PUBLIC SUBMISSION

Received: May 28, 2025
Tracking No. mb8-1s4a-6woi
Comments Due: May 28, 2025 **Submission Type:** API

Docket: NSF-2025-OGC-0001
NITRD_FRDOC_0001

Comment On: NSF-2025-OGC-0001-0001
Request for Information: Development of a 2025 National Artificial Intelligence Research and Development Strategic Plan

Document: NSF-2025-OGC-0001-DRAFT-0129
Comment on FR Doc # 2025-07332

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General Comment

See attached file(s)

Attachments

RFI_2025_0001_AI

Title:
Response to RFI: Strategic Necessity of Fundamentally New Learning Algorithms to Secure U.S. Leadership in Artificial Intelligence

Submitter:
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Reference:
RFI (Docket ID No. NSF-2025-OGC-0001).

Mandatory Statement:
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Management Summary:
Despite remarkable progress, current AI approaches, particularly those based on deep learning and backpropagation, face critical limitations that threaten U.S. strategic competitiveness. The computational inefficiency, significant data requirements, and fundamental theoretical shortcomings of existing AI methods underscore the urgency for developing fundamentally new learning algorithms. Such a fundamentally new and alternative learning algorithm has already been developed and demonstrated. A "Manhattan Project" scale initiative aimed at achieving transformative breakthroughs in AI is necessary, particularly in the context of global competition, where China may already be undertaking similar strategic efforts.

Limitations of Current AI Paradigms:

While deep learning, powered by backpropagation, has led to significant advances, such as remarkable progress in image recognition, language processing, and generative AI, it suffers fundamental shortcomings:

- **Computational and Energy Intensity:** Today's deep neural networks demand massive computational resources and power consumption, posing barriers to scalability, sustainability, and widespread deployment.
- **Data Dependency:** Current methods require vast, often prohibitively large, labeled datasets, limiting applicability in data-scarce contexts and increasing vulnerability to biased outcomes.
- **Biological Implausibility:** The prevalent reliance on backpropagation, while effective, is fundamentally at odds with known mechanisms of biological learning, suggesting missed opportunities in exploring more efficient and biologically plausible models.

- **Additional Limitations:** These include susceptibility to adversarial attacks, poor robustness under domain shifts, limited explainability ("black-box" nature), and incapability of continuous incremental learning without catastrophic forgetting.

Strategically, these limitations represent a significant risk to national security, economic competitiveness, and scientific leadership. Relying exclusively on these approaches without exploring alternatives could erode U.S. advantages in technology and innovation.

Advocating for a New Research Priority: Fundamental Learning Algorithms:

The development of fundamentally new learning algorithms must become a national priority, given the potential transformative impact of achieving true artificial general intelligence (AGI). Such advanced AI systems could profoundly reshape global power dynamics. The nation that achieves and scales AGI first will possess unparalleled technological and geopolitical advantages. Currently, only the U.S. and China have the resources and infrastructure necessary to credibly pursue this goal.

This research aligns directly with the priorities outlined in the RFI, including fundamental advances in AI algorithms, high-risk/high-reward AI research, and next-generation approaches beyond deep learning. It represents a strategic area where government leadership is critical, given industry's propensity to prioritize incremental, short-term applications.

Possible breakthroughs from investing in fundamental new learning algorithms include:

- **Energy-Efficient AI:** Drastically reduced computational demands through algorithmic efficiency.
- **Explainable AI:** Transparent decision-making processes, crucial for trust and regulatory compliance.
- **Continuous Learning:** Systems capable of lifelong learning without catastrophic forgetting, adapting continuously in dynamic environments.
- **Robust and Secure AI:** Improved resilience against adversarial attacks and unforeseen domain shifts.
- **Data Efficiency:** Effective learning from minimal datasets, greatly expanding AI applicability.
- **AI-driven Scientific Discovery:** Novel AI approaches that can autonomously derive insights, leading to unprecedented scientific advancements.
- **Adaptive Robotics:** Enhanced robotic systems that can adapt and generalize robustly across varied tasks and environments.

Notably, such an algorithm not only exists theoretically—as evidenced by highly efficient natural systems—but has already been technically developed and demonstrated.

Recommendations for Government Action and Funding Mechanisms:

To realize this vision, specific actions include:

- **Classified Government-Led Initiatives:** Establishing focused, exploratory programs targeting fundamentally new, currently industry-overlooked pathways toward genuine AGI.
- **Innovative Partnership Models:** Creating novel collaboration frameworks between government agencies, academic research institutions, and—subsequently—industry partners to bridge the gap from fundamental research to practical deployment.
- **Hardware and Algorithm Integration:** Strategically aligning algorithm development with emerging hardware technologies, such as optical and neuromorphic processors, to exploit synergies for revolutionary computational paradigms.
- **Strategic International Partnerships:** Forging targeted alliances, especially with European nations, to attract and consolidate global intellectual talent and maintain technological superiority.

Conclusion:

The future of AI and the United States' leadership position critically depends on significant investment in fundamental AI research beyond current paradigms. The transformative potential of fundamentally new learning algorithms cannot be overstated. Immediate strategic focus and commitment from the government in pioneering these next-generation AI technologies will safeguard national security, enhance economic prosperity, and solidify U.S. dominance in global technology leadership.

I am eager and ready to engage further in discussions to support and realize this vision.