Defense Advanced Research Projects Agency and Innovation

Dr. Kathleen Fisher, Director
Information Innovation Office (I2O)

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STRATEGIC SURPRISE

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February 7, 1958 – DoD Directive 5105.15

February 7, 1958
NUMBER 5105.15

Department of Defense Directive

SUBJECT Department of Defense Advanced Research Projects Agency

I. PURPOSE

The purpose of this directive is to provide within the Department of Defense an agency for the direction and performance of certain advanced research and development projects.

II. RESPONSIBILITY AND AUTHORITY

A. Establishment

In accordance with the provisions of the National Security Act of 1947, as amended, and Reorganization Plan No. 6 of 1953, there is established in the Office of the Secretary of Defense the Department of Defense Advanced Research Projects Agency. The Agency will be under the direction of the Director of Advanced Research Projects.

B. Responsibility

The Agency shall be responsible for the direction or performance of such advanced projects in the field of research and development as the Secretary of Defense shall, from time to time, designate by individual project or by category.

C. Authority

Subject to the direction and control of the Director:

1. The Agency is authorized to direct such research and development projects being performed within the Department of Defense as the Secretary of Defense may designate.

2. The Agency is authorized to arrange for the performance of research and development work by other agencies of Government, including the military departments, as may be necessary to accomplish its mission in relation to projects assigned.

3. The Agency is authorized to enter into contracts and agreements with individuals, private business entities, educational, research or scientific institutions including federal or state institutions.

4. The Agency is authorized to acquire or construct such research, development and test facilities and equipment as may be approved by the Secretary of Defense, in accordance with applicable statutes. However, existing facilities of the Department of Defense shall be utilized to the maximum extent practicable.

III. ORGANIZATION

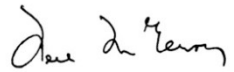
A. The Director of Advanced Research Projects shall report to the Secretary of Defense.

B. The Department of Defense Advanced Research Projects Agency shall be provided such personnel and administrative support as may be approved by the Secretary of Defense.

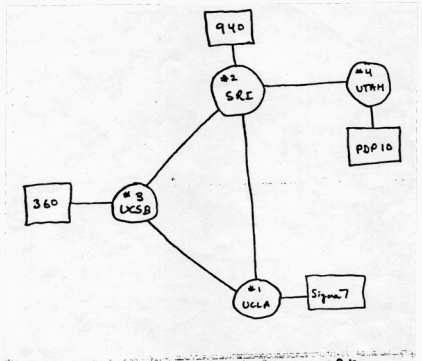
C. Other officers and agencies of the Office of the Secretary of Defense within their respective areas of responsibility shall provide support to the Director of the Advanced Research Projects Agency as may be necessary for him to carry out his assigned functions.

IV. EFFECTIVE DATE

This directive is effective immediately.



Information Innovation

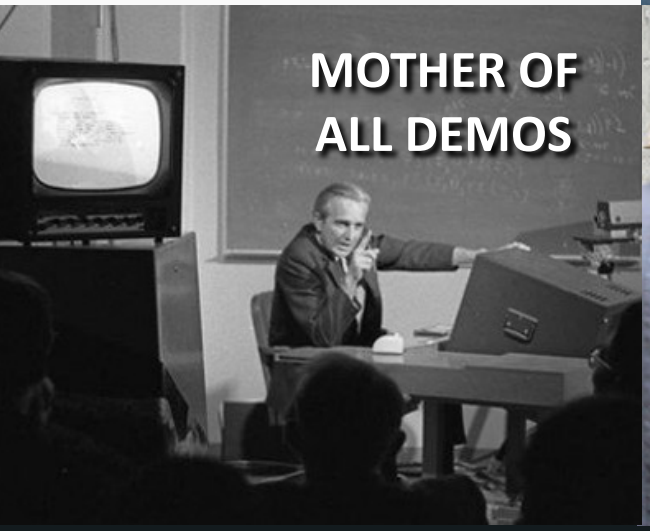


THE INTERNET

ADDRESS SPACE LAYOUT RANDOMIZATION

RED BALLOON CHALLENGE

CYBER GRAND CHALLENGE



MOTHER OF ALL DEMOS

LANGUAGE TRANSLATION

AUTONOMOUS VEHICLES

PERSONALIZED ASSISTANT THAT LEARNS

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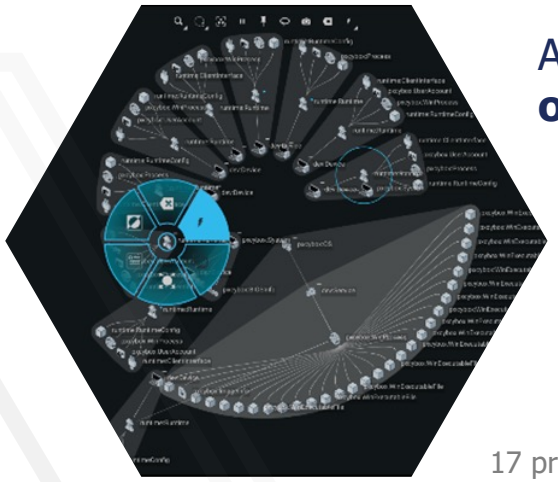
Information Innovation Office (I2O)

