



A Glimpse of NSF/CISE Programs

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Computer and Information Science and Engineering (CISE)
National Science Foundation (NSF)

CISE Organization and Core Programs

Office of Advanced Cyberinfrastructure (OAC)

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

Computing & Communication Foundations (CCF)

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

CISE Leadership



Greg Hager,
Assistant Director



Joydip Kundu,
Deputy Assistant Director

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

Computer & Network Systems (CNS)

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

Information & Intelligent Systems (IIS)



Katie Antypas
Office Director



Amy Walton
Deputy Office Director



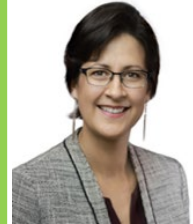
Ellen Zegura,
Division Director



Behrooz Shirazi,
Deputy Division Director



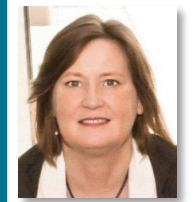
Dilma Da Silva
Division Director



Irina Dolinskaya,
Deputy Division Director



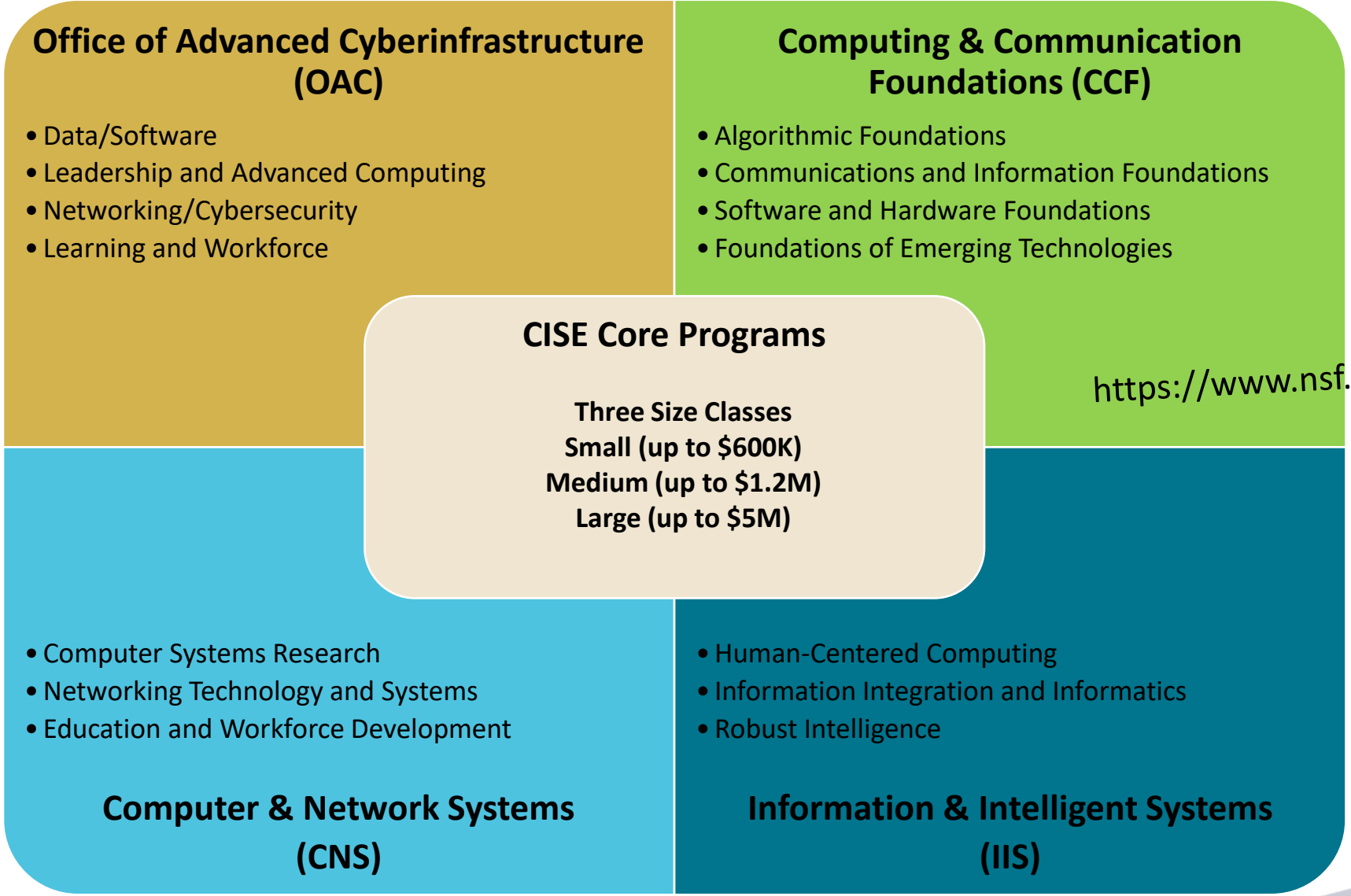
Michael Littman,
Division Director



Wendy Nilsen,
Deputy Division Director



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

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)
- CIRC – Community Infrastructure for Research in CISE
- Cyberinfrastructure for Sustained Scientific Innovation (CSSI)
- Campus Cyberinfrastructure (CC*)

