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and the
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on

“Federal Science Agencies and the Promise of AI in Driving Scientific Discoveries”

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Introduction

Chairman Collins, Chairman Williams, Ranking Member Stevens, Ranking Member Bowman, and Members of the Subcommittees, it is a privilege to appear before you today to discuss the important roles the U.S. National Science Foundation (NSF) plays in harnessing artificial intelligence (AI) to drive discoveries in new scientific domains and pursue leading-edge AI research. My name is Tess deBlanc-Knowles and I serve as Special Assistant to the Director for Artificial Intelligence at NSF.

Established by the National Science Foundation Act of 1950 (P.L. 81-507), NSF is an independent federal agency charged with the 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 is unique in carrying out its mission by supporting research across all fields of science, technology, engineering, and mathematics (STEM), and at all levels and settings of STEM education. NSF investments contribute significantly to the economic and national security interests of the Nation, and the development of a future-focused science and engineering workforce that draws on the talents of all Americans.

For more than seven decades, NSF has invested in research, researchers, innovations and innovators, and world-class scientific research infrastructure that has garnered incredible benefits to the nation. The Internet, 3D printing, and the economic theory underpinning spectrum auctioning and kidney exchanges are all examples of the outcomes and benefits of NSF investments. Many of the technologies and industries that are the focus of national conversations

around competitiveness today — AI, quantum information science, advanced manufacturing, advanced wireless, and biotechnology, to name a few — are rooted in sustained NSF and other federal investments, in many cases over several decades, for research at the frontiers of science and engineering.

NSF’s ability to leverage expertise across disciplines allows the agency to bring diverse groups of scientists and engineers together with private industry, communities, philanthropic organizations, and others to identify problems and use science, engineering, and technology to develop solutions. In addition, NSF works closely with our federal agency partners through the National Science and Technology Council, as well as through direct collaborations, to leverage resources and expertise. In doing so, the agency tackles problems from the national level to the local level, with the goal of ensuring that citizens from every geographic and demographic background benefit from NSF investments and breakthroughs.

NSF’s Leadership in Advancing AI

AI is transforming the world around us — impacting everything from how we learn, to how we do business, to how we defend the nation. As one of the primary non-defense federal funders of AI research, NSF is driving cutting-edge innovations that expand our understanding of AI concepts and techniques, accelerating trustworthy AI development, democratizing access to AI resources, and preparing the next-generation AI workforce. NSF’s unique role in supporting scientific research across multiple disciplines enables the agency to bring diverse teams of researchers together and positions our organization to play a pivotal role in advancing the fundamentals of AI and harnessing its potential to accelerate discovery and innovation across all fields of science and engineering and many sectors of our economy.

AI-driven technologies — such as chatbots, image generators, and digital assistants — are already ubiquitous in Americans’ daily lives. AI holds the promise of driving practical solutions to global challenges, from food production to climate resilience, to healthcare, and of supercharging the process of scientific discovery. At the same time, the adoption of AI brings with it potential risks, like amplifying biases and displacing workers. Building on over six decades of support for the field, NSF supports critical work to advance safety, security, and trustworthiness of current and future AI systems, while investing in innovation to set the foundation for the next technical breakthroughs, all in an effort to ensure that AI will advance the public good. Across all 50 states, D.C., and Puerto Rico, NSF invests more than \$800 million each year on AI research, education, and infrastructure. These investments fuel multidisciplinary research in AI, including in machine learning and deep learning, natural language technologies, human-AI interfaces, robotics and advanced cyberinfrastructure for AI, and ethical trustworthy application and use of these technologies.

The United States currently leads the world in AI innovation, and we must take steps to ensure that we continue to maintain that leadership. At a moment of intense global competition, it is imperative that the United States continue to invest in advancing AI while translating basic research into leading technologies so that American principles and the U.S. workforce are at the forefront of AI innovation and economic opportunity.

NSF promotes the application of AI across the full range of science and engineering disciplines supported through the agency. For example, the recently launched Collaborations in Artificial Intelligence and Geosciences (CAIG) program aims to advance the innovative use of AI methods to enable breakthroughs in scientific understanding of the Earth system and the Computational and Data-enabled Science and Engineering (CDS&E) program supports opportunities for scientific and engineering breakthroughs through new computational and data-analysis approaches. In the field of biotechnology, NSF-funded researchers are using neural networks to design new proteins with stable structures, predict results of RNA splicing, and identify strains of crops with favorable characteristics to improve crop yields. In engineering domains, NSF-funded researchers are leveraging AI to address supply chain gaps, test quantum networking hardware, and optimize aviation maintenance and inspection.

NSF also champions translational research that links AI innovation with science and the economy, including in the fields of agriculture, manufacturing, biotechnology, and health. In fact, 66% of NSF's Fiscal Year 2023 Small Business Innovation Research program awards, totaling approximately \$80 million, are supporting start-ups and small businesses advancing breakthrough AI and machine learning techniques and applications. For example, NSF-funded projects are using AI to design new catalysts that turn raw materials into products and improve water hazard responses and planning. In the health sector, NSF-funded researchers are developing AI tools to improve fertility potential, monitor patients with lung disease, and alert medical staff to patients at risk for sepsis.

