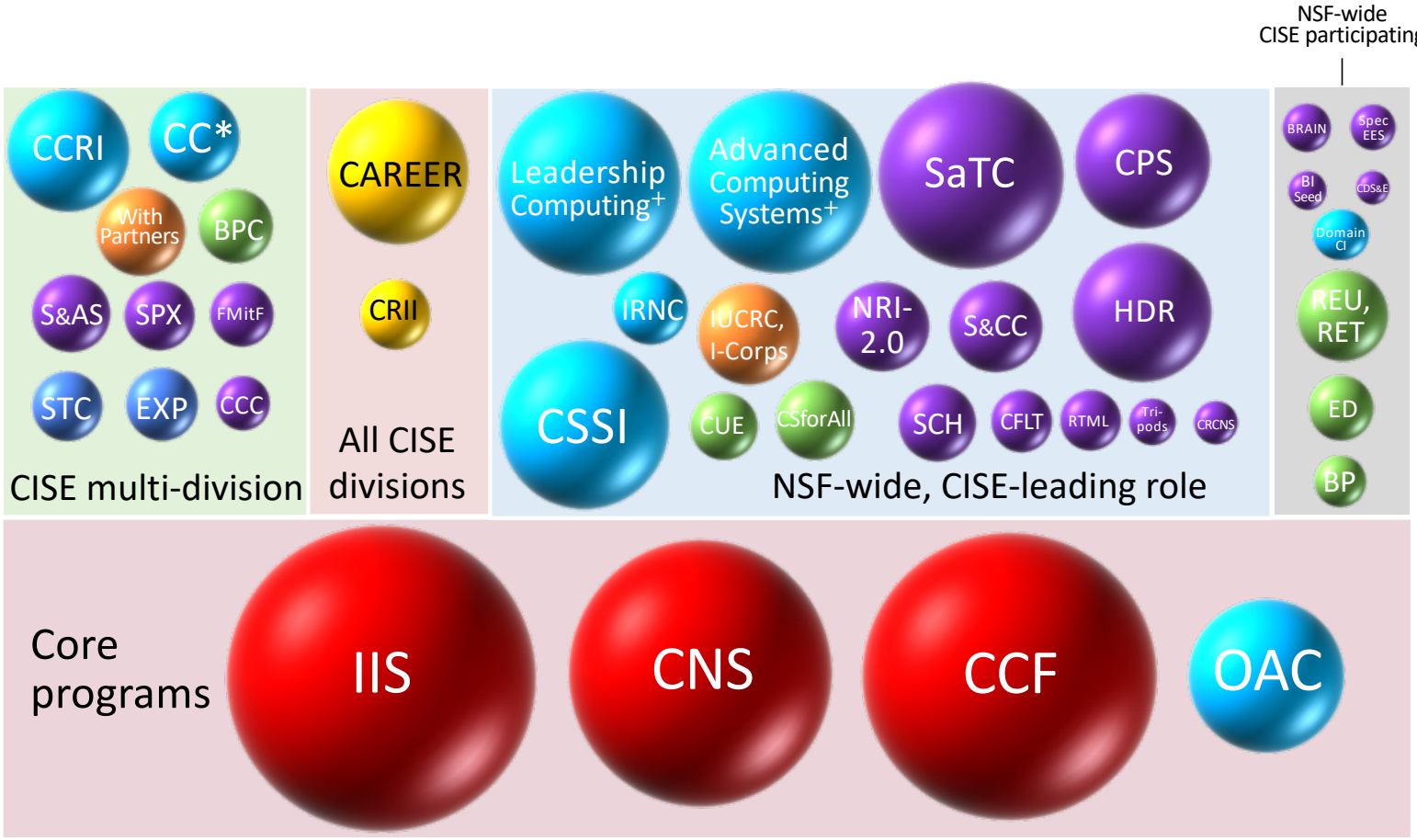
Senate Budget Resolution

Sept. 24, 2019

Outline


NSF/CISE Overview
Selected Programmatics
Looking Forward

FY 2019 CISE programmatics at a glance



KEY:

