National Artificial Intelligence (AI) Research Institutes Accelerating
Research, Transforming Society, and Growing the American Workforce

PROGRAM SOLICITATION
NSF 22-502

REPLACES DOCUMENT(S):
NSF 20-604

National Science Foundation

Department of Homeland Security, Science & Technology Directorate

Institute of Education Sciences, U.S. Department of Education

National Institute of Food and Agriculture

National Institute of Standards and Technology

Department of Defense

Office of the Under Secretary of Defense for Research and Engineering

IBM Corp.

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

January 14, 2022

Full Proposal Deadline(s) (due by 5 p.m. submitter's local time):

May 13, 2022

IMPORTANT INFORMATION AND REVISION NOTES

Revision Summary:

- This solicitation significantly extends the time and process afforded for the development of proposals. See the program calendar under Program Description.
- Preliminary proposals are now required as a method to increase both the quality of eventual full submissions and to reduce the proposers' unnecessary effort in preparation of proposals that are unlikely to be successful for a competition that will result in a small number of awards.
- Desiderata for AI Research Institutes, proposal submission instructions, and solicitation-specific review criteria are revised to stress the role and importance of foundational AI research.
- Desiderata and proposal submission instructions have been revised to emphasize the importance of achieving a whole that is greater than the sum of the parts through both internal synergies and external partner engagement.
- New themes for Institute proposals (see Program Description).
- Agency and Industry partners on this solicitation have changed.
- Guidelines for the participation of the industry sponsor and its affiliated personnel in proposals to this solicitation apply only to the sponsored theme and are detailed in the program description. Restrictions apply only to the partner listed in this solicitation.

Any proposal submitted in response to this solicitation should be submitted in accordance with the revised *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) (NSF 22-1), which is effective for proposals submitted, or due, on or after October 4, 2021.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

National Artificial Intelligence (AI) Research Institutes

Synopsis of Program:

Artificial Intelligence (AI) has advanced tremendously and today promises personalized healthcare; enhanced national security; improved transportation; and more effective education, to name just a few benefits. Increased computing power, the availability of large datasets and streaming data, and algorithmic advances in machine learning (ML) have made it possible for AI research and development to create new sectors of the economy and revitalize industries. Continued advancement, enabled by sustained federal investment and channeled toward issues of national importance, holds the potential for further economic impact and quality-of-life improvements.

The 2019 update to the National Artificial Intelligence Research and Development Strategic Plan, informed by visioning activities in the scientific community as well as interaction with the public, identifies as its first strategic objective the need to make long-term investments in AI research in areas with the potential for long-term payoffs in AI. The National AI Research Institutes program enables longer-term research and U.S. leadership in AI through the creation of AI Research Institutes.

This program is a joint government effort between the National Science Foundation (NSF), U.S. Department of Agriculture (USDA) National Institute of Food and Agriculture (NIFA), U.S. Department of Education (ED) Institute of Education Sciences (IES), U.S. Department of Homeland Security (DHS) Science & Technology Directorate (S&T), National Institute of Standards and Technology (NIST), Department of Defense (DOD) Office of the Under Secretary of Defense for Research and Engineering (OUSD (R&E)), and IBM Corporation (IBM).

This program solicitation expands upon the nationwide network established by the first 18 AI Research Institutes to pursue transformational advances in a range of economic sectors, and science and engineering fields. In this round, the program invites proposals for institutes that have a principal focus in one of the following themes, detailed in the Program Description:

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

Cognizant Program Officer(s):

Please note that the following information is current at the time of publishing. See program website for any updates to the points of contact.

- AI Research Institutes Program Team, telephone: (703) 292-5111, email: AIInstitutesProgram@nsf.gov

Applicable Catalog of Federal Domestic Assistance (CFDA) Number(s):

- 10.310 --- USDA-NIFA Agriculture and Food Research Initiative
- 47.041 --- Engineering
- 47.049 --- Mathematical and Physical Sciences
- 47.050 --- Geosciences
- 47.070 --- Computer and Information Science and Engineering
- 47.074 --- Biological Sciences
- 47.075 --- Social Behavioral and Economic Sciences
- 47.076 --- Education and Human Resources
- 47.079 --- Office of International Science and Engineering
- 47.083 --- Office of Integrative Activities (OIA)
- 84.305 --- Institute of Education Sciences, U.S. Department of Education
- 97.108 --- Department of Homeland Security, Science & Technology Directorate

Award Information

Anticipated Type of Award: Cooperative Agreement

Estimated Number of Awards: 7

NSF plans to make approximately one Institute award in each of themes 1-5, and one award to each of the two tracks listed in theme 6 as described below.

Anticipated Funding Amount: $140,000,000

Institute awards will be made for between $16,000,000 and $20,000,000 for four to five years ($4,000,000 per year on average). Proposals outside this range may be returned without review. Estimated program budget, number of awards and average award size/duration are subject to the availability of funds.

Eligibility Information

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Institutions of Higher Education (IHEs) - Two- and four-year IHEs (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Special Instructions for International Branch Campuses of US IHEs: If the proposal includes funding to be provided to an international branch campus of a US institution of higher education (including through use of subawards and consultant arrangements), the proposer must explain the benefit(s) to the project of performance at the international branch campus, and justify why the project activities cannot be performed at the US campus.
- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization: 2

An organization may submit no more than two preliminary proposals to this solicitation as lead institution. An organization may submit up to two full proposals that correspond to preliminary proposals reviewed under this solicitation. In the event that an organization exceeds these limits, preliminary proposals will be accepted based on earliest date and time of preliminary proposal submission, i.e., the first two preliminary proposals will be accepted, and the remainder will be returned without review. A full proposal that does not correspond to a preliminary proposal reviewed in this program will be returned without review.

Limit on Number of Proposals for Senior Personnel: 1

An individual may be designated as senior personnel (which includes but is not limited to PI or co-PI) on at most one preliminary proposal, and at most one full proposal to this solicitation. In the event that an individual exceeds this limit, proposals will be accepted based on earliest date and time of submission, i.e., the first compliant preliminary or full proposal will be accepted, and the remainder will be returned without review.

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Not required
- **Preliminary Proposals:** Submission of Preliminary Proposals is required. Please see the full text of this solicitation for further information.
- **Full Proposals:**
  - Full Proposals submitted via FastLane: *NSF Proposal and Award Policies and Procedures Guide* (PAPPG) guidelines apply. The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.

  - Full Proposals submitted via Grants.gov: *NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov* guidelines apply (Note: The *NSF Grants.gov Application Guide* is available on the Grants.gov website and on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide).

B. Budgetary Information

- **Cost Sharing Requirements:**

Inclusion of voluntary committed cost sharing is prohibited.

- **Indirect Cost (F&A) Limitations:**

The following instructions apply to awards made by USDA-NIFA:

For awards made by USDA-NIFA under this solicitation, Section 1462(a) and (c) of the National Agricultural Research, Extension, and Teaching Policy Act of 1977 (NARETPA) (7 U.S.C. 3310) limits indirect costs for the overall award to 30 percent of Total Federal Funds Awarded (TFFA) under a research, education, or extension grant. The maximum indirect cost rate allowed under the award is determined by calculating the amount of indirect costs using:

1) the sum of an institution's negotiated indirect cost rate and the indirect cost rate charged by subawardees, if any; or

2) 30 percent of TFFA (TFFA = Field K., Total Costs and Fee, on SF-424 R&R Budget).

The maximum allowable indirect cost rate under the award, including the indirect costs charged by the subawardee(s), if any, is the lesser of the two rates.

If the results of 1), is the lesser of the two, the grant recipient is allowed to charge the negotiated indirect cost rate on the prime award and the subaward(s), if any. Any subawards would be subject to the subawardee's negotiated indirect cost rate. The subawardee may charge its negotiated indirect cost rate on its portion of the award, provided the sum of the indirect cost rate charged under the award by the prime awardee and the subawardee(s) does not exceed 30 percent of the TFFA.

If the result of 2), is the lesser of the two, then the maximum indirect cost rate allowed for the overall award, including any subaward(s), is limited to 30 percent of the TFFA. That is, the indirect costs of the prime awardee plus the sum of the indirect costs charged by the subawardee(s), if any, may not exceed 30 percent of the TFFA.

In the event of an award, the prime awardee is responsible for ensuring the maximum indirect cost allowed for the award is not exceeded when combining indirect costs for the Federal portion (i.e., prime and subawardee(s)) and any applicable cost-sharing (see 7 CFR 3430.52(b)). Amounts exceeding the maximum allowable indirect cost is considered unallowable and will be handled accordingly. See 2 CFR 200.408 and 2 CFR 200.410.

- **Other Budgetary Limitations:**

  Other budgetary limitations apply. Please see the full text of this solicitation for further information.

C. Due Dates

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

  January 14, 2022

- **Full Proposal Deadline(s)** (due by 5 p.m. submitter's local time):

  May 13, 2022

Proposal Review Information Criteria

Merit Review Criteria:

National Science Board approved criteria. Additional merit review criteria apply. Please see the full text of this solicitation for further information.

Award Administration Information

Award Conditions:

Additional award conditions apply. Please see the full text of this solicitation for further information.

Reporting Requirements:

Additional reporting requirements apply. Please see the full text of this solicitation for further information.

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I. INTRODUCTION

AI is advancing rapidly, enabled and significantly fueled by federally-funded basic research. Increasingly sophisticated and integrated approaches for AI systems appear in applications across all sectors of the economy, and new challenges emerge for advancing, applying, and governing these promising technologies. AI holds the potential to transform lives across our Nation through increased economic prosperity, improved educational opportunities and quality of life, and enhanced security. At the same time, the potential capabilities and complexities of AI, combined with the wealth of interactions with human users and the environment, make it critically important to further advance our understanding of AI, including aspects of transparency, security, and control. Among federal research investments, institute-scale activities enable multidisciplinary, multi-stakeholder teams to focus on larger-scale, longer-time horizon challenges in both foundational and use-inspired AI research, and development of the future AI workforce, as well as addressing some of society's grand challenges. National AI Research Institutes will serve as national nexus points for collaborative efforts spanning institutions of higher education, federal agencies, industry, and nonprofits/foundations in such areas. They should also accelerate the transition of AI innovations into many economic sectors, and nurture and grow the next generation of talent. A long-term, substantive, and highly visible investment in AI research, infrastructure, and workforce development will realize the potential of, and enable the U.S. to maintain global leadership in, AI.

I.A. Definition of AI

AI enables computers and other automated systems to perform tasks that have historically required human cognition and human decision-making abilities. Research in AI is therefore concerned with the understanding of the mechanisms underlying thought and intelligent behavior and their implementation in machines. The full AI endeavor is inherently multidisciplinary, encompassing the research necessary to understand and develop systems that perceive, learn, reason, communicate, and act in the world; exhibit flexibility, resourcefulness, creativity, real-time responsiveness, and long-term reflection; use a variety of representation or reasoning approaches; and demonstrate competence in complex environments and social contexts.

What is sometimes referred to as "core AI" research addresses, in general, the theory and methods that give rise to these target abilities and their implementation in machines. It includes research in all matters of learning, abstraction, and inference required for intelligent behavior as well as general architectures for intelligence, integrated intelligent agents, and multi-agent systems. Machine learning, that is, methods for solving tasks by generalizing from data, has made great advances in recent years through the combination of new algorithms, increases in computing power, and the growing availability of data. Machine learning does not, however, encompass all of core AI; that also includes research on knowledge representation, logical and probabilistic reasoning, planning, search, constraint satisfaction, and optimization.

In some lines of AI research, computational models and mechanisms of intelligence draw direct inspiration from living systems. Biologically-inspired computing draws from connectionism, behavior, and emergence in living systems to inform algorithm and system design. Computational neuroscience contributes models based on theory and analysis of computational processes in the nervous system. Behavioral and cognitive science informs much of the motivation and design of systems seeking to implement behavior typical of human perceptual, motor, and cognitive processes and their interactions.

Perception and communication are critical capabilities associated with intelligent behavior. Where AI is concerned, the field of computer vision studies methods that enable systems to sense and reason about the visual world. Human language technologies (also known as "natural language processing" and "natural language understanding") research enables intelligent systems to analyze, produce, translate, and respond to human text and speech.

Intelligent systems may be able to act upon the world through embodiment. Robotics is closely aligned with but not identical to embodied AI. While an embodied AI may be a robot, this solicitation does not include in the scope of this definition tele-operated robots or industrial robots that simply repeat programmed patterns of motion.

As intelligent systems amplify humans' capabilities to accomplish individual and collective goals, research is needed to assess the benefits, effects, and risks of AI-enabled computing systems; and to understand how human, technical, and contextual aspects of systems interact to shape those effects. Relevant research areas therefore include consideration of explainable and trustworthy AI; validation of AI-enabled systems; AI safety, security, and privacy; and the role of emotion and affect in the design and perception of increasingly sophisticated machine intelligence.

Research in AI also encompasses novel software and hardware architectures, as well as methods for carrying out AI algorithms on a variety of computing systems and platforms, including those that operate under additional constraints such as time (e.g., real-time) or energy, or those targeting specific application classes or use cases. Developing hardware further optimized for AI and ML algorithms or hardware offers the potential for even higher levels of performance.

