COMMITTEE ON
SCIENCE, SPACE
AND TECHNOLOGY
CHAIRMAN FRANK LUCAS

SUBCOMMITTEE ON RESEARCH AND TECHNOLOGY AND SUBCOMMITTEE ON ENERGY

HEARING CHARTER

"*Federal Science Agencies and the Promise of AI in Driving Scientific Discoveries*"

Tuesday, February 06, 2024
10:00 a.m.
2318 Rayburn House Office Building

Purpose

Hearing Purpose: The purpose of this hearing is to examine how federal science agencies can further harness artificial intelligence (AI) to drive discoveries in new scientific domains and pursue leading-edge AI research. The hearing will be an opportunity for the committee to explore the recommendations from the National AI Research Resource (NAIRR) Task Force's report, the NAIRR Pilot Program at the National Science Foundation, and efforts within the Department of Energy's National Labs network to drive advances in AI. The hearing will also examine the state of access to AI research resources, including advanced computational power and large data sets, for researchers and how industry can partner in this important effort. This hearing will inform current and future oversight and legislative efforts of the Science, Space, and Technology Committee.

Witnesses

- **Ms. Tess DeBlanc Knowles**, Special Assistant to the Director for Artificial Intelligence, National Science Foundation
- **Dr. Georgia Tourassi**, Associate Laboratory Director, Computing and Computational Sciences, Oak Ridge National Laboratory
- **Dr. Chaouki Abdallah**, Executive Vice President for Research, Georgia Institute of Technology
- **Dr. Louay Charma,** Dean, School of Engineering and Computer Science, Oakland University
- **Mr. Jack Clark**, Co-Founder and Head of Policy, Anthropic

Overarching Questions

- What is the status of the National AI Research Resource (NAIRR)?
- What are the current efforts of Department of Energy's Labs network to integrate AI and high-performance computer resources to advance their fundamental research?
- What are the current barriers for scientists, particularly those from academic institutions, to pursue cutting-edge AI research and AI-driven discoveries?
- How are current federal AI R&D programs addressing the challenges of accessing enough computational power and data?
- What is the threat of an AI resource divide and how could it impact the AI research ecosystem?
- What is the federal government's role in ensuring AI research resources are readily available?
- How can the federal government partner with industry to address the AI research resource divide? What are the barriers that can limit such partnership?
- How will improved access to national AI research infrastructure advance scientific discoveries?
- Do we have an AI trained workforce prepared to both build and utilize such resources? What would such resources mean for a future AI workforce more broadly?

Background

Artificial intelligence (AI) is "a machine-based system that can, for a given set of human-defined objectives, make predictions, recommendations or decisions influencing real or virtual environments."[1] refers to computer systems capable of performing tasks that typically require human intelligence, such as analyzing data, decision-making, or content creation. Despite the recent attention, AI is not a new technology. Many forms of automation using computer systems can be considered as AI, including automated warehouse robots, social media recommendation algorithms, and fraud detection in financial systems.

Although the term "artificial intelligence" was first coined in 1955, the field progressed slowly until the "machine learning" (ML) approach was popularized in the 2000s. The term "machine learning" refers to an application of artificial intelligence that is characterized by providing systems the ability to automatically learn and improve on the basis of data or experience, without being explicitly programmed.[2] AI may prove to be one of the most disruptive technologies of the 21st Century, and the field is advancing rapidly.

AI technology development presents many benefits and opportunities for society, but also challenges and pitfalls. For example, AI technologies can speed up data processing and provide insights by optimizing performance for complex tasks and systems. However, AI systems may perpetuate or amplify bias and often depend on massive datasets that are not widely accessible to facilitate R&D due to privacy concerns.

Additionally, many researchers lack the necessary access to computing, data, software, and educational resources required to conduct research and train the next generation of researchers. While AI holds potential to help tackle global challenges, many researchers lack access to the requisite resources to conduct R&D activities. Advances in AI are also being slowed by a domestic

[1] P.L. 116-283
[2] P.L. 116-283

and global shortage of workers with skills and experience necessary to meet industry's demand. Congress continues to discuss issues such as trustworthiness, potential bias, ethical uses, potential disruptions to the workforce, and the appropriate balance of federal and private investments in AI R&D to promote U.S. innovation and competitiveness.