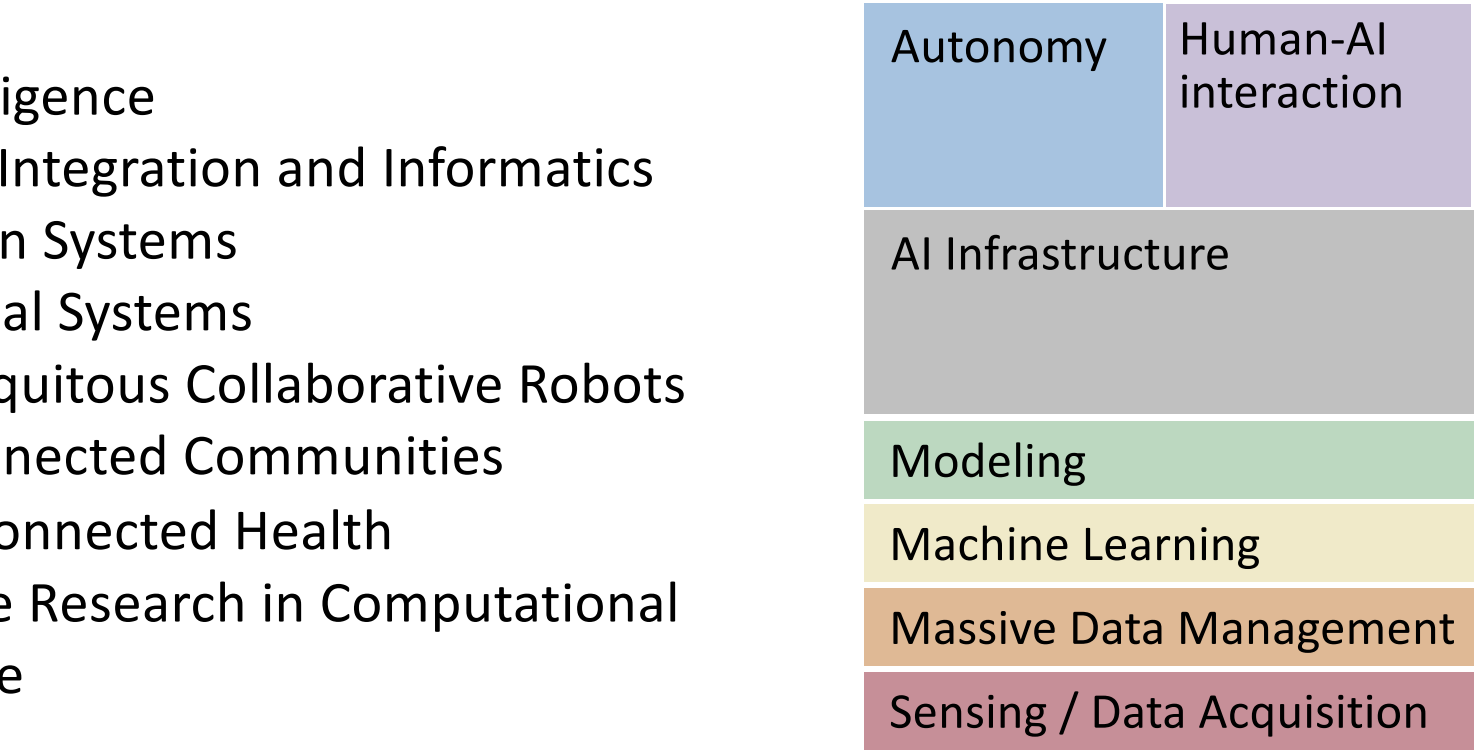
- Core Research Programs
- Named Research Programs
- Education & Workforce
- Early-career
- Center
- Industry & Innovation
- Research Infrastructure
- $10M. Area proportional to FY18 investment level

+Funded by OAC but benefits all of S&E

NSF's AI portfolio

Transformative science that holds promise for tremendous societal and economic benefit with potential to revolutionize how we discover, work, learn, and communicate

- Robust Intelligence
- Information Integration and Informatics
- Cyber-Human Systems
- Cyber-Physical Systems
- NRI-2.0: Ubiquitous Collaborative Robots
- Smart & Connected Communities
- Smart and Connected Health
- Collaborative Research in Computational Neuroscience



New in FY 2019 and FY 2020

- **AI and Society, with the Partnership on AI**
  - $4.5M joint funding: CISE and SBE, with PAI, in FY 2019

PAI Founding Members

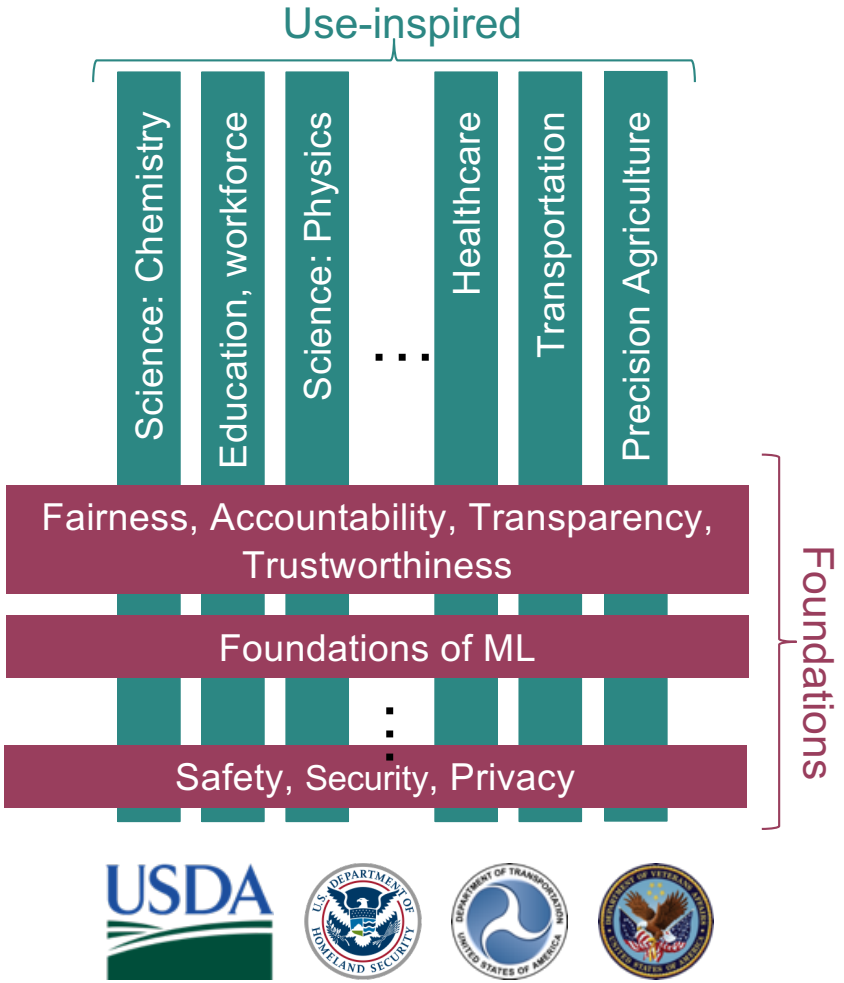
- **NSF/DARPA Program on Real-Time Machine Learning (RTML)**
  - $11M total, with CISE and ENG beginning in FY 2019

