



National Artificial Intelligence (AI) Research Institutes

**Accelerating Research, Transforming Society, and
Growing the American Workforce**


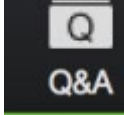
*James Donlon and Rebecca Hwa, CISE/IIS
Program Webinar, November 16, 2021*

While you wait: Review the FAQ! Easy access from Program web page:

<https://beta.nsf.gov/funding/opportunities/national-artificial-intelligence-research-institutes>



Questions

- **Submit your questions using the Q&A module**  
 - Will answer questions live (not in the module)
- **Program-wide** questions are encouraged
- Theme leads are here to address your **theme questions**
- If your question is not answered, feel free to email programmatic questions to AllInstitutesProgram@nsf.gov; theme-related questions to relevant program contacts
- Webinar materials (slides, script, and audio recording) will be posted on the program/webinar web page



Program/Theme Leads

Theme	Program Directors
Program-Wide	James Donlon, Rebecca Hwa
1. Intelligent Agents for Next-Generation Cybersecurity	Dan Cosley, CISE/IIS
2. Neural and Cognitive Foundations of Artificial Intelligence	Sri Raghavachari, BIO/IOS
3. AI for Climate-Smart Agriculture and Forestry	Ann Stapleton, USDA NIFA
4. AI for Decision Making	Hector Munoz-Avila, CISE/IIS
5. Trustworthy AI	Todd Leen, CISE/IIS
6. AI-Augmented Learning to Expand Education Opportunities and Improve Outcomes	Amy Baylor, EHR/DRL



Welcome

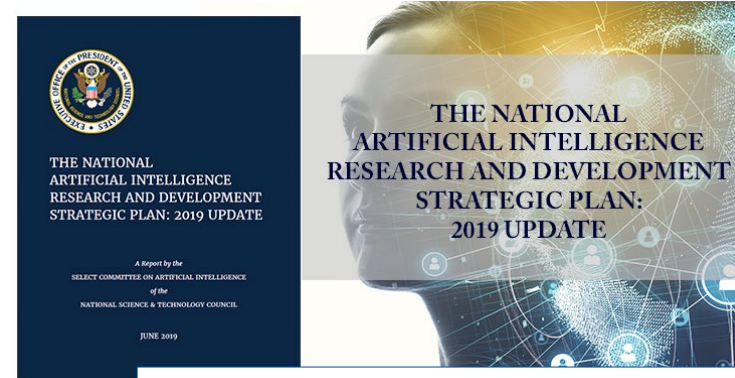
Margaret Martonosi

*Assistant Director, Directorate for Computer and
Information Science and Engineering (CISE)*



Background

- **2019 Update to National AI R&D Strategic Plan**
- May 2019: NSF Convening of potential partners
- **Oct 2019: Program Launched**



National AI R&D Strategic Plan



Convening of Partners



Background

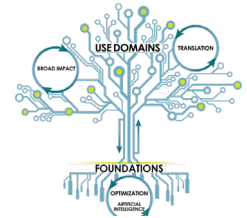
- Aug 2020: First cohort of Institutes
- Aug 2020: Second Solicitation
- Jul 2021: Second cohort of Institutes
- Sep 2021: This funding opportunity



AIFARMS



MOLECULE
MAKER LAB
INSTITUTE



AIIRA
AI Institute for Resilient Agriculture



AI Institute for Advances
in Optimization



Link to all awards: [NSF Award Search](#)

Growth & Partnerships

Year 1 (2020 Awards)

- 5 NSF Institutes,
2 NIFA Institutes,
11 Planning grants



Year 2 (2021 Awards)

- 9 NSF Institutes,
2 NIFA Institutes



- More funding
partners



This Round (2023 Awards)

- 6 themes
- 4 new potential
funding partners



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Outline

- Program overview and structure
- A detailed look at the themes of this solicitation
- Program-wide considerations
- Future plans
- Questions



National Artificial Intelligence (AI) Research Institutes

- Continuation of a multi-year, multi-sector national initiative.
- Goals:
 - Significantly **advance research in AI** (foundational, use-inspired)
 - Accelerate development of **transformational, AI-powered innovation**
 - **Grow a workforce** of future AI researchers and practitioners
 - **Nexus points** between universities, federal agencies, industries, and nonprofits



New/changes

- Longer time period for development of proposals.
- Preliminary proposals are now required.
- Revised program description, proposal submission instructions, and solicitation-specific review criteria.
- Guidelines for the participation of the industry sponsor and its affiliated personnel apply only to the sponsored theme.