Proficient **artificial intelligence**

11 programs + 5 AI explorations



Advantage in **cyber operations**

17 programs

Confidence in the **information domain**

6 programs

Resilient, adaptable, and **secure systems**

15 programs

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DARPA is

Culture

People

Performers

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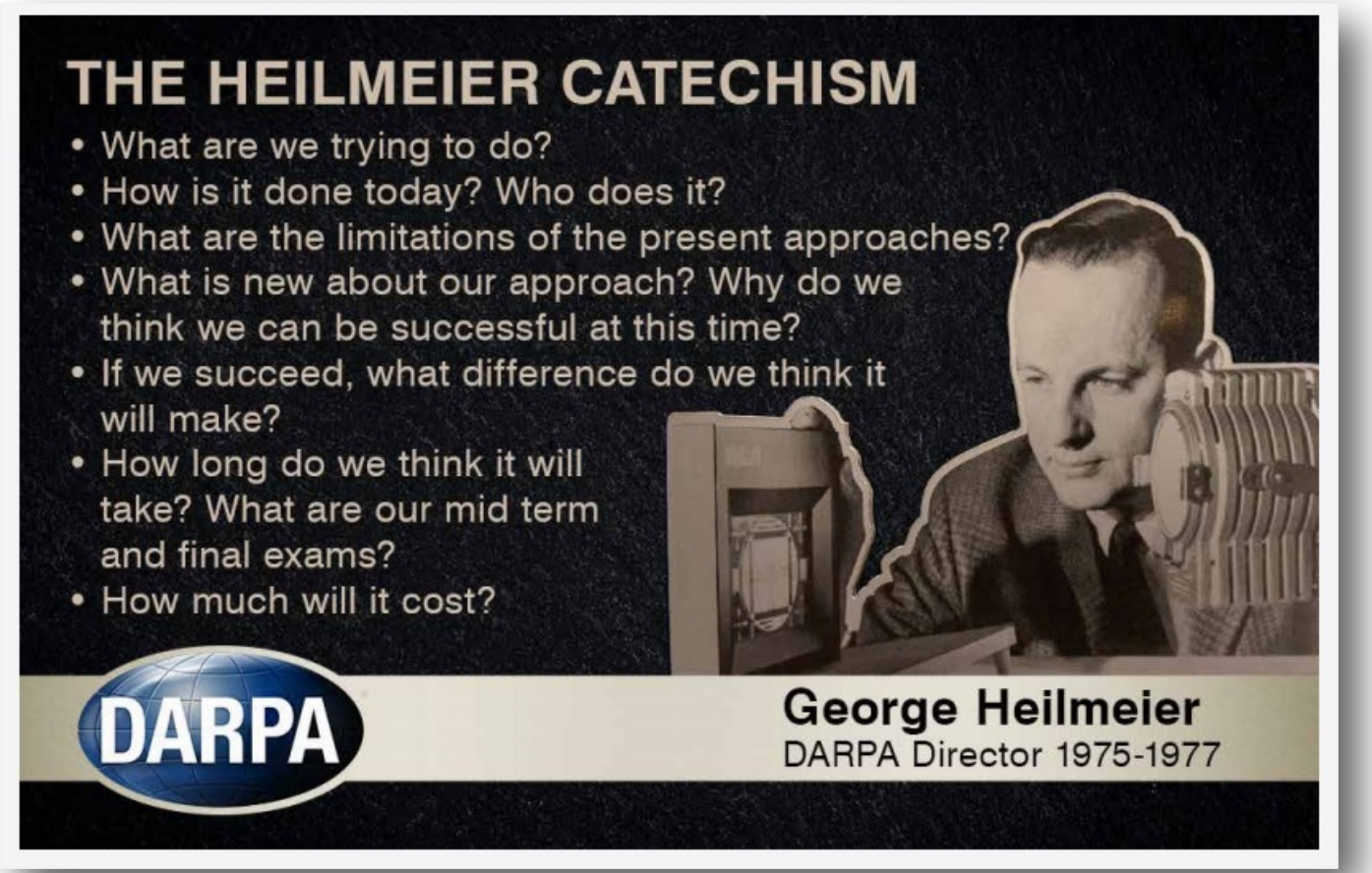
Culture



Mission: prevent strategic technological surprise

- Willingness to take risks and tolerate failure
- Entrepreneurial
- "Projects" focus on proving something is possible, then move on
    - Keep ideas fresh through planned turnover in personnel
- Programs executed by competitively selected performers external to DARPA
- DARPA offices organized around broad technical thrusts
    - Flat organization with the program manager as the nucleus

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People

Program managers and their teams are the core of the organization

- Delegated authority to execute programs
- Trusted to manage significant funds to impact problems facing national security
- Are passionate about their field
- Came here to start a program that solves a problem they could not solve anywhere else
- Incredible opportunity to
  - Serve the country
  - Solve a problem with an impact to national security
  - Develop a network among the brightest people on the planet

