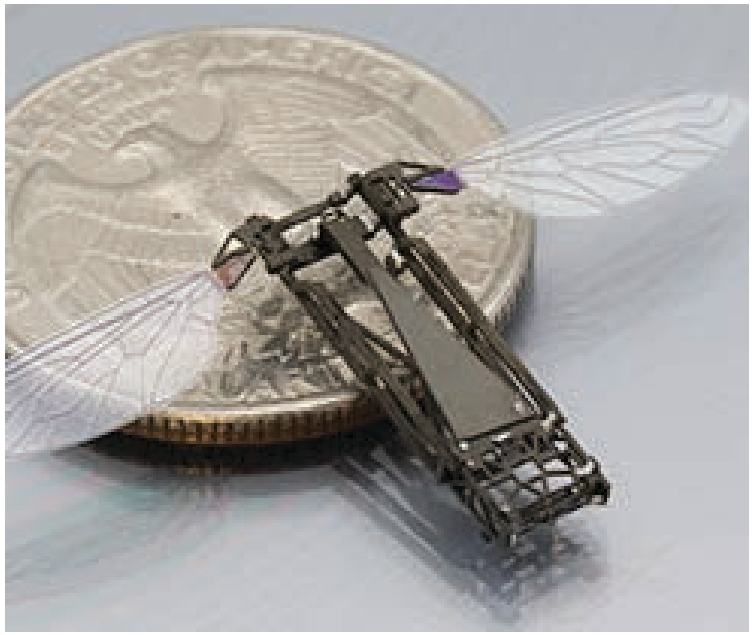
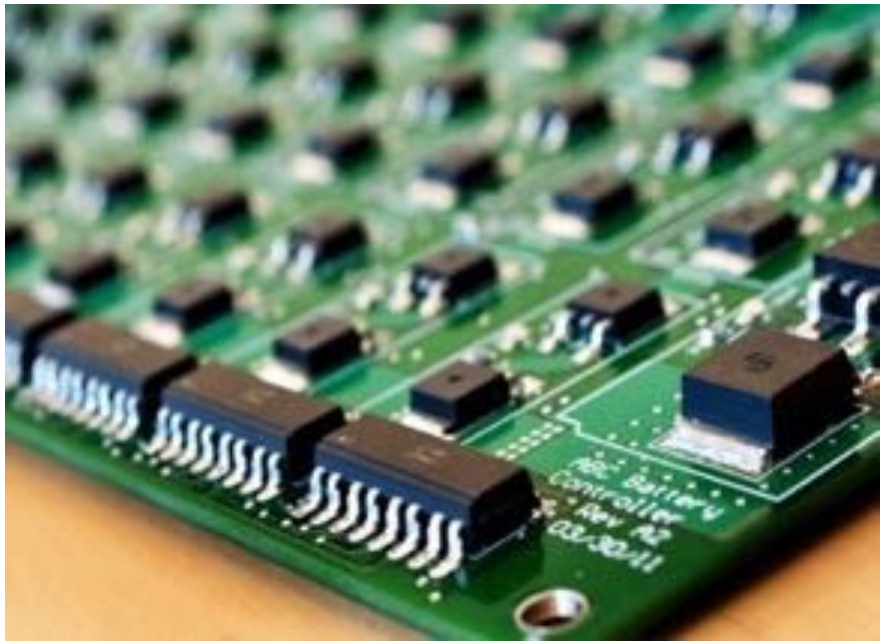




CCC Board Meeting: CISE Overview

Margaret Martonosi

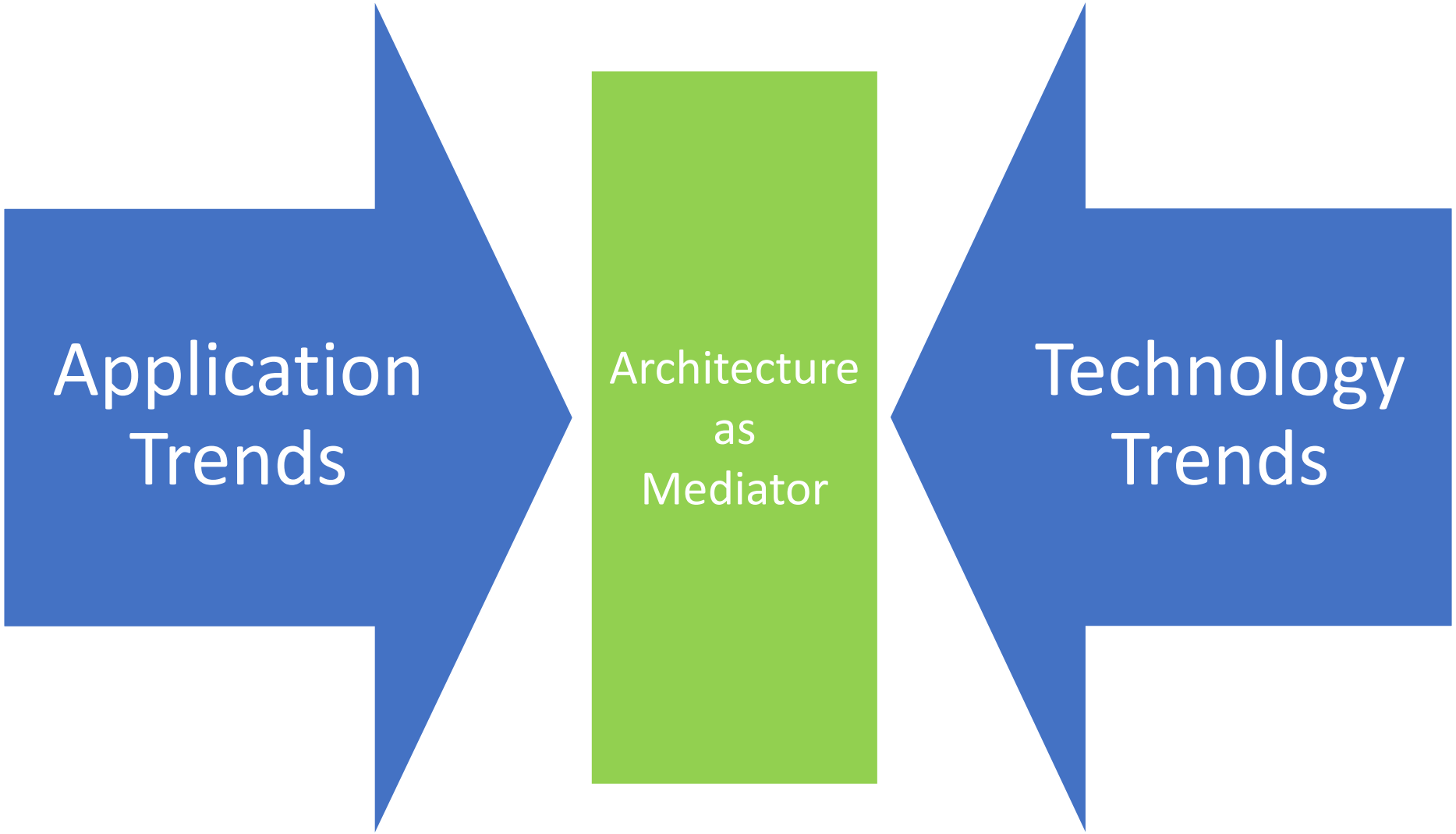
NSF Assistant Director for Computer and Information Science and Engineering (CISE)