U.S. AI R&D Expenditures

There is a global consensus that AI will be transformative across the scientific, economic, and defense realms. For that reason, there is a global race among great powers to lead in both fundamental AI research and commercial applications. The U.S. remains the leader in fundamental research and consistently produces cutting-edge AI applications, such as ChatGPT, before other nations However, adversarial nations like China have historically taken the lead in narrow fields such as facial recognition.

The most recent estimate of total U.S. federal research and development (R&D) spending on AI was $2.9 billion in 2022. [3] While the private sector funds and performs the majority of U.S. R&D, the Federal government has been the leading source of support for basic research, funding R&D in areas that industry lacks incentives to fund, as well as areas critical for national security.

The business sector has accounted for most of the growth in total U.S. R&D over the last decade. Building cutting-edge AI systems requires large amounts of data, computing power, and financial resources to which industry members tend to have greater access compared with nonprofits and academia. According to the Stanford University AI Index Report 2023, private U.S. businesses invested $47.4 billion in 2022, roughly 3.5 times the amount invested by the next highest country's private industry (China, $13.4 billion).[4] The U.S. is also the global leader in newly funded AI companies, with almost double the number of new companies in the European Union and United Kingdom combined, and 3.4 times more than China.[5]

[3] NITRD, *Artificial Intelligence R&D Investments Fiscal Year 2019 – Fiscal Year 2024*, available at https://www.nitrd.gov/apps/itdashboard/ai-rd-investments/.
[4] N. Maslej, et al. "The AI Index 2023 Annual Report," AI Index Steering Committee, Institute for Human-Centered AI, Stanford University, Stanford, CA, April 2023. Available at https://aiindex.stanford.edu/wp-content/uploads/2023/04/HAI_AI-Index-Report_2023.pdf.
[5] *Id.*

Federal Agency Investment in AI R&D

Since 2018, federal spending for nondefense AI R&D has increased from $560 million in fiscal year 2018 to $1.8 billion in 2023.[6] In general, all federal science agencies are making substantial investments in fundamental AI R&D.

Federal R&D Expenditures for AI by Agency (U.S. dollars, in millions)[7]

Agency	FY 2022 Actual	FY 2023 Enacted*	FY 2024 Requested
DOE	224.9	246.4	240.6
NASA	5.7	6.6	12.8
NIH	861	919.3	925.7
NIST	31.5	36.2	36.4
NOAA	6.5	6.4	5
NSF	731	662.1	757.6
USDA	135.9	141.3	156.9

*Includes FY 2023 supplemental amounts

University R&D

Academic research advances foundational knowledge in science and technology. Pursuits of fundamental science research and teaching in universities drive discoveries that can lead to new or improved technologies, and rigorous teaching of math and science can bolster opportunities for underrepresented groups. Universities are also the source of thousands of spin-off companies that contribute to regional economic development and job creation. Such spin-offs are primarily clustered in geographic proximity to the university.

Universities, community colleges, and career and technical education programs can also be ideal homes for upskilling programs that help trades and workers apply skills to technology areas. Federal investments in these programs can help the existing workforce adapt to the integration of AI tools in the workplace. Some institutions have begun credentialing programs to streamline the education and training of our existing workforce.

Public-Private Partnerships

There are many partnerships between the government (including national labs), universities, and the private sector, and the Committee on Science, Space and Technology often explores the nature of those partnership models - what works, what can be expanded, and what new models may be viable. Such partnerships require a sustained commitment by all parties and flexibility as new challenges and opportunities arise. They also require new thinking as to who the partners must include. There is increasing focus on bringing to the table non-traditional partners, including local governments and community organizations, civil society organizations, labor organizations, and others who might be users of, or might be affected by, the research being carried out.