- **NSF/Amazon Program on Fairness in AI**
  - $21M joint funding: CISE and SBE, with Amazon, in FY 2020

- **DCL on FEAT for CISE: Fairness, Ethics, Accountability, and Transparency for CISE Research (NSF 19-016)**

National AI Research Institutes

- Planning grants for future Institutes
- Up to six multidisciplinary, multi-institutional research institutes
- ***National nexus points for universities, federal agencies, industry and nonprofits to advance AI research and workforce development***
- Anticipated investment: about $200 million over six years, beginning in FY 2020



NSF leadership in AI across the USG

Office of Science & Technology Policy

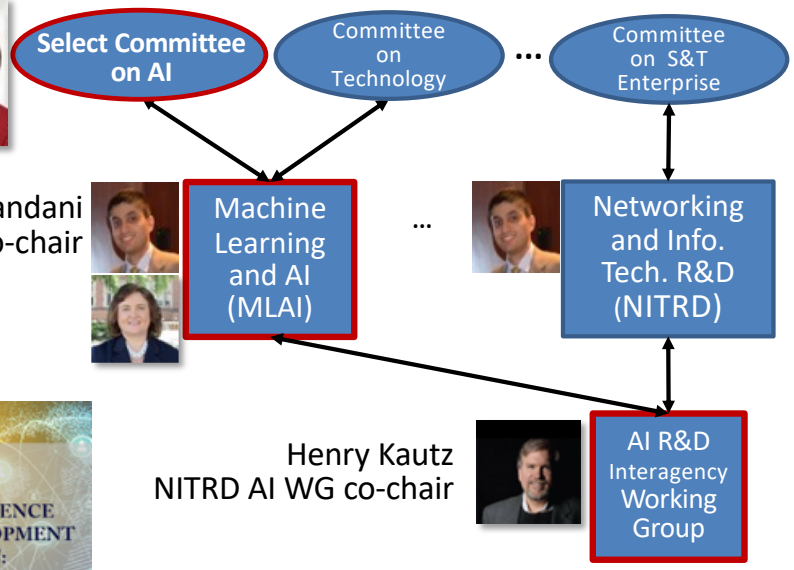
Lynne Parker
Assistant Director for AI

National Science and Technology Council (NSTC)

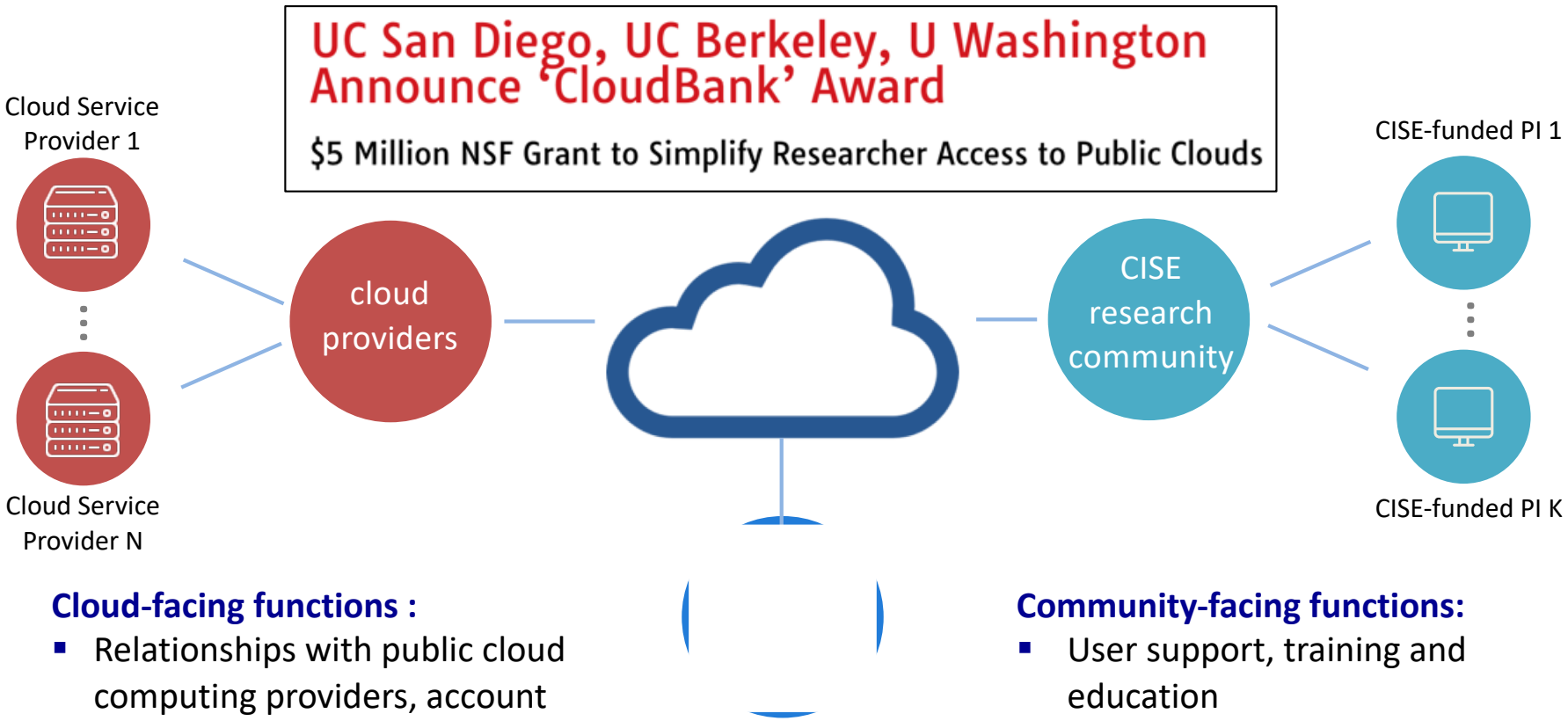
France Córdova
AI Select Committee
Co-chair (with DARPA, OSTP)