March 24, 2020

NSF Coronavirus Webpage

- https://www.nsf.gov/news/special_reports/coronavirus/
- DCL on RAPIDs for research + computing resources
- Proposal deadline extensions
- PI and budget guidance

A few years ago, Me describing Architecture…



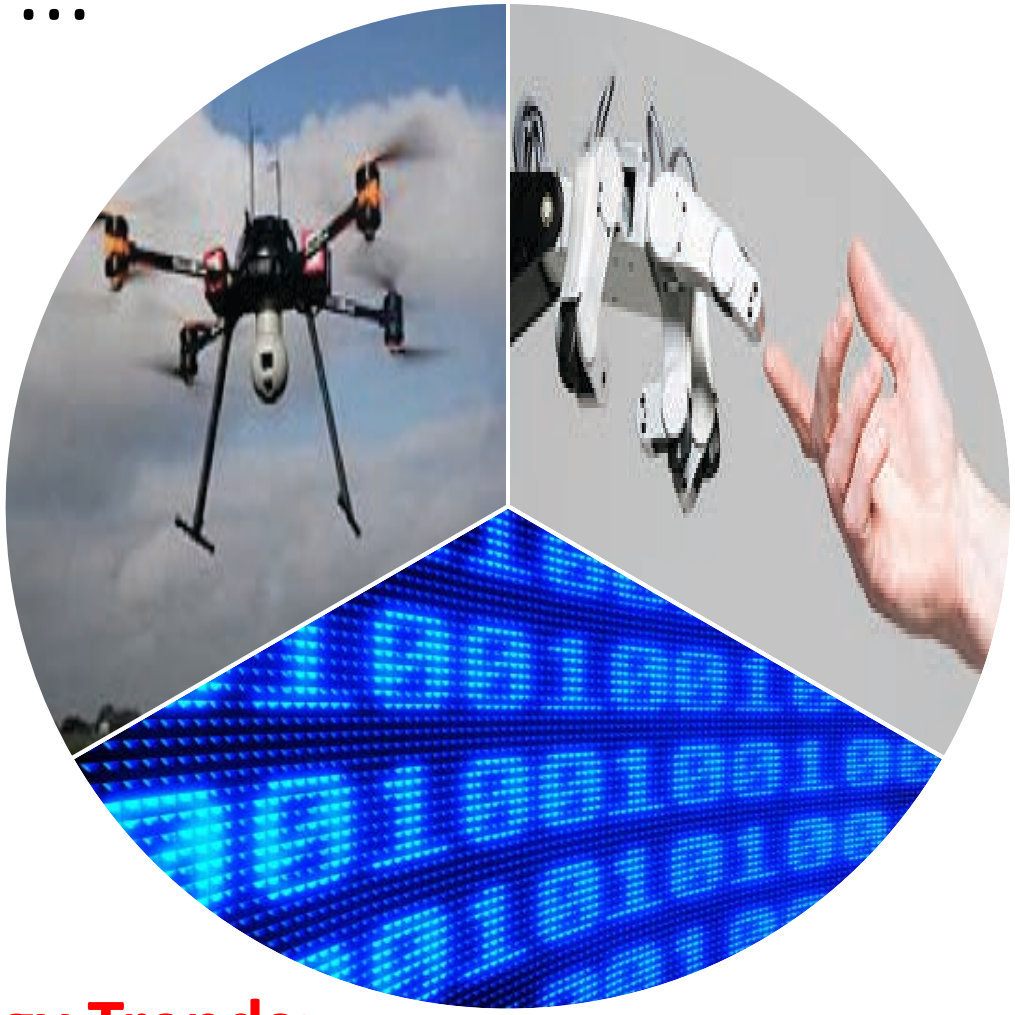
Computing Research in a Post-Moore World: Seismic Shift…

- **Context**: Technology and Application Trends are reshaping computing
- **Challenge**: Across many different topic areas, a fundamental need to design new interface layers & design practices.
- **Opportunity**: Could introduce sweeping change across many CISE research topics.
- Hardware 2.0 and beyond…
- Software 2.0 and beyond…
- Curriculum 2.0 and beyond...

Our field, today…

Interfacing to other Computers & the Environment:

- Distributed systems, Cyberphysical Systems, Networking, Wireless, …



Interfacing to humans and society

- Sociotechnical, HCI, Fairness, Privacy, Usability…

Influenced by Technology Trends:

- Emerging computing, communication, and interface technologies fundamentally reshaping the hardware and software systems built from them.