In addition, NSF supports the advancement of fairness, ethics, accountability, transparency, reliability, safety, and security across all areas of AI, working to strengthen our ability to protect privacy, civil rights, and civil liberties when deploying AI systems. These efforts include NSF's Safe Learning-Enabled Systems program, which seeks to foster foundational research that leads to the design and implementation of autonomous and AI technologies that are guaranteed to be both safe and resilient. The aim is to make safety a design priority in AI systems the way it is for civil infrastructure like buildings and bridges. Just last month, NSF launched a \$16 million program in collaboration with five philanthropic partners that seeks to ensure that ethical, legal, community and societal considerations are embedded in the lifecycle of technology's creation and use. The Responsible Design, Development and Deployment of Technologies (ReDDDoT) program aims to help create technologies that promote the public's wellbeing and mitigate potential harms.

The NSF-led Launch of the National AI Research Resource Pilot

In January 2024, NSF and collaborating agencies across the federal government launched the National Artificial Intelligence Research Resource (NAIRR) Pilot, a first step towards realizing the vision for a shared research infrastructure that will strengthen and democratize access to critical resources necessary to power responsible AI discovery and innovation. This step also meets a goal outlined in Executive Order 14110, signed by President Biden in October 2023, directing NSF to launch a pilot for NAIRR within 90 days. The pilot will run for two years, serving as the proof of concept for a full-scale NAIRR that can effectively democratize access to AI innovation and support critical work advancing the development of trustworthy AI. The approach to the NAIRR Pilot has been coordinated through an interagency working group and follows the concept and

framework set out by a Congressionally mandated NAIRR Task Force in its final report and implementation plan for the NAIRR, submitted to the President and Congress in January 2023. The NAIRR Task Force, co-chaired by NSF and the White House Office of Science and Technology Policy, was responsive to the National AI Initiative Act of 2020.

While AI holds the potential to accelerate discovery and innovation and help solve critical societal and global challenges, many researchers lack access to the computing, data, software, and educational resources needed to fully conduct AI research and to train the next generation of researchers. The NAIRR Pilot aims to bridge this gap and ensure that AI resources and tools are accessible to the broad research and education communities. It is only by expanding access to the resources that fuel AI research throughout the US that the full breadth of skillsets of the American workforce can be harnessed, and the full economic, social, and scientific benefits of AI can be reached. Partnering with 10 other federal agencies as well as 25 private-sector, nonprofit, and philanthropic organizations, the NAIRR Pilot will provide access to advanced computing, datasets, models, software, training, and user support to U.S.-based researchers and educators. By connecting researchers and educators with the resources needed to support their work, the NAIRR Pilot will power innovative AI research and, as it continues to grow, inform the design of the full NAIRR ecosystem.

The NAIRR Pilot will support work that pushes the boundaries of AI technology while promoting its safety, security, and trustworthiness, and that applies AI to other fields of science and engineering to tackle societal challenges. Initially, pilot resources will prioritize support for AI research to advance safe, secure, and trustworthy AI, as well as the application of AI to scientific challenges in healthcare and environmental and infrastructure sustainability. The pilot will also provide infrastructure support to educators to enable student training on AI technologies and their responsible approaches.

The NSF-led National AI Research Institutes

The NSF-led National AI Research Institutes, or AI Institutes, program is the agency's flagship effort focused on use-inspired AI research and is the nation's largest AI research ecosystem, funded in partnership with other federal agencies and industry leaders. Launched in 2020, the AI Institutes represent a \$500 million investment connecting over 500 funded and collaborative institutions across the U.S. and around the world. The nationwide network of 25 AI Institutes reaches into almost every state, supporting cutting-edge research that is applying AI to societal challenges like agriculture, weather, public health, and education.

Many of these institutes are advancing breakthroughs in scientific domains. The NSF AI Institute for Research on Trustworthy AI in Weather, Climate and Coastal Oceanography, or AI2ES, led by the University of Oklahoma, is developing models that improve the accuracy and reliability of AI techniques that drive weather predictions. The NSF AI Institute in Dynamic Systems, which is led by the University of Washington, is developing the next generation of advanced machine learning tools for controlling complex physical systems, such as smart buildings. The NSF Molecule Maker Lab Institute, led by the University of Illinois Urbana-Champaign, is developing new AI-enabled tools to accelerate automated chemical synthesis and advance the discovery and

manufacture of novel materials. And the NSF AI Institute for Artificial and Natural Intelligence, led by Columbia University, aims to use AI to advance understanding of the brain. Each AI Institute represents a consortium of partnering academic institutions and involves collaborations with partners ranging from industry to national laboratories to philanthropies to local businesses, as well as in their communities to advance AI education at the K-12 and community-college levels.

Furthermore, in 2023, NSF launched the Expanding AI Innovation through Capacity Building and Partnerships program to build AI research capacity at minority-serving institutions by creating partnerships between those institutions and NSF AI Institutes.