Erwin Gianchandani
MLAI co-chair

Henry Kautz
NITRD AI WG co-chair



CloudBank



Cloud-facing functions :

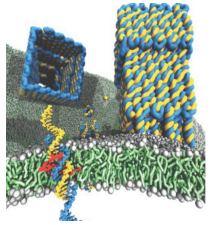
- Relationships with public cloud computing providers, account management, resource allocations
- Strategic planning for public cloud use by CISE community

Community-facing functions:

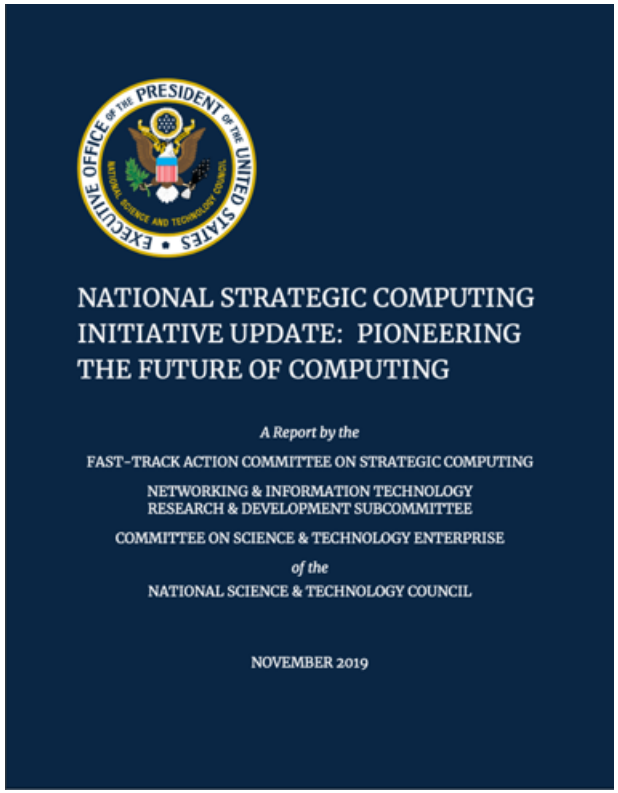
- User support, training and education
- Advice and strategic technical guidance research and education projects

Frontera

- A leadership-class computational instrument with the broadest utility for all of S&E applications
- The largest CPU system on a US academic campus
- A national asset that complements other leadership-class computing investments in the US research ecosystem
- **Launched September 2019**



National Strategic Computing Initiative update

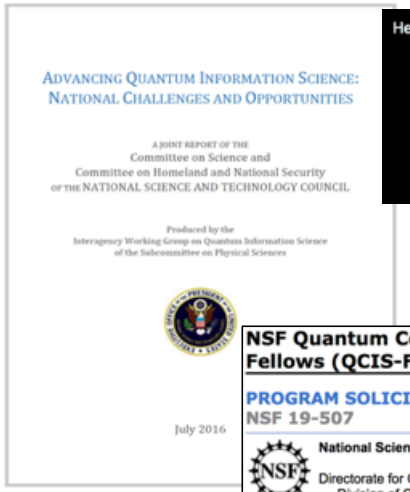


Three re-focused objectives:

- Pioneer new frontiers of digital and non-digital computation to address the scientific and technological challenges and opportunities of the 21st century
- Develop, broaden, and advance the Nation's computational infrastructure and ecosystem
- Forge and expand partnerships for the future of computing to ensure American leadership in science, technology, and innovation

Quantum Information Science & Engineering

- **Growing capacity** in the computing and information science research community through tenure-track faculty lines
- **Access to emerging quantum platforms** in industry
- **Novel algorithms, architectures, and software**
- Aligned with Quantum Leap Big Idea


ADVANCING QUANTUM INFORMATION SCIENCE:
NATIONAL CHALLENGES AND OPPORTUNITIES

A JOINT REPORT OF THE
Committee on Science and
Committee on Homeland and National Security
OF THE NATIONAL SCIENCE AND TECHNOLOGY COUNCIL

Produced by the
Interagency Working Group on Quantum Information Science
of the Subcommittee on Physical Sciences

July 2016

NSF Quantum Computing & Information Science Faculty Fellows (QCIS-FF)

PROGRAM SOLICITATION
NSF 19-507

National Science Foundation

Directorate for Computer & Information Science & Engineering
Division of Computing and Communication Foundations
Office of Advanced Cyberinfrastructure