The above definition of AI and its principal disciplines establishes the scope of this National AI Research Institutes program.

I.B. Foundational and Use-Inspired AI Research

Research in foundational AI seeks to develop theory and methods that are independent of any particular domain of application. Use-inspired AI research refers to basic research that has use for society in mind. Use-inspired research seeks new methods and understanding in AI by situating the research in a domain of application to simultaneously inform progress in AI and solve particular use cases. As an example, foundational research in machine learning gave rise to breakthroughs in deep neural networks motivated by performance in controlled contexts like character recognition. Later, use-inspired research in the intersection of machine learning and linguistics led to the development of recurrent neural networks in AI while also revolutionizing language modeling for speech and text processing. We use the phrase "use-inspired" rather than "applied" to emphasize that this solicitation seeks to support work that goes beyond merely applying known techniques and adds new knowledge and understanding in both foundational AI and use-inspired domains. Ideally there is a virtuous cycle between foundational and use-inspired research, where foundational results provide a starting point for use-inspired research, and the results from use-inspired research are generalized and made foundational.

I.C. Program Vision

AI has advanced tremendously and today promises personalized healthcare; enhanced national security; improved transportation; and more effective education, to name just a few benefits. Increased computing power, the availability of large datasets and streaming data, and algorithmic advances in ML have made it possible for AI development to create new sectors of the economy and revitalize industries. Continued advancement, enabled by sustained federal investment and channeled toward issues of national importance, holds the potential for further economic impact and quality-of-life improvements.

The 2019 update to the National Artificial Intelligence Research and Development Strategic Plan, informed by visioning activities in the scientific community as well as interaction with the public, identifies as its first strategic objective the need to make long-term investments in AI research in areas with the potential for long-term payoffs in AI. The President's Council of Advisors for Science and Technology (PCAST), in a report issued in 2020, identifies AI as requiring new and sustained research to drive science and technology progress. A subsequent 2021 PCAST report builds upon this strategy for convergent AI research,

emphasizes the ubiquitous role of AI in societal challenges, and situates this National AI Research Institutes program as a long-term multi-sector initiative to enhance innovation through foundational and use-inspired research.

II. PROGRAM DESCRIPTION

Building upon the network established by the first 18 AI Research Institutes, this National AI Research Institutes program solicitation will fund Institutes comprised of scientists, engineers, and educators united by a common focus on advancing the research frontiers in AI. The program seeks to build a broader nationwide network to pursue transformational advances in a range of economic sectors, and science and engineering fields. AI Research Institutes will have as their primary focus the advancement of multidisciplinary, multi-stakeholder research on larger-scale, longer-time-horizon challenges in AI research than are supported in typical research grants. They will accelerate the development of transformational technologies by grounding that research in critical application sectors that can serve as motivation for foundational research advances and provide opportunities for the effective fielding of AI-powered innovation.

II.A. AI Research Institutes Scope

The vision of the National AI Research Institutes program is broad and ambitious. It is expected that each AI Research Institute will pursue this vision in ways that are uniquely suited to its selected research focus, facilities, collaborations, and other unique circumstances. Proposers are encouraged to convey the unique qualities of the proposed Institute, while addressing the following desiderata common to all AI Research Institutes proposed to this program:

- AI Research Institutes **advance foundational AI research** that will have broad and lasting impact, contributing new knowledge or methods toward understanding of the mechanisms underlying thought and intelligent behavior and their implementation in machines (see the definition of AI specified above). Institutes aimed at advancing established AI lines of research should demonstrate the potential to radically advance these areas beyond the state of the art. Institutes might also address new foundational AI research priorities that arise from rapid advances in AI and the increasing ubiquity of AI-enabled technology. **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 solicitation.**
- AI Research Institutes **conduct use-inspired research** that both informs foundational AI advances and drives innovations in related sectors of science and engineering, segments of the economy, or societal needs. Effective use-inspired research achieves synergy among a group of researchers to enable transformative advances in AI, related sectors, and the interfaces between these areas. This dimension of an AI Research Institute will feature clear and compelling goals to advance AI and to accelerate the fielding of AI-powered innovation; it also enhances the transfer of knowledge through the meaningful exchange of scientific and technical information with external stakeholders such as industrial partners, public policy makers, or international organizations, as well as with the broader scientific and educational community. Through use-inspired research, Institutes have the potential to create and share new community infrastructure, including data and software, to further research, promote reproducibility, and support education.

    It is critical that proposals clearly specify how the use-inspired context for Institute research reveals the opportunities for *foundational AI* advances and how those *foundational AI* advances in turn contribute to the related sectors that define the use-inspired context.

- AI Research Institutes **actively build the next generation of talent** for a diverse, well-trained workforce. Specifically, AI Research Institutes should leverage the visionary nature of their research foci to drive new and innovative education and development tailored toward e.g. undergraduates, graduate students, and post-doctoral researchers, as well as through community colleges and skilled technical workforce training and other opportunities as appropriate that advance knowledge and education of AI, including public understanding of AI. This could include innovative pedagogy and instructional materials, advanced learning technologies, project-driven training, cross-disciplinary and collaborative research, industry partnerships, and new career pathways. Institutes should offer broad, deep, and diverse experiences to build the next generation of the AI workforce, with a focus on broadening participation among the full range of groups currently under-represented in science and engineering. AI Research Institutes should maximize their unique position to grow the next generation of talent that will provide new discoveries and leadership.
- AI Research Institutes are 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 in application sectors of national importance. The multidisciplinary nature of these Institutes will catalyze foresight and adaptability beyond what is possible in single research projects; further, the individual projects that an Institute carries out should meaningfully integrate into fundamental contributions beyond the sum of the individual projects.
- Each Institute will be comprised of **multiple organizations working together to create significant new research capabilities**. NSF and partner organizations seek to grow the network of National AI Research Institutes in lead organizations distributed throughout the country to grow new centers of AI leadership and leveraging existing centers of excellence as appropriate. Institutes are strongly encouraged to include organizations that can directly contribute to NSF's commitment to broadening participation by engaging a diverse, globally engaged research community, integrating research with education and building capacity, and expanding efforts to broaden participation from underrepresented groups and diverse institutions across all geographical regions. Participants should be meaningfully integrated into a diverse Institute that is more than just the sum of the parts. Each Institute will have a lead PI with demonstrated vision, experience, and capacity to manage a complex, multi-faceted, and innovative enterprise that integrates research, education, broadening participation, and knowledge transfer. Each Institute will also be staffed with a Managing Director or Project Manager (distinct from the lead PI) and a suitable Management Team to oversee the operations of the Institute. An External Advisory Board is required for all AI Research Institutes. (Potential Advisory Board members should not be approached or identified until the Institute is funded.)
- AI Research Institutes are **nexus points for collaborative efforts**. The "nexus point" function in this program is not a mere state of being, but rather an active set of priorities, programs, mechanisms, etc., whereby an AI Research Institute pursues the continuing growth of collaborations with external partners to bring together people, ideas, problems, and technical approaches for maximum impact beyond the members and the boundaries of the Institute itself. As nexus points, Institutes have the potential to continue to connect with new partners with the best teams and approaches from institutions of higher education, federal agencies, industry, nonprofits/foundations, centers/institutes, and national networks. As nexus points, Institutes promote organizational collaborations and linkages within and between campuses, schools, and the world beyond, and further the Institute's mission to broaden participation in research, education, and knowledge transfer activities through a network of partners and affiliates.

II.B. Institute Themes

In this round of Institutes, proposals are being solicited in the following high-priority areas. Submissions MUST have as a principal focus one of the following themes.

Theme 1: Intelligent Agents for Next-Generation Cybersecurity

The U.S. invests significantly in cybersecurity R&D each year, defending government agencies, companies, critical infrastructure, and educational and health organizations from increasingly diverse and sophisticated threats to computing and cyberinfrastructure. The hazards of cyber-attacks include loss of intellectual

property or even ability to function, privacy risks and misuse of personal information for fraud or blackmail, and the fabrication or spread of disinformation.

Significant advances have been made in harnessing recent advances in AI to monitor, predict, prevent, and respond to specific cybersecurity-related vulnerabilities; for example, by recognizing suspicious patterns in user activities, system traces, and network traffic. As cuber defenses and AI technologies become more sophisticated, however, so do cyber-attacks. Next generation cybersecurity must go beyond local, individual vulnerabilities to safeguard against complex attacks involving multiple sophisticated and intelligent adversaries carrying out coordinated strikes on multiple systems. These threats pose grave problems for both human security teams and the purely data-driven machine-learning based tools they use because of their scale, novelty, and complexity.

The goal of this Institute is to prepare us for a future where both defenders and attackers increasingly use AI-powered tools as they pursue cybersecurity-related goals. Research at the Institute will deepen knowledge and capabilities in both AI and cybersecurity through transformational advances in agent-based AI systems driven by cybersecurity needs. In this theme we use the term "agent" to refer to an AI system that frames the overall challenge as one of appropriately autonomous reasoning and action in a complex multi-agent environment. The Institute will develop methods for modeling the actions, beliefs, and goals of the machine and human agents involved in cyber-attacks and cuber defenses, improving the ability of defenders to deter, protect, detect, and respond to cybersecurity risks. The research should also account for the limitations and uncertainties of these agents, ensuring that they operate responsibly and in concert with human supervisory control in security operations.

A **non-exhaustive** list of potential research topics at this Institute includes:

- AI-enabled analytics across multiple kinds of data for modeling cybersecurity threats, including, but not limited to: natural language intelligence reports from threat reporting registries; dark web chatter; network, process, and access log data; and sensitive data controlled and protected by defenders who need to cooperate while maintaining privacy and security of their own data.
- Plan recognition, plan generation, and flexible plan execution for threat deterrence, detection, and response. This might include intelligent prioritization of network traffic and information, automated synthesis of code patches and system configurations, active defenses and strategic counterattacks, developing and deploying counter narratives to misinformation, and other capabilities that reduce cybersecurity risks.
- Tools for reasoning about uncertainty in a system's evaluations, managing mistakes and mitigating risks around them, and acting with appropriate levels of autonomy in coordination with existing security responsibility and operations structures.
- Principled methods for interaction and coordination between humans and AI agents working together in cybersecurity teams. The methods should take into account the differing strengths and limitations of human experts and AI components, including adapting to best leverage the expertise of particular members on the team and supporting the transfer of the expertise from humans to AI agents.
- Defenses against adversarial methods that sophisticated attackers would deploy against the proposed foundational AI advances. For the topics above, these might include inducing incorrect models of human objectives, capabilities, and methods; poisoning or evading machine learning-based components of larger agent-based AI systems; distorting data collection and analysis methods in threat intelligence systems; inducing attacker-friendly or defense-costly response plans; misleading system evaluations of confidence and appropriate autonomy; and interfering with defender coordination.
- Methods for recognizing multi-step, multi-agent attack plans from incomplete and uncertain information. This could include the ability to discover new attacks from first principles, and the provenance and evolution of new attacks from existing ones.
- Game-theoretic models of cybersecurity, in which agents may deploy strategies designed to mislead their opponents. These strategies may also need to account for coordination and competition between individual attackers and defenders, and the networks of other agents they can control or influence.

As a reminder, this institute is focused on advancing foundational AI research with a focus on reasoning and agency, guided by the problems posed in complex cybersecurity environments. In the proposal. these advances should be compellingly integrated to improve cybersecurity against sophisticated threats in real-world critical contexts. Proposals where the main focus is on general work in adversarial ML/AI, that primarily apply existing AI and ML methods to security problems, or that read more as many small proposals on disconnected problems rather than an integrated research plan connecting foundational AI advances to important cybersecurity problems are unlikely to be responsive to this theme.

The Department of Homeland Security Science and Technology Directorate (DHS S&T) and IBM Corporation are providing partial support for this institute theme.

Theme 2: Neural and Cognitive Foundations of Artificial Intelligence

Advances in our understanding of neural, biological, and cognitive processes provide a rich set of models and mechanisms for guiding the development of AI to abilities and levels of performance comparable to that of humans. Deep integration of these advances with theoretical and algorithmic advances in AI have the potential to transform AI conceptualization and implementation (from algorithms to hardware). Likewise, in neuroscience and cognitive science, AI is beginning to transform data analysis and model discovery but has yet to be fully integrated into the theory and foundations of the fields. The purpose of an Institute in the Neural and Cognitive Foundations of AI is to unify and jointly raise the expectations of these fields, taking full advantage of recent developments across disciplines and new opportunities to develop shared models, abstractions, and common frameworks for research. In this way, research at the Institute will advance our understanding of intelligence, both in nature and in engineered systems, and build upon these advances to explain biological intelligence and design next-generation AI.