Program Timeline

Milestone	Program-wide timeline
Solicitation release/	Oct 8, 2021
Webinar	Today
Preliminary proposals due	Jan 14, 2022
Results of preliminary proposal review	Mid-Feb 2022
Full proposals due	May 13, 2022
Schedule Reverse Site Visits*	Oct 10-28, 2022
Reverse Site Visits*	Nov 28-Dec 22, 2022
Anticipated start date of awards*	Jun 1, 2023

* Proposers to Theme 6 Track B can anticipate earlier milestones for these steps.



This solicitation:

- **Must respond to one of six identified themes**

1. Intelligent Agents for Next-Generation Cybersecurity (NSF, DHS, IBM)
2. Neural and Cognitive Foundations of Artificial Intelligence (NSF, DOD OUSD(R&E))
3. AI for Climate-Smart Agriculture and Forestry (USDA/NIFA)
4. AI for Decision Making (NSF)
5. Trustworthy AI (NSF, NIST)
6. AI-Augmented Learning to Expand Education Opportunities and Improve Outcomes (NSF, ED IES)

- Cooperative Agreements for 4-5 yr/\$16-20M institutes to award in 2023.



Preliminary Proposals - Requirements

- MUST be submitted prior to a full proposal
- 6-page project description: **Primary focus on the scope of proposed research activities and the suitability of personnel to carry them out**

Sections:

- A. Vision.. research goals
- B. Foundational AI research
- C. Use-Inspired Research
- D. Broader Impacts
- E. Key Personnel / organization

Do not include:

- Results from Prior NSF Support
- Budget and Budget Justification
- Data Management Plan
- Postdoc Mentoring Plan
- Current and Pending Support
- Facilities, Equipment, ...
- Letters of Collaboration



Preliminary Proposals – Process and Benefit

- Submitted to a theme
 - Reviewed internally by NSF and partner agencies
 - Advisory (i.e., non-binding) “Encourage”/“Discourage” decision
 - ~ 1 month turnaround
- Benefits of Preliminary Proposal Stage:
 - Affords more time for high quality proposal development
 - Early feedback about responsiveness to the solicitation
 - Allows teams to adjust proposals and plans based on feedback
 - Reduces effort preparing proposals unlikely to succeed in a competition with few awards.
- More NSF policy on preliminary proposals in the [PAPPG](#).



Full Proposals – Requirements

- Must follow a Preliminary Proposal - submitted to same theme by same lead organization (more info on next slide)
 - 25 pg. Project Description. Must include sections listed
 - Overview and Rationale for Institute Approach
 - Description of the Research Plan of the Institute
 - Broader Impacts
 - Education and Workforce Development
 - Broadening Participation Plans
 - Collaboration and Knowledge Transfer
 - Key Personnel, Management and Integration Plan
- Include each of these headings
Reorder if you want
Add others as needed
Number as you wish
- Results of Prior NSF Support may now be moved to a 1-pg Supp Doc
 - Several Other required and optional supplementary docs and single-copy docs required
 - Follow all [PAPPG](#) guidance for items not specified in the instructions



Identifying updates in the Full proposal

Required single-copy* document in the Full proposal):

- Update since preliminary proposal (1 page max). Identify the required preliminary proposal submission for this full proposal and summarize updates in three additional sections:
 - Preliminary proposal #: (NSF-assigned proposal #)
 - Changes to PI/Co-PIs: (list additions, deletions, changes of role)
 - Changes to funded collaborative organizations: (listed added/deleted subawardee, contract, or otherwise-funded organizations)
 - Summary of significant changes of research scope: (no more than 250 words, bulleted)

* "Single-copy" documents are for NSF-use only, and are not provided to reviewers



Desiderata for All AI Research Institutes

1. Advance foundational research
2. Conduct use-inspired research
3. Grow the next generation of talent
4. Be multidisciplinary
5. Leverage multiple organizations
6. Be nexus points for collaborative efforts



Advance Foundational AI Research

- Add significant new knowledge and understanding to artificial intelligence and demonstrate the potential to radically advance areas beyond the state of the art.
- Address new foundational AI research priorities that arise from rapid advances in AI and the increasing ubiquity of AI-enabled technology.
- Address areas in clear need of larger efforts over longer timeframes; the research will have broad and lasting impact.