Beyond the overall investment figures, key policy issues and challenges present barriers to capitalizing on R&D expenditures. For instance, some observers have described a "valley of death" between basic research conducted at U.S. universities and the commercialization activities

[6] *Id*.
[7] *supra* note 3.

typically carried out by industry, since universities generally do not have the means of production necessary to take the results of initial research and generate marketable products. According to the American Academy of Arts and Sciences, the pace of American translation of discoveries and inventions from laboratory research to products must accelerate in order for the U.S. to remain competitive.[8] Closer cooperation among industry, government, and academia could increase technology transfer, stimulate innovation, lead to new products and processes, and expand markets.[9]

NATIONAL SCIENCE FOUNDATION ACTIVITIES

National Artificial Intelligence Research Resource (NAIRR) Task Force

The National AI Initiative Act of 2020 directed the creation of a Task Force to examine the feasibility of establishing and sustaining a national AI research resource, which would connect U.S. researchers to computations, data, software, model and training resources needed to participate in AI research. The NAIRR Task Force published a final report in January 2023.[10] The Task Force deliberated on key NAIRR uses, potential impacts, system requirements, and design elements and developed a roadmap for implementation of the NAIRR. The Task Force issued final recommendations with the goal of strengthening and democratizing the U.S. AI innovation ecosystem in a way that protects privacy, civil rights, and civil liberties.[11] These recommendations include:

- Establishing strategic and measurable goals to spur innovation, increase available talent, improve capacity, and advance trustworthy AI.
- Housing basic operations within a single federal agency to serve as an administrative home, and establishing a Steering Committee comprised of representatives from federal agencies with equities in AI research.
- Providing data resources, testbeds, software and testing tools, and user support via an integrated portal that are readily accessible for community and academic research collaboration.
- Setting universal standards for the design and implementation of AI governance processes.
- Establishing a multi-pronged approach to cybersecurity.

NAIRR Pilot Program

On January 24, 2024, the National Science Foundation (NSF) launched a two-year pilot program for NAIRR, in partnership with 10 other Federal agencies and more than 25 private sector, non-profit, and philanthropic organizations.[12] The goals of the pilot program are to serve as a proof-of-

---

[8] Moore, J., & Wilson, I. (2021, January 04). *Decades of basic research paved the way for today's Covid-19 vaccines*. Retrieved February 22, 2023, from https://www.statnews.com/2021/01/05/basic-research-paved-way-for-warp-speed-covid-19-vaccines/.

[9] Congressional Research Service, RL32076, *The Bayh-Dole Act: Selected Issues in Patent Policy and the Commercialization of Technology*, December 2012.

[10] National Artificial Intelligence Research Resource Task Force, *Strengthening and Democratizing the U.S. Artificial Intelligence Innovation Ecosystem: An Implementation Plan for a National Artificial Intelligence Research Resource*, January 2023, available at https://www.ai.gov/wp-content/uploads/2023/01/NAIRR-TF-Final-Report-2023.pdf.

[11] *Id.*

[12] National Science Foundation, "Democratizing the future of AI R&D: NSF to launce National AI Research Resource pilot", *press release*, January 24, 2024, available at https://new.nsf.gov/news/democratizing-future-ai-rd-nsf-launch-national-ai.

concept model for connecting researchers and educators to resources and to demonstrate NAIRR's ability to advance novel and transformative AI research. The first round of funding will prioritize proposals that address 1) safe, secure, and trustworthy AI, 2) healthcare, 3) environment and infrastructure, and 4) AI education.

National Artificial Intelligence Research Institutes

The National Artificial Intelligence Research Institutes program at NSF consists of 25 AI institutes initially funded at $20 million over a five-year span. NSF collaborates with five government agencies and five industry partners to stand up this $500 million federal investment. Each awardee is made up of one or more research institutions across the U.S., and seeks to promote foundational AI research focused on:

- Trustworthy and ethical AI.
- Foundations of machine learning.
- Agriculture and food systems.
- AI and advanced cybersecurity.
- Human-AI interaction and collaboration.
- AI-augmented learning.

DEPARTMENT OF ENERGY ACTIVITIES

Overview

The United States Department of Energy (DOE) and its National Laboratory complex have been investing in the research and development of AI since the 1960s. During this time, they have been responsible for the development of cutting-edge AI tools and high-performance computing for both open science and classified research needs. [13] According to the latest Top500, the organization that gathers and publishes the fastest supercomputers in the world, DOE currently has four of the top ten supercomputers (number one Frontier at ORNL, number two Aurora at Argonne National Lab, number seven Summit at ORNL and number ten Sierra at LLNL) in the world.[14] Due to DOE's advanced knowledge and computational capability assets, largely through the Advanced Scientific Computing Research Program Office (ASCR), the President's Executive Order on AI tasked DOE with helping supply their expertise and computational resources.