Proposals to this theme are encouraged to convey a research strategy that is visionary, but also timely and appropriately scoped, as the breadth of potential advances in this theme is beyond the capacity of a single Institute to address. Whatever its chosen focus, research at the Institute is expected to leverage and extend the current state of the art across levels of abstraction in understanding and modeling intelligence, and to explicate the relationships between biological and artificial intelligence. The topics listed below are illustrative of the range of research questions appropriate for this theme:

- Neural and cognitive theories that inform the design of AI systems with the potential for active and continuous learning across diverse tasks, dynamic environments, and self-motivated exploration. This may include theories of brain development, plasticity, and regulatory processes (e.g., sleep, dreaming, and memory consolidation) for their potential role and impact on artificial neural networks.
- How insights and mathematical concepts that enable AI systems to solve complex perceptual, reasoning, and decision-making tasks can inform and test hypotheses for the structure of cognitive and neural instantiations of such computations in biological systems. This could include the identification and understanding of biological processes that may reflect computational processes such as gradient-based learning, vector representations of concepts, contrastive learning, and other computational processes as well as novel concepts.
- Theories of how cognitive phenomena -- such as perceptual understanding, innate behaviors, memory, learning, associations, causal reasoning, and decision making that enable organisms to adapt to structure in the physical world and apply learned information to new tasks -- can be implemented and tested in AI systems.
- Mechanisms underlying collective behaviors such as social hierarchy, communication and cooperative behaviors that enable organisms to effectively function as collective units, allowing for the emergent behavior of complex AI eco-systems with collective intelligence.
- The use of artificial neural networks as in-silico organisms for exploring theories of neural development, learning, and development in the brain.
- Joint approaches to understanding high-level and abstract cognitive concepts and skills (e.g., language, analogical reasoning, and theory of mind) in neural and artificial systems.

This list is neither limiting nor exhaustive. Institutes should be organized around a strategic set of topics where closely aligned questions and reciprocal interactions across levels of scientific analysis will have maximum impact.

The Office of the Under Secretary of Defense for Research and Engineering is providing partial support for this institute theme.

Theme 3: AI for Climate-Smart Agriculture and Forestry

Agricultural systems occupy a major portion of the nation's landscape and play a critical role in a rapidly changing climate. These systems play a critical role in increasing quality of life and economic opportunities for individuals, businesses, and communities. AI, and agriculture and food systems research, must advance in an integrated way if we are to realize resilient, climate-smart agriculture and forestry, increased nutrition security, rural economic revitalization, and increased equity and inclusion.

Use-inspired research in this theme might address, for example, collecting and analyzing data to predict future climate scenarios with high degrees of accuracy, providing support to decisions about which crops to plant, determining best climate-smart practices to implement, and/or calculating the greenhouse-gas footprint resulting from various distributions of crops and animals 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 challenge(s) being addressed and the AI advances necessary to achieve those goals.

Proposals can address any relevant combination of solutions and research foci. Some examples of AI-driven solutions are provided below. This list is meant to stimulate thought about the many potential application areas and is not prescriptive.

- Prediction of optimized and spatially explicit combinations of greenhouse gas mitigation, carbon sequestration, and other natural resource management activities that maximize carbon credits, profitability, and ecosystem services.
- Decision tools for markets and value chains that explicitly build trust through producer- and consumer-oriented methods such as modeling of cooperative market-making and peer-to-peer input and feedback.
- Tools that adaptively learn to support the specific forecasting and market needs of the full range of agricultural and forestry stakeholders, and tools that suggest new information and approaches to proactively build continuous learning rapidly and at scale.
- Design and function of scalable systems for management of spatially optimal, climate-smart agriculture from the plot to watershed level, with market and return embedded into the modeling and decision support system, and with fully integrated risk and reliability measures and error propagation analyses.
- Optimization of the markets and systems underlying climate-smart allocation of resources of various kinds, e.g., for delivery of learning, equity programming, and agriculture interventions that are synergistic with rapidly changing business solutions.
- Improving models by integrating data from the public and private sectors while preserving data rights, to better understand the impacts of agricultural conservation techniques and to prioritize the efficient adoption of conservation practices for maximum impact.

To meet the scale and complexity of climate-driven threats, this theme encourages the advancement of new and transformative approaches for modeling complex agricultural systems and systems interventions. Proposals should clearly justify both the selection of the climate change threats to systems and the breakthroughs needed in foundational AI research necessary to make agricultural and food systems more resilient. Whatever the proposed research foci, proposals should demonstrate the potential for those foundational advances to benefit AI research more broadly through the dissemination of new knowledge (i.e., advances in methods or theory), as well as the potential for these advances to contribute to solving other challenges of such grand scale.

Proposals are expected to convey a vision and approach appropriate for the scale of these Institutes and produce transformative outcomes. Institute structure, activities, and management should clearly convey the synergistic function of the institute as a nexus point for the co-creation of the desired outcomes. Specifically, such synergies might include the full engagement of the nation's diverse new agricultural and food system participants, addressing the rural to urban continuum, and mechanisms for equitable allocation and use of resources, including those in education, extension, and positive youth development.

This theme is fully funded by the US Department of Agriculture National Institute of Food and Agriculture (USDA-NIFA).

Theme 4: AI for Decision Making

The world is facing countless decision problems that often require balancing competing criteria: How to respond to new pandemic diseases while reducing their economic impact? How to react to a changing climate while sustaining economic growth? How to reduce community violence while preserving liberties? How to plan for city growth while considering effects to the environment and social inequality?

Governments and industries are making enormous expenditures and drastic social interventions in order to address these and many other problems. In many – perhaps most – cases, however, the decisions are driven by overly simple predictive models or no mathematical model at all. Overly simple models confuse association with causation and can lead to interventions that fail to address the causes of the problem. In situations where there are many different models that support different interventions, there is a strong temptation to dismiss any attempt to make an evidence-based decision and instead to "go with one's gut instinct".

Although algorithms and reasoning mechanisms for decision making have been studied in AI almost since the inception of the field, fundamental challenges still need to be satisfactorily addressed. These include:

Underlying Principles:

- Principles for deriving causal models from data together with prior knowledge, and for performing causal and counter-factual reasoning. The ultimate goal will be to create a science of causality that informs research and applications across all sciences and structures of social governance.
- Principles for validating mechanistic models in the absence of the ability to run controlled randomized trials and for making individual-level decisions on the basis of population-level models.
- Principles for fusing different decision models while taking into account the reliability of each, as well as including principles for developing models that are aware of their own limitations.
- Principles for decision making when our knowledge or the facts on the ground are changing over time, and principles for making trade offs between decision quality and time to decision.

Methodologies:

- Scalable methods for handling multiple-objective decision problems, in order to address situations where different parties to the decision have different goals.
- Methods for creating decision models that are understandable, justifiable, and explainable.

Decision Support:

- Methods to support decision making when the decision makers' preferences (e.g., over alternatives) are not known a priori but must be obtained by explicit preference solicitation or by implicit methods such as analysis of past decisions.
- Understanding the kinds of systematic errors and biases people exhibit in decision making and strategies for countering those errors. As an important special case, principles for designing interventions that lead to people reacting in desirable ways to those interventions (e.g., nudges and framing).
- Principles for designing decision-support systems for interactive human-AI 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. The proposal must aim at making clear foundational contributions to areas at the intersection of AI and decision making, such as (not an exclusive list) causal modeling, planning, and knowledge representation and reasoning. Use case domains could include political science, public health, economics, climate change, or any other domain(s) of national importance.

The Institute team should include experts in AI as well as experts in other fields that study the foundations of decision making, such as philosophy, psychology, economics, management science, or other relevant domains, as well as experts in the use-case domain(s). A strong proposal will include innovative approaches to education on the science of decision making at both the graduate and undergraduate levels.

Theme 5: Trustworthy AI

Increasing trustworthiness of AI is key to accelerating its acceptance and adoption, and thus realize all of its potential benefits to society. Today, the ability to measure and ensure AI trustworthiness is limited. It is vital to develop AI technology that is not only powerful and accurate, but also trustworthy. Achieving trustworthy AI will require technological advances informed by social context and guiding principles and policies. The strongest proposals will include an agenda for foundational and use-inspired research, and work towards best practices and standards for design, development, evaluation, deployment, audit, and monitoring of trustworthy AI.

Proposals to the Trustworthy AI theme must address the following three dimensions.

Foundations of Trust and Trustworthiness

What makes an AI system trustworthy? Identifying, prioritizing, and satisfying the fundamental attributes that render an AI trustworthy are open research challenges. We trust established technologies, such as automobiles or electric lighting, because they are reliable, predictable, governed by rigorous and measurable standards, and provide the expected benefits. Facilitated by basic knowledge of their operation, we are familiar with common faults and how to address them, and there is infrastructure to deal with problems we cannot handle ourselves. As we consider AI systems of increasing complexity, and especially as AI researchers pursue general (a.k.a. strong) AI, the requirements for trustworthy systems become much more complex and nuanced; they begin to resemble our requirements for trusting other humans. People want to know that AI systems will act in their best interests, that they will act responsibly and legally, that they adhere to ethical principles that engender trust, and that they take into account the values of users and other stakeholders. Tightly coupled theoretical foundations, formal frameworks, and empirical studies should be brought to bear towards understanding user trust in AI and the trustworthiness of AI.

Building Trustworthy Systems

To be trustworthy, AI systems need to meet requirements, correctly implement specifications, and have observably acceptable behaviors and consequences. The processes for developing and evolving trustworthy systems present new challenges when incorporating AI components (such as deep learning models, constraint satisfaction networks, planning and other AI mechanisms). Reliability and dependability are not sufficient to establish AI systems that are trustworthy in the eyes of users and other stakeholders. Beyond reliability and dependability, AI systems should exhibit transparency, accountability and explainability, among other attributes, in order to be deemed trustworthy. They must effectively function under uncertainty due to ambiguity, inconsistency, and untrusted actors and information. They need to be able to ascertain their own limitations and estimate their reliability or competence in each situation. They should recognize when they do not have sufficient expertise to succeed. AI systems need to be robust in the presence of unexpected events, questionable decisions, and data of unknown provenance or designed to fool the system. To maintain system trustworthiness and trust of individuals, AI systems must be able to adapt, recover, repair, reconfigure, or reprogram in response to changes in operational requirements, constraints, and other limiting conditions. They also need to communicate these limitations and actions to users in a timely fashion.

In addition to these technical criteria for the resulting systems, factors related to the practice of system design, development, testing, deployment, and auditing (such as the areas of expertise of the development team, broad and equitable stakeholder involvement, and soundness of processes) are also necessary. Finally, the goal is to produce trustworthy systems that are, in fact, trusted by the people who use and are affected by them. This depends not only on the technical criteria met by the system and the team and processes used for its construction, but also on the system's ability to effectively collaborate with humans in a manner that engenders trust. Trust also depends on how the systems are embedded in the wider socio-technical environment. We expect that the research in Foundations of Trust and Trustworthiness, described above, will inform the dual goals of realizing trustworthy and trusted AI systems. Proposals submitted to this theme should present a coherent, unifying framework for achieving these goals.

Ethical and Societal Considerations

Trustworthy and responsible AI systems need to take into account the ethical and social values of those affected by them. Such systems must also work with and within existing economic and social structures, respecting the autonomy, agency, practices, and constraints of the people and organizations they are designed for and consideration of unintended consequences. This challenge is heightened by the diversity of social, economic, ethnic, and racial groups that may be affected by a single deployed system, as well as diversity of belief systems, learning styles, modes of communication, and traditions. Successful solutions thus require collaboration between technologists, social scientists, and other experts to enhance design and development of technologies that serve the broader society. The design and implementation of AI for ethical and societal considerations is relatively underdeveloped and needs to be integrated into AI research and systems.

Proposals submitted to the Trustworthy AI theme must integrate research on the three dimensions above, pursuing theoretical underpinnings, formal methods, and empirical foundations of Trust and Trustworthiness, which in turn serve as the unified framework for creating and managing trustworthy AI, taking ethical and societal considerations into account. In all three of these central thrusts, sound measurement processes and science need to be established. The research should be driven by problems in use-inspired research that requires synergies across the project to succeed. Proposals to this theme must consider use-inspired domain(s) that demonstrate the importance and benefit of trustworthy systems in domains where AI has significant impact on individuals, groups, and society at large.

NSF expects that the Institute will work closely with industrial partners identified by the investigator team. In addition, co-sponsor NIST seeks a collaborative relationship with the Institute. The institute should play a major role in the development of meaningful measures, benchmarks, testbeds, and certification methods. The research community has begun to identify and advance important topics essential to trust and trustworthiness – such as safety, fairness, privacy, transparency, explainability, accountability, accuracy, and reliability. Additional attention to these topics is welcome, and breaking new ground is strongly encouraged. An Institute for Trustworthy AI will collaborate closely with NIST as a research partner in areas that may include evaluation benchmarks and metrics, and developing best practices for building, procuring, deploying, and evaluating AI systems. NIST also welcomes the Institute to collaborate on identifying grand challenge problems and establishing data sets in support of work on them. We encourage creative plans for engaging with NIST as part of the nexus-building activities of an AI Institute.

Proposals must be unified in the pursuit of trustworthy AI and have sufficient breadth to justify an institute-level investment. The institute's activities must be strongly coupled through common goals that serve trustworthy AI. Projects must work toward shared goals such as a unified theoretical framework, common representations, solutions that work across domains, and integration of the technical, human, and social aspects, and shared infrastructure.

The National Institute of Standards and Technology (NIST) is providing partial support to this theme.