Institute proposals that do not describe a clear plan to achieve **ambitious advances in foundational AI research** are not likely to be responsive to this program



Advance Foundational AI Research: Scope of AI

- Understanding the mechanisms underlying thought and intelligent behavior and their implementation in machines.
- “Core” theory and methods that give rise to these abilities and their implementation in machines
 - Research in all matters of learning, abstraction, and inference required for intelligent behavior.
 - General architectures for intelligence, integrated intelligent agents, and multiagent systems.



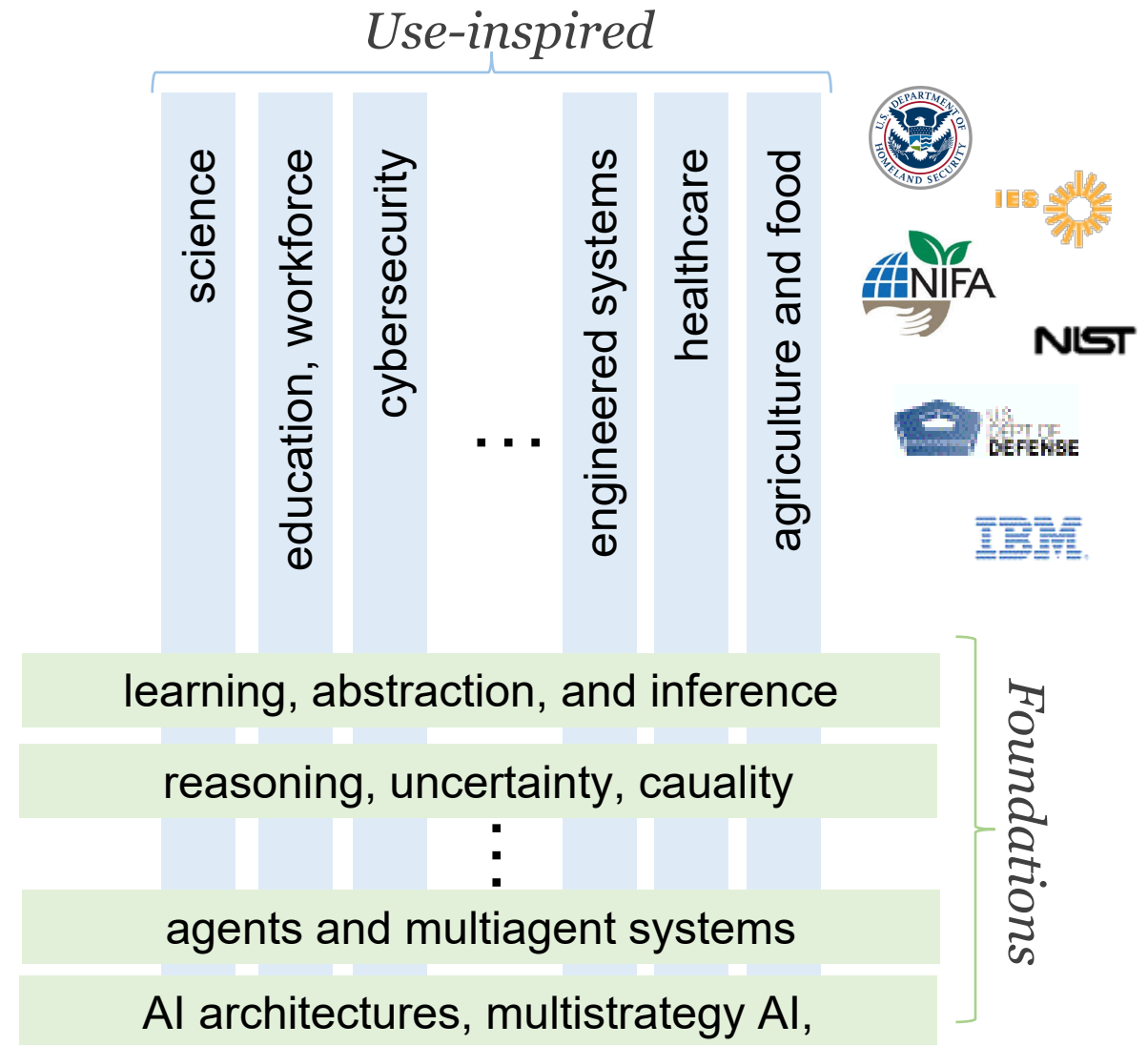
Advance Foundational AI Research: Scope of AI, continued