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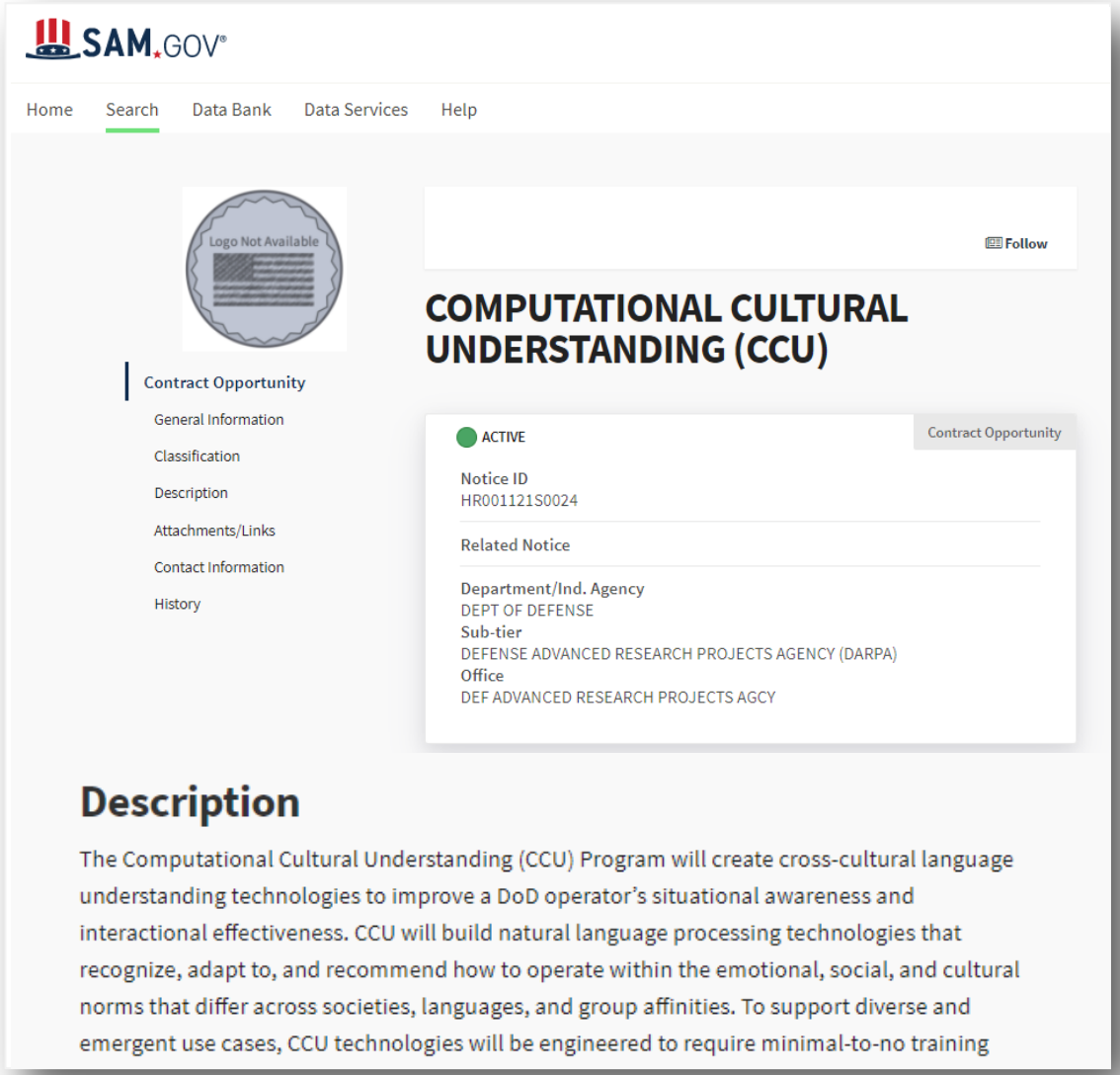
Performers



Performers do the work

- DARPA maintains no laboratories or infrastructure
- Competitive, public solicitation of proposals
- Seek out the best talent on the planet
- Performer ecosystem:
  - Big and small companies, universities, government and quasi-government organizations
- Performers sometimes encouraged to join teams to cover multiple fields
- Average program duration of 4-5 years
- Success means transition
  - Defense
  - Commercial

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Doing business with DARPA

Program Managers are key to working with DARPA

- Become familiar with DARPA's challenges and opportunities for National Security
- Contact a PM about your idea prior to submitting a abstract, white paper, or proposal to gain insight

Typical Solicitation Types:

- Program-specific BAAs released throughout the year (typically allow any type of award)
- Office-wide BAAs for one or two years with general tech-office scope
- Research announcements for grants or cooperative agreements (e.g., Young Faculty Award)
- Program Solicitations for Other Transactions (e.g., Artificial Intelligence Exploration)

Funding durations and amounts vary based on objectives

- Programs are typically three to four years
- Concept studies can be 6 to 12 months
- Program and study funding amounts are based on proposed research level of effort
- AIEs are 18 months for feasibility study with awards up to $1 million each
    - Streamlined contracting procedures to start within three months announcement

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www.darpa.mil

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The US National Science Foundation (NSF): A Primer

Margaret Martonosi
NSF Computer and Information Science and Engineering (CISE)
(on leave from Princeton University CS Faculty)

National Science Foundation's Mission

"To promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense..."