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

The primary focus of an institute in AI-Augmented Learning includes research and development of AI-driven innovations to radically improve human learning and education. Achievement and opportunity gaps, particularly for learners from disadvantaged or underserved communities, have always been present, but COVID-19 has exacerbated them. Institute plans for this theme should address and measure outcomes with direct education impact, in both the short- and long- term, that have practical significance to educators, parents, or other decision-makers. Plans must also directly address algorithmic bias, model transparency, security and data privacy in the support of learning.

Two Institutes are solicited in this theme. Proposals to this theme should have a primary focus on one of the following two tracks.

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

An institute with this focus should advance AI research for digital learning platforms to create next-generation learning architectures in STEM preK-12 contexts. Here, research could include the design and implementation of AI technologies (e.g., intelligent/cognitive tutors) that support highly adaptable, personalized, and distributed systems to expand access, equity, and depth of learning across diverse learners, institutions, and settings. Advances in AI could help to provide diagnostic information that supports formative, continuous, and summative assessments, as well as skill and aptitude discovery, drawing upon multimodal and smart and connected data.

Track A proposals should directly address the Grand Challenge of "Education for All" with a focus on AI-driven learning architectures and digital platforms of the future. The institute should include research relevant to education in the United States and must address factors under the control of U.S. education systems. The proposed research should aim to reduce achievement gaps, improve access, and address the needs of all learners. Research that addresses multiple factors related to learning (e.g., cognitive, affective, motivational, contextual) is encouraged. Institutes must investigate the feasibility, usability, and potential promise for improving education outcomes within settings to include: prekindergarten, public and private K-12 schools, after-school, distance learning, or online learning programs. This could include a cost-effectiveness analysis so that education policymakers and practitioners can understand the costs, including time and resources, to achieve the improvements in AI-driven learning. The activities of the institute should include learners from disadvantaged or underserved communities.

With the goal of closing the widening gaps in student achievement, partners should include experts from across multiple sectors (e.g., AI researchers, education/learning researchers, industry, state education agencies, local education agencies, non-profits). At a minimum, the Institute should partner with stakeholders from school districts and/or state education agencies.

TRACK B: AI-Augmented Learning for Individuals with Disabilities

Individuals with disabilities comprise a diverse population with varying levels of challenges and strengths, the latter of which are often overlooked, underutilized, or dismissed. The need for intensive efforts to support these learners has become even more critical given that the COVID-19 pandemic has further widened existing gaps and resulted in decreased access and opportunities for students with disabilities to learn and receive support services.

An AI Research Institute with this focus should advance AI-driven research and innovations for learners (birth through postsecondary) with or at risk for physical, cognitive, or social disabilities. The Institute should advance AI research to transform identification, assessment, and support for these learners. The ultimate goal of this Institute is to improve the developmental, education, and transition outcomes of individuals with disabilities, which will lead to active, essential, and fully engaged participants in a diverse workforce.

Examples of AI-driven research that an Institute might pursue include (but are not limited to):

- identifying early indicators that signal the need for intervention or monitoring of students with or at risk for disabilities;
- assessing students to identify the levels of support needed in academic and social- emotional- behavioral areas, such as behavioral self-regulation, or work in fluency and practice in math or reading where deficits were exacerbated by COVID-19;
- developing and testing universal and ability-based interventions; and
- facilitating improved communication through systems that integrate speech, text, affect, and other modalities.

Proposals must identify and address the necessary advances in foundational AI research to achieve the targeted outcomes for individuals with disabilities. These research areas could include, for example:

- socially assistive robots and/or conversational agents;
- augmented perception to support learning and communication;
- real-time adaptive and personalized dialogue; image interpretation and description to support instruction; and
- explainable AI to facilitate learners in exploring open-ended learning environments.

The Institute must conduct research in education environments or other settings where educational or developmental intervention services are provided. These include homes, community or childcare settings, preschools, public and private K-12 schools, alternative schools and settings (such as juvenile justice and residential treatment facilities), and colleges/universities. These may include after-school, online, and remote learning contexts that are under the auspices of education agencies. Proposed research must address and measure one or more student outcomes that support success in school and afterwards. These may include developmental, school readiness, literacy, STEM (science,

technology, engineering, and/or mathematics), social/emotional/behavioral, functional, secondary/transition, or postsecondary outcomes.

The U.S. Department of Education's (ED) Institute of Education Sciences (IES) is providing partial support for Institutes funded by this theme.

II.C. Industry Funding Partners in this Solicitation

Companies specifically listed in this solicitation have committed to providing annual unrestricted donations to the NSF for the purpose of funding Institutes in select themes awarded under this solicitation. The reference to "industry partners" in this section refers specifically to these entities and their role as funding partners in this solicitation. The donations from these partners have been agreed upon on the basis of a shared belief in the importance of making progress in the research, education, and workforce development goals identified in this program. Specifically, the following partner is contributing to support the following theme:

- IBM Corp.: Theme 1, Intelligent Agents for Next-Generation Cybersecurity.

Prior to award, the partner company will not participate in or observe the merit review of proposals. After completion of the merit review process, NSF may share with representatives of the industry partner the subset of proposals which are under consideration for funding by NSF in the associated theme(s), along with corresponding unattributed reviews, panel summaries, and Reverse Site Visit reports. NSF will take into consideration the input of all funding partners prior to making final funding decisions but will retain final authority for making all award decisions.

NSF will administer awards under the Program in accordance with standard NSF policies and procedures. All awards will be subject to standard NSF terms and conditions. Industry partners will not oversee the activities or use of funds by grantees under this Program but may engage with grantees as outlined below.

Specifically, subsequent to Institute awards, the partner company may make available, at a minimum to all Institutes funded within the respective theme(s), direct contributions of resources including but not limited to software (prototypes or products), data sets, other computing infrastructure. No awardee will be required to use any company's offered contributions.

A company may also arrange to fund its own personnel as researchers-in-residence (RinR) to directly participate, part-time or full-time, with funded Institutes within the theme(s) in which they are participating. These arrangements will be optional and upon the mutual consent of the companies and respective Institutes. No awardee will be required to accept a RinR.

Guidelines for the Participation of Partner Companies and Affiliated Individuals in Proposals

Guidelines for Partner Companies

A partner company is permitted to participate in proposals to the themes in which it is not a funding partner.

A partner company is not, however, permitted to participate in proposals to the theme(s) in which it is a funding partner, as identified in this solicitation. The company may not participate in such proposals in any way as a collaborator, whether funded or unfunded. For example, the company may not submit a letter of collaboration as part of any proposals to the theme.

Guidelines for Individuals Affiliated with Partner Companies

Individuals affiliated with a partner company may participate in proposals to the themes in which the partner company is not a funding partner.

Individuals affiliated with a partner company may participate in proposals to the theme(s) in which the partner company is a funding partner subject to certain limitations and allowances. These limitations and allowances apply to individuals who are currently employed by, consulting for, or on an active agreement to provide services for the company. Specifically:

- Such individuals may not participate in their capacity with the company.
- Such individuals may participate if they (i) hold a primary appointment at another organization not partnered on the theme (e.g., a primary academic appointment at an institution of higher education), as applicable to and defined by that organization, and (ii) do so strictly in their capacity at that other organization.

Proposals that violate the above restrictions may be returned without review.

Proposers are not restricted from making use of the widely accessible products or services of partner companies.

Proposers to this program may **not** directly contact partner companies with questions pertaining to the company's participation in this solicitation. Proposers with questions about eligibility and industry partnerships in general should contact the program leads listed in this solicitation.

II.D. Webinar

NSF will hold an informational webinar in the first half of November 2021. The date and registration information for this webinar will be posted on the Program Web page on or before October 22nd, 2021.

II. E. Program Timeline for this AI Research Institutes competition:

NSF provides the timeline below for planning purposes for proposers to this program. While NSF will make every attempt to adhere to this timeline, circumstances beyond NSF's control may affect the specific dates/activities outlined.

- Webinar announcement: October 22, 2021
- Preliminary proposals due: January 14, 2022
- Results of preliminary proposal review to teams: Mid-Feb 2022
- Full proposals due: May 13, 2022
- Reverse Site Visit (RSV) notifications and scheduling: Oct 10-28 2022 (earlier for Theme 6, Track B)
- RSVs conducted: Nov 28-Dec 22, 2022 (earlier for Theme 6, Track B)
- Declined proposers informed, and recommended awards announced: Estimated April 2023 (earlier for Theme 6, Track B)
- Anticipated start date of awards: June 1, 2023 (January 1, 2023 for Theme 6, Track B)

III. AWARD INFORMATION

NSF plans to make approximately one Institute award in each of themes 1-5, and one award to each of the two tracks listed in theme 6. Institute awards will be made for between $16,000,000 and $20,000,000 for four to five years ($4,000,000 per year on average). Proposals outside this range may be returned without review. Estimated program budget, number of awards and average award size/duration are subject to the availability of funds.

IV. ELIGIBILITY INFORMATION

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Institutions of Higher Education (IHEs) - Two- and four-year IHEs (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Special Instructions for International Branch Campuses of US IHEs: If the proposal includes funding to be provided to an international branch campus of a US institution of higher education (including through use of subawards and consultant arrangements), the proposer must explain the benefit(s) to the project of performance at the international branch campus, and justify why the project activities cannot be performed at the US campus.
- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization: 2

An organization may submit no more than two preliminary proposals to this solicitation as lead institution. An organization may submit up to two full proposals that correspond to preliminary proposals reviewed under this solicitation. In the event that an organization exceeds these limits, preliminary proposals will be accepted based on earliest date and time of preliminary proposal submission, i.e., the first two preliminary proposals will be accepted, and the remainder will be returned without review. A full proposal that does not correspond to a preliminary proposal reviewed in this program will be returned without review.

Limit on Number of Proposals for Senior Personnel: 1

An individual may be designated as senior personnel (which includes but is not limited to PI or co-PI) on at most one preliminary proposal, and at most one full proposal to this solicitation. In the event that an individual exceeds this limit, proposals will be accepted based on earliest date and time of submission, i.e., the first compliant preliminary or full proposal will be accepted, and the remainder will be returned without review.

Additional Eligibility Info:

For proposals that designate USDA-NIFA as the requested funding agency, in accordance with the guidelines outlined in the Proposal Preparation Instructions, eligible applicants include:(1) State agricultural experiment stations; (2) Colleges and universities (including junior colleges offering associate degrees or higher); (3) University research foundations; (4) Other research institutions and organizations; (5) Federal agencies, (6) National laboratories; (7) Private organizations, foundations, or corporations; (8) Individuals who are U.S. citizens, nationals, or permanent residents; and (9) any group consisting of two or more entities identified in (1) through (8).

The list of USDA-NIFA eligible institutions does not include foreign and international organizations.

The USDA-NIFA specific eligibility criteria listed above apply only to proposals submitted to a theme identified as fully funded by USDA-NIFA or that otherwise explicitly designate USDA-NIFA as the requested funding agency. For all other proposals, including those targeting a specific agency other than USDA-NIFA for sponsorship, eligibility criteria are specified under "Who May Submit Proposals" above. Proposals that do not meet these eligibility criteria will be returned without review.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Preliminary Proposals *(required)*: Preliminary proposals are required and must be submitted via the NSF FastLane system, even if full proposals will be submitted via Grants.gov.

Preliminary proposals must be submitted in accordance with the instructions below. The NSF decision made on the preliminary proposal is advisory (non-binding) and may include feedback on proposed activities and the responsiveness to program and theme. Submission of a Preliminary Proposal is required in order to be eligible to submit a Full proposal.

Proposers must be sure to check the box "If this is a preliminary proposal then check here" in the middle of the cover sheet. This box appears on the cover sheet template just under the section labeled "Previous NSF Award."

As a multi-organization activity, the proposal must be submitted as a single, integrated proposal by the lead organization; information about other participating institutions, partners, and PIs should be given in section "E. Key Personnel and prospective organization" as described below. Linked collaborative proposals from multiple organizations will be returned without review.

Required components of the preliminary proposal are given below. **Page limitations given here will be strictly enforced, and preliminary proposals that are not compliant with this solicitation will be returned without review.** It is the submitting organization's responsibility to ensure that the preliminary proposal is compliant with all applicable requirements.

Preliminary proposals must consist of five elements as follows and **no other sections are permitted**:

1. Cover Sheet. The title of the proposal must be preceded by "Theme *n*: ", where n is the theme number that is the primary theme to which you are submitting. If you are submitting to Theme 6 (AI-Augmented Learning), please use "Theme 6A: " to denote track A, or "Theme 6B: " to denote track B in that theme. The title should describe the project in concise, informative language that is understandable to a technically-literate reader.

For planning purposes, June 1, 2023 should be shown as the start date on the cover page and elsewhere in the proposal (January 1, 2023 for Theme 6, Track B).

2. Project Summary (1-page limit): The Project Summary consists of an overview, a statement on the intellectual merit of the proposed activity and a statement on the broader impacts of the proposed activity. The project summary for a preliminary proposal should summarize appropriately the elements required in the Project Description and is not expected to summarize a fully developed institute concept. At a minimum the summary should provide an overview of the Institute vision and rationale, its research objectives, and broader impacts. Proposals may incorporate a Keywords section as the last line of the Project Summary. You may use the keywords section to highlight any special emphasis in sectors relevant to partner agencies, or to identify relevance to themes other than the one to which the proposal is submitted.

