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Request for Information: Development of a 2025 National Artificial Intelligence Research and Development Strategic Plan

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Submitter Information

Organization: Binghamton University

General Comment

See attached file(s)

Attachments

RFI Response-Binghamton

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Introduction

Binghamton University, part of the State University of New York (SUNY) system, has a long-standing reputation for innovative and impactful research and scholarship. We offer highly recognized undergraduate education programs alongside master's and doctoral programs in the liberal arts, sciences, engineering, nursing, and other professional fields. Binghamton University was designated a Very High Research (R1) institution in 2018 by the *Carnegie Classification of Institutions of Higher Education*. Our research programs, particularly in artificial intelligence (AI), advance knowledge and develop transformative solutions across multiple areas, including healthcare, manufacturing, cybersecurity, and energy. We are committed to cultivating a highly skilled workforce to support the growing AI sector and its applications across various industries. In addition to our degrees and credential programs, Binghamton University promotes STEM awareness and engagement in our local K-12 schools through our Community Schools and New York State's Master Teacher programs. Our education programs align with the interests of students and industry, ensuring a strong pipeline of skilled students and professionals for our industry partners.

Binghamton University has significant expertise in AI research through its numerous faculty (nearly 40 focused on AI research and development), especially in the Watson College of Engineering and Applied Science, and specialized research centers, including the *Watson Institute for Systems Excellence* (WISE), the *Center for Information Assurance and Cybersecurity* (CIAC), the *Center for Imaging, Acoustics, and Perception Science* (CIAPS), and the newly established *Institute for AI & Society*. These centers actively collaborate on AI-driven projects funded by federal agencies, New York State, and industry partners. Our programs include AI-focused cybersecurity, health sciences, data analytics, and comprehensive AI curricula at undergraduate and graduate levels. Our recently launched *Institute for AI & Society* emphasizes interdisciplinary AI research, education, and community impact. Our faculty members researching AI have a vested interest in advancing fundamental AI research and expanding education programs and applications for AI. We recognize the critical importance of developing AI technologies that are safe and secure. Our interest also extends to fundamental advances in AI algorithms, next-generation AI hardware, AI applications in cybersecurity beyond commercial uses, advances in AI standards, security, and reliability. These initiatives demonstrate our ability to contribute valuable insights to the National Artificial Intelligence (AI) Research and Development (R&D) Strategic Plan. The request for information aligns with our ongoing efforts to foster interdisciplinary research, workforce training, and industry collaboration, ensuring that AI technologies serve the nation.

The rapid advancement of AI has created both significant opportunities and challenges, necessitating foundational research and strategic investments in infrastructure. Our comments address the critical need for comprehensive investment in AI algorithms, hardware innovations, and interdisciplinary research to maximize human-AI collaboration, enhance creativity, and ensure U.S. leadership in global AI competitiveness. We highlight the importance of prioritizing research

areas, including precision medicine, scalable and secure computing infrastructures, trustworthy AI frameworks, and embodied AI systems. Our response emphasizes the need for fundamental AI research, high-risk, high-reward investigations, research into trustworthy AI systems and security, next-generation hardware developments, and infrastructure support outlined in the RFI.

Needs Assessment

Binghamton University's AI-related projects provide clear evidence that comprehensive investment in both fundamental and applied AI research has a significant impact on multiple areas. Our research demonstrates that strong interdisciplinary efforts are essential to enhance creativity and innovation in human-AI collaborative frameworks, particularly addressing the risks of homogenization and decreased organizational creativity resulting from AI outputs. In precision medicine, Binghamton's initiatives have demonstrated that integrating multi-omics data with advanced AI methods accelerates biomarker discovery and drug development, while enhancing diagnostic precision and supporting personalized healthcare approaches. Additionally, our cybersecurity research highlights the critical need to develop trustworthy AI frameworks that ensure security, privacy, and reliability, particularly against sophisticated AI-generated threats in critical infrastructure. Furthermore, our examination of embodied AI and robotics reveals a significant gap in U.S. competitiveness, underscoring the need for strategic investments and partnerships in advanced robotics hardware to secure a leading global position in emerging AI technologies. Collectively, our experience substantiates the need for targeted federal support in these key AI research areas to maintain and enhance U.S. leadership and innovation:

Human-AI interactions

The current explosion of AI technology risks decreasing (rather than increasing) creativity at collective levels due to the inherent design homogenization resulting from AI outputs. At this point, no systematic research has been conducted regarding how AI and other interactive agent technologies can enhance or harm social and organizational creativity. Therefore, there is an urgent need to find out how to effectively utilize AI to enhance the creativity of humans and organizations.

Security

As sophisticated AI-generated attacks continue to pose significant threats to public safety, national security, and societal trust, particularly in sensitive domains such as healthcare, energy infrastructure, and virtual communications, the National AI R&D Strategic Plan must prioritize efforts to strengthen AI authenticity and integrity. Our research underscores the critical importance of developing strong, secure, and trustworthy artificial intelligence frameworks, especially in emerging digital ecosystems such as digital twins and the metaverse. Promoting interdisciplinary research collaborations to enhance AI-driven security solutions will be key to creating resilient, secure, and reliable virtual environments for all stakeholders.