- AI is a multidisciplinary endeavor
 - Computational methods draw insight from fields such as biology, neuroscience, behavioral and cognitive science.
 - Computer vision and human-language technologies provide critical capabilities to many AI systems.
 - Robotics is closely aligned with but not identical to embodied AI. AI systems may be able to act upon the world through embodiment.



Conduct Use-Inspired Research

- **Use-inspired AI research** is basic research that has use for society in mind.
- Use-inspired research is a context that informs foundational AI advances and drives innovations in related sectors through use cases, affording:
 - Clear and compelling goals to advance AI and to accelerate the fielding of AI-powered innovation.
 - The transfer of knowledge through the meaningful exchange of scientific and technical information with internal participants and external stakeholders.
 - The potential for the creation and sharing of community infrastructure, including data and software, to further research, promote reproducibility, and support education.
- Within the use-inspired context, balance the application of AI with the advancement of foundational AI as appropriate to your Institute vision





Grow The Next Generation of Talent

- Drive education about AI across educational levels and institution types, including post-secondary, workforce training, and other public education.
- Develop innovative pedagogy and instructional materials, advanced learning technologies, project-driven training, cross-disciplinary and collaborative research, industry partnerships, and new career pathways.
- Offer broad, deep, and diverse experiences with a focus on broadening participation among the full range of groups traditionally under-represented in science and engineering.
- Leverage the visionary research focus and integrate education and workforce development for a whole *“greater than the sum of its parts.”*



Be Multidisciplinary

- Coherent multidisciplinary groups of scientists, engineers and educators appropriate for a large-scale, long-term research agenda for the advancement of AI and the fielding of AI-powered innovation.
- Catalyze foresight and adaptability beyond what is possible in single research projects.
- Significant integration of multidisciplinary research can be a significant basis of confidence that your proposed Institute will be *“greater than the sum of its parts”*.



Leverage Multiple Organizations

- Create significant new research capabilities in new centers of AI leadership.
- Create a network for broadening participation from underrepresented groups and diverse institutions.
- Multiple organizations meaningfully integrated into a diverse Institute is another way to form a whole *“greater than the sum of its parts”*.
- Will be staffed with a Managing Director or Project Manager (distinct from the lead PI) and a suitable Management Team.
- Will have an External Advisory Board - non-collaborators who are a source of objective, external advice

Potential Advisory Board members should not be approached or identified until the Institute is funded



Nexus Points for Collaborative Efforts

- As nexus points, Institutes have the potential to continue to connect with new partners for continued growth and opportunities -- another way to be *“greater than the sum of its parts”*.
- The "nexus point" function in this program is not a mere state of being for an Institute. You should describe as appropriate your priorities, programs, mechanisms, and other considerations for operating as a nexus point.
- Continuing growth of collaborations with external partners can bring together people, ideas, problems, and technical approaches for maximum impact and for broadening participation beyond the members and the boundaries of the Institute itself.
- Promote organizational collaborations among the best teams and approaches from institutions of higher education, federal agencies, industry, and nonprofits/foundations.



FY 2023 Institute Themes

This year, proposals are being solicited in six high-priority areas:

1. Intelligent Agents for Next-Generation Cybersecurity
2. Neural and Cognitive Foundations of Artificial Intelligence
3. AI for Climate-Smart Agriculture and Forestry
4. AI for Decision Making
5. Trustworthy AI
6. AI-Augmented Learning to Expand Education Opportunities and Improve Outcomes

NSF estimates approximately 7 awards: one per theme in 1-5, and one in each of two tracks in Theme 6.