3. Project Description (6 pages maximum). The project description is brief and should focus on the scope of proposed research activities and the suitability of assembled personnel to make the proposed advances. Detailed research plans are not appropriate. Results from Prior NSF Support should not be included. The project description must consist of the following sections, in the order shown and using the headings indicated.

A. Vision and integrated research goals of the Institute. *(Suggested length: 1/2 page).* Provide a brief, holistic description of the motivation and vision for the proposed Institute, and a high-level description of the proposed research areas/themes.

B. Foundational AI research. *(Suggested length: 1 to 2 pages).* Address the following questions using the underlined headings:

- **Limitations**. What are the specific limitations in the current state of AI revealed in the Institute's vision for use-inspired research and societal impact?
- **Foundational AI contributions**. In which of those areas of AI research will the Institute investigate/develop *significant new knowledge or methods* to overcome those challenges?
- **Basis of confidence**. What special conditions or prior work make the proposed Institute uniquely suited for addressing these AI research challenges?

C. Use-Inspired Research. *(Suggested length: 1 to 2 pages).* Address the following questions using the underlined headings:

- **Use-inspired research contributions**. In what use-inspired research areas will the Institute make advances, and what is the role of AI in those advances?
- **Areas of additional AI application**. In addition to the areas of AI research identified for advancement under *Foundational AI contributions*, what other areas of AI are expected to be applied in the use-inspired research?
- **Concept for use-inspired research**. How does the institute plan to structure its activities to best leverage the use-inspired research context to establish a virtuous cycle of inquiry and discovery across all research activities?

D. Broader Impacts. *(Suggested length: up to 1 page).* How will the Institute make a lasting strategic impact beyond its research outcomes? Highlight intent or preliminary plans for new activities in any or all of Education and Workforce Development, Broadening Participation, Collaboration, and Knowledge Transfer.

E. Key Personnel and prospective organization. *(Suggested length: 1 to 2 pages).*

- **Organization**. Describe the preliminary network of organizations comprising the Institute and their relationships to one another.
- **Key Personnel**. Identify key contributors to the Institute's prospective research activities, their primary research thrusts related to the institute goals and how this demonstrates their suitability to drive and disseminate the research advances AI and associated disciplines/sectors presented in this preliminary proposal.

Deviations from the PAPPG:

- You may omit the PAPPG-required section on Results from Prior NSF Support.

4. References Cited: Section. List only references cited in the Project Description. See PAPPG for format instructions.

5. Biographical Sketches (3-page limit per person): Biographical sketches are required for the PI, any co-PIs, and each of the participating Senior Personnel listed in the Project Description. All biographical sketches submitted in response to this solicitation are expected to follow the NSF-approved format in accordance with the policy found at https://www.nsf.gov/bfa/dias/policy/biosketch.jsp. Note that this policy states that effective October 4, 2021, the page limitation for biographical sketches will be increased to 3 pages.

No other sections or documents are permitted. This includes Budget and Budget Justification, Data Management Plan, Postdoctoral Researcher Mentoring Plan, Current and Pending Support, Facilities, Equipment, and Other Resources, and Letters of Collaboration.

Full Proposal Preparation Instructions: Proposers may opt to submit proposals in response to this Program Solicitation via FastLane or Grants.gov.

- Full proposals submitted via FastLane: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG). The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg. Paper copies of the PAPPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-8134 or by e-mail from nsfpubs@nsf.gov. Proposers are reminded to identify this program solicitation number in the program solicitation block on the NSF Cover Sheet For Proposal to the National Science Foundation. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.

- Full proposals submitted via Grants.gov: Proposals submitted in response to this program solicitation via Grants.gov should be prepared and submitted in accordance with the *NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov*. The complete text of the *NSF Grants.gov Application Guide* is available on the Grants.gov website and on the NSF website at: (https://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide). To obtain copies of the Application Guide and Application Forms Package, click on the Apply tab on the Grants.gov site, then click on the Apply Step 1: Download a Grant Application Package and Application Instructions link and enter the funding opportunity number, (the program solicitation number without the NSF prefix) and press the Download Package button. Paper copies of the Grants.gov Application Guide also may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-8134 or by e-mail from nsfpubs@nsf.gov.

See PAPPG Chapter II.C.2 for guidance on the required sections of a full research proposal submitted to NSF. Please note that the proposal preparation instructions provided in this program solicitation may deviate from the PAPPG instructions.

The solicitation addresses deviations from the PAPPG, addressing program-specific considerations for certain sections. Where not otherwise addressed, submissions must conform fully to the Proposal Preparation Instructions outlined in the NSF PAPPG, including all required *Sections of the Proposal* (https://www.nsf.gov/pubs/policydocs/pappg22_1/pappg_2.jsp#IIC2) that are not specifically excluded in these preparation instructions.

Important Instructions: **Full proposals will be accepted only if they are based on a preliminary proposal submitted to this program (whether "encouraged" or not).** Due to the complexity of the proposals being submitted, use of FastLane to prepare and submit proposals is strongly encouraged. When preparing a full proposal for this competition, proposers are advised to review the Program Description and the Proposal Review Information found in this solicitation for general information pertinent to this program.

As a multi-organization activity, the proposal must be submitted as a single, integrated proposal by the lead organization, with proposed subawards to the other partner organizations. Linked collaborative proposals from multiple organizations will be returned without review.

1. Cover Sheet. The title of the proposal must be preceded by "Theme n: ", where n is the theme number that is the primary theme to which you are submitting. If you are submitting to Theme 6 (AI-Augmented Learning), please use "Theme 6A: " to denote track A, or "Theme 6B: " to denote track B in that theme. The title should describe the project in concise, informative language that is understandable to a technically-literate reader.

For planning purposes, June 1, 2023 should be shown as the start date on the cover page and elsewhere in the proposal (January 1, 2023 for Theme 6, Track B).

2. Project Summary (1-page limit): The Project Summary consists of an overview, a statement on the intellectual merit of the proposed activity and a statement on the broader impacts of the proposed activity. Include an overview of the Institute description and rationale, its research objectives, education and workforce development activities, and community building activities. Proposals may incorporate a Keywords section as the last line of the Project Summary. You may use the keywords section to highlight any special emphasis in sectors relevant to partner agencies, or to identify relevance to themes other than the one to which the proposal is submitted.

3. Project Description: The Project Description must include the sections described below and must not exceed 25 pages including tables and illustrations. In addition to these and other PAPPG requirements, the Project Description for an Institute proposal must include the following clearly-labeled sections.

Deviations from the PAPPG:

- You may omit the PAPPG-required section, **"Results from Prior NSF Support"**. If omitted from the Project Description, the required information must be submitted, if applicable, as a supplementary document (described below).

3.a. Overview and Rationale for Institute Approach: Provide a description of the challenge that engendered the proposal and the importance of specific aspects of this challenge that you aspire to solve. Include timeliness of addressing this problem. Discuss why the National AI Research Institutes program is particularly suited to support this effort. Discuss the long-term strategic goals and potential impact of an Institute.

3.b. Description of the Research Plan of the Institute: State the overall vision and long-range research goals of the Institute. Describe the proposed research areas/themes, how this plan synergistically advances foundational AI research and use-inspired research, and how these efforts will be integrated in service of the Institute's research vision. **Clearly specify the areas of foundational AI research in which significant new knowledge or methods will contribute to an understanding of the mechanisms underlying thought and intelligent behavior and their implementation in machines, why those areas are selected, and the institute's unique capabilities to advance and disseminate those outcomes to the broader AI research community. Convey how those advances benefit from and contribute to the related sectors in the chosen use-inspired research context**. Identify key contributors to these research activities and demonstrate their suitability to drive and disseminate the research advances in AI and associated disciplines/sectors. Provide a five-year timeline for the implementation activities. Indicate the specific role of each partner organization or participant in each research topic/goal area. The research plan should provide sufficient detail to allow assessment of the scientific merit and to justify the necessity for the proposed mode of operation. Explain how the proposed research relates to other state and national research capabilities (including related centers, institutes, facilities and national laboratories) as well as international programs in the proposed fields of research. If the Institute plans include the development of shared research facilities, describe plans to build, manage, and sustain such facilities.

3.c. Broader Impacts: The Project Description **must** contain, as a separate section within the narrative, a section labeled, "Broader Impacts". This section should include, at a minimum, the following three subsections.

3.c.1. Education and Workforce Development: With the goal of advancing AI knowledge and education, present plans to actively build the next generation of talent for a diverse well-trained workforce through new and innovative approaches to education and workforce development. Participants may include undergraduate and graduate students, community colleges and post-doctoral researchers, skilled technical workforce, K12 students, and/or professionals looking to shift career focus. Describe plans for the mentoring and professional development of participants involved in institute activities. Describe how the institute will integrate research and education. Describe all proposed activities in sufficient detail to allow assessment of their intrinsic merit, potential effectiveness, and their anticipated contribution toward a highly competent new generation of AI workforce. Plans may also include mechanisms to engage participants in informal settings (e.g., museums, nature centers, libraries; TV/film; citizen science; and other on-line experiences).

3.c.2. Broadening Participation Plans: Describe the broadening participation objectives and outline evidence-based strategies for achieving them, based on relevant literature. Describe plans for increasing diversity through the participation of underrepresented groups, including women, minorities, and persons with disabilities, in all organizational levels of institute activities, and cite the relevant literature on effective practices. This could, for example, intentionally target specific combinations of groups (e.g., by race/ethnicity, gender and/or disability) with an analysis of how institute activities impact their participation in the AI workforce. Describe the contribution/role of partner organizations in the

broadening participation plans. Describe plans, if appropriate, for partnerships with minority-serving institutions, women's colleges, and/or organizations that primarily serve persons with disabilities. Explain why these organizations were selected and what they will contribute to the project. Indicate the role of students and faculty from these organizations and how they will be fully integrated and engaged into institute activities. Explain how progress will be measured and how strategies will be adapted, if necessary. Describe the proposed activities in sufficient detail to allow assessment of their intrinsic merit and potential effectiveness.

3.c.3. Collaboration and Knowledge Transfer: Describe how the Institute will function as a nexus point for collaborative efforts, including plans to link organizations, people, ideas, problems, and technical approaches for maximum impact. Present plans to integrate partner organizations and participants into a diverse Institute that is more than just the sum of its parts. Include here plans to effect knowledge transfer. Knowledge transfer involves the exchange of scientific and technical information between the Institute and external non-academic stakeholders (such as industrial partners or public policy-makers) with the objective of applying that knowledge. State the specific goals for knowledge transfer and the expected impact of the activities. Linkages should involve significant intellectual exchange and could involve, for example, mechanisms such as internships or novel use of cyberinfrastructure to enhance connections.

3.d. Key Personnel, Management and Integration Plan: Describe the multidisciplinary group of scientists, engineers and educators comprising the Institute and their suitability to conduct large-scale, long-term research agenda for the advancement of AI and the fielding of AI-powered innovation in application sectors of national importance. Describe the network of organizations comprising the Institute and their relationships to one another. Include a diagram to explain the organizational relationships and reporting structure among the key areas of responsibility. Identify key members of the Institute Management Team and explain their specific roles and areas of responsibility, including in the day-to-day management and operations of the Institute. Describe the relevant experience and qualifications of the lead PI, Managing Director/Project Manager (required, and distinct from PI), and other key members of the management team to lead and manage a complex, multi-faceted, and innovative enterprise that integrates research, education, broadening participation, and knowledge transfer. Describe the processes to be used to prioritize institute activities; to select and integrate research projects with one another and with other institute activities; to identify and sunset projects that cease to align with institute goals; to allocate funds and equipment across institute activities and among partners; resolve conflict; and to select a replacement for key leaders if needed. An External Advisory Board is required for all AI Research Institutes. Your plan may describe your plan to form the board, but potential members should not be approached or identified unless the Institute is funded.

4. References Cited: Section. List only references cited in the Project Description. See PAPPG for format instructions.

5. Biographical Sketches (3-page limit per person): Biographical sketches are required for the PI, any co-PIs, and each of the participating Senior Personnel listed in the Project Description. All biographical sketches submitted in response to this solicitation are expected to follow the NSF-approved format in accordance with the policy found at https://www.nsf.gov/bfa/dias/policy/biosketch.jsp. Note that this policy states that effective October 4, 2021, the page limitation for biographical sketches will be increased to 3 pages.

6. Budget and Budget Justification: Provide a budget for each of the five years. FastLane or Grants.gov will automatically provide a cumulative budget. The proposed budget should be consistent with the needs and complexity of the proposed activity. The budget and budget justification should reflect start-up activities at the commencement of the institute activities. Funds allocated for research, education, broadening participation, and knowledge transfer areas must be discernible. Be careful not to include inappropriate entries under Participant Support Costs (e.g., most employee costs, speakers and trainers, incentive payments to research subjects, contracted services). Guidance on participant support is available in PAPPG Chapter II.C.2.g(v). Funds also should be included for attendance at up to three site visits (and/or reverse site visits) as well as other planned cross-Institute meetings, to include the retreat required in Special Award Conditions.

