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General Comment

See attached file.

This comment is submitted in response to the National Science Foundation's Request for Information on the development of the 2025 National Artificial Intelligence (AI) Research and Development Strategic Plan. We appreciate the opportunity to contribute.

Attachments

RFI Response AI Strategy

THE UNIVERSITY OF CHICAGO
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Response to the RFI on the "Development of a 2025 National AI R&D Strategic Plan"

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Federal investment can leverage academic strengths to advance national priorities on security and defense, scientific innovation, and economic growth. Our recommendations are to (1) advance fundamental AI research; (2) accelerate AI-enabled scientific discovery; (3) position universities as engines of innovation through collaboration and workforce development; and (4) invest in large-scale, shared AI computational infrastructure. With federally funded research yielding annual returns of 25–40%[1] continued investment in ***university-led innovation*** is essential to sustaining U.S. global AI leadership.

Strategic recommendation 1: Prioritize advances in fundamental AI algorithms, architectures, and mathematical foundations. Achieving transformative AI breakthroughs depends on fostering a robust innovation ecosystem. Advances in optimization (e.g., Adagrad[2], ADAM[3]) and distributed algorithms are essential for the efficient training of neural networks, uncertainty quantification methods facilitate trustworthy AI, and differential privacy provides robust protections for Americans' data. Complementary technologies, such as cloud infrastructure, high-performance computing, and parallel architectures, play an equally pivotal role in enabling the training, scaling, and deployment of AI models. Federal investments in high-performance computing and distributed processing—totaling over $1 billion[4]

[1] Willett, R., & Hoffmann, H. (2025, February 25). *Federal budget cuts threaten to decimate America's AI superiority—and other countries are watching*. Fortune. https://fortune.com/2025/02/25/federal-budget-cuts-threaten-america-ai-tech-superiority/
[2] Duchi, J., Hazan, E., & Singer, Y. (2011). Adaptive subgradient methods for online learning and stochastic optimization. *Journal of machine learning research*, 12(7).
[3] Kingma, D. P., & Ba, J. (2015). *Adam: A method for stochastic optimization*. In *3rd International Conference on Learning Representations (ICLR)*. https://arxiv.org/abs/1412.6980
[4] Roland, A., & Shiman, P. (2002). Strategic computing: DARPA and the quest for machine intelligence, 1983–1993. MIT Press. Retrieved from https://gwern.net/doc/cs/hardware/2002-roland-strategiccomputing-darpaandthequestformachineintelligence19831993.pdf

since the 1980s—have seeded core technologies in companies like NVIDIA, AWS, and Google Cloud, laying the groundwork for an AI chip market projected to exceed $200 billion by 2030[5]. Similarly, initiatives such as the DARPA Grand Challenge, initiated in 2004, accelerated university-led innovation in autonomous vehicle technologies, well ahead of industry adoption. This program spurred university-led advances in computer vision, sensing, and distributed AI, which today impact diverse domains, including healthcare, agriculture, and logistics. To sustain U.S. leadership in AI, strengthen national security, and drive long-term economic growth, ongoing federal investment in the fundamental AI ecosystem remains essential.

Strategic recommendation 2. Invest in scientific AI -- the development of AI tools and talent to advance scientific discovery, ensuring the U.S. remains at the forefront of innovation. Scientific AI breakthroughs rely on a robust ecosystem comprising mathematical and statistical methods, deep scientific domain expertise, rich datasets, and large-scale computing infrastructure. A prime example is AlphaFold, a landmark AI system for protein structure prediction, which emerged from federal investments in academic research. Co-developed by University of Chicago alumnus and 2024 Nobel Prize recipient John Jumper, AlphaFold builds on foundational advances from the Toyota Technological Institute at Chicago, such as RaptorX - a university-developed platform[6] for protein structure and function prediction – and the federally funded Protein Data Bank. This pioneering academic work in structure prediction underscores the potential of scientific AI to catalyze convergent, cross-disciplinary innovation. In drug development alone, AlphaFold's transformative impact is expected to fuel a $10.82 billion[7] computational biology market by 2028. Similarly, AI is increasingly being used to track space debris[8] that threatens GPS, communications, and defense satellite systems[9]; these innovations build upon federal investments in machine learning foundations, sensor fusion, signal processing, and satellite imaging technologies[10]. Without such cross-cutting federal support, AI-driven defenses against space debris would not be feasible.

[5]Yahoo Finance. (2023, February 27). *Artificial intelligence chip market projected to reach USD 207.4 billion by 2030, growing at a CAGR of 37.9%.* https://finance.yahoo.com/news/artificial-intelligence-chip-market-projected-163000015.html
[6] https://home.ttic.edu/~wangsheng/software.html
[7]Vantage Market Research. (2022, February 14). *Computational biology market to reach USD 10.82 billion by 2028 - Recent improvements in R&D of bioinformatics, application of data-analytical & theoretical methods is expected to drive the computational biology market.* GlobeNewswire. https://www.globenewswire.com/news-release/2022/02/14/2384117/0/en/Computational-Biology-Market-to-Reach-USD-10-82-Billion-by-2028-Recent-Improvements-in-R-D-of-Bioinformatics-Application-of-Data-Analytical-Theoretical-Methods-is-Expected-to-Drive.html
[8]Chu, J. (2017, June 19). *Space junk: The cluttered frontier*. MIT News. https://news.mit.edu/2017/space-junk-shards-teflon-0619
[9]Wells, S. (2023, July 1). *AI battles the bane of space junk.* IEEE Spectrum. https://spectrum.ieee.org/space-junk-ai-cleanup
[10]Li, Z. (2024, July 19). *How AI improves operations on NOAA GOES-R weather and environmental satellites.* SpaceNews. https://spacenews.com/ai-already-improving-operations-noaa-goesr-weather-environmental-satellites/