Research:
Planting seeds
today,
to foster the
next generation
of discoveries
and discoverers.

Example: How NSF helped give Duolingo their wings

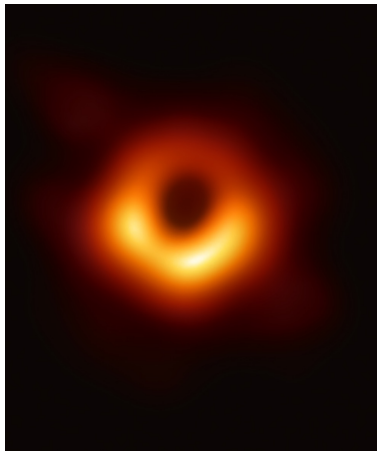
NSF supported Luis von Ahn (CEO, Duolingo) from graduate school through his early career research as an academic PI, including support of graduate students Severin Hacker (CTO, Duolingo), and Karin Tsai (Senior Director of Engineering, Duolingo)

Luis von Anh's CISE funding resulted in advancements in computational models for social network organization and for human computational systems

Duolingo arose out of CISE funded research harnessing education as a tool for generating data to train more accurate machine learning algorithms for language translation, voice recognition, and computer vision

Duolingo has grown into a >$3 Billion free & accessible language and math learning app with 50 million users around the globe learning 40+ different languages

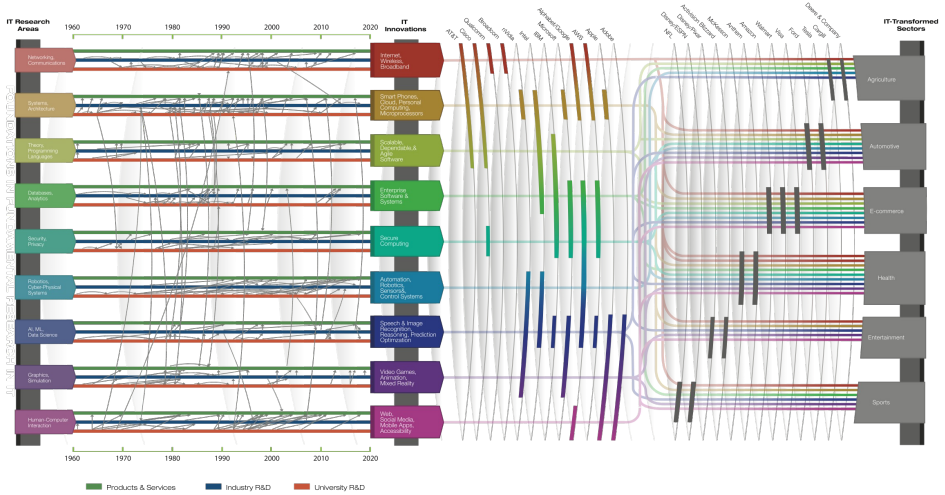
Planting Trees: Foundational, Translational, Societal Impacts



Foundational

CISE-funded research has led the world in fundamental questions of how information is gathered and analyzed

44 of the 73 Turing Awardees have received NSF funding



Translational

CISE-funded research has changed how the world computes and communicates.

>$1Trillion of economic impact via the IT sector and beyond.

Societal

CISE-funded research is benefitting American communities

Changing the face of computing, and changing the world

https://www.nationalacademies.org/our-work/depicting-innovation-in-information-technology

NSF by the Numbers

$9.9B FY 2023 Enacted

93% funds research, education, and related activities

$1.6B for STEM education

$255M to business to move discoveries into the marketplace

67% of Turing Awardees are NSF-funded

39K+ proposals evaluated

11K awards funded/year

1.8K funded institutions

352K people funded

Investigator-driven Science

Infrastructure

Centers and Institutes

Researchers

Trainees and Students

Industry and Others

Programmatic directorates and offices supporting the NSF Mission

CISE Organization and Core Programs

Office of Advanced Cyberinfrastructure (OAC)

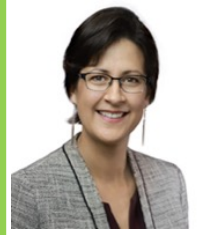
Manish Parashar
Office Director

Amy Walton
Deputy Office Director

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

Computing & Communication Foundations (CCF)

Dilma Da Silva
Division Director



Irina Dolinskaya,
Deputy Division Director

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

CISE Leadership

Margaret Martonosi,
Assistant Director

Joydip Kundu,
Deputy Assistant Director

Behrooz Shirazi,
Acting Division Director

Ann Von Lehman,
Acting Deputy Division Director

- Computer Systems Research
- Networking Technology and Systems
- Education and Workforce Development

Computer & Network Systems (CNS)

Michael Littman,
Division Director

Wendy Nilsen,
Deputy Division Director

- Human-Centered Computing
- Information Integration and Informatics
- Robust Intelligence

Information & Intelligent Systems (IIS)

CISE by the Numbers

NSF funds **80%** of federally-funded CS in the US at academic institutions.