Education programs

- CSGrad4US
- Computer Science for All
- Computing in Undergraduate Education
- Broadening Participation in Computing Alliances

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

CORE PROGRAMS in SOFTWARE FOUNDATIONS

Core Program in Software Foundations (NSF 23-561)

- Programming languages, Concurrency, and Compilers
 - Anindya Banerjee; Damian Dechev
- Formal Methods and Verification
 - Pavithra Prabhakar
- Software Engineering and Testing
 - Sol Greenspan; Andi Marcus

<https://new.nsf.gov/funding/opportunities/computer-information-science-engineering-core>



Programming Languages, Compilers, Concurrency

- Programming language foundations, design, implementation
- Type theory, semantics, logic
- Concurrency, parallelism, distribution
- Language design, domain specific Languages, scripting languages
- Compilers and run-time systems, optimizing compilers
- Verified compilation, verified systems
- Program analysis (static and dynamic), abstract interpretation
- Emerging areas: stochastic program optimization, Machine Learning for program analyses, concurrent data structures for non-volatile memory, language-based foundations for Big Data

...and more

Formal Methods and Verification

- Logics, semantics, abstraction, compositionality
- Decision procedures, constraint and logic solvers
 - Satisfiability (SAT), Satisfiability Modulo Theories (SMT), Integer Linear Programming
- Automated verification (e.g. model checking)
- User guided verification (e.g. theorem proving)
- Program synthesis (automatic and user in loop)
- Verified Cyber-Physical Systems, Methods for verification of Neural Networks, Operating Systems, Computer Networks, Internet of Things
- Large-language models (LLMs) for proof automation (theorem proving using machine learning based methods)

...and more

Software Engineering and Testing

- Theories and models for software design and development
- Automation of software development tasks such as comprehension, analysis, testing, repair, refactoring, traceability, component reuse, etc
- Statistical language modeling for software engineering
- Deep Learning for software engineering and vice versa
- Study of programmers, projects, environments
- Reformulate the relationships between requirements, design, assurance and evolution of software – toward new software engineering paradigms

...and more

Community Building

- Mentoring workshops
 - Programming languages mentoring workshop (POPL, PLDI, OOPSLA, ICFP), Verification mentoring workshop (CAV, LICS), Software Engineering Mentoring Workshops (ICSE, FSE)
- Summer Schools
 - Formal methods summer school (2012-present), Oregon Programming Languages Summer School (2002 – present), SAT/SMT summer school, Midwest Verification Workshop (2014-present), Midwest Programming Languages Summit (2015 – present)
- Student travel grants
 - CAV, POPL, PLDI, ICFP, ICSE, OOPSLA, PPoPP, CGO, PACT, VMCAI, FMCAD, ...

CROSS-CUTTING PROGRAMS

NEW Correctness for Scientific Computing Systems (CS²) (NSF 24-571)

- Joint program with Dept. of Energy (DOE)
- Grew out of DOE/NSF Workshop on Correctness in Scientific Computing (PLDI'23)
- **Challenge**: Elevate correctness as a fundamental requirement for scientific computing tools and tool chains
- **Requirement**: Close and continuous collaboration between researchers in **scientific computing** and researchers in **formal reasoning and mechanized proving of properties of programs**.
- Deadline: August 13, 2024

<https://new.nsf.gov/funding/opportunities/correctness-scientific-computing-systems-cs2>

Formal Methods in the Field (FMitF) NSF 24-509

Inspired by Robin Milner's double thesis that

“the design and implementation of computing systems can only properly succeed if it is well-grounded in theory, and that the important concepts in a theory can only emerge through protracted exposure to application”. [Inaugural Lecture, LFCS, Edinburgh, 1986]

- Formal methods (FM) key to building safe and trustworthy software systems
- New FM & applications of FM disjoint prior to 2017
- Program requires bi-directional interaction between FM & field area
 - Original field areas: OS/Dist. Systems, Networks, ML, Embedded/CPS, Human Centered Computing
 - Latest solicitation (NSF 24-509): **any** field area within CISE.
- **Grow** research community to symbiotically increase reliability across all fields
- Next deadline (NSF 24-509): February 18, 2025
<https://new.nsf.gov/funding/opportunities/formal-methods-field-fmitf/nsf24-509/solicitation>