Assisting NAIRR Pilot Program

Leveraging the Department of Energy's computational assets can be seen with the recent NAIRR pilot program. Part of NAIRR will run on Oak Ridge's Summit Supercomputer. Summit was initially slated for decommissioning at the end of 2023 but has had its life extended through October 2024 to assist this program. [15] Along with providing computational power from its system,

[13] Department of Energy, "Innovation, Safety, and Security: DOE Leads on AI", October 31, 2023, available at https://www.energy.gov/articles/innovation-safety-and-security-doe-leads-ai.
[14] https://www.top500.org/lists/top500/list/2023/11/.
[15] Department of Energy, "DOE Advancing Safe and Secure AI Research Infrastructure Through the National Aritificial Intelligence Research Resource Pilot," January 24, 2024, available at https://www.energy.gov/articles/doe-advancing-safe-and-secure-ai-research-infrastructure-through-national-artificial#:~:text=WASHINGTON%2C%20D.C.%20%E2%80%94%20The%20U.S.%20Department,managing%20the%20risks%20of%20artificial.

DOE will also be assisting with access to several different National Laboratory projects including Argonne National Laboratory's Leadership Computing Facility's AI Testbed, Oak Ridge's CITADEL framework, and DOE's Biopreparedness Research Virtual Environment (BRaVE) program. These projects show the diverse topical areas that the DOE can use its capabilities to advance in support of NAIRR.

DOE Artificial Intelligence Recommendations

DOE, along with the National Laboratories, conducted a series of workshops that resulted in a report being released in the summer of 2023 that shows how DOE capabilities can drive progress in key areas of AI development.[16] This report highlighted the unique computational modeling activities conducted by DOE's supercomputers and how they will be able rapidly advance the development of complex AI models. These AI models will have the potential to accelerate discovery in several basic science fields like materials science, chemistry, and biology.[17] These AI models will eventually have the ability to co-design with classical computational resources to create heterogeneous platforms with greater capabilities. DOE has also recently introduced a proposal titled "Frontiers in Artificial Intelligence for Science, Security, and Technology" (FASST) that highlights some of the key areas within their jurisdiction where AI could rapidly be leveraged. These areas include increasing the reliability of the electricity grid, responding to natural disasters in a more practical manner, more effective cancer screenings and treatment, and the stewardship of the nuclear weapons stockpile. The FASST proposal aims to do this by creating models both in the open and classified space that can develop next-generation capabilities to manage threats to the nation. Through work already conducted at the Department by the Exascale Computing Project, DOE is positioned to progress the future hardware and software needs that will be required to support these new AI models. DOE and its National Laboratories also represent a large, highly skilled workforce capable of tackling a challenge of this size and technical complexity.

DOE AI Office and Chief AI Officer

In December of 2023, the Department announced it was standing up the Office of Critical and Emerging Technology (CET) as called for by an AI Executive order issued by President Biden in October 2023. This office is headed by Helena Fu who also serves as DOE's Chief Artificial Intelligence Officer. [18] CET's mission is "to leverage capabilities and expertise across DOE and its 17 National Laboratories to sustain and extend U.S. leadership in technology in support of DOE's energy, science, and security mission."[19] The Office of Critical and Emerging Technology will serve as the DOE's single point of contact on critical and emerging technologies to help ensure the Federal Government and its partnerships with the private sector and academia continue to lead in research, development, and deployment of key innovations in U.S. competitiveness and security. Chief Artificial Intelligence Officer (CAIO) Helena Fu is a former White House official and served