1: Intelligent Agents for Next-Generation Cybersecurity

- Vision: AI-based agents in an ecosystem of attackers and defenders in complex cybersecurity contexts, making advances to help them take appropriate autonomous action:
 - Modeling, predicting, responding to other agents and threats
 - Collaborating with, learning from defenders
 - Robust self-monitoring and repair around uncertainty and attack
 - Acting under safety, operational, legal, ethical constraints
- Remember: large scale vision, agent and action focus
- *Partial support for this theme is provided by DHS and IBM.*



2: Neural and Cognitive Foundations of Artificial Intelligence

Neural and Cognitive Science

Artificial Intelligence

Vision – Deep conceptual integration of neural and cognitive science and AI to advance both fields.

- Translate advances in understanding of neural and cognitive processes into the theory, conceptualization and design of new AI systems.
- Address foundational AI problems that bridge these areas.
- Capitalize on theoretical and algorithmic advances in AI to test hypotheses regarding cognitive and neural computations in biological systems.
- Bring together neuroscientists and cognitive scientists with AI researchers around closely aligned questions for maximal impact.

Partial support for this theme is provided by DOD OUSD(R&E).



3: AI for Climate-Smart Agriculture and Forestry

Use-inspired research in this theme might address, for example:

- collecting and analyzing data to predict future climate scenarios with high degrees of accuracy,
- decisions about which cropping systems to establish,
- determining best climate-smart practices to implement,
- calculating the greenhouse-gas footprints for animal and cropping system options,

while ameliorating equity biases in predictions.

This research will demand more than mere application of established techniques.

Proposals to this theme should address both the agricultural challenge(s) being addressed and the AI advances necessary to achieve those goals, and the feedback and synergy between the AI advances and solutions to challenges.

USDA priorities



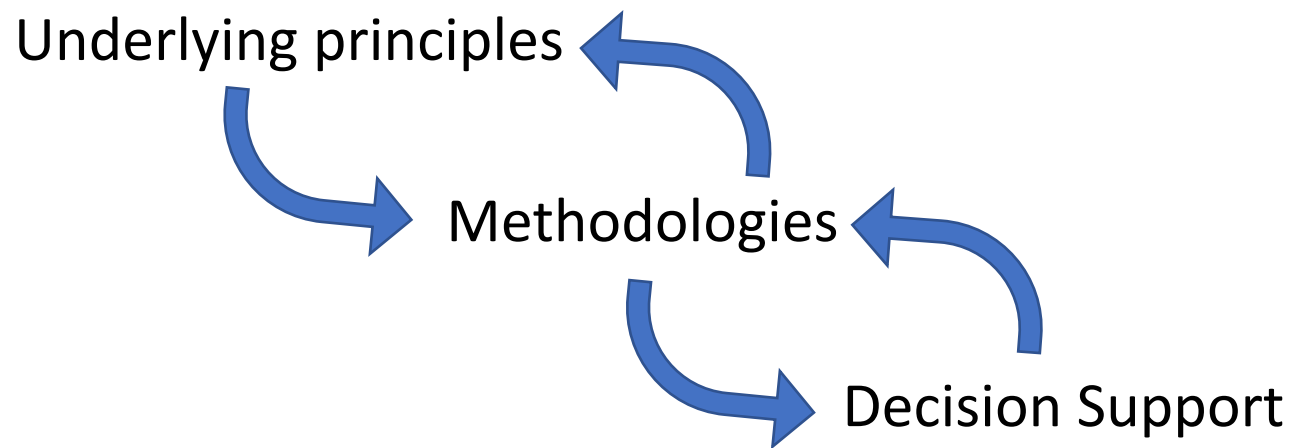
General priorities from Secretary Vilsack, who will work to address inequity and inequality, meet the moment on climate and nutrition insecurity, and build fairer markets and stronger rural communities.

- Equity and inclusion
- Climate-smart and regenerative agriculture
- Rural economic development
- Nutrition security
- Open and competitive markets



4: AI for Decision Making

Research at the Institute for AI for Decision Making will develop breakthroughs in AI that are framed by underlying principles of decision making, develop novel methodologies based on those principles and propose decision support of real-world use cases.