New AIMing: Artificial Intelligence, Formal Methods, and Mathematical Reasoning (NSF 24-554)

Scientific Scope

- To support research at the interface of innovative computational and artificial intelligence (AI) technologies and new strategies/technologies in mathematical reasoning to automate knowledge discovery.
- Requires meaningful collaborations between researchers in Maths and CS – with clear articulation of advances in both.
- Expected advancements may include, but are not limited to:
 - advancing AI for mathematical conjecture, proof, verification
 - advancing interactive theorem provers for mathematical proof and verification, software/hardware verification, and related applications.
 - developing training data for AI algorithms for mathematical reasoning,
 - novel approaches for infusing logic, mathematical reasoning, and compositionality into AI.

Multi-directorate Solicitation: MPS/DMS, CISE/IIS, CISE/CCF

Proposal Due Date: June 3, 2024 (February 5, 2025 and February 5, 2026 thereafter)

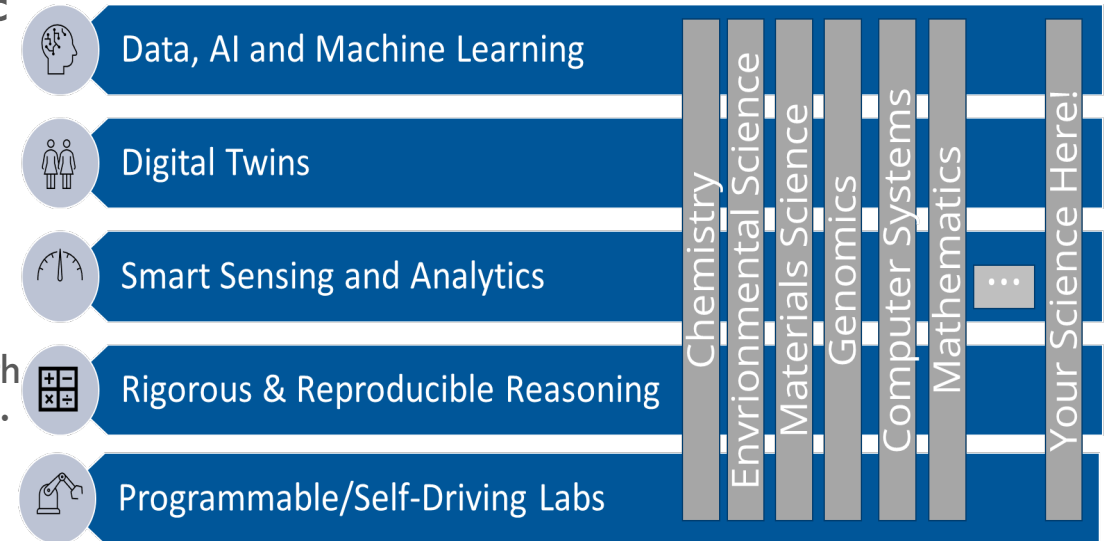
Contact: aiming@nsf.gov

<https://new.nsf.gov/funding/opportunities/artificial-intelligence-formal-methods/nsf24-554/solicitation>