Robotics

Significant breakthroughs have occurred in the digital realm of AI, spanning machine learning, neural networks, and foundation models. Now, AI is moving into the physical world, which demands embodiments through robotics. The U.S. holds key advantages in computational resources, talent, and a strong culture of innovation. However, it is falling behind in hardware, especially in robot manufacturing. As GPUs are essential for training digital AI, advanced robotic hardware is foundational for embodied AI. For example, a robot manufacturer based in Hangzhou, China, currently manufactures approximately 75% of the world's legged robots. This trajectory

mirrors the rise of DJI, which by 2024 produced over 90% of the global consumer drone market. As such, there is a need to strengthen the domestic manufacturing production in the U.S. and provide a bridge from fundamental research to the domestic industry.

Health Applications- Precision Medicine

The advancement of AI for precision medicine should be a national priority. Precision medicine represents a transformative approach to healthcare that tailors treatment and prevention strategies to individual variability in genes, environment, and lifestyle. AI is uniquely positioned to accelerate progress in this domain by enabling the integration and analysis of complex, multimodal biomedical data.

The National AI R&D Strategic Plan's actions to prioritize fundamental AI research, next-generation hardware, and strong standards can enhance U.S. global leadership in AI, improve security in critical infrastructure, and advance precision medicine and healthcare outcomes. These initiatives might also foster high-risk, high-reward research leading to technological breakthroughs. NSF's related views on the transformative potential of high-risk AI research are well-founded and supported by historical breakthroughs from fundamental inquiry. Nonetheless, potential unintended outcomes of such a strategy may include overlooking the intricacies and resource requirements necessary for collaboration in precision medicine and secure computing, as well as the potential mismatch between long-term fundamental research and the short-term goals of private industry.

Recommendations

To support long-term growth in fundamental AI research and ensure that such research benefits both industry and society, we recommend that the National AI R&D Strategic Plan prioritize creating funding mechanisms specifically targeted at long-term, fundamental research through interdisciplinary and cross-sector collaboration. Investing in fundamental AI research will ensure long-term innovation and sustain the U.S.'s leadership in AI. Supplemental funding and expansion of existing programs, such as GOALI, would strengthen academia-industry-government partnerships and the bridge between fundamental research and the transition to market. Dedicated funding streams and programs that explicitly address workforce transitions and human-AI collaborative creativity will build upon current industry initiatives and provide for the long-term continuation and growth of the AI sector.

Evidence from Binghamton University's successful interdisciplinary projects, such as precision medicine initiatives and cybersecurity frameworks, highlights the enhanced outcomes from collaborative, integrated research approaches. Our experience also shows the effectiveness of targeted workforce training in bridging skill gaps, promoting workforce productivity, and enabling smoother transitions amidst rapid technological advancements. Ensuring access to infrastructure and focusing explicitly on long-term impacts will foster a stronger national AI ecosystem, ultimately leading to sustained U.S. leadership in AI.

To remain competitive, the U.S. must invest more aggressively in robotic hardware manufacturing and strengthen connections between robotics companies and higher education institutions. Federal agencies could, for instance, establish partnerships with companies like Boston Dynamics to make their hardware more accessible for academic research and training. Previous collaborations, such as those between the NSF and Amazon in machine learning, have offered successful models for similar efforts.

In terms of AI applications in healthcare and precision medicine, key R&D priorities should include:

- **AI-Enabled Biomarker and Drug Discovery:** AI techniques, such as machine learning and deep learning, can identify novel biomarkers and therapeutic targets by analyzing large datasets, including genomic, proteomic, metabolomic, and clinical data. Integrating quantum computing may significantly accelerate molecular simulations and optimization tasks crucial for drug development.
- **Medical Image Analysis:** AI shows substantial promise in radiology, pathology, and histology through image classification, segmentation, and anomaly detection. Ongoing investment in AI-driven imaging analysis will enable earlier, more accurate diagnoses and real-time treatment monitoring.
- **Foundational Models and Generative AI for Multi-Omics Integration:** Foundational models integrating multi-omics data (genomics, transcriptomics, proteomics), medical imaging, and electronic health records (EHRs) are crucial for advancing personalized therapies and diagnostics. Generative AI models support hypothesis generation and in silico experimentation, improving R&D efficiency.
- **Scalability via High-Performance and Cloud Computing:** AI models must scale across healthcare systems to facilitate real-world clinical applications. Integrating high-performance computing (HPC) and secure cloud infrastructure is vital for training large models and deploying them in clinical settings with minimal latency and maximum reliability.
- **Privacy-Preserving AI Techniques:** As AI models utilize sensitive patient data, technologies like federated learning and differential privacy must be incorporated into R&D workflows. These strategies are essential for complying with privacy regulations and maintaining public trust while enabling collaborative research across institutions.

Federal support for these initiatives is uniquely essential given the high computational costs, infrastructure demands, and regulatory considerations involved. By investing in these areas, the U.S. can enhance its global leadership in AI, deliver tangible improvements in health outcomes, and boost the pharmaceutical industry.

Binghamton University appreciates the opportunity to provide insights and recommendations to the National AI R&D Strategic Plan. We are committed to supporting the plan's implementation and contributing our expertise in interdisciplinary, collaborative, and applied AI research. Through strategic investments and thoughtful policy considerations, NSF can ensure sustained U.S. leadership and innovation in AI, fostering beneficial outcomes for society.