- Clear foundational contributions to areas at the intersection of AI and decision making
- Use case domains include any domain of national importance
- Combine expertise in AI and other fields studying foundations for decision making



4: AI for Decision Making

- Underlying principles:
 - Principles for deriving causal models from data and prior knowledge
 - Validating mechanistic models for making individual-level decisions
 - Robustness under changes over time, tradeoffs between quality and time to decision
- Methodologies:
 - Scalable decisions for handling multi-objective decision problems
 - Decision models that are understandable, justifiable and explainable
- Decision Support
 - Methods to support decision making under decision maker's preferences
 - Understanding systemic errors and biases during decision making
 - Principles for designing decision support systems for interactive human-AI decision making



5: Trustworthy AI

AI technology must be not only powerful and accurate, but also trustworthy. Technology advances must be informed by social context, guiding principles and policies, and measures of trustworthiness.

Three dimensions – all must be addressed by each proposal:

- **Foundations of Trust and Trustworthiness** – What makes an AI system trustworthy? Interdisciplinary theoretical and formal explorations coupled with empirical studies should be harnessed to understand user trust and trustworthiness.
- **Building Trustworthy Systems** – AI systems that are trusted by those who use and are affected by them must meet technical requirements, incorporate development teams and processes that engender trust, and collaborate with humans in expected and trustworthy ways.
- **Ethical and Societal Considerations** – Trustworthy AI systems will respect the ethical and social values of those affected by them (sometimes across cultures). This requires collaboration between technologists, social scientists, and other experts, and strong integration of ethical and societal considerations into AI research and systems.

Partial support for this theme is provided by NIST



5: Trustworthy AI (cont'd)

Some addition points:

- Sound measurement processes and science need to be established in all three dimensions.
- Established directions in fairness, safety, privacy, transparency and so forth are in scope, but we seek new ground for Trustworthy AI.
- The Institute is expected to work closely with industrial partners identified by the investigator team.
- If awarded, the institute is expected to interact with NIST, who is co-sponsoring Trustworthy AI Institute(s) (but should not contact NIST during preparation of the proposal)



6: AI-Augmented Learning to Expand Education Opportunities and Improve Outcomes

- For this competition we seek AI Research Institutes with a focus on learning and education that have **direct education impact in both the short- and long- term, and that have practical significance to educators, parents, or other decision-makers.**
- We solicit two institutes that each respond to one of two tracks

Partial support for this theme is provided by the Institute of Education Sciences at the Department of Education



6: AI-Augmented Learning to Expand Education Opportunities and Improve Outcomes

Track A: AI-Driven Digital Platforms to Expand and Accelerate STEM Learning in PreK-12 Settings

- Address the Grand Challenge of “Education for All” with a focus on AI-driven learning architectures and digital platforms of the future
- Aim to reduce achievement gaps, improve access, and address the needs of all learners

Track B: AI-Augmented Learning for Individuals with Disabilities

- Advance AI-driven research and innovations for learners (birth through postsecondary) with or at risk for physical, cognitive, or social disabilities
- Transform identification, assessment, and support for these learners
- Proposal must discuss how the work will respond to needs of learners with or at risk for a disability in an area where the COVID-19 pandemic has further widened existing gaps



Industry Partners

- In this solicitation, IBM Corporation is a funding partner in Theme 1. Thus, IBM and affiliated individuals are generally not allowed to participate in proposals to Theme 1.
 - This partner company and its affiliated individuals are permitted to participate in proposals to the themes in which it is not a funding partner.
 - See the solicitation for specific guidelines and other scenarios.
- Proposers to Theme 1 should NOT contact the industry funding partner or make any prior arrangements during the proposal process.
- After award, the industry funding partner may offer collaboration opportunities to the funded Institute(s) in the theme, including software, data sets, other computing infrastructure, and/or researchers-in-residence.