Economy

Science

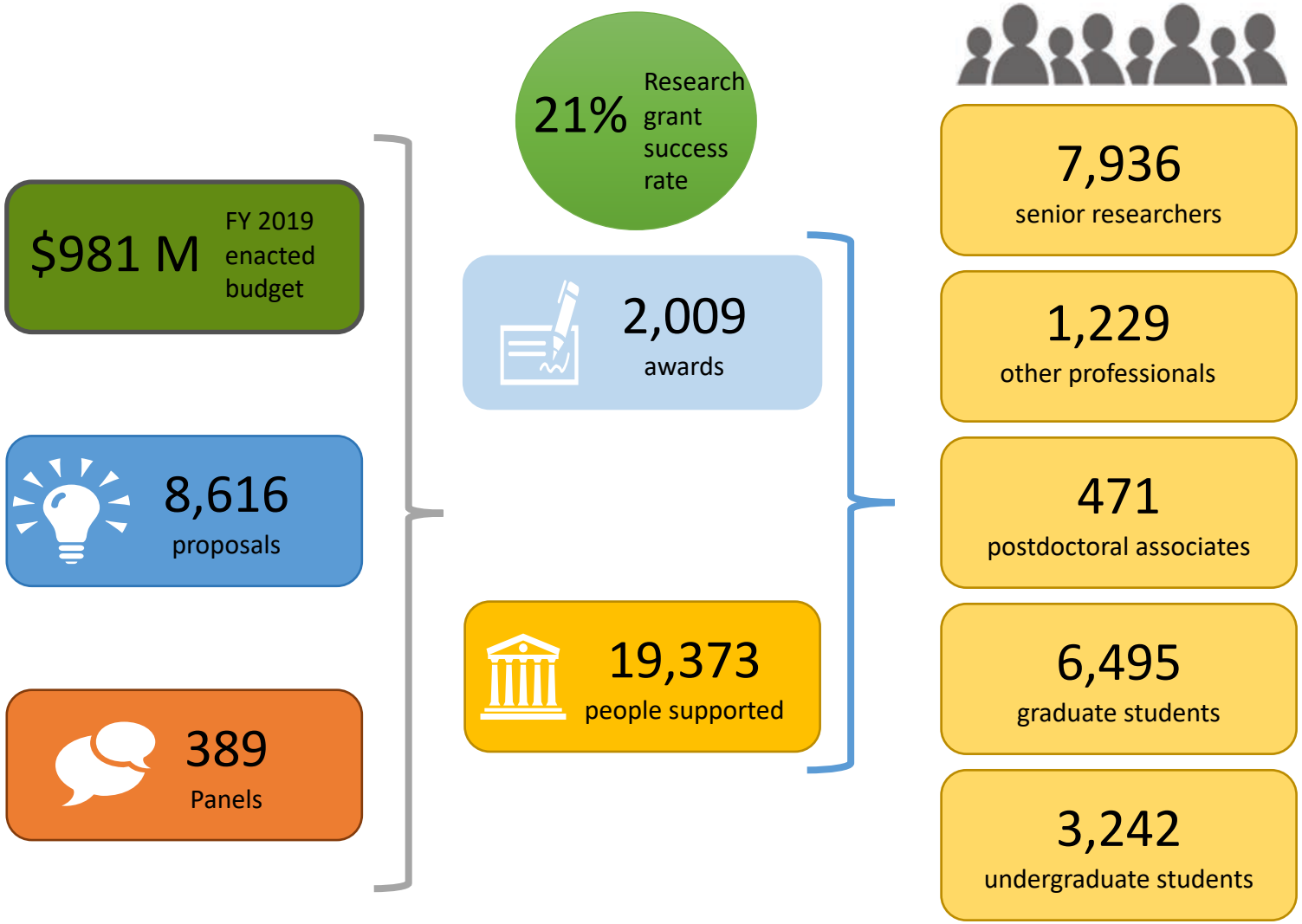
Democracy

Humanity

Today…

- NSF CISE and Budget Updates
- Program and Research Highlights
- Q&A

CISE by the numbers, FY 2019



Budget process: reminder

Markup, reconciliation of appropriation bills

THE WHITE HOUSE
WASHINGTON

BUDGET

NSF

BUDGET

Request

U.S. HOUSE OF REPRESENTATIVES

House Budget Resolution

UNITED STATES SENATE

Senate Budget Resolution

Budget process: FY 2020

FY 2020 Estimate:

- NSF: $8.28B
  (+2.5% over FY 2019 CP)
- CISE: TBD

(Reminder)
FY 2020 Request:

- NSF: $7.07B
- CISE: $883.04M

Markup, reconciliation of appropriation bills

December 20, 2019

THE WHITE HOUSE
WASHINGTON

BUDGET

NSF

Request

March 18, 2019

U.S. HOUSE OF REPRESENTATIVES

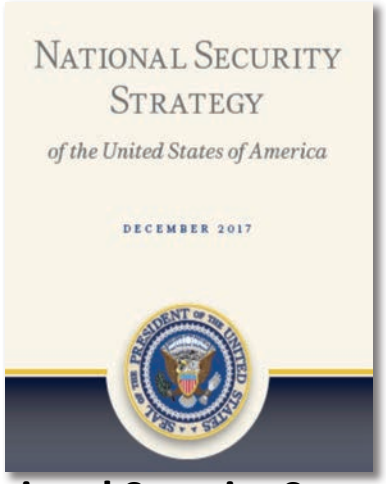
June 25, 2019
House Budget Resolution

UNITED STATES SENATE

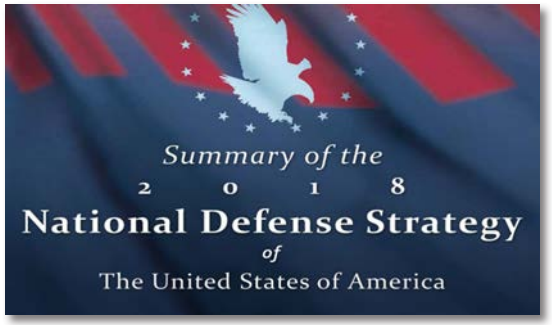
Senate Budget Resolution

Sept. 24, 2019

CISE Programs Align with Administration, Congressional Priorities



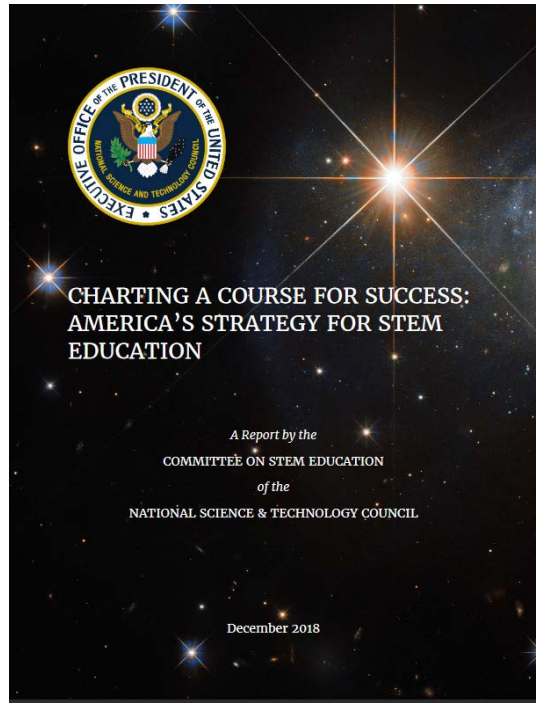
National Security Strategy



National Defense Strategy

AI Executive Order

National Quantum Initiative Act



Budget process: FY 2021

FY 2021 Request (over FY 2019 Actuals):

- NSF: $7.74B (-5.0%)
- R&RA: $6.21B (-5.6%)
- CISE: $1.06B (+7.8%)

Markup, reconciliation of appropriation bills

TBD

THE WHITE HOUSE WASHINGTON

BUDGET

NSF

BUDGET

Request

Feb. 10, 2020

U.S. HOUSE OF REPRESENTATIVES

TBD

House Budget Resolution

UNITED STATES SENATE

Senate Budget Resolution

TBD

FY 2021 request, detailed

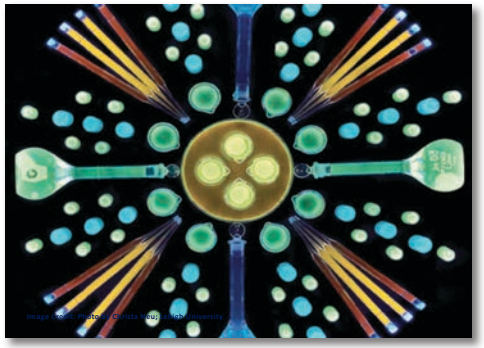
NATIONAL SCIENCE FOUNDATION FY 2021 BUDGET REQUEST TO CONGRESS (Dollars in Millions)					
				FY 2021 Request change over:	
				FY 2019 Actual	
NSF R&RA Budgets	**FY 2019 Actual**	**FY 2020 Enacted**	**FY 2021 Request**	**Amount**	**Percent**
BIO	$783.75	-	$704.95	-$78.80	-10.1%
CISE	985.12	-	1,062.40	77.28	7.8%
ENG	991.15	-	909.78	-81.37	-8.2%
GEO	969.88	-	836.61	-133.27	-13.7%
MPS	1,490.61	-	1,448.32	-42.29	-2.8%
SBE	271.17	-	246.84	-24.33	-9.0%
OISE	49.00	-	44.01	-4.99	-10.2%
OPP	488.68	-	419.78	-68.90	-14.1%
IA	547.31	-	538.73	-8.58	-1.6%
Research & Related Activities	**$6,578.14**	**$6,737.20**	**$6,213.02**	**-$365.12**	**-5.6%**
Education & Human Resources	**$934.53**	**$940.00**	**$930.93**	**-$3.60**	**-0.4%**