Preliminary Proposal Due Date(s) *(required)* (due by 5 p.m. submitter's local time):

December 17, 2018

July 01, 2019

Submission Window Date(s) (due by 5 p.m. submitter's local time):

February 11, 2019 - February 25, 2019

Award Abstract #1730449

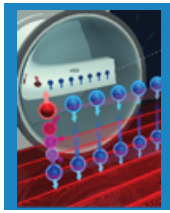
Collaborative Research: EPiQC: Enabling Practical-Scale Quantum Computation

NSF's 10 Big Ideas

RESEARCH IDEAS

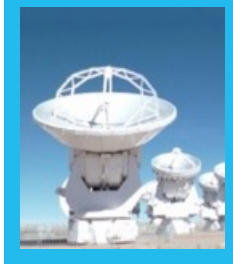
Harnessing Data for 21st Century Science and Engineering

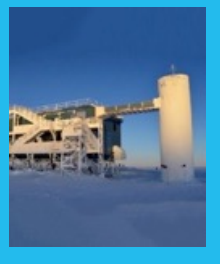
Future of Work at the Human-Technology Frontier



Quantum Leap: Leading the Next Quantum Revolution

Windows on the Universe





Understanding the Rules of Life

Navigating the New Arctic

PROCESS IDEAS

Mid-scale Research Infrastructure

NSF-INCLUDES

NSF 2026

Growing Convergent Research

NSF's 10 Big Ideas

- **Convergent research:** many disciplines required
- **Budget model:** five years, $30M/Big Idea/year, "outside" directorates
- **CISE engagement in the Big Ideas:** requires you
- ***New funding opportunities for FY 2020***

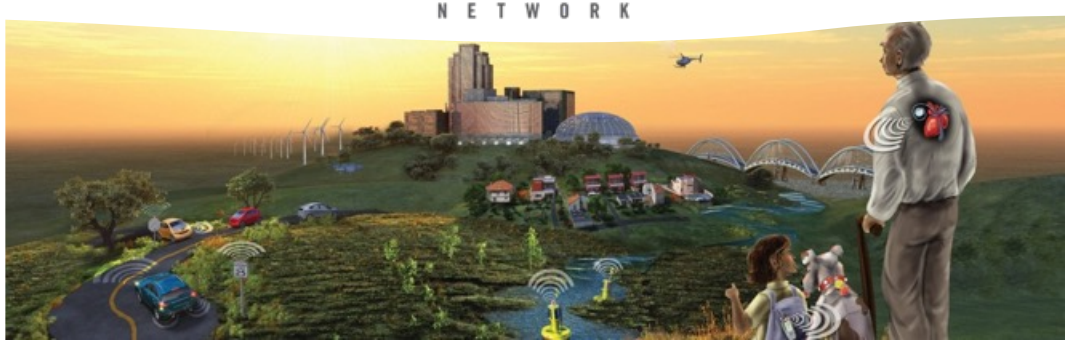
Smart & Connected Communities

- **Improving quality of life, health, well-being, and learning in communities**
- Integrating intelligent technologies with the natural and built environments
- Integrative research addressing technological, social dimensions
- Meaningful engagement of community stakeholders

CIVIC INNOVATION CHALLENGE

POWERING SMART & CONNECTED COMMUNITIES

METROLAB NETWORK



Broadening participation in computing pilot

- Medium, Large projects in core, CPS, SaTC **must have approved BPC plans** in place **by the time of award**
- Increased exposure, engagement → culture change
- Equipping program officers, reviewers to evaluate BPC activities in proposals
- Best practices, resources on BPCnet.org

BPCnet
RESOURCE PORTAL

Computing education & workforce

2007
BPC-A
Broadening Participation in Computing Alliances

2010
CS10K
Training 10,000 K-12 CS teachers

2015 RED
2016 CSforAll
REvolutionizing eng/cs Departments

2019
CUE

Computer Science for All (CSforAll)

Access to rigorous, engaging CS education for all K-12 students

New College Board Advanced Placement® exam launched

Computing in Undergraduate Education

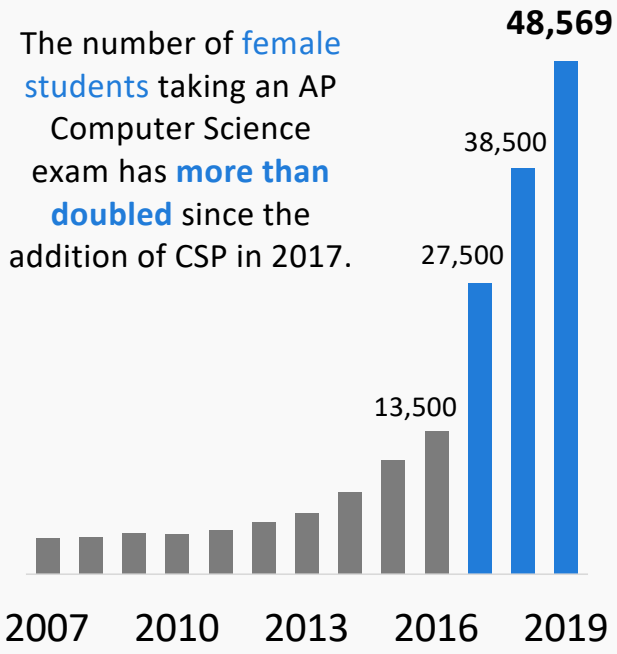
Integrating computing with other fields of knowledge, challenge areas