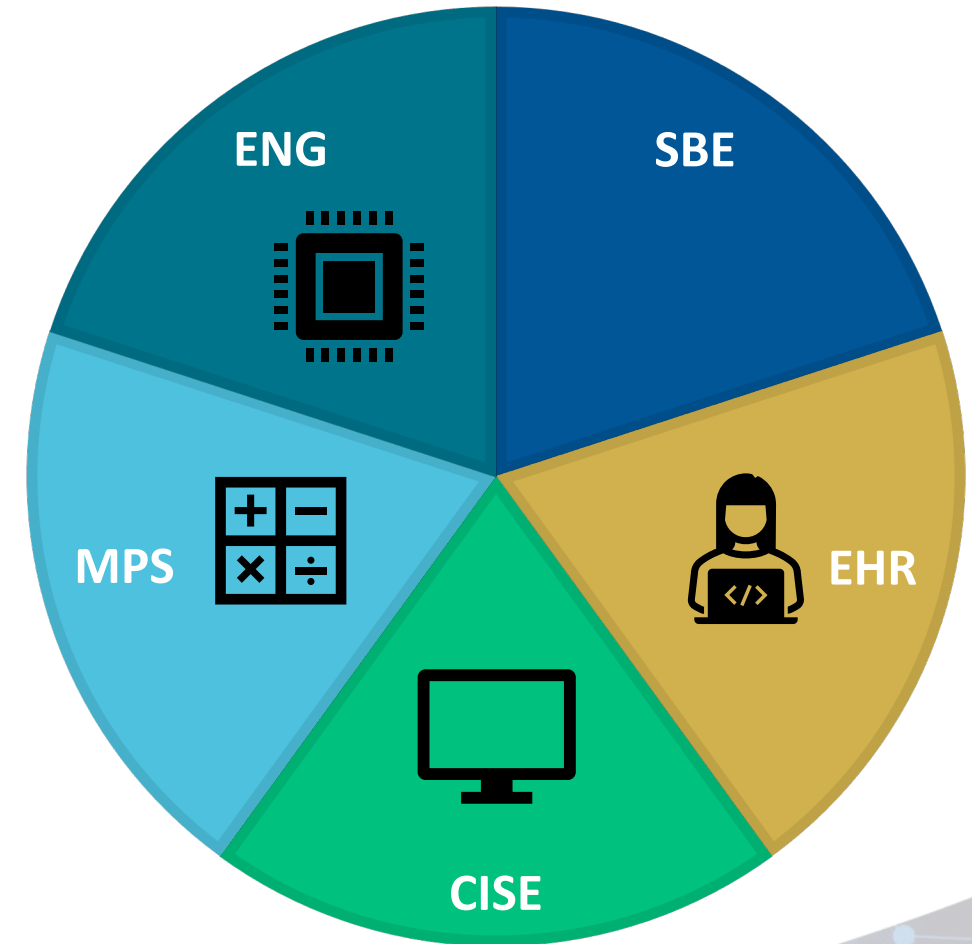
New ACED: Accelerating Computing-Enabled Scientific Discovery (NSF 24-541)

- New solicitation designed to harness computing in a virtuous cycle that: (a) benefits scientific disciplines through computational technologies and (b) fosters novel computing technologies that will enable advances beyond the specific use cases/domain.
- Requires collaborations between researchers in computing and another scientific or engineering discipline.
- The ACED program solicits proposals in two tracks:
 - Track I: Emerging Ideas Proposals: Support speculative multidisciplinary projects that explore bold new research directions. Projects are limited to \$500,000 in total budget, with durations of up to 18-24 months. Proposals due May 13, 2024.
 - Track II: Discovery Proposals: The objective of this track is to support transformative interdisciplinary research that will significantly advance both computing and the scientific discipline(s). Projects are up to 4 years with a total budget of up to \$3,000,000. Proposals due January 14, 2025-2026.
- ACED supports NSF Priority Areas: Emerging Industries, Resilient planet and Research Infrastructure with CISE, BIO, ENG, MPS, and TIP



SaTC: Secure and Trustworthy Cyberspace

- One of NSF's largest research programs
- Launched in 2011
 - Over 3800 awards, over \$1B to date
 - Awards range from \$300K - \$10M
- Broad and inter-disciplinary focus
 - A socio-economic-technical lens
 - DCLs, PI meetings to build interdisciplinary communities
- Holistic approach
 - Research + Education + Transition to Practice



Expeditions in Computing

- **Discover:** To catalyze far-reaching research or research cyberinfrastructure explorations motivated by deep scientific questions or hard problems in the computer and information science and engineering fields and/or by compelling applications and novel technologies that promise significant scientific and/or societal benefits;
- **Inspire:** To inspire current and future generations of Americans, especially those from under-represented groups, to pursue rewarding careers in computer and information science and engineering;
- **Impact:** To stimulate significant research and education outcomes that, through effective knowledge transfer mechanisms, promise scientific, economic and/or other societal benefits.
- Multi-institution center scale investments by CISE (\$15M for 7 years)
- Ambitious, fundamental research agendas that promise to define the future of computing.

Expeditions in Formal Methods and Verification

- Understanding the World Through Code (Armando Solar-Lezama, MIT, 2020)
- The Science of Deep Specification (Andrew Appel, Princeton, 2016)
- Expeditions in Computer Augmented Program Engineering (Rajeev Alur, Penn, 2012)
- Next-Generation Model Checking and Abstract Interpretation with a Focus on Embedded Control and Systems Biology (Ed Clarke, CMU, 2009)

Early-Career; EPSCoR DCL; REU; International Partnerships

Faculty Early Career Development Program (CAREER) (NSF 22-586)

- “A foundation-wide activity that offers NSF’s most prestigious awards in support of early-career faculty who have the potential to serve as academic role models in research and education and to lead advances in the mission of their department or organization.”
- “Activities pursued by early-career faculty should build a firm foundation for a lifetime of leadership in integrating education and research.”
- Solicitation-specific criteria: plan for integrating research and education.
- Duration of award: 5 years.