CISE has long addressed national priorities

AI, Big Data, & Robotics

Cybersecurity

Manufacturing & Microelectronics



Quantum Information Sciences

Future Computing Systems

Smart Communities

Computer Science Education

Advanced Wireless Research

Artificial Intelligence (AI)

+$402.88M in AI research in FY 2021 (over FY 2019 actuals)

Cross-directorate programs:

- Collaborative Research in Computational Neuroscience (BIO, CISE, ENG, MPS, SBE, OISE, NIH, international)
- Cyber-Physical Systems (CISE, EHR, ENG, SBE, DHS, DOT, NIH, USDA)
- NRI-2.0: Ubiquitous Collaborative Robots (CISE, EHR, ENG, SBE, AFOSR, DARPA, DOE/EM, NASA, ONR,USDA/NIFA)
- Smart & Connected Communities (CISE, EHR, ENG, SBE)
- Smart and Connected Health (CISE, ENG, SBE, NIH)

New in FY 2019 – FY 2021:

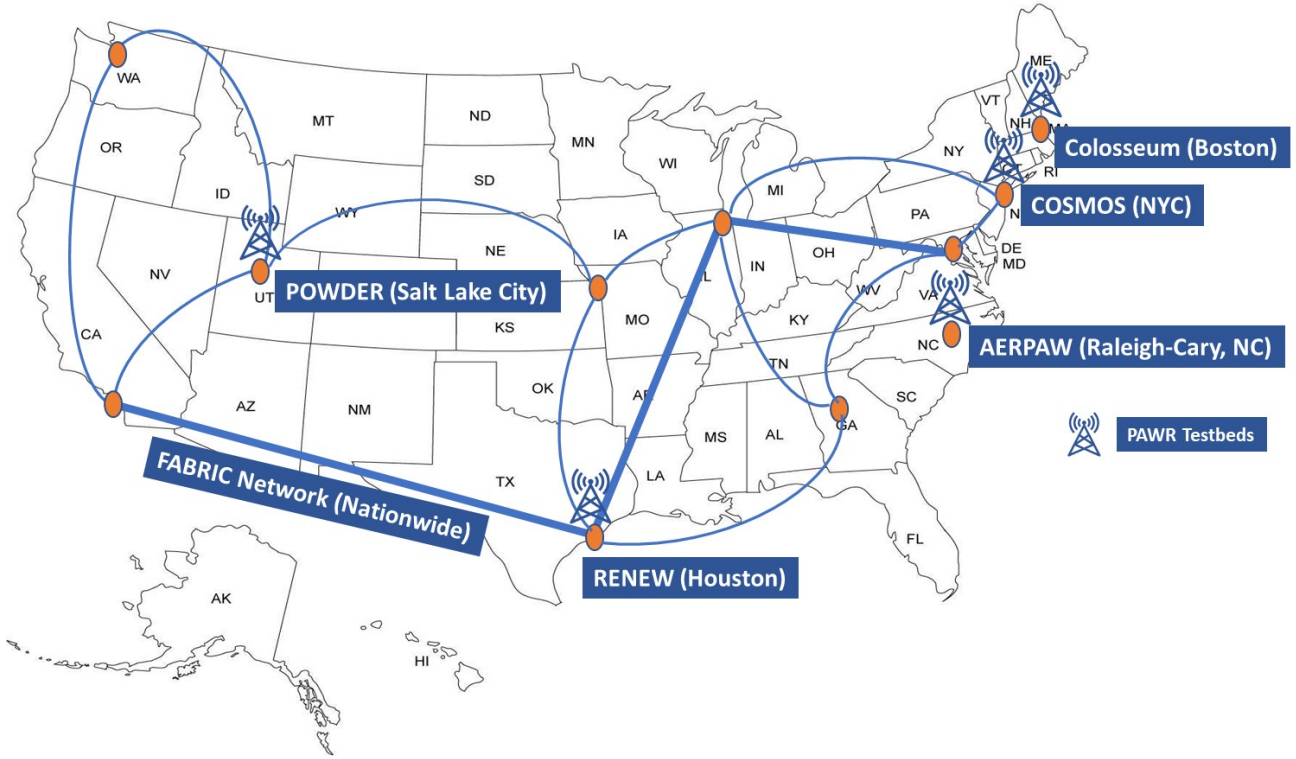
- AI and Society (CISE, SBE, Partnership on AI)
- Real-Time Machine Learning (CISE, ENG, DARPA)
- CISE FEAT DCL: Fairness, Ethics, Accountability, and Transparency (NSF 19-016)
- Fairness in AI (CISE, SBE, Amazon)
- AI Research Institutes (NSF-wide, DHS/S&T, DOT/FHWA, USDA/NIFA, VA)

AI and the other IotF: *opportunities for cross-cutting, convergent research, catalyzing new Industries*

Advanced Wireless (AWR) Research

+$15.60M in AWR research in FY 2021 (over FY 2019 actuals)

- **Platforms for Advanced Wireless Research (PAWR):**
  Public-private partnership with 32 companies/associations, totaling $100M over 5 years, to build 4 city-scale experimental platforms in sub-6 GHz and mmWave frequencies, including UASs.