Cultivating "networked improvement communities"

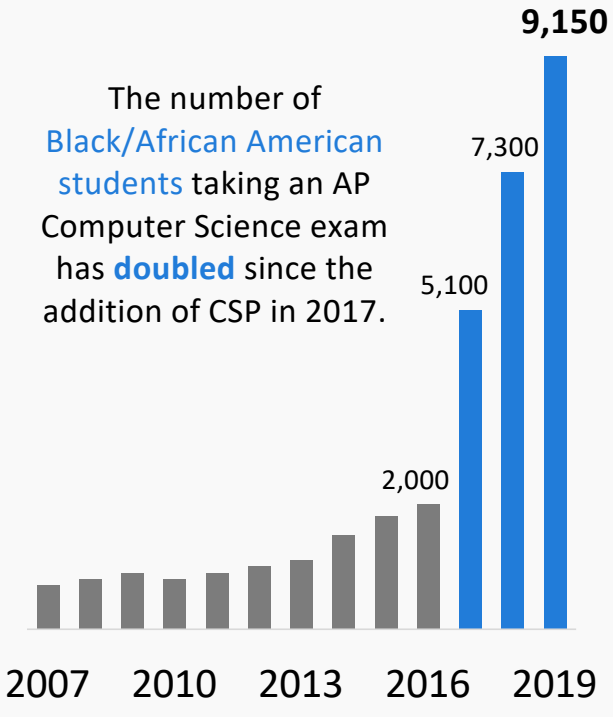
Encouraging integrating the **study of ethics**

Students taking AP® computer science exams

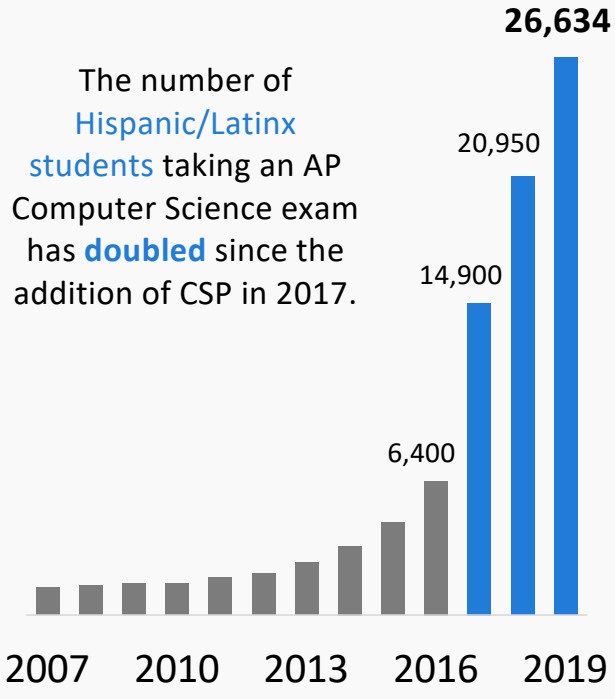
The number of female students taking an AP Computer Science exam has **more than doubled** since the addition of CSP in 2017.



The number of Black/African American students taking an AP Computer Science exam has **doubled** since the addition of CSP in 2017.

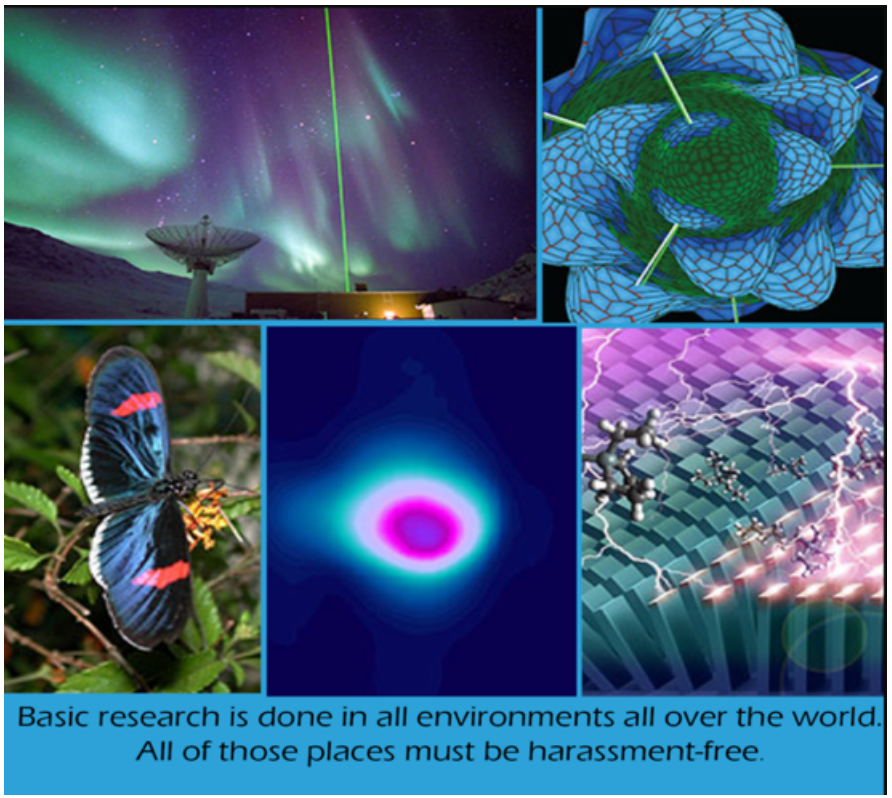


The number of Hispanic/Latinx students taking an AP Computer Science exam has **doubled** since the addition of CSP in 2017.