7. Facilities, Equipment and Other Resources: Provide a synopsis of organizational resources that will be available to the Institute (dedicated space, access to facilities and instrumentation, faculty and staff positions, access to programs that assist with curriculum development or broadening participation, or other organizational programs that could provide support to the Institute). In order for NSF, and its partners, to assess the scope of a proposed project, all resources (including those from collaborating organizations) available to the project, must be described in this section. Note that inclusion of voluntary committed cost sharing is prohibited. The description should be narrative in nature and must not include any quantifiable financial information.

8. Special Information and Required Supplementary Documents

- *Results of Prior NSF Support* (Up to one page). This supplementary document may be used to report Results of Prior NSF Support as required in the PAPPG if applicable to any PI or co-PI per the PAPPG and not addressed in Project Description. This document may also contain results of support from other funding agencies listed in this solicitation following the same content guidelines as given for the NSF requirement.
- *Ethics Plan* (required, up to one page). Provide a clear statement of the proposed Institute's policies on ethics training, responsible conduct of research, and intellectual property rights. Discussion should address the nature of the research, methodologies used, ownership of research and ideas, and roles and responsibilities regarding intellectual property. A program of training in ethics and responsible conduct of research within the cross-disciplinary and multi-organizational context of the Institute, for all Institute and subawardee staff, including faculty, visiting faculty, industrial fellows, postdoctoral researchers, and graduate and undergraduate students is required. Training topics should include the nature of the research, methodologies used, ownership of research and ideas, and roles and responsibilities regarding intellectual property. Proposers are encouraged to address the relationship between the Institute's ethics plan and the broader consideration of ethics in AI.
- *Data Management Plan* (required, up to two pages). In addition to the general elements of the data management plan described in the PAPPG, Institute proposals should address their plans for data-sharing across the team, the role of data management in the Institute's internal integration into a greater whole, and the data considerations for external engagement.
- *Postdoctoral Researcher Mentoring Plan*. As applicable. In addition to the general elements of the postdoctoral mentoring plan described in the PAPPG, address how the activities of the Institute will especially enhance the professional development of postdoctoral researchers (e.g. by virtue of access to multiple projects and organizations comprising the Institute).
- *Letters of Collaboration*. Letters should document collaborative arrangements of significance to the proposal and MUST stay within the PAPPG requirement to state only the intent to collaborate. They should not contain endorsements or evaluation of the proposed project. Letters of Collaboration will be provided in the Supplementary Documents section of the proposal and should follow the format instructions specified in the NSF PAPPG. Note that letters of collaboration are not necessary for subawardee organizations, whose commitment is explicit in the proposal. **Letters of Support are not permitted**. Consult the PAPPG for instructions (https://www.nsf.gov/pubs/policydocs/pappg22_1/pappg_2.jsp#collab).
- *A list of Project Personnel and Partner Organizations (required):*

  Provide current, accurate information for all personnel and organizations involved in the project. NSF staff will use this information in the merit review process to manage reviewer selection. The list **must** include all PIs, co-PIs, Senior Personnel, paid/unpaid Consultants or Collaborators, Subawardees, and Postdocs. This list should be numbered and include (in this order) Full name, Organization(s), and Role in the project, with each item separated by a semi-colon. Each person listed should start a new numbered line. For example:

  - Mary Smith; XYZ University; PI
  - John Jones; University of PQR; Senior Personnel

- Jane Brown; XYZ University; Postdoctoral Researcher
- Bob Adams; ABC Community College; Paid Consultant
- Susan White; DEF Corporation; Unpaid Collaborator
- Tim Green; ZZZ University; Subawardee

9. Current and Pending Support. Current and pending support information must be separately provided through use of an NSF-approved format, for each individual designated as senior personnel on the proposal. See PAPPG for full details.

10. Single Copy Documents

Required:

- **Update since preliminary proposal** (1 page maximum). Identify the required preliminary proposal submission for this full proposal and summarize updates in three additional sections as follows:

    - Preliminary proposal #: (NSF-assigned proposal #)
    - Changes to PI/Co-PIs: (listed additions, deletions, changes of role)
    - Changes to funded collaborative organizations: (listed additions or deletions of subawardee or otherwise-funded (i.e., contract) organizations).
    - Summary of significant changes of research scope: (no more than 250 words, bulleted).

- **Collaborators and Other Affiliations Information**: Proposers should follow the guidance specified in Chapter II.C.1.e of the NSF PAPPG.

Optional:

- List of suggested reviewers or reviewers not to include (with a brief explanation or justification for why the reviewer should be excluded).
- **Identification of proprietary or privileged information**. Proposers may wish to include proprietary or privileged information as part of their proposals. Per PAPPG Chapter II.D.1, NSF defines such information as "patentable ideas, trade secrets, privileged or confidential commercial or financial information, disclosure of which may harm the proposer," While providing this information is not required, a proposer to this program who wishes to include proprietary or privileged information **must provide any and all such information as a Single-Copy Document** in the Proposal Preparation Module in FastLane or Research.gov. That is, **this information shall not appear in other parts of the proposal**. In keeping with NSF's practice, the Single Copy Document will not be shared with reviewers or with agency/industry funding partners. In the case that a proposal is transferred to another agency for funding there, this document may be included in that transfer of proposal.

    While NSF will make every effort to prevent unauthorized access to such material, the Foundation is not responsible or in any way liable for the release of such material.

    Note: Because proprietary or privileged information may only be specified in the Single Copy Document, **PIs should not check the "Proprietary or Privileged Information" box on the Cover Sheet**; that box applies only to such content appearing in the body of a proposal.

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

Indirect Cost (F&A) Limitations:

The following instructions apply to awards made by USDA-NIFA:

For awards made by USDA-NIFA under this solicitation, Section 1462(a) and (c) of the National Agricultural Research, Extension, and Teaching Policy Act of 1977 (NARETPA) (7 U.S.C. 3310) limits indirect costs for the overall award to 30 percent of Total Federal Funds Awarded (TFFA) under a research, education, or extension grant. The maximum indirect cost rate allowed under the award is determined by calculating the amount of indirect costs using:

1) the sum of an institution's negotiated indirect cost rate and the indirect cost rate charged by subawardees, if any; or

2) 30 percent of TFFA (TFFA = Field K., Total Costs and Fee, on SF-424 R&R Budget).

The maximum allowable indirect cost rate under the award, including the indirect costs charged by the subawardee(s), if any, is the lesser of the two rates.

If the results of 1), is the lesser of the two, the grant recipient is allowed to charge the negotiated indirect cost rate on the prime award and the subaward(s), if any. Any subawards would be subject to the subawardee's negotiated indirect cost rate. The subawardee may charge its negotiated indirect cost rate on its portion of the award, provided the sum of the indirect cost rate charged under the award by the prime awardee and the subawardee(s) does not exceed 30 percent of the TFFA.

If the result of 2), is the lesser of the two, then the maximum indirect cost rate allowed for the overall award, including any subaward(s), is limited to 30 percent of the TFFA. That is, the indirect costs of the prime awardee plus the sum of the indirect costs charged by the subawardee(s), if any, may not exceed 30 percent of the TFFA.

In the event of an award, the prime awardee is responsible for ensuring the maximum indirect cost allowed for the award is not exceeded when combining indirect costs for the Federal portion (i.e., prime and subawardee(s)) and any applicable cost-sharing (see 7 CFR 3430.52(b)). Amounts exceeding the maximum allowable indirect cost is considered unallowable and will be handled accordingly. See 2 CFR 200.408 and 2 CFR 200.410.

Other Budgetary Limitations:

Cost Sharing Requirements for awards made by USDA-NIFA:

In accordance with 7 U.S.C. 3157, if a funded applied **Research or Integrated Project** with an applied research component, is commodity-specific and not of national scope, the grant recipient is required to match the USDA funds awarded on a dollar-for-dollar basis from non-Federal sources with cash and/or in-kind contributions.

For Equipment Grants: The amount of Federal funds provided may not exceed 50 percent of the cost of the equipment acquired using funds from the grant, or $50,000, whichever is less. Grantees are required to match 100 percent of Federal funds awarded from non-Federal sources. The Secretary of Agriculture may waive all or part of the matching requirement if all three of the following criteria are met: (1) applicants must be a college, university, or research foundation maintained by a college or university that ranks in the lowest one third of such colleges, universities, and research foundations on the basis of Federal research funds received (see Additional Eligibility Information for proposals that designate USDA-NIFA as the requested funding agency); (2) if the equipment to be acquired using funds from the grant costs not more than $25,000; and (3) has multiple uses within a single research project or is usable in more than one research project. If the organization believes it is eligible for the waiver for matching funds, the budget justification must include a letter signed by the organization's administrative representative stating this information. USDA-NIFA will consider this justification when ascertaining final matching requirements or in determining if required matching can be waived. USDA-NIFA retains the right to make final determinations regarding matching requirements.

Budget Preparation Instructions:

Include travel budgets for applicable personnel to attend annual PI meetings, attendance at up to three site visits (and/or reverse site visits) as well as other planned cross-Institute meetings, to include the retreat required in Special Award Conditions.

C. Due Dates

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

    January 14, 2022

- **Full Proposal Deadline(s)** (due by 5 p.m. submitter's local time):

    May 13, 2022

D. FastLane/Grants.gov Requirements

For Proposals Submitted Via FastLane:

To prepare and submit a proposal via FastLane, see detailed technical instructions available at: https://www.fastlane.nsf.gov/a1/newstan.htm. For FastLane user support, call the NSF Help Desk at 1-800-673-6188 or e-mail fastlane@nsf.gov. The NSF Help Desk answers general technical questions related to the use of the FastLane and Research.gov systems. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this funding opportunity.

For Proposals Submitted Via Grants.gov:

Before using Grants.gov for the first time, each organization must register to create an institutional profile. Once registered, the applicant's organization can then apply for any federal grant on the Grants.gov website. Comprehensive information about using Grants.gov is available on the Grants.gov Applicant Resources webpage: https://www.grants.gov/web/grants/applicants.html. In addition, the NSF Grants.gov Application Guide (see link in Section V.A) provides instructions regarding the technical preparation of proposals via Grants.gov. For Grants.gov user support, contact the Grants.gov Contact Center at 1-800-518-4726 or by email: support@grants.gov. The Grants.gov Contact Center answers general technical questions related to the use of Grants.gov. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this solicitation.

Submitting the Proposal: Once all documents have been completed, the Authorized Organizational Representative (AOR) must submit the application to Grants.gov and verify the desired funding opportunity and agency to which the application is submitted. The AOR must then sign and submit the application to Grants.gov. The completed application will be transferred to the NSF FastLane system for further processing.

Proposers that submitted via FastLane may use Research.gov to verify the status of their submission to NSF. For proposers that submitted via Grants.gov, until an application has been received and validated by NSF, the Authorized Organizational Representative may check the status of an application on Grants.gov. After proposers have received an e-mail notification from NSF, Research.gov should be used to check the status of an application.

VI. NSF PROPOSAL PROCESSING AND REVIEW PROCEDURES

Proposals received by NSF are assigned to the appropriate NSF program for acknowledgement and, if they meet NSF requirements, for review. All proposals are carefully reviewed by a scientist, engineer, or educator serving as an NSF Program Officer, and usually by three to ten other persons outside NSF either as *ad hoc* reviewers, panelists, or both, who are experts in the particular fields represented by the proposal. These reviewers are selected by Program Officers charged with oversight of the review process. Proposers are invited to suggest names of persons they believe are especially well qualified to review the proposal and/or persons they would prefer not review the proposal. These suggestions may serve as one source in the reviewer selection process at the Program Officer's discretion. Submission of such names, however, is optional. Care is taken to ensure that reviewers have no conflicts of interest with the proposal. In addition, Program Officers may obtain comments from site visits before recommending final action on proposals. Senior NSF staff further review recommendations for awards. A flowchart that depicts the entire NSF proposal and award process (and associated timeline) is included in PAPPG Exhibit III-1.

A comprehensive description of the Foundation's merit review process is available on the NSF website at: https://www.nsf.gov/bfa/dias/policy/merit_review/.

Proposers should also be aware of core strategies that are essential to the fulfillment of NSF's mission, as articulated in *Building the Future: Investing in Discovery and Innovation - NSF Strategic Plan for Fiscal Years (FY) 2018 – 2022*. These strategies are integrated in the program planning and implementation process, of which proposal review is one part. NSF's mission is particularly well-implemented through the integration of research and education and broadening participation in NSF programs, projects, and activities.

One of the strategic objectives in support of NSF's mission is to foster integration of research and education through the programs, projects, and activities it

supports at academic and research institutions. These institutions must recruit, train, and prepare a diverse STEM workforce to advance the frontiers of science and participate in the U.S. technology-based economy. NSF's contribution to the national innovation ecosystem is to provide cutting-edge research under the guidance of the Nation's most creative scientists and engineers. NSF also supports development of a strong science, technology, engineering, and mathematics (STEM) workforce by investing in building the knowledge that informs improvements in STEM teaching and learning.

NSF's mission calls for the broadening of opportunities and expanding participation of groups, institutions, and geographic regions that are underrepresented in STEM disciplines, which is essential to the health and vitality of science and engineering. NSF is committed to this principle of diversity and deems it central to the programs, projects, and activities it considers and supports.