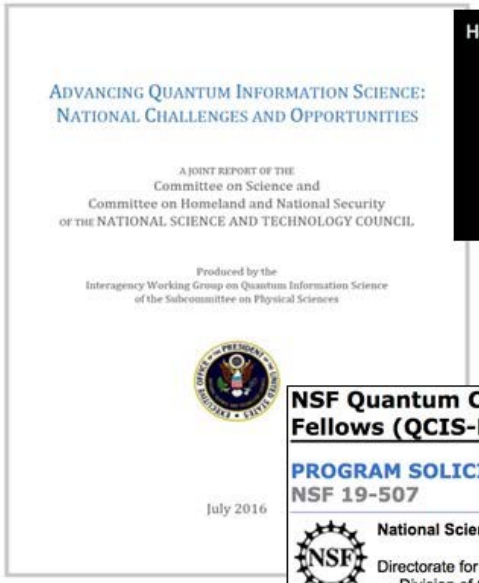
New in FY 2020 – FY 2021:

- Spectrum and Wireless Innovation enabled by Future Technologies (SWIFT) (ENG, CISE, MPS, GEO)
- NSF/Intel Program on Machine Learning for Wireless Networks (MLWiNS) ENG, Intel)

Quantum Computing and Information Science

+$120.22M in QIS research in FY 2021 (over FY 2019 actuals)

- **Growing capacity** in the computing and information science research community through tenure-track faculty lines
- **Novel algorithms, architectures, and software**, enabling quantum information processing and leading to next-generation quantum systems
- **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

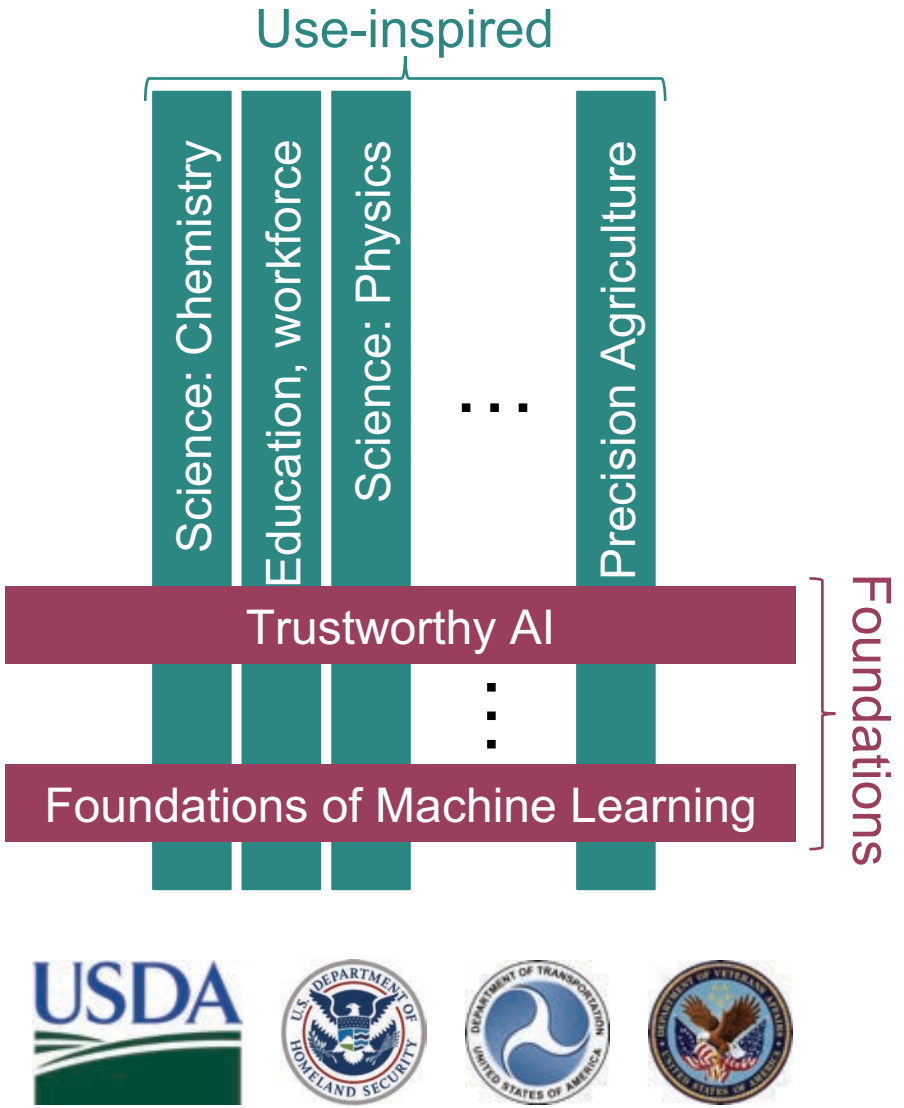
Award Abstract #1730449

Collaborative Research: EPiQC: Enabling Practical-Scale Quantum Computation

Program and Research Highlights

National Artificial Intelligence Research Institutes

- National hubs for universities, federal agencies, industry, and nonprofits to advance AI research and education
- In FY 2020:
  - *Planning grants* for future Institutes
  - Launching up to six multidisciplinary, multi-institutional research *Institutes*
- Anticipated investment: ~$200 million over six years, beginning in FY 2020



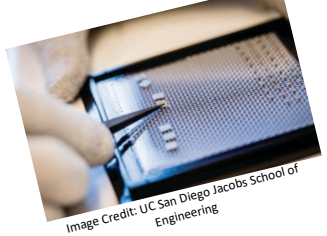


Image Credit: UC San Diego Jacobs School of Engineering


Image Credit: UC San Diego Jacobs School of Engineering

Expeditions in Computing

25! ~~22~~ awards since 2007

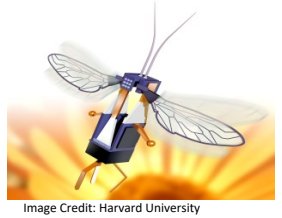


Image Credit: Harvard University

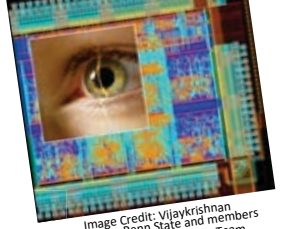


Image Credit: Vijaykrishnan Narayanan, Penn State and members of Visual Cortex on Silicon Team

Molecular Programming/ Synthetic Biology

- *Evolvable Living Computing -- Understanding and Quantifying Synthetic Biological Systems' Applicability, Performance, and Limits*, Boston U, MIT, Lincoln Labs, 2016
- *Molecular Programming Architectures, Abstractions, Algorithms and Applications,* Caltech, Harvard, UCSF, UW, 2013
- *The Molecular Programming Project*, CalTech, UW, 2008

Sustainability & Environment

- *CompSustNet: Expanding the Horizons of Computational Sustainability*, Cornell, Bowdoin College, California Institute of Technology, CMU, Georgia Tech, Howard, Oregon State, Princeton, Stanford, UMass-Amherst, USC, Vanderbilt, 2016
- *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

Limits of Computation

- *Enabling Practical-scale Quantum Computing*, U of Chicago, 2018
- *The Science of Deep Specification,* Princeton, UPenn, Yale, MIT, 2016
- *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
- *Understanding, Coping with, and Benefiting from Intractability,* Princeton, Rutgers, NYU, Institute for Advanced Study, 2008

Healthcare & Wellbeing

- *Computational Photo-Scatterography: Unraveling Scattered Photons for Bio-imaging,* Rice, 2018
- *Visual Cortex on Silicon*, Penn State, USC, Stanford, York College, UCSD, SCLA, Pitt, MIT, 2013
- *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, CMU, 2010

Robotics

- *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

Wireless & Internet

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

Formal Modeling and Verification

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

Big Data

- *Secure, Real-Time Decisions on Live Data, Ion Stoica,* UC Berkeley, 2018
- *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)

Revised Expeditions in Computing program

- Revisions recognize changing nature of frontier problems:
  - Greater complexity
  - Need for multi-disciplinary collaborations to enhance societal impact
  - Increasingly data-driven, computationally-intensive
- Longer runway, enabling a path toward sustainability
- Preliminary proposals due June 16, 2020
- Innovation Transition (InTrans) awards:
  - For teams nearing end of their Expeditions as well as SaTC and CPS Frontier projects.
  - Goal: Continue the long-term vision and objectives of CISE's center-scale projects. Through In Trans awards, CISE will provide limited funds to match industry support.