$1,012M
Enacted FY22 Budget

6,466
Proposals evaluated

1,780
Awards made

28%
Funding rate

376
institutions supported

6,621
Grad Students

20,390
Individuals from Sr. Researchers to Undergrads

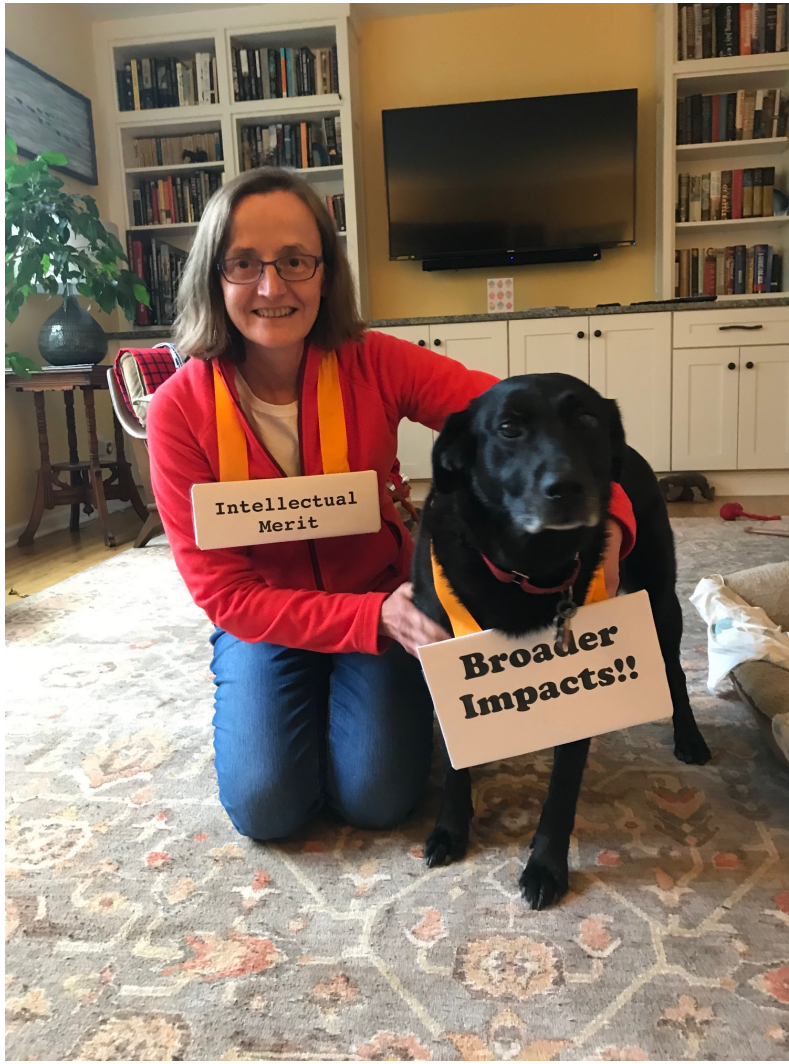
50 + 2
states and territories funded

74
Minority-serving Institutions (MSIs) with awards

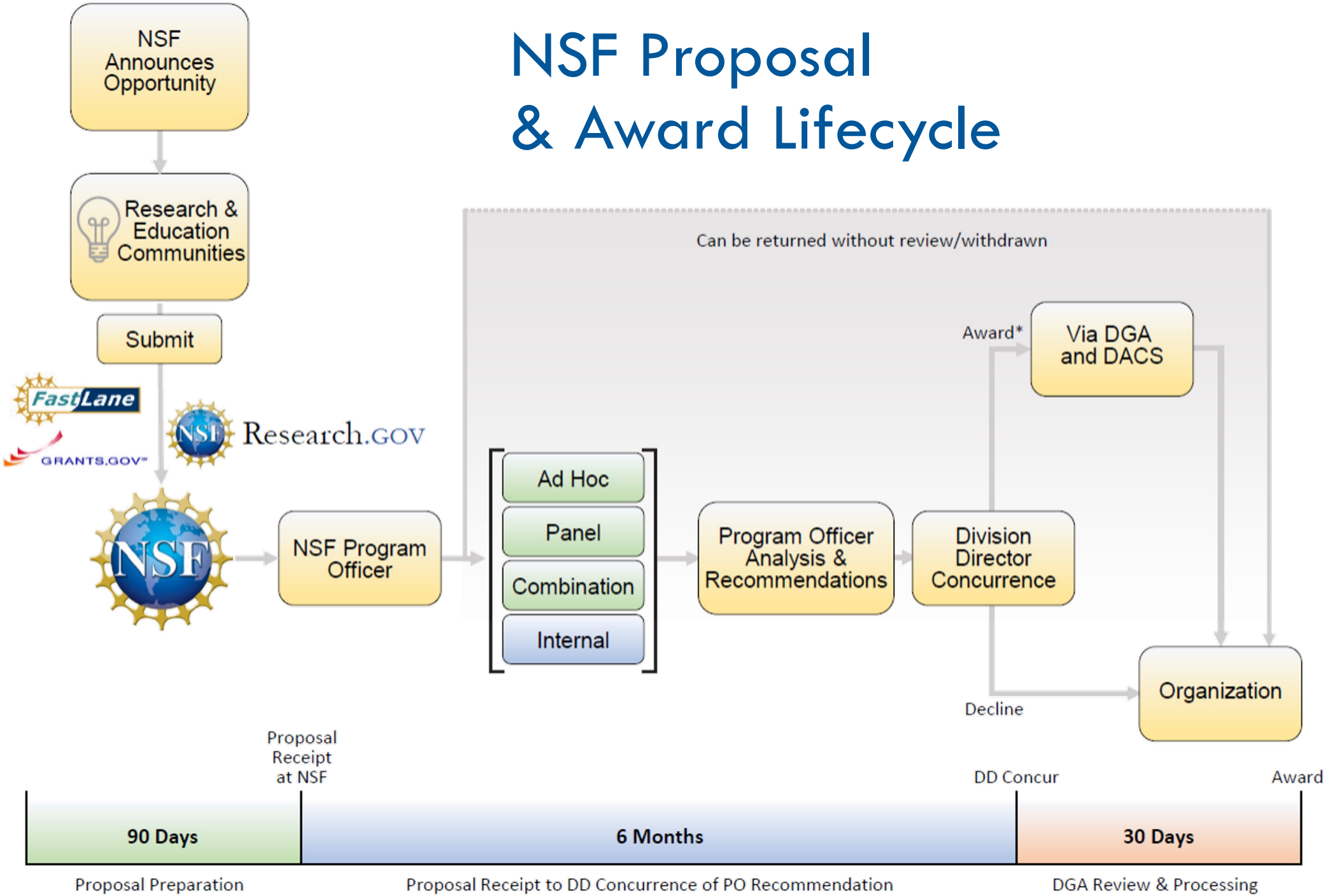
All data depicted is for FY 22

The Basics of an NSF Proposal

- Pay for faculty, students, equipment, travel etc.
- Principal Investigator (PI) is typically a faculty member
- Deadline or no-deadlines
- About 15 pages
- Questions -> Ask your program officer (found on webpage)
- Merit review by other researchers
- Two main review criteria: Intellectual Merit and Broader Impacts
- Ask your professor if you can help with proposal writing!



NSF Proposal & Award Lifecycle



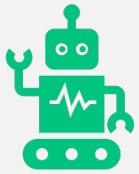
Merit Review Elements

Consider the following elements in the review for both criteria:

1. What is the potential for the proposed activity to:
   - **Advance knowledge and understanding** within its own field or across different fields (intellectual merit)?
   - **Benefit society** or advance desired societal outcomes (broader impacts)?
2. To what extent do the proposed activities suggest and explore creative, original, or **potentially transformative** concepts?
3. Is the plan for carrying out the proposed activities **well-reasoned, well-organized, and based on a sound rationale**?
4. Does the plan incorporate a mechanism to **assess success**?
5. How **well qualified** is the individual, team, or institution to conduct the proposed activities?
6. Are there **adequate resources available** to the PI (either at the home institution or through collaborations) to carry out the proposed activities?

CISE Overarching Technical Themes

CISE in a Post-Moore's Law World: Seismic Shift



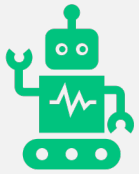
Transcendence of Artificial Intelligence: AI for Everyone

Designing Beneficial Sociotechnical Systems

CISE Overarching Technical Themes

CISE in a Post-Moore's Law World: Seismic Shift

End of Moore/Dennard Scaling impacts all aspects of computing: hardware, software, security, reliability, curriculum… Opportunity to reinvent!