	2007	…	2016	2017	2018	2019
Women	18%	…	23%	27%	28%	29%
Underrepresented Minorities	12%	…	15%	20%	21%	22%

Term & condition on harassment



New measures to combat sexual harassment at grantee institutions:

- New award requirements
- Awardee organizations must have standards of behavior for harassment-free research workplaces
- Enhanced Web resources, including reporting, at nsf.gov/harassment

Outline


NSF/CISE Overview
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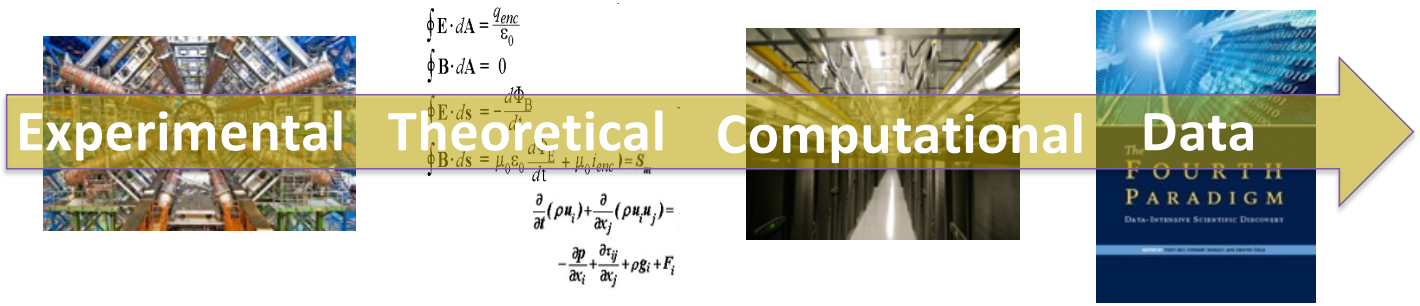
Growing importance of cyberinfrastructure



- Growth of computation, data as research paradigms
- CI and Large Facilities Workshop
- Education & workforce: the role of the CI Professional

CI CoE PILOT

Science & Security

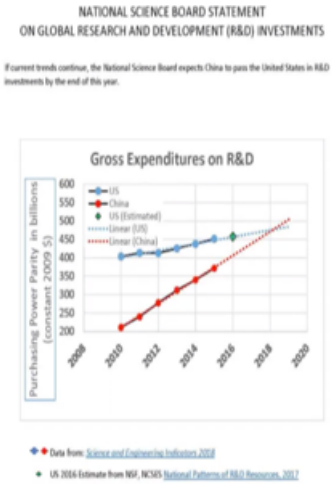
Statement of the NSB on Science & Security

"…As partners in the scientific enterprise, U.S. universities and colleges must help promote scientific openness and integrity and safeguard information that impacts national security and economic competitiveness. The NSB recommends that all institutions conducting fundamental research supported by the National Science Foundation embrace transparency and rigorously adhere to conflict of interest and conflict of commitment policies. The Board also encourages those institutions to educate their communities about how to protect the integrity of research."

--Oct. 23, 2018

Science & Security Panel at the July 2019 NSB meeting

Taken from Augustine/Lane Letter to House Science Committee 4/26/19



https://www.youtube.com/watch?v=lqO0-8vN-2M

Science & Security II

Securing the U.S. Research Enterprise from China's Talent Recruitment Plans

November 19, 2019 10:00AM

Location: SD-342, Dirksen Senate Office Building

Rebecca Keiser

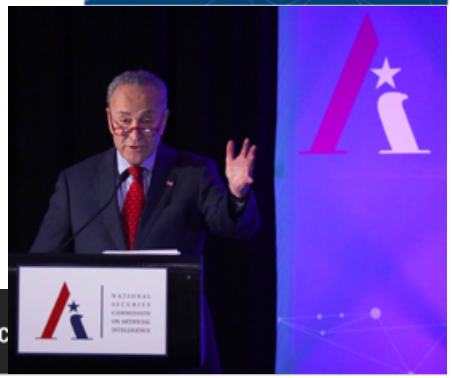
Office Head

International Science & Engineering

"The need to continue to attract and cultivate this talent has been reinforced by countless studies of the research enterprise, including most recently by the National Security Commission on Artificial Intelligence… "One of America's advantages is the fact that its universities, companies, and innovation culture are magnets for the world's best AI talent. We need to encourage that talent to come, contribute, and stay." Indeed, historically, a majority of foreign students receiving post-graduate training in the U.S. prefer to stay here once they receive their degrees. … The long-term stay rates, defined as remaining 10 years or more in the U.S., stood at 70% in computer and mathematical sciences in 2015. However, recent reports suggest this stay rate may be decreasing."

NSCAI, WH, and Sen. Schumer

"We are examining other ideas, including establishing an entity within the NSF analogous to the National Cancer Institute… or an interagency effort akin to the [NNI]."