Expeditions characteristics	Beginning with 2020 deadline	Projects initially funded 2008-2020
Project funding level	Up to $15 million	Up to $10 million
Project duration	7 years (acceleration + steady-state + wrap-up phases)	5 years
Broadening participation in computing (BPC)	Dedicated funding and a BPC coordinator required	Not a requirement
Project coordinator	Dedicated project coordinator required	Not a requirement

SAGE

A Software-Defined Sensor Network - Cyberinfrastructure for ***AI at the Edge***

Science Justification

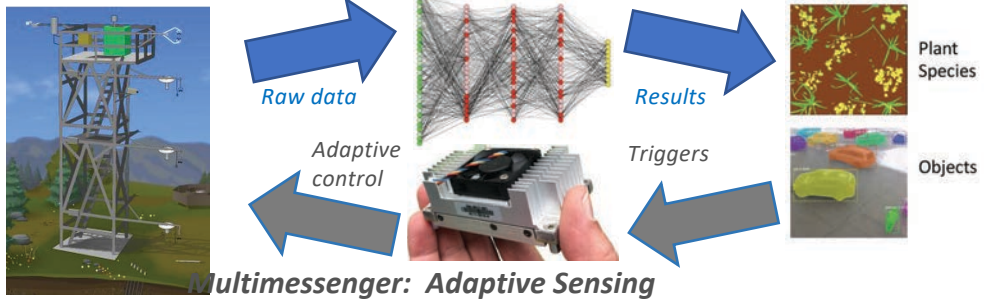
- Understanding resilience —why do ecosystems, cities, neighborhoods respond differently to phenomena such as gradual changes in ecological diversity, increased severe weather, or catastrophic events? What are the mechanisms of resilience, or indices of fragility?

Research Community Benefits

- New cyberinfrastructure for exploring machine learning in a national-scale instrument network
- Flexible national-scale measurement infrastructure
- New measurements via software-defined sensors

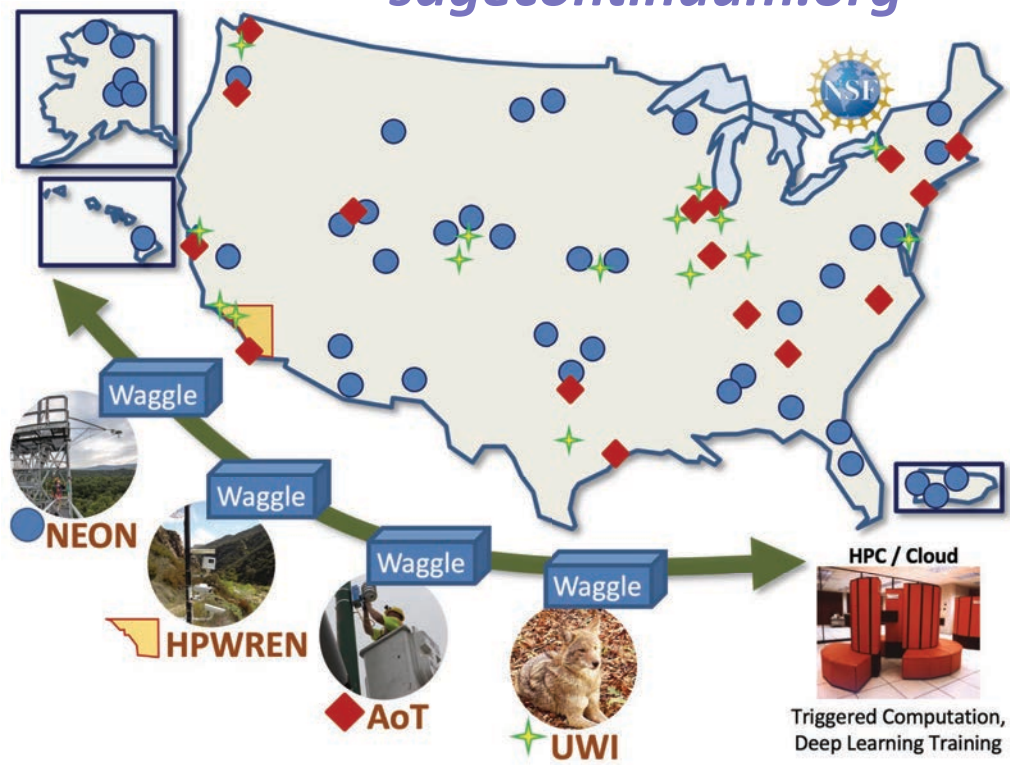
Cyberinfrastructure Use Modalities

- Open Data, Open Calibration, Education
- Triggered Computation
- Scheduled Edge Computation
- Machine Learning for the Edge (AI@Edge)



Multimessenger: Adaptive Sensing

sagecontinuum.org



Education & Training

Broadening Participation

Leadership Team


Pete Beckman
(NU; Director)


Nicola Ferrier
(NU; Deputy Dir.


Ilkay Altuntas
(SDSC; Data)


Charlie Catlett
(UChicago; AoT)


Scott Collis
(NU; ARM)


Valerie Taylor
UChicago; Broader Impacts)


Jim Olds
(GMU; Life Sci, Risk)


Dan Reed
(Utah; Architecture)


Eugene Kelly
(CSU; NEON)


Irene Qualters
(LANL; Advisory Committee Chair)

SAGE: A cyberinfrastructure to bring diverse disciplinary expertise to bear on complex questions, *revealing the hidden layer of mechanisms and relationships to understand the causality* inherent in these systems and at their intersections. SAGE will enable convergent science teams to integrate concepts and methods from different disciplines and conducting research on shared infrastructure that is generative and diverse.