A. Merit Review Principles and Criteria

The National Science Foundation strives to invest in a robust and diverse portfolio of projects that creates new knowledge and enables breakthroughs in understanding across all areas of science and engineering research and education. To identify which projects to support, NSF relies on a merit review process that incorporates consideration of both the technical aspects of a proposed project and its potential to contribute more broadly to advancing NSF's mission "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes." NSF makes every effort to conduct a fair, competitive, transparent merit review process for the selection of projects.

1. Merit Review Principles

These principles are to be given due diligence by PIs and organizations when preparing proposals and managing projects, by reviewers when reading and evaluating proposals, and by NSF program staff when determining whether or not to recommend proposals for funding and while overseeing awards. Given that NSF is the primary federal agency charged with nurturing and supporting excellence in basic research and education, the following three principles apply:

- All NSF projects should be of the highest quality and have the potential to advance, if not transform, the frontiers of knowledge.
- NSF projects, in the aggregate, should contribute more broadly to achieving societal goals. These "Broader Impacts" may be accomplished through the research itself, through activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. The project activities may be based on previously established and/or innovative methods and approaches, but in either case must be well justified.
- Meaningful assessment and evaluation of NSF funded projects should be based on appropriate metrics, keeping in mind the likely correlation between the effect of broader impacts and the resources provided to implement projects. If the size of the activity is limited, evaluation of that activity in isolation is not likely to be meaningful. Thus, assessing the effectiveness of these activities may best be done at a higher, more aggregated, level than the individual project.

With respect to the third principle, even if assessment of Broader Impacts outcomes for particular projects is done at an aggregated level, PIs are expected to be accountable for carrying out the activities described in the funded project. Thus, individual projects should include clearly stated goals, specific descriptions of the activities that the PI intends to do, and a plan in place to document the outputs of those activities.

These three merit review principles provide the basis for the merit review criteria, as well as a context within which the users of the criteria can better understand their intent.

2. Merit Review Criteria

All NSF proposals are evaluated through use of the two National Science Board approved merit review criteria. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

The two merit review criteria are listed below. **Both** criteria are to be given **full consideration** during the review and decision-making processes; each criterion is necessary but neither, by itself, is sufficient. Therefore, proposers must fully address both criteria. (PAPPG Chapter II.C.2.d(i). contains additional information for use by proposers in development of the Project Description section of the proposal). Reviewers are strongly encouraged to review the criteria, including PAPPG Chapter II.C.2.d(i), prior to the review of a proposal.

When evaluating NSF proposals, reviewers will be asked to consider what the proposers want to do, why they want to do it, how they plan to do it, how they will know if they succeed, and what benefits could accrue if the project is successful. These issues apply both to the technical aspects of the proposal and the way in which the project may make broader contributions. To that end, reviewers will be asked to evaluate all proposals against two criteria:

- **Intellectual Merit:** The Intellectual Merit criterion encompasses the potential to advance knowledge; and
- **Broader Impacts:** The Broader Impacts criterion encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes.

The following elements should be considered in the review for both criteria:

1. What is the potential for the proposed activity to
   a. Advance knowledge and understanding within its own field or across different fields (Intellectual Merit); and
   b. 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? Does the plan incorporate a mechanism to assess success?
4. How well qualified is the individual, team, or organization to conduct the proposed activities?
5. Are there adequate resources available to the PI (either at the home organization or through collaborations) to carry out the proposed activities?

Broader impacts may be accomplished through the research itself, through the activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. NSF values the advancement of scientific knowledge and activities that contribute to achievement of societally relevant outcomes. Such outcomes include, but are not limited to: full participation of women, persons with disabilities, and other underrepresented groups in science, technology, engineering, and mathematics (STEM); improved STEM education and educator development at any level; increased public scientific literacy and public engagement with science and technology; improved well-being of individuals in society; development of a diverse, globally competitive STEM workforce; increased partnerships between academia, industry, and others; improved national security; increased economic competitiveness of the United States; and enhanced infrastructure for research and education.

Proposers are reminded that reviewers will also be asked to review the Data Management Plan and the Postdoctoral Researcher Mentoring Plan, as

appropriate.

Additional Solicitation Specific Review Criteria

In addition to the National Science Board merit review criteria, reviewers will be asked to apply the following criteria when reviewing proposals submitted to this solicitation:

1. **Advance foundational AI:** How well does the proposed Institute contribute new knowledge or methods toward understanding of the mechanisms underlying thought and intelligent behavior and their implementation in machines?
2. **Conduct use-inspired research:** How well does the proposed Institute leverage the use-inspired research context to both advance AI and drive innovations in related sectors of science and engineering, segments of the economy, or societal needs?
3. **Strategic impact:** What is the potential for the Institute to make a lasting strategic impact beyond its research outcomes? Specifically,
    - How will the proposed Institute actively **nurture and grow the next generation of talent**?
    - To what extent is the proposed Institute activity **comprised of a multidisciplinary group of scientists, engineers, and educators** appropriate to the project?
    - How well does the proposed Institute **leverage multiple organizations** to create significant new research capabilities in new centers of AI leadership and create a network for broadening participation from underrepresented groups and diverse institutions?
    - How well does the proposal exhibit plans to operate as a **nexus point for collaborative efforts** to engage externally and add to a diverse Institute that is more than just the sum of the parts?

B. Review and Selection Process

Proposals submitted in response to this program solicitation will be reviewed by Ad hoc Review and/or Panel Review, or Reverse Site Review.

Preliminary Proposal Determinations: Preliminary proposals will be reviewed by NSF and an advisory determination will be sent to the PI and the organization's SPO (Encourage/Discourage). Feedback may be sent by email to the PI for both Encouraged and Discouraged proposals.

Full Proposal Review Process:

Full proposals will normally be reviewed by a Review Panel augmented as necessary with *ad hoc* reviews, and possibly followed by a reverse site visit, following the *NSF Selection Process* described below. **Some proposals may be selected for a Reverse Site Visit (RSV) prior to final selection of Institutes**. If your proposal is selected, you will be asked to choose key project personnel and make them available to participate in this RSV via video teleconference. In the program calendar (under Program Description) you will find listed the window for these RSVs and the period during which you can expect to be contacted about RSV invitations. If there are changes to this schedule, lead PIs will be notified by email.

Final selection of new AI Research Institutes will be conducted by NSF in consultation with relevant funding partners named in this solicitation. The Agency funding partners may act as observers in the review process. Proposals, unattributed reviews, and panel summaries may be shared securely with both Agency and Industry funding partners.

Federal Agency Partners Process:

- USDA-NIFA: Following the *NSF Selection Process*, proposals will be selected for funding by NIFA based on the results of the NSF peer review process and local agency priorities and funding availability. Proposals selected for funding by NIFA will be forwarded to the NIFA Awards Management Division for award processing in accordance with the NIFA procedures. These awards are made and managed at NIFA.
- All other agency partners: Proposals will be selected for funding in accordance with the *NSF Selection Process* described below. Funds transferred from these partners to NSF will be combined with NSF and other partner funds where applicable to make awards under this Program. These awards are made and managed at NSF.

Industry Partners Process:

Industry funding partners listed in this solicitation as funding partners will not observe or otherwise participate in reviews, panels, or reverse site visits. Following merit review and prior to the award recommendation to the cognizant Division Director (see *NSF Selection Process* described below), the NSF Program Officer may share with industry partners the results of the review process for proposals under final consideration in the partner's sponsored theme(s). Materials shared may include proposals, unattributed reviews, panel summaries, and RSV materials. Industry partners may provide feedback to NSF as input to NSF's final award recommendations.

NSF Selection Process:

Reviewers will be asked to evaluate proposals using two National Science Board approved merit review criteria and, if applicable, additional program specific criteria. A summary rating and accompanying narrative will generally be completed and submitted by each reviewer and/or panel. The Program Officer assigned to manage the proposal's review will consider the advice of reviewers and will formulate a recommendation.

After scientific, technical and programmatic review and consideration of appropriate factors, the NSF Program Officer recommends to the cognizant Division Director whether the proposal should be declined or recommended for award. NSF strives to be able to tell applicants whether their proposals have been declined or recommended for funding within six months. Large or particularly complex proposals or proposals from new awardees may require additional review and processing time. The time interval begins on the deadline or target date, or receipt date, whichever is later. The interval ends when the Division Director acts upon the Program Officer's recommendation.

After programmatic approval has been obtained, the proposals recommended for funding will be forwarded to the Division of Grants and Agreements for review of business, financial, and policy implications. After an administrative review has occurred, Grants and Agreements Officers perform the processing and issuance of a grant or other agreement. Proposers are cautioned that only a Grants and Agreements Officer may make commitments, obligations or awards on behalf of NSF or authorize the expenditure of funds. No commitment on the part of NSF should be inferred from technical or budgetary discussions with a NSF Program Officer. A Principal Investigator or organization that makes financial or personnel commitments in the absence of a grant or cooperative agreement signed by the NSF Grants and Agreements Officer does so at their own risk.

Once an award or declination decision has been made, Principal Investigators are provided feedback about their proposals. In all cases, reviews are treated as confidential documents. Verbatim copies of reviews, excluding the names of the reviewers or any reviewer-identifying information, are sent to the Principal Investigator/Project Director by the Program Officer. In addition, the proposer will receive an explanation of the decision to award or decline funding.

VII. AWARD ADMINISTRATION INFORMATION

A. Notification of the Award

Notification of the award is made to *the submitting organization* by a Grants Officer in the Division of Grants and Agreements. Organizations whose proposals are declined will be advised as promptly as possible by the cognizant NSF Program administering the program. Verbatim copies of reviews, not including the identity of the reviewer, will be provided automatically to the Principal Investigator. (See Section VI.B. for additional information on the review process.)

B. Award Conditions

An NSF award consists of: (1) the award notice, which includes any special provisions applicable to the award and any numbered amendments thereto; (2) the budget, which indicates the amounts, by categories of expense, on which NSF has based its support (or otherwise communicates any specific approvals or disapprovals of proposed expenditures); (3) the proposal referenced in the award notice; (4) the applicable award conditions, such as Grant General Conditions (GC-1)*; or Research Terms and Conditions* and (5) any announcement or other NSF issuance that may be incorporated by reference in the award notice. Cooperative agreements also are administered in accordance with NSF Cooperative Agreement Financial and Administrative Terms and Conditions (CA-FATC) and the applicable Programmatic Terms and Conditions. NSF awards are electronically signed by an NSF Grants and Agreements Officer and transmitted electronically to the organization via e-mail.

*These documents may be accessed electronically on NSF's Website at https://www.nsf.gov/awards/managing/award_conditions.jsp?org=NSF. Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-8134 or by e-mail from nsfpubs@nsf.gov.

More comprehensive information on NSF Award Conditions and other important information on the administration of NSF awards is contained in the NSF *Proposal & Award Policies & Procedures Guide* (PAPPG) Chapter VII, available electronically on the NSF Website at https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.

Special Award Conditions:

AI Research Institute awards are made in the form of cooperative agreements. The cooperative agreements will have an extensive section of Special Conditions relating to the period of performance, statement of work, awardee responsibilities, NSF responsibilities, joint NSF-awardee responsibilities, funding and funding schedule, reporting requirements, key personnel, and other conditions. NSF has responsibility for providing general oversight and monitoring of Institutes to help assure effective performance and administration, as well as facilitating any coordination among the Institutes as necessary to further the objectives of the program. Within the first 90 days of the Award, a retreat of the Institute's key personnel to address strategic planning of the Institute will be required.

Support for each year of the cooperative agreement of a funded AI Research Institute will be contingent upon a satisfactory annual review (possibly including a site visit or reverse site visit) by NSF of the Institute's progress and future plans, with an emphasis on the quality of the research, education, broadening participation, and knowledge transfer activities. All funding is subject to availability.

NSF (or other lead funding agency) may conduct site visits and/or reverse site visits as part of annual review of Institute performance. These visits will be led by lead agency staff, with additional participation from partner agencies and industry partners as applicable to each Institute. These visits may include a panel of external evaluators. The frequency or schedule of site visits and/or reverse site visits for an Institute will be further specified in the award-specific terms and conditions of that Institute's cooperative agreement

Acknowledgement of Support

Awardees will be required to include appropriate acknowledgment of NSF and partner support in reports and/or publications on work performed under an award. An example of such an acknowledgement would be: "This material is based upon work supported by the AI Research Institutes program supported by NSF [and USDA-NIFA, IES, NIST, DOD OUSD (R&E), DHS S&T, IBM, per award letter] under Award Title and No. [Recipient enters project title and awards number(s)]."

Role of Partner Agencies in Research

Agency employees may not be included as personnel or collaborators in proposals, and may not receive funding through proposals. (For the purpose of proposals submitted for consideration by USDA-NIFA, this does not apply to USDA ARS or other USDA agencies. Any other inquiries should be directed to the relevant program contacts). Once awarded, at the request of an awardee, or of the funding agency with the awardee's consent, agencies may separately fund their own personnel to participate in research, part-time or full-time, with organizations awarded under the AI Research Institutes program.