<https://new.nsf.gov/funding/opportunities/faculty-early-career-development-program-career>

CAREER Workshops/Webinar

- CRA Career Mentoring Workshop (February)
- CISE Career Mentoring Workshop (April)
- CAREER Proposal Submission Logistics Webinar (June 7, 2024)

CISE Research Initiation Initiative Program (CRII)

- Aims to level the playing field by offering “startup package” opportunities to new Early-Career faculty in CISE-relevant topics at **non-R1** institutions
- Funds may be used to support faculty, undergraduate and/or graduate students
- Each award will be up to \$175,000 for a period of 24 months
- Solicitation-specific criteria:
 - Potential of research to produce sufficient preliminary results to serve as basis for future competitive research proposals
 - Proposed activities are necessary and critical for the PI to launch their research career.

<https://beta.nsf.gov/funding/opportunities/computer-and-information-science-and-engineering-research-initiation>

FY24 DCL: Expanding Geographical and Institutional Diversity in CISE

- Goal: Increase representation of NSF awards and funding to organizations across 28 EPSCoR-eligible jurisdictions
 - DCL responds to CHIPS and Science Act (2022)
 - Collaborative proposals between EPSCoR (lead) and non-EPSCoR eligible jurisdictions
 - Proposals from Minority-Serving Institutions (MSIs) and Emerging Research Institutions (ERIs) in EPSCoR states

Some examples (more in DCL)

- CISE Core proposals led by EPSCoR institutions.
- CISE cross-cutting/multi-disciplinary proposals led by EPSCoR institutions.
- EARly-concept Grants for Exploratory Research (EAGER) proposals from EPSCoR institutions.
- Expeditions in Computing, Cyber-Physical Systems (CPS) Frontiers, Secure and Trustworthy Cyberspace (SaTC) Frontiers proposals, collaborative with EPSCoR institutions.

<https://www.nsf.gov/pubs/2024/nsf24056/nsf24056.jsp?org=IIS>

REU: Research Experience for Undergraduates (NSF 23-601)

- REU Sites program: approx. 10 undergraduates selected to work in research programs of host institution. <https://www.nsf.gov/crssprgm/reu>
 - REPL (Research Experience for Undergraduates in Programming Languages) at Penn: research with faculty and graduate students from Penn PLClub. <https://penn-repl.github.io>
 - REUSE (Research Experience for Undergraduates in Software Engineering) at CMU: projects in distributed systems, machine learning, privacy, security, software testing, and verification. <https://www.cmu.edu/scs/s3d/reuse/>
- REU Supplements: Engage students in research related to a new or ongoing NSF research award.
 - CISE REU Supplement DCL: <https://www.nsf.gov/pubs/2024/nsf24048/nsf24048.jsp>
 - Submissions before March 31 **strongly encouraged**
 - 2 undergraduate students, \$10,000/student

<https://new.nsf.gov/funding/opportunities/research-experiences-undergraduates-reu>

CISE International Partnerships

We invite international participation

- As unfunded collaborators on NSF awards
 - As NSF proposal reviewers and panelists
 - Through NSF programs that foster International Partnerships
-
- NSF CISE International Partnerships:
<https://new.nsf.gov/cise/international-partnerships>
 - CISE core topics; cybersecurity and privacy; AI; Quantum Science; Wireless communication technology.

Fellowship Programs

Graduate Research Fellowship Program (GRFP)

- Oldest NSF program.
- Help ensure the quality, vitality, and diversity of the scientific and engineering workforce of the United States.
- Broaden participation of the full spectrum of diverse talents in STEM.
- Five-year fellowship provides three years of financial support inclusive of an annual stipend of \$37,000.

<https://www.nsfgrfp.org/>

Can I apply for the NSF GRFP if I do not know where I will be attending graduate school? I don't know if I will be accepted by the program of my choice so the research I plan to conduct may change.

*Yes. Undergraduate seniors and Bachelor's degree holders who plan to enter graduate school in an NSF GRFP-eligible field by the coming fall are **strongly** encouraged to apply.*

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



Encourage your former students to apply!
<https://www.nsf.gov/cise/CSGrad4US/>



Interacting with NSF

- Interact with NSF program directors
 - Zoom/phone calls, email, ...
 - Webinars
 - Clarifications on program solicitations, solicitation-specific criteria, ...
 - Conferences
 - PI meetings
- Inform us about topics that deserve more attention and are missing in solicitations
- Serve on NSF panels.
- Serve as an NSF program director.