Award # 1935984 for $9,026,927, 3-year duration

SAGE

A Software-Defined Sensor Network - Cyberinfrastructure for AI at the Edge

sagecontinuum.org

Science Justification

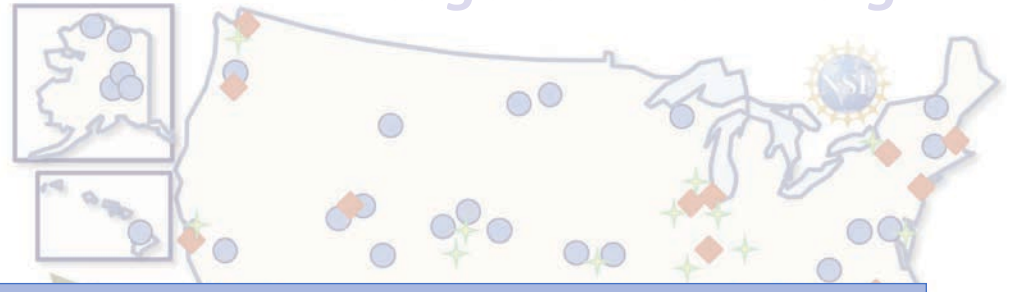
- Understanding resilience —why do ecosystems, cities, neighborhoods respond differently to phenomena such as gradual changes in ecological diversity, increase
- the mechanisms

Research Commu

- New cyberinfrast
- scale instrument
- Flexible national-
- New measureme

Cyberinfrastructure

- Open Data, Oper
- Triggered Compu
- Scheduled Edge C
- Machine Learning

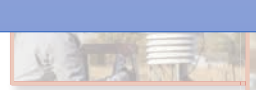


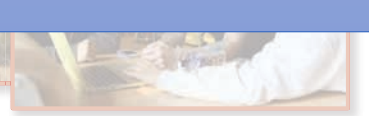
- **Funded through Mid-Scale Research infrastructure program as one of NSF's Big Ideas.**
- ***Keep an eye out for future Mid-Scale Research Infrastructure solicitations.***
- ***Think broadly about what "infrastructure" is.***
  -> Data as infrastructure!

Raw da

Ac co

Multimessenger: Adaptive Sensing





Broadening Participation

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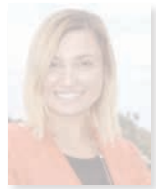

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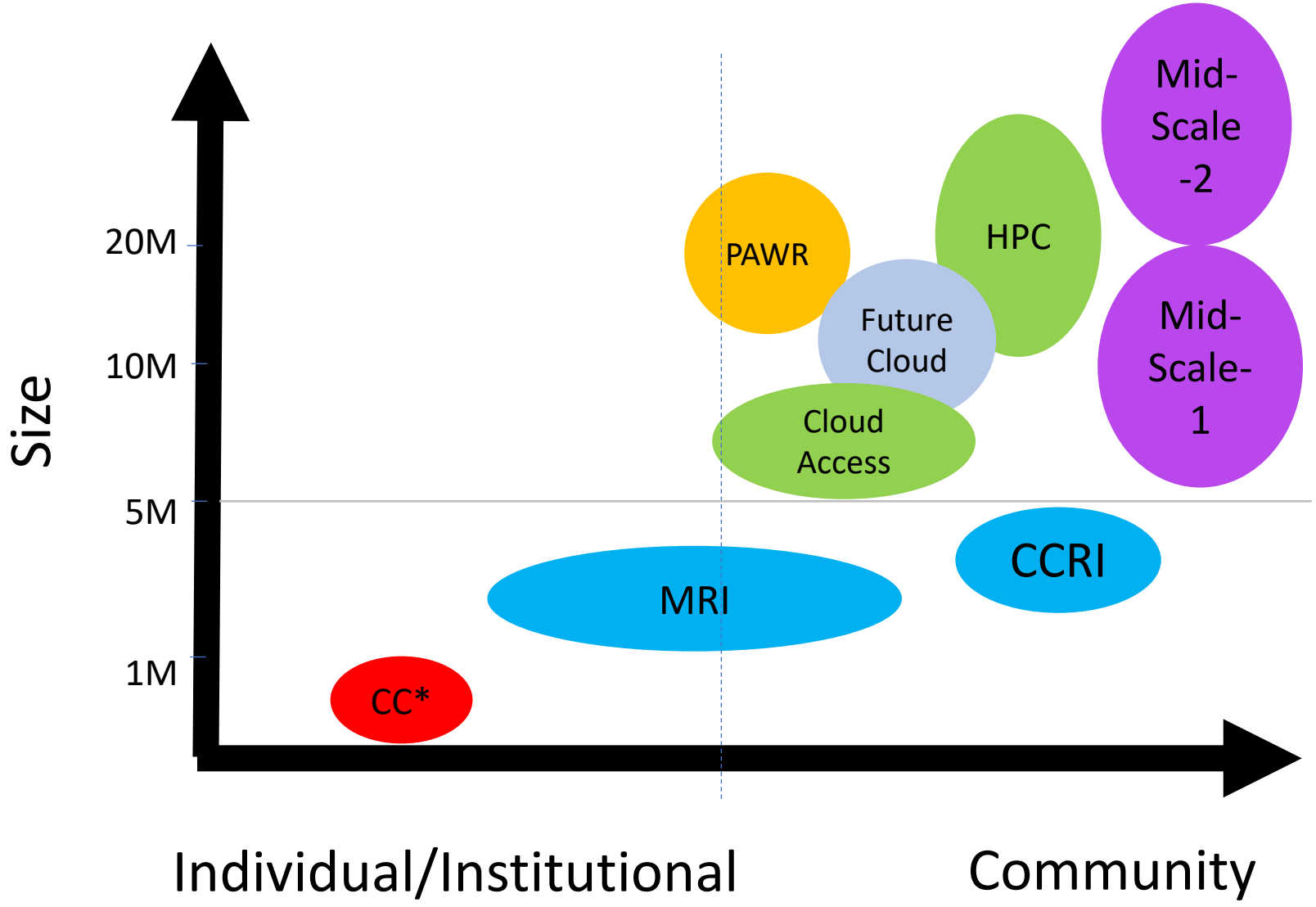
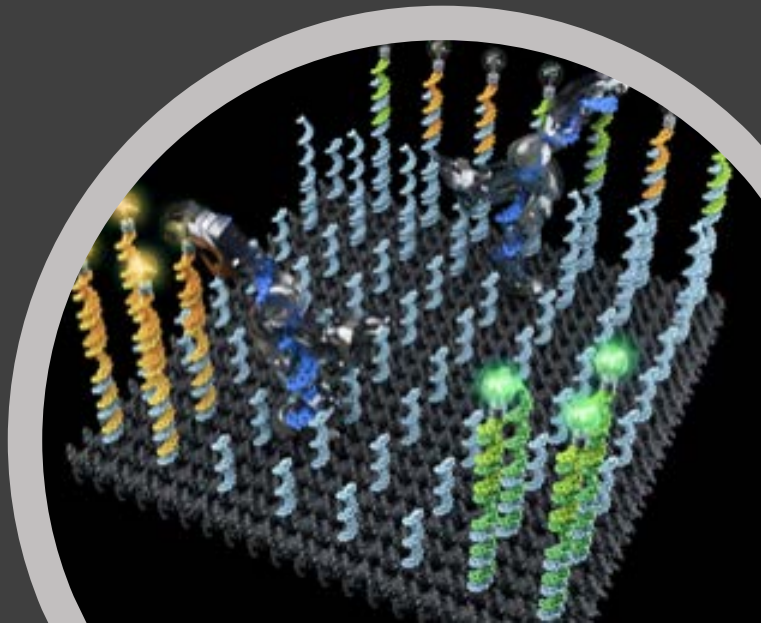
CISE Infrastructure Programs