NSF is Fostering an AI-Ready Workforce

AI is shifting the future of work and presenting new challenges alongside new capabilities. NSF is focused on developing solutions to enhance current job positions and create new job opportunities, while also mitigating the impact of automation on the existing workforce. Beyond the work being done through the AI Institutes and the NAIRR Pilot, NSF invests in strategic educational and experiential programs to expand the AI workforce and employment opportunities in every sector and career stage. We are helping to advance AI expertise and knowledge at the many levels that will be needed to support the integration of AI across our economy, the sciences, and society. And, importantly, we're providing opportunities for students and researchers from communities and regions that have been underserved.

Investing in critical early foundations, NSF's Discovery Research PreK-12 program enhances preK-12 teachers' and students' STEM learning that is necessary for U.S. students to excel in AI fields while the Innovative Technology Experiences for Students and Teachers program increases preK-12 students' interest in careers in STEM through technology-based learning experiences, including hands-on AI experiences. In addition, NSF's Computer Science for All program supports the development of inclusive AI educational activities for U.S. students at preK-12 levels.

Between 2009 and 2016, NSF invested in the development of a new Advanced Placement (AP) exam framework, Computer Science Principles (CSP), and associated course materials, such as the Beauty and Joy of Computing and Mobile CSP. This effort culminated in the largest launch of an AP exam in The College Board's then 60-year history in 2016-2017, with more than 55,000 students taking the inaugural offering of the AP CSP exam. In 2023, 169,000 high school students took the AP CSP Exam. According to the College Board, students who take this course are three times more likely to major in computer science in college.¹

In higher education, NSF's Advanced Technical Education program supports the education of the AI skilled technical workers at two-year institutions of higher education in response to industry needs, and our Computing in Undergraduate Education program develops innovative approaches to engage students interested in computer science at the undergraduate level and broadening participation in the field. NSF's Experiential Learning for Emerging and Novel Technologies program also supports opportunities for learners at all career levels, including those in the

¹ <https://apcentral.collegeboard.org/media/pdf/ap-csp-and-stem-cs-pipelines.pdf>

workforce today, to develop the skills needed to succeed in AI and other emerging technology fields.

NSF Regional Innovation Engines

In January 2024, NSF announced the first-ever NSF Regional Innovation Engines (NSF Engines), investing in 10 teams spanning 18 states. Each NSF Engine will initially receive \$15 million over two years and may receive up to \$160 million over 10 years subject to progress and future appropriations. The establishment of these NSF Engines represents one of the largest, broad investments in place-based research and development in the nation’s history, uniquely placing science and technology leadership as a central driver for regional economic competitiveness.

These investments intend to harness science and technology and regional-level resources to spur innovation, leading to breakthrough technologies and new jobs. Each NSF Engine will focus on advancing a suite of key technologies in the context of solving a regional or national challenge.

Among the 10 inaugural NSF Engines, seven involve a significant focus on the application of AI technologies. For example, the Illinois-based Great Lakes Water Innovation Engine aims to develop intelligent water resource recovery systems, leveraging leading AI capabilities to support sustainable water-intensive industry; and the North Dakota Advanced Agriculture Technology Engine aims to improve sustainable agriculture by combining advanced sensor technologies, crop and genetic data, and AI and climate modeling. In North Carolina, the Piedmont Triad Regenerative Medicine Engine will tap the world’s largest regenerative medicine cluster to create and scale breakthrough clinical therapies, including by leveraging AI.

Last year, NSF announced NSF Engine Development Awards to 44 unique teams spanning universities, nonprofits, businesses, and other organizations across the U.S. states and territories. These awards are helping organizations create connections and develop their local innovation ecosystems within two years, and in turn, allow them to prepare strong proposals for becoming a future NSF Engines. Each awardee team will receive up to \$1 million for two years, and the awardees span a broad range of states and regions, reaching geographic regions that have not fully benefited from the technology boom of the past decades. Fifteen of those development awards, like the “Advancing next generation agriculture in Southern Georgia” project led by the University of Georgia and the “Advancing technology-enabled mobility solutions” project led by the University of Tennessee, seek to seed innovation in AI.

Looking Forward

By investing in fundamental AI research in tandem with investments in innovative applications of AI across all fields of science and engineering, NSF will continue to transform and accelerate scientific discovery, overcome unique challenges faced by the research community, and drive the development of solutions for the public good. NSF is well-positioned to promote equitable and cutting-edge AI at the intersection of scientific fields, including those long-associated with AI and those newly embracing its potential. By partnering with other agencies and organizations as we have done in launching the NAIRR Pilot, and by inspiring talent from all geographic and

demographic backgrounds, NSF strives to deliver the benefits of our investments to everyone in the United States.

NSF appreciates Congress's longstanding support, which has enabled the agency to invest in research, education, and advanced infrastructure that has fostered the advancements of today and will lead to the scientific advances and industries of tomorrow. With the continued support of this Committee and the Congress, NSF will continue to unlock greater understanding of AI technologies, accelerate their application to national, scientific, societal, economic, and geostrategic challenges, and improve safety and security of AI systems— an example of how NSF-funded research and researchers positively impact the nation and help secure our future.

Thank you for the opportunity to testify before you today.