Notes on Submission and Eligibility

- Institutions who may apply.
 - Institutions of Higher Education (IHEs)
 - Non-profit, non-academic organizations
 - Other organization types **may** be included as subawardees on proposals
 - See special criteria for Theme 3 (USDA-NIFA)
- Limit on Number of Proposals per Organization: 2
 - Collaborative proposals are to be submitted from a single organization.
 - Limit applies to the submitting (i.e., “lead”) organization
 - No limit on participation as non-lead (collaborating) organizations
- Limit on Number of Proposals for Senior Personnel: 1
 - Senior personnel defined in PAPPG, includes but not limited to PI/co-PI
 - PI/co-PI are subset of “senior personnel”

Eligibility and submission limits apply to both Preliminary proposals and Full proposals



Frequently-Asked Questions

- [FAQ](#) for the program is published
- 46 general program questions
- Theme-specific questions
- Linked from program page:

<https://beta.nsf.gov/funding/opportunities/national-artificial-intelligence-research-institutes>



Selected Frequently-Asked Questions

- **Can I submit an Institute proposal that responds to multiple themes? Is it a good idea?**
 - The solicitation does not prohibit this, but it is not encouraged, either.
 - It is most effective to respond as fully as possible to the scope of the theme you addressed.
 - Relevance to other themes might be identified in the proposal text and/or keywords included in the Project Summary.
 - Consult program contacts in the respective themes for advice



Selected Frequently-Asked Questions

- **What is the appropriate balance between foundational AI research and use-inspired research?**
 - The first two desiderata are not in opposition to one another!
 - Choose appropriate use-inspired research contexts that:
 - Drive advancement of foundational AI
 - Lead to application of AI with high impact in the relevant sectors
 - Facilitate transition of AI-powered innovation in those sectors



Selected Frequently-Asked Questions

- **Letters of collaboration...**
- Should I obtain letters of collaboration from organizations appearing in the budget as collaborating organizations?
 - No, their participation is explicit in your proposal.
- Can the letter include statements of support or capability?
 - No. Follow the guidance in the PAPPG (see Chapter II.C.2.j)
- Can/Should I obtain one from any of the programs' funding partners?
 - No. Collaborations with partners may take place post-award.



Selected Frequently-Asked Questions

- Letters of collaboration...

"If the proposal submitted by Dr. [insert the full name of the Principal Investigator] entitled [insert the proposal title] is selected for funding by NSF, it is my intent to collaborate and/or commit resources as detailed in the Project Description or the Facilities, Equipment and Other Resources section of the proposal."



Selected Frequently-Asked Questions

- **How do the submission limits apply to campuses of the same university system?**
 - Follow the PAPPG and consult the related FAQ
https://www.nsf.gov/bfa/dias/policy/papp/pappg22_1/faqs22_1.pdf
 - **Eligibility: “Can different campuses of the same university system submit separate proposals in response to a program solicitation that limits the number of proposals to one per organization?”**
 - A distinct organization for this purpose:
 - Has its own DUNS and is registered via an NSF electronic system using that;
 - has separate Sponsored Projects Offices that can submit proposals directly to NSF;
 - is listed as the awardee organization on the NSF Cover Sheet;
 - **and can therefore submit up to two proposals to this solicitation.**



Selected Frequently-Asked Questions

- **Can we consult with program contacts about our proposal plans?**
- Program contacts prefer that you email your questions.
- Address all program contacts in the theme.
- Include a project summary of up to two pages.
- AFTER THE PRELIMINARY PROPOSAL DEADLINE, interaction will be limited to clarification of the feedback received on the preliminary proposal.



Selected Frequently-Asked Questions

- **May submitters who receive an unfavorable (“Discourage”) review of the Preliminary proposal nonetheless submit a Full proposal?**
- Yes, this is allowable.
- Make your decisions carefully -- each theme is highly selective.
- For discouraged proposals, it is assumed that significant revision would be needed to have a chance to succeed as a Full proposal.



Selected Frequently-Asked Questions

- **What features of the proposal may NOT change from the Preliminary to the Full proposal?**
- The Full proposal must be submitted by the same lead organization (Q44), to the same theme (Q45).
- It is permissible for subawardee organizations and other partnerships to change.
- It is permissible for there to be changes in proposal title (Q42), as well as to personnel and their roles (Q41, Q43).


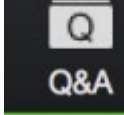


Selected Frequently-Asked Questions

- **May an individual be listed as Senior Personnel on a Preliminary proposal, and then later listed as Senior Personnel on a Full proposal from another submitter (i.e., based on a different Preliminary proposal)?**
- Yes, this is allowable, as long as the individual is listed on at most one proposal at each stage.



Questions

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 - Will answer questions live (not in the module)
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