[16] Argonne National Laboratory, *AI for Science, Energy, and Security Report*, May 2023, available at https://www.anl.gov/ai-for-science-report.
[17] *Id.*
[18] Department of Energy, "DOE Launches New Office to Coordinate Critical and Emerging Technology", December 12, 2023, available at https://www.energy.gov/articles/doe-launches-new-office-coordinate-critical-and-emerging-technology
[19] Department of Energy, Office of Critical and Emerging Technology, available at https://www.energy.gov/cet/office-critical-and-emerging-technology.

on the National Security Council and with the Office of Science and Technology Policy. Her role as the DOE's Chief Artificial Intelligence Officer put her in charge of DOE's coordination of AI, managing risks from its use, and promoting innovation as laid out in the executive order on AI.[20]

LEGISLATIVE ACTIONS

National AI Initiative Act

In December 2020, Congress passed the National Artificial Intelligence Act of 2020.[21] This bipartisan legislation, which was led by the House Science Committee, accelerated and coordinated Federal investments and new public-private partnerships in research, standards, and education in trustworthy artificial intelligence. This Act established the American AI Initiative, the National AI Initiative Office, an interagency committee at OSTP, the National AI Advisory Committee, the Subcommittee on AI and Law Enforcement, and a task force to investigate the feasibility of a National AI Research Resource. This legislation also directed NSF, the National Institute of Standards and Technology (NIST), and the National Oceanic and Atmospheric Administration (NOAA) to conduct research and support development of AI technologies.

H.R. 5077, the CREATE AI Act of 2023

H.R. 5077 was introduced in July 2023 by Representatives Eshoo, McCaul, Beyer, and Obernolte and has a Senate companion, S. 2714, led by Senators Heinrich, Young, Booker, and Rounds. The CREATE AI Act authorizes the development of the NAIRR, which would be overseen by NSF through a program management office. An interagency steering committee would also be created. The day-to-day operations of the NAIRR, including procurement of computational and data resources needed to do AI research, would be run by an independent non-governmental entity. This operational entity, which would be selected through a competitive process, would be an educational institution or federally funded research and development center (FFRDC), or a consortium of universities or FFRDCs.

After the establishment of the NAIRR, researchers at institutions of higher education (and certain small businesses that receive executive branch funding) would be eligible to use the NAIRR for AI research, with time allocations on the NAIRR selected through a merit-based process. Time allocations on the NAIRR could also be rented for researchers who need more resources.

EXECUTIVE ORDERS

On February 11, 2019, President Trump issued an Executive Order to launch the American AI Initiative, which directs federal agencies to develop AI R&D budgets to support their core missions. [22] Federal agencies are also directed to increase access to their resources to drive AI research by identifying high-priority federal data and models, improving public access to and the quality of federal AI data, and allocating high-performance and cloud computing resources to AI-

[20] https://www.energy.gov/articles/doe-launches-new-office-coordinate-critical-and-emerging-technology
[21] P.L. 116-283.
[22] E.O. 13859 of February 11, 2019, available at https://trumpwhitehouse.archives.gov/presidential-actions/executive-order-maintaining-american-leadership-artificial-intelligence/.

related applications and R&D. [23]

On October 30, 2023, President Biden issued an Executive Order to establish a government-wide effort to guide responsible AI development and deployment through federal agency leadership, regulation of industry, and engagement with international partners.[24] It also directed NSF to launch the NAIRR pilot program to provide researchers and students with the necessary access to data and resources to advance AI research.[25]

Further Reading:

- CRS - Artificial Intelligence: Background, Selected Issues, and Policy Considerations
- CRS - Overview of Artificial Intelligence
- IBM - Artificial Intelligence Basics
- Democratizing the future of AI R&D: NSF to launch National AI Research Resource pilot | NSF - National Science Foundation
- Executive Order on the Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence | The White House
- Fact Sheet: Biden-Harris Administration Announces Key AI Actions Following President Biden's Landmark Executive Order
- NSF's FY24 Goals for AI

[23] *Id*.
[24] Congressional Research Service, R47843 *Highlights of the 2023 Executive Order on Artificial Intelligence for Congress*, November 17, 2023.
[25] E.O. 14110 of October 30, 2023, available at https://www.whitehouse.gov/briefing-room/presidential-actions/2023/10/30/executive-order-on-the-safe-secure-and-trustworthy-development-and-use-of-artificial-intelligence/.