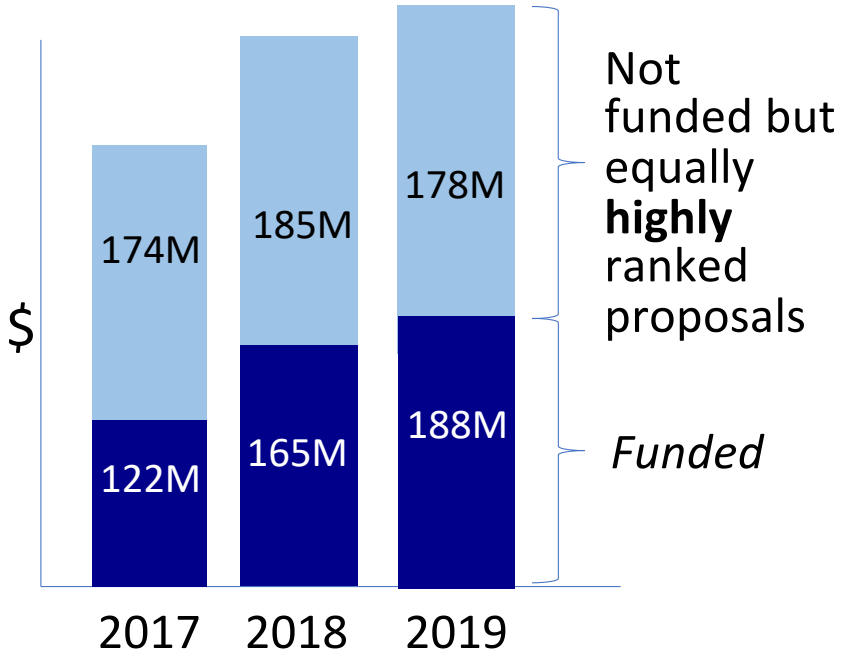


Science Contents News C

United States should make a massive investment in AI, top Senate Democrat says

By Jeffrey Mervis | Nov. 11, 2019 , 11:45 AM

Foundational AI proposals



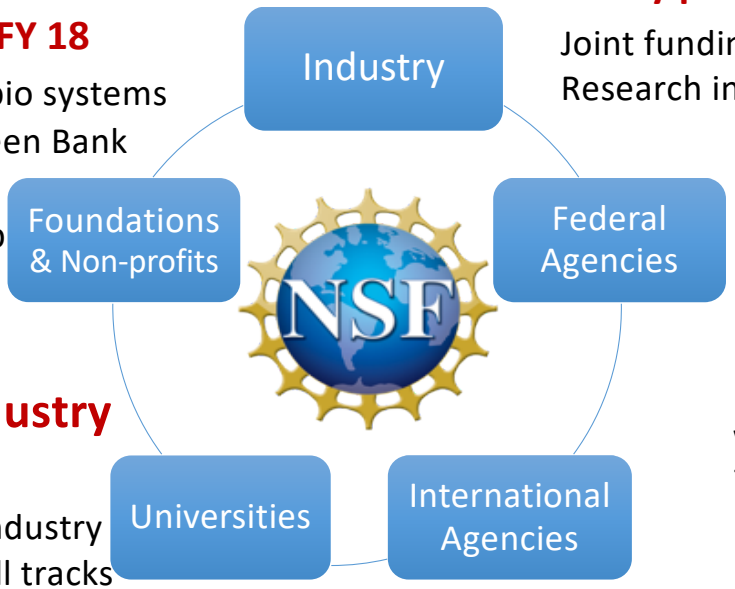
Scaling partnerships

4 foundation partnerships in FY 18

Simons Foundation: complex bio systems
Breakthrough Foundation: Green Bank Observatory
Stand Up To Cancer: IDEAS Lab
Gates Foundation: BREAD

8 industry partnerships in FY 18

Joint funding opportunities
Research infrastructure



57 interagency partnerships in FY 18

Joint funding opportunities
Research infrastructure
Workforce training
Individual projects

with 34 agencies/departments &
7 also included international partners

University-led, with industry partners

Convergence Accelerator: industry collaboration required for all tracks
I/UCRC: center co-funding ($1:$7 match, NSF:others). >1100 members in 75 I/UCRCs
Engineering Research Centers
GOALI: Grant Opportunities for Academic Liaison with Industry

30 international partnerships in FY 18 (estimated)

Joint funding opportunities
Research infrastructure
Individual projects

CISE + industry, FY 2014-FY 2019

Partner	No. joint solicitations	NSF investment	Partner investment
Semiconductor Research Corporation (SRC)	8	$37 million	$18 million
Intel Labs	6	$14.5 million	$15 million
VMware, Inc.	2	$8 million	$4 million
PAWR Industry Consortium (>25 companies)	1	$50 million	$50 million
Cloud credits via Amazon, Google, IBM, and Microsoft	2	$48 million	$12 million
Totals	**19**	**$157.5 million**	**$99.0 million**

CISE + other agencies, FY 2019

Program-Partner	#NSF Awards	NSF FY 2019 investment	Other Agency FY 2019 Investments
Collaborative Research in Computational Neuroscience (CRCNS) - NIH	20	$7.4 million	$22.3 million
Cyber-Physical Systems (CPS) – DHS/S&T, DOT/FHWA, NIH, USDA/NIFA	95	$40.1 million	$9.1 million
National Robotics Initiative (NRI) – USDA/NIFA, DOD/DARPA, AFOSR, DOE, ONR	44	$30.1 million	$4.7 million
Smart and Connected Health (SCH) - NIH	13	$12.0 million	$21.4 million

An *amazing* time to be in CISE!

Ubiquity

Computing is *everywhere* – across all of science and engineering, and all of society

Engagement

Computing intertwines with many *communities*

Urgency

Computing is *rapidly expanding and evolving*. There is tremendous opportunity … *now*!