Research Highlights

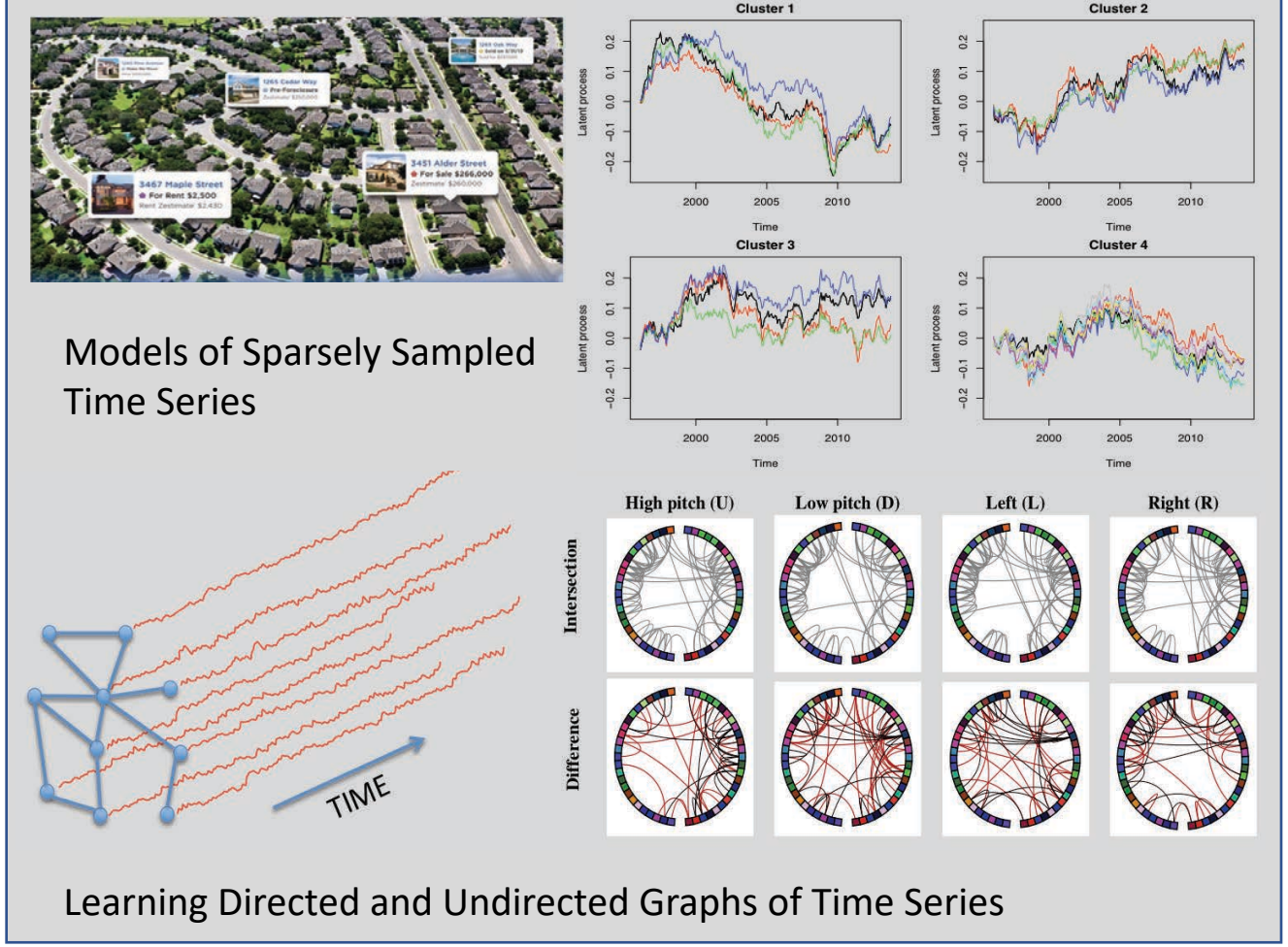
Programming Molecules

- **CCF-1351081**: Robust and Systematic Molecular Engineering with Synthetic DNA Neural Networks and Collective Molecular Robots (CAREER)
  - PI: Lulu Qian (Caltech)
  - *Foundational research into molecular programming, a new field that uses insights and techniques from computation to design and 'program' complex molecular systems."*
- **Motivating applications**: Precision medicine, Programmable materials.
- **Achievements**: Computing with DNA, neural networks with DNA, molecular robots, tic-tac-toe using DNA, …
- **Press**: Science, Nature, LA Times, ABC News, Newsweek, Smithsonian, …



CAREER: Scaling up Modeling and Statistical Inference for Massive Collections of Time Series

Fox, Emily B.
University of Washington
IIS - 1350133



Models of Sparsely Sampled Time Series

Learning Directed and Undirected Graphs of Time Series

- Goal: Discover structured relationships in massive time series where the individual data streams often include only infrequent observations such that each alone does not provide sufficient data for accurate inferences (e.g., spread of influenza, crime prediction, consumer trends).
- Approach: Bayesian nonparametric approach, integrating and advancing ideas from machine learning, systems, engineering, and statistics.
- Results:
  - Open source software
  - Coursera specialization in Machine Learning
  - 70+ publications; 3,000+ citations
- Broader impacts: Economic study of the housing sector, homelessness modeling, and neuroscience (how networks in the brain are activated in response to specific tasks, as well as in understanding gene regulatory networks)
- Education, BPC: ML courses: Grad, Undergrad CS, non-CS, high school, summer school; female and underrepresented students mentoring; Workshop on "The Delicate Career-Family-Life Balance, Career Trajectories, and Other Advice“
- More:
  - New award: IIS – 1607468, CRCNS: Bayesian Modeling of Interacting Time Series to Discover Cortical Networks Associated with Auditory Processing Dysfunction
  - 3 wonderful children

Stay tuned this year

- CISE/SBE collaborations: Virtual workshops on topics of joint interest
- Mid-scale Research Infrastructure Calls: Send your Best Ideas!
- PPoSS: First proposals and rollout
- AI Research Institutes: First round grantees announced
- SaTC No-deadlines experiment continuing
- BPC Pilot Progress
- And much more!

Join Us!

Students

- Research Experiences for Undergraduates (REU)
- NSF Graduate Fellowships

Faculty

- Send us your great proposals
- Proposal Writing Workshops
- Tell us your research triumphs
- Be an NSF Panel Reviewer
- Be an NSF Rotator!

NSF Coronavirus Webpage

- https://www.nsf.gov/news/special_reports/coronavirus/
- DCL on RAPIDs for research + computing resources
- Proposal deadline extensions
- PI and budget guidance

Pointers and Discussion Questions

- CAREER Proposal Writing Workshop:
  - Going virtual
- Thoughts on No deadlines? Feedback on SATC?
- Trends in jobs/hiring?