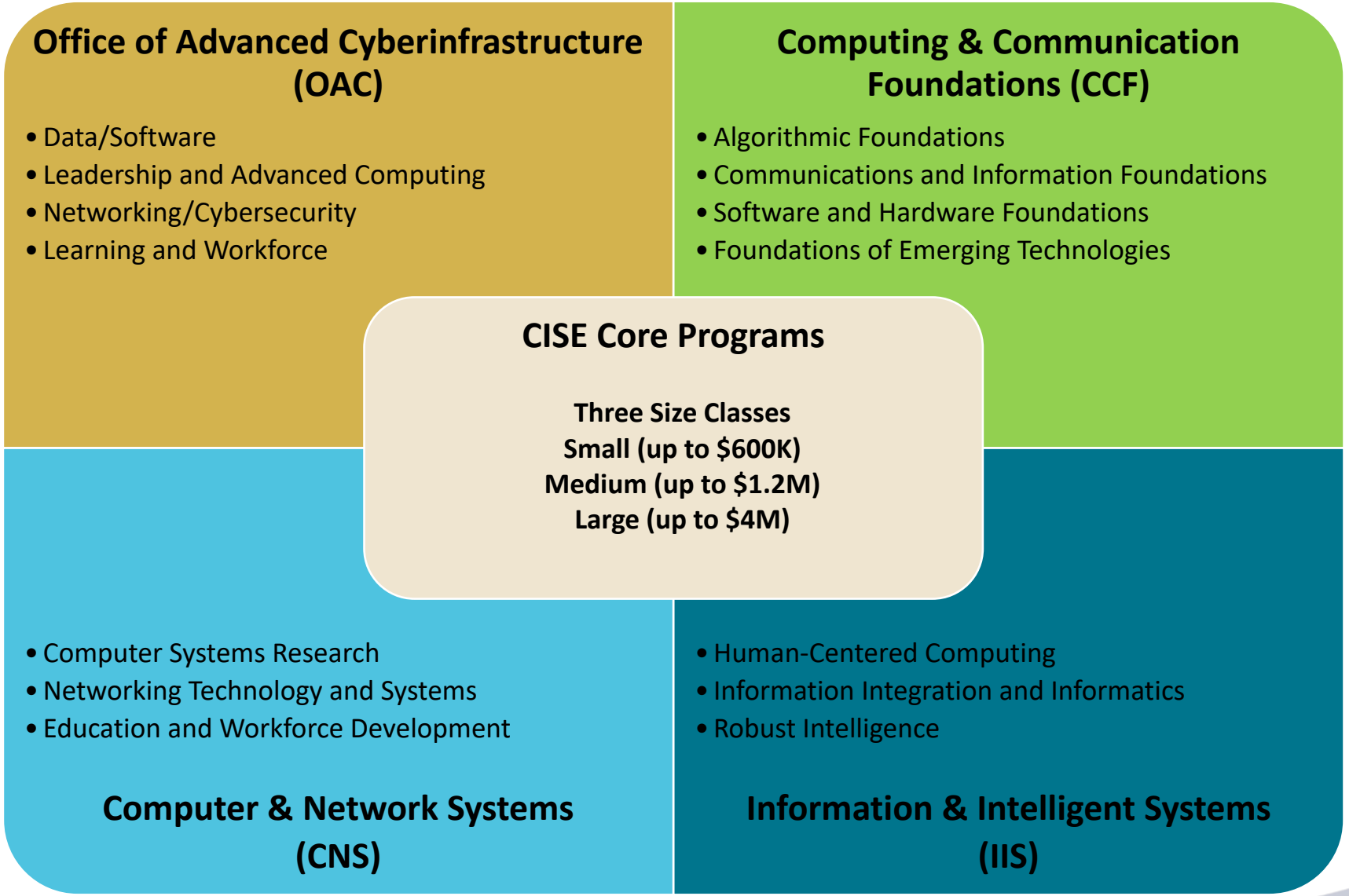
Transcendence of Artificial Intelligence: AI for Everyone

AI today draws from all-of-CISE Inflection Point: algorithms, data, systems.
Likewise, AI broadly fuels advances across our field and society.

Designing Beneficial Sociotechnical Systems

More so than ever, our field is shaped by integrated perspectives on our technologies and on how humans use them and are shaped by them.

Topics we support (Slide 1 of 2)



Many More Funding Opportunities in CISE topics (Slide 2 of 2)

Multi-directorate Programs led by CISE

- Secure and Trustworthy Cyberspace
- Cyber-physical Systems
- National AI Research Institutes
- Expand AI
- Smart and Connected Health
- Smart and Connected Communities
- Civic Innovation Challenge (CIVIC)
- Research on Emerging Technologies for Teaching and Learning
- Collaborative Research on Computational Neuroscience
- Designing Accountable Software Systems

Other CISE Programs

- CISE-MSI Research Expansion
- Principles and Practices of Scalable Systems
- Safe Learning-Enabled Systems
- Formal Methods in the Field
- Big Data Hubs (community resource)

Early-Career

- CAREER
- CISE Research Initiation Initiative (CRII)

Other cross-cutting programs

- Designing Materials to Revolutionize and Engineer our Future
- Foundational Robotics
- Future of Work
- Future Manufacturing
- Future Semiconductors (FuSe)
- Spectrum Innovation Initiative
- Sustainable Regional Systems
- Neural and Cognitive Systems

Entrepreneurship and Translation

- Convergence Accelerator
- I-Corps, SBIR/STTR
- Industry/University Cooperative Research Centers (IUCRC)

Infrastructure

- Major Research Instrumentation
- Mid-Scale Research Infrastructure – Size classes 1 ($4-20M) and 2 ($20-100M)
- CCRI – CISE Community Research Infrastructure
- Cyberinfrastructure for Sustained Scientific Innovation (CSSI)
- Campus Cyberinfrastructure (CC*)

Education programs

- Computer Science for All
- Computing in Undergraduate Education
- Broadening Participation in Computing Alliances