USDA-NIFA Award Administration and Conditions:

Within the limit of funds available for such purpose, the USDA-NIFA awarding official shall make grants to those responsible, eligible applicants whose applications are judged most meritorious under the procedures set forth in this solicitation. The date specified by the USDA-NIFA awarding official as the effective date of the grant shall be no later than September 30 of the federal fiscal year in which the project is approved for support and funds are appropriated for such purpose, unless otherwise permitted by law. The project need not be initiated on the grant effective date, but as soon thereafter as practical so that project goals may be attained within the funded project period. All funds granted by USDA-NIFA under this solicitation may be used only for the purpose for which they are granted in accordance with the approved application and budget, regulations, terms and conditions of the award, applicable federal cost principles, USDA assistance regulations, and USDA-NIFA General Awards Administration Provisions at 7 CFR part 3430, subparts A through E.

Responsible and Ethical Conduct of Research

In accordance with 2 CFR 422.2, 2 CFR 422.3, and 2 CFR 422.8, institutions that conduct USDA-funded extramural research must foster an atmosphere conducive to research integrity, bear primary responsibility for prevention and detection of research misconduct, and maintain and effectively communicate and train their staff regarding policies and procedures. In the event an application to USDA-NIFA results in an award, the Authorized Representative (AR) assures, through acceptance of the award that the institution will comply with the above requirements. Award recipients shall, upon request, make available to USDA-

NIFA the policies, procedures, and documentation to support the conduct of the training.

For information about USDA-NIFA's implementation of Responsible and Ethical Conduct of Research requirements, see https://nifa.usda.gov/responsible-and-ethical-conduct-research.

C. Reporting Requirements

For all multi-year grants (including both standard and continuing grants), the Principal Investigator must submit an annual project report to the cognizant Program Officer no later than 90 days prior to the end of the current budget period. (Some programs or awards require submission of more frequent project reports). No later than 120 days following expiration of a grant, the PI also is required to submit a final project report, and a project outcomes report for the general public.

Failure to provide the required annual or final project reports, or the project outcomes report, will delay NSF review and processing of any future funding increments as well as any pending proposals for all identified PIs and co-PIs on a given award. PIs should examine the formats of the required reports in advance to assure availability of required data.

PIs are required to use NSF's electronic project-reporting system, available through Research.gov, for preparation and submission of annual and final project reports. Such reports provide information on accomplishments, project participants (individual and organizational), publications, and other specific products and impacts of the project. Submission of the report via Research.gov constitutes certification by the PI that the contents of the report are accurate and complete. The project outcomes report also must be prepared and submitted using Research.gov. This report serves as a brief summary, prepared specifically for the public, of the nature and outcomes of the project. This report will be posted on the NSF website exactly as it is submitted by the PI.

More comprehensive information on NSF Reporting Requirements and other important information on the administration of NSF awards is contained in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) Chapter VII, available electronically on the NSF Website at https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.

Multi-agency Reporting Process:

PIs must also submit copies of annual and final project reports directly to the cognizant Program Officers from agencies jointly funding the research, if relevant.

Additionally, industry partners will also receive annual reports of Institute activities and progress.

The above requirements will be detailed in the award notice or award-specific programmatic terms and conditions.

USDA-NIFA-specific Reporting Process:

The output and reporting requirements are included in the award terms and conditions (see https://nifa.usda.gov/terms-and-conditions for information about USDA-NIFA award terms). If there are any program or award-specific award terms, those, if any, will be identified in the award. PIs must also submit copies of reports directly to the cognizant Program Officers from NSF.

Other USDA-NIFA Requirements: Several federal statutes and regulations apply to grant applications considered for review and to project grants awarded under this program. These may include, but are not limited to, the ones listed on the USDA-NIFA web page: https://nifa.usda.gov/regulations-and-guidelines.

The USDA-NIFA Federal Assistance Policy Guide — a compendium of basic USDA-NIFA policies and procedures that apply to all USDA-NIFA awards, unless there are statutory, regulatory, or award-specific requirements to the contrary — is available at http://nifa.usda.gov/policy-guide.

VIII. AGENCY CONTACTS

Please note that the program contact information is current at the time of publishing. See program website for any updates to the points of contact.

General inquiries regarding this program should be made to:

- AI Research Institutes Program Team, telephone: (703) 292-5111, email: AIInstitutesProgram@nsf.gov

For questions related to the use of FastLane or Research.gov, contact:

- FastLane and Research.gov Help Desk: 1-800-673-6188
- FastLane Help Desk e-mail: fastlane@nsf.gov
- Research.gov Help Desk e-mail: rgov@nsf.gov.

For questions relating to Grants.gov contact:

- Grants.gov Contact Center: If the Authorized Organizational Representatives (AOR) has not received a confirmation message from Grants.gov within 48 hours of submission of application, please contact via telephone: 1-800-518-4726; e-mail: support@grants.gov.

For general inquiries regarding this program (not theme specific) please email the program leads at:

- **AIInstitutesProgram@nsf.gov**

Program Leads (Reachable at the above address)

- James Donlon, CISE/IIS, jdonlon@nsf.gov
- Rebecca Hwa, CISE/IIS, rhwa@nsf.gov

For inquiries related to the responsiveness of your ideas for the Themes listed in this solicitation, please contact the program officers listed below. You are advised to address theme-specific questions to **all program contacts listed for that theme**.

Theme 1: Intelligent Agents for Next-Generation Cybersecurity

- Dan Cosley, CISE/IIS, dcosley@nsf.gov
- Balakrishnan (Prabha) Prabhakaran, CISE/IIS, bprabhak@nsf.gov
- Benjamin Salazar, DHS S&T, benjamin.salazar@hq.dhs.gov

Theme 2: Neural and Cognitive Foundations of Artificial Intelligence

- Sridhar Raghavachari, BIO/IOS, sraghava@nsf.gov
- Roger Mailler, CISE/IIS, rmailler@nsf.gov
- Ken Whang, CISE/IIS, kwhang@nsf.gov
- Betty Tuller, SBE/BCS, btuller@nsf.gov
- Jean Luc Cambier, Scientific Advisor, OUSD (R&E), jeanluc.cambier.civ@mail.mil

Theme 3: AI for Climate-Smart Agriculture and Forestry

- James Donlon, CISE/IIS, jdonlon@nsf.gov
- Ann E. Stapleton, USDA/NIFA, ann.stapleton@usda.gov
- Steven Thomson, USDA/NIFA, steven.j.thomson@usda.gov

Theme 4: AI for Decision Making

- Hector Munoz Avila, CISE/IIS, hmunoz@nsf.gov
- Claudia Gonzalez-Vallejo, SBE/SES, clagonza@nsf.gov
- Roger Mailler, CISE/IIS, rmailler@nsf.gov

Theme 5: Trustworthy AI

- Todd Leen, CISE/IIS, tleen@nsf.gov
- Sol Greenspan, CISE/CCF, sgreensp@nsf.gov
- Tim McBride, NIST, timothy.mcbride@nist.gov

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

- Amy L. Baylor, EHR/DRL, abaylor@nsf.gov
- Tatiana D. Korelsky, CISE/IIS, tkorelsk@nsf.gov
- Leilah Lyons, EHR/DRL, llyons@nsf.gov
- Rob Ochsendorf, EHR/DRL, rochsend@nsf.gov
- Li Yang, EHR/DGE, liyang@nsf.gov
- Track A: Christina Chhin, IES, Christina.Chhin@ed.gov
- Track B: Sarah Brasiel, IES, Sarah.Brasiel@ed.gov

Other Agency Contacts

- USDA-NIFA
  - Ann E. Stapleton, National Program Leader, USDA/NIFA, ann.stapleton@usda.gov, 816-274-1941
  - Steven Thomson, USDA/NIFA, steven.j.thomson@usda.gov, 202-603-1053
- ED, IES
  - Christina Chhin, IES, Track A, Christina.Chhin@ed.gov
  - Sarah Brasiel, IES, Track B, Sarah.Brasiel@ed.gov
- NIST
  - Tim McBride, NIST, timothy.mcbride@nist.gov
  - Mark A. Przybocki, NIST, mark.przybocki@nist.gov
  - Reva B. Schwartz, NIST, reva.schwartz@nist.gov
  - Ellen M. Voorhees, NIST, ellen.voorhees@nist.gov
- DOD OUSD (R&E)
  - Bindu Nair, Director of Basic Research, OUSD (R&E), bindu.r.nair.civ@mail.mil
  - Jean Luc Cambier, Scientific Advisor, OUSD (R&E), jeanluc.cambier.civ@mail.mil
- DHS S&T
  - Laura Parker, Senior Advisor for Sensors, laura.parker@hq.dhs.gov
  - Alexandria Phounsavath, Subject Matter Expert, Data Analytics, alexandria.phounsava@hq.dhs.gov
  - Benjamin Salazar, Subject Matter Expert, Cyber Security Systems, benjamin.salazar@hq.dhs.gov

IX. OTHER INFORMATION

The NSF website provides the most comprehensive source of information on NSF Directorates (including contact information), programs and funding opportunities. Use of this website by potential proposers is strongly encouraged. In addition, "NSF Update" is an information-delivery system designed to keep potential proposers and other interested parties apprised of new NSF funding opportunities and publications, important changes in proposal and award policies and procedures, and upcoming NSF Grants Conferences. Subscribers are informed through e-mail or the user's Web browser each time new publications are issued that match their identified interests. "NSF Update" also is available on NSF's website.

Grants.gov provides an additional electronic capability to search for Federal government-wide grant opportunities. NSF funding opportunities may be accessed

via this mechanism. Further information on Grants.gov may be obtained at https://www.grants.gov.

ABOUT THE NATIONAL SCIENCE FOUNDATION

The National Science Foundation (NSF) is an independent Federal agency created by the National Science Foundation Act of 1950, as amended (42 USC 1861-75). The Act states the purpose of the NSF is "to promote the progress of science; [and] to advance the national health, prosperity, and welfare by supporting research and education in all fields of science and engineering."

NSF funds research and education in most fields of science and engineering. It does this through grants and cooperative agreements to more than 2,000 colleges, universities, K-12 school systems, businesses, informal science organizations and other research organizations throughout the US. The Foundation accounts for about one-fourth of Federal support to academic institutions for basic research.

NSF receives approximately 55,000 proposals each year for research, education and training projects, of which approximately 11,000 are funded. In addition, the Foundation receives several thousand applications for graduate and postdoctoral fellowships. The agency operates no laboratories itself but does support National Research Centers, user facilities, certain oceanographic vessels and Arctic and Antarctic research stations. The Foundation also supports cooperative research between universities and industry, US participation in international scientific and engineering efforts, and educational activities at every academic level.

Facilitation Awards for Scientists and Engineers with Disabilities (FASED) provide funding for special assistance or equipment to enable persons with disabilities to work on NSF-supported projects. See the *NSF Proposal & Award Policies & Procedures Guide* Chapter II.E.6 for instructions regarding preparation of these types of proposals.

The National Science Foundation has Telephonic Device for the Deaf (TDD) and Federal Information Relay Service (FIRS) capabilities that enable individuals with hearing impairments to communicate with the Foundation about NSF programs, employment or general information. TDD may be accessed at (703) 292-5090 and (800) 281-8749, FIRS at (800) 877-8339.

The National Science Foundation Information Center may be reached at (703) 292-5111.

> The National Science Foundation promotes and advances scientific progress in the United States by competitively awarding grants and cooperative agreements for research and education in the sciences, mathematics, and engineering.
>
> To get the latest information about program deadlines, to download copies of NSF publications, and to access abstracts of awards, visit the NSF Website at https://www.nsf.gov
>
> - **Location:**   2415 Eisenhower Avenue, Alexandria, VA 22314
>
> - **For General Information**   (703) 292-5111
>   (NSF Information Center)**:**
>
> - **TDD (for the hearing-impaired):**   (703) 292-5090
>
> - **To Order Publications or Forms:**
>
>   Send an e-mail to: nsfpubs@nsf.gov
>
>   or telephone: (703) 292-8134
>
> - **To Locate NSF Employees:**   (703) 292-5111

PRIVACY ACT AND PUBLIC BURDEN STATEMENTS

The information requested on proposal forms and project reports is solicited under the authority of the National Science Foundation Act of 1950, as amended. The information on proposal forms will be used in connection with the selection of qualified proposals; and project reports submitted by awardees will be used for program evaluation and reporting within the Executive Branch and to Congress. The information requested may be disclosed to qualified reviewers and staff assistants as part of the proposal review process; to proposer institutions/grantees to provide or obtain data regarding the proposal review process, award decisions, or the administration of awards; to government contractors, experts, volunteers and researchers and educators as necessary to complete assigned work; to other government agencies or other entities needing information regarding applicants or nominees as part of a joint application review process, or in order to coordinate programs or policy; and to another Federal agency, court, or party in a court or Federal administrative proceeding if the government is a party. Information about Principal Investigators may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See System of Record Notices, NSF-50, "Principal Investigator/Proposal File and Associated Records," and NSF-51, "Reviewer/Proposal File and Associated Records." Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of receiving an award.

An agency may not conduct or sponsor, and a person is not required to respond to, an information collection unless it displays a valid Office of Management and Budget (OMB) control number. The OMB control number for this collection is 3145-0058. Public reporting burden for this collection of information is estimated to average 120 hours per response, including the time for reviewing instructions. Send comments regarding the burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to:

Suzanne H. Plimpton
Reports Clearance Officer
Policy Office, Division of Institution and Award Support
Office of Budget, Finance, and Award Management
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