Sustained investment in scientific AI is essential to unlocking new frontiers of discovery while reinforcing the U.S.'s position as an innovation leader across industries.

Strategic recommendation 3: Strengthen support for universities' contributions to AI workforce development, preparing the next generation of innovators for roles in industry, national laboratories, and academia. Federal funding for university-based AI training programs is essential to ensuring the U.S. maintains leadership in this transformative field. For decades, the NSF has played a critical role in supporting basic research in AI that laid the groundwork for large language models like GPT-4[11]. While industry labs published some of the most well-cited generative AI papers, a significant number of their authors were trained in university programs funded by the NSF. The economic impact of large language models is expected to grow substantially, powering a $4.4 trillion[12] generative AI market by 2032. These trends highlight how investments in university-based AI training position the U.S. to lead in technology, industry, and national security for decades to come. We recommend a two-pronged approach to cultivate a workforce capable of advancing U.S. leadership in AI research, technology, and innovation. First, the U.S. must build on highly successful NSF training models, such as the NRT and GRFP, which are critical to nurturing domestic talent pipelines. Beyond domestic efforts, strategic investments should also prioritize the global recruitment and retention of top AI talent. Establishing federal mechanisms to support international scholars and expand global partnerships in AI research will enhance the U.S.'s scientific influence and innovation capacity. International collaboration is fundamental to accelerating breakthroughs in AI while maintaining long-term competitive strength.[13] Data underscores the importance of global talent: "Immigrants have founded or cofounded nearly two-thirds (65% or 28 of 43) of the top AI companies in the United States, and 70% of full-time graduate students in fields related to artificial intelligence are international students, according to a new National Foundation for American Policy (NFAP) analysis. Seventy-seven percent of the leading U.S.-based AI companies were founded or cofounded by immigrants or the children of immigrants. Forty-two percent (18 of 43) of the top U.S.-based AI companies had a

[11]National Science Foundation. (n.d.). *Building the foundations of artificial intelligence*. https://www.nsf.gov/impacts/ai
[12]Chui, M., Hazan, E., Roberts, R., Singla, A., Smaje, K., Sukharevsky, A., Yee, L., & Zemmel, R. (2023, June 14). The economic potential of generative AI: The next productivity frontier. McKinsey & Company. https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/the-economic-potential-of-generative-ai-the-next-productivity-frontier
[13]Wagner, C. S., & Jonkers, K. (2017). "Open countries have strong science." Nature, 550(7674), 32–33. [https://doi.org/10.1038/550032a]

founder who came to America as an international student."[14] Investing in both domestic and global talent pipelines will be critical to maintaining U.S. leadership in AI innovation, safeguarding economic competitiveness, and reinforcing the nation's scientific and technological influence worldwide.

Strategic recommendation 4: Develop large-scale, shared AI computational infrastructure accessible to university researchers. Existing federal programs designed to support AI computational infrastructure for universities are no longer sufficient in terms of the scale, speed, or coordination needed to meet the demands of cutting-edge AI research. The U.S. risks losing ground in the global AI race, as other nations are investing heavily in national compute capacity, integrated data ecosystems, and university-led innovation pipelines[15]. To remain competitive, the federal government must prioritize AI infrastructure as a vital component of our national research infrastructure, similar to its historical investments in shared facilities at national laboratories, quantum computing, and broadband. As demonstrated by recent federal and academic advances in quantum computing - such as the University of Chicago's cutting-edge quantum research initiative[16], and MIT's progress toward a fault-tolerant quantum computer[17] - sustained investment in research infrastructure can propel innovation, deliver groundbreaking results, and secure long-term leadership in critical technologies.

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[14]Anderson, S. (2023). *AI and immigrants* (NFAP Policy Brief). National Foundation for American Policy. https://nfap.com/wp-content/uploads/2023/06/AI-AND-IMMIGRANTS.NFAP-Policy-Brief.2023.pdf

[15] Council on Foreign Relations. (n.d.). The state of U.S. infrastructure. Council on Foreign Relations. https://www.cfr.org/backgrounder/state-us-infrastructure

[16] University of Chicago Pritzker School of Molecular Engineering. (n.d.). *Quantum at UChicago: Advancing quantum information science and engineering*. https://pme.uchicago.edu/quantum-uchicago-research/quantum-computing

[17] Massachusetts Institute of Technology. (2025, April 30). *MIT engineers advance toward a fault-tolerant quantum computer*. MIT News. https://news.mit.edu/2025/mit-engineers-advance-toward-fault-tolerant-quantum-computer-0430