And many, many more that might fit you and your work…

Cross-cutting Enablers

Budget and Program Portfolio

Infrastructure

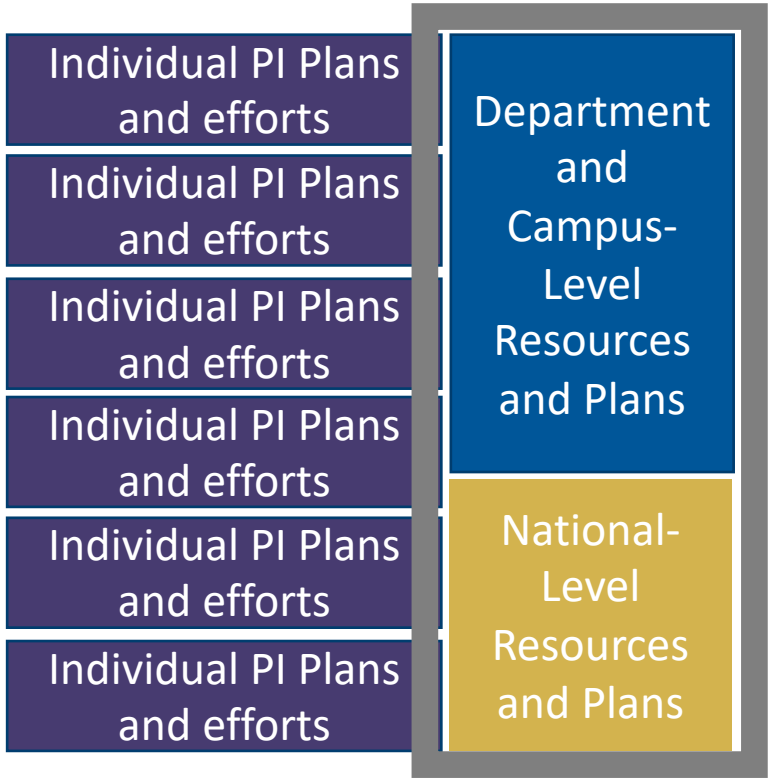
People

Partnerships

BPCnet RESOURCE PORTAL

BPCNet provides resources for CISE PIs

- https://bpcnet.org
- Developed and curated by CRA, NCWIT
- Best and promising practices: Evidence-based and vetted resources
  - Not just ***what*** but ***how***
  - Departmental data and teaching efforts
- Departmental and Individual BPC Plan Workshops
  - + Ongoing 1-1 Consulting Office Hours
  - Vetting, Hosting Departmental Plans in a Single Library



CSGrad4US Fellowship Program

- Goal: Enhance number and diversity of US citizen and permanent resident graduate students in computing fields
  - Booming undergrad enrollments, but relatively few go on to grad school
- Target: Bachelor's degree holders returning from industry into Ph.D. programs
- Fellowship begins with 1-year mentorship program: graduate school application, process, and research success

CSGrad4US Fellows
Next Deadline: June 5, 2023

	2021	2022
Number of Fellows	34	68
Demographics		
Women	32%	44%
Hispanic/Latinx	9%	16%
Black/African American	3%	10%
Disability	15%	24%
Current Status		
Enrolled in graduate school	47%	-
Applying this year	29%	98%

https://www.nsf.gov/cise/CSGrad4US/

A few bits of advice…

Skills

Be ready to learn **new technical tricks** and topics

Be ready to work on your **oral and written communication skills**

Find **strategies for time-management** and context-switching that **work for you.**

People

Be a **good colleague** and enjoy the fun of working with good colleagues.

Ask for **feedback and advice** from a lot of people… Then integrate it and **make it your own**.

Everyone needs **several mentors**

Keep connected to your friends / colleagues as you progress

Mindset

Get some sleep!

Find the fun in this adventure. There's a lot of fun to be found.

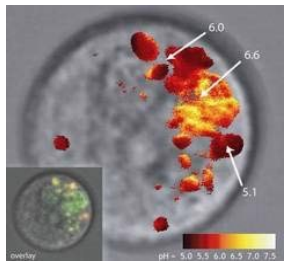
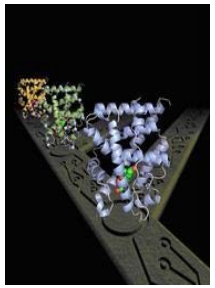
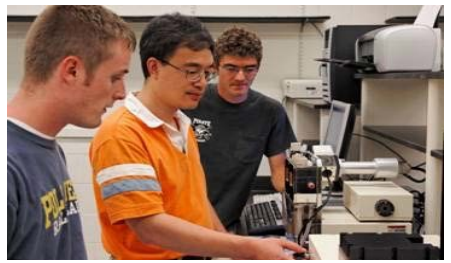
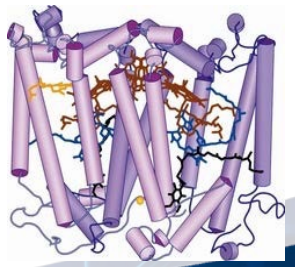
You BELONG here!
We need you!
Welcome!

NSF

Questions?

Some takeaway links

- https://www.nsf.gov
- https://www.nsf.gov/CISE
- CSGrad4US Graduate Fellowships: STUDENTS APPLY. Due May 19
  - https://www.nsf.gov/pubs/2022/nsf22061/nsf22061.jsp
- For your faculty to know about and apply:
  - CIVIC Innovation Challenge: Deadline May 5
    - https://beta.nsf.gov/funding/opportunities/civic-innovation-challenge-civic
  - US-Canada AI Collaborations
    - https://www.nsf.gov/pubs/2022/nsf22031/nsf22031.jsp
  - International Research Experiences for Students (IRES): Deadline Sept 20
    - https://beta.nsf.gov/funding/opportunities/international-research-experiences-students-ires-0

International Research Experiences for Students (IRES)

- Offered by NSF Office of International Science & Engineering
- Faculty can apply to offer student professional development through international research and research-related activities
  - Faculty-led cohort of undergrads and/or grad students
  - Seminar-style training for graduate students