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General Comment

See attached file(s)

Attachments

comments

Comment on the 2025 National AI R&D Strategic Plan RFI

Subject: Prioritizing AI R&D for Understanding Brain and Cognition to Inspire Next-Generation AI

The 2025 National AI R&D Strategic Plan presents a crucial opportunity to direct Federal investment towards high-impact areas of AI research. I strongly believe that a significant priority should be placed on leveraging AI and data-driven modeling to advance our understanding of human and animal cognition and the underlying neural encoding mechanisms in the brain. Furthermore, this foundational knowledge holds immense promise for inspiring the next generation of AI models, including large language models (LLMs), robotic agents, and other foundation models.

Promising Research Directions:

1. **AI-Driven Discovery in Neuroscience:** AI techniques are uniquely positioned to analyze the vast and complex datasets emerging from modern neuroscience (e.g., electrophysiology, neuroimaging, connectomics, behavioral data). Prioritized research should focus on developing novel AI algorithms and architectures for:
    - **Decoding Neural Representations:** Creating models that can accurately decode cognitive states, sensory information, and decision-making processes from neural activity.
    - **Identifying Fundamental Principles of Neural Computation:** Using AI to uncover the core computational principles and algorithms employed by the brain for learning, memory, reasoning, and perception.
    - **Modeling Brain Dynamics:** Developing sophisticated AI models capable of simulating the complex temporal and spatial dynamics of neural circuits and large-scale brain networks.
    - **Understanding Individual Differences:** Applying AI to analyze the variability in brain structure and function across individuals and relate it to cognitive abilities and behavioral traits.
2. **Brain-Inspired AI for Next-Generation Models:** Insights gained from understanding biological intelligence can provide crucial inspiration for overcoming current limitations in AI. Promising research areas include:
    - **Developing More Robust and Adaptable AI:** Biological systems exhibit remarkable robustness to noise, damage, and environmental changes, as well as the ability to learn and adapt continuously. Research should focus on translating these principles into more resilient and flexible AI architectures.
    - **Enhancing Reasoning and Planning in AI:** The brain's ability for abstract reasoning, planning, and problem-solving remains a significant challenge for current AI. Investigating neural mechanisms of these processes can inspire novel AI approaches.
    - **Improving Human-AI Interaction:** Understanding how the brain processes and responds to social cues and intentions can lead to the development of more intuitive, collaborative, and trustworthy human-AI interfaces.
    - **Creating More Efficient and Energy-Saving AI:** The brain achieves remarkable computational power with extremely low energy consumption. Research into the principles of neural computation could inspire the design of more energy-efficient AI hardware and algorithms.
    - **Advancing Agentic and Embodied AI:** Studying how biological agents perceive, act, and learn in the physical world can provide valuable insights for developing more capable and adaptable robotic and embodied AI systems.

Why Prioritization is Crucial (Serving National Interests):

- **Fundamental Scientific Advancement:** Understanding the brain is one of the grand challenges of science. AI offers unprecedented tools to accelerate discovery in this critical domain.
- **Long-Term AI Leadership:** Investing in fundamental research inspired by biological intelligence can lead to truly transformative AI breakthroughs that go beyond incremental improvements in current deep learning paradigms, securing long-term U.S. leadership in AI.
- **Addressing Limitations of Current AI:** Many of the limitations of current AI systems (e.g., lack of robustness, explainability, common-sense reasoning) might be overcome by drawing inspiration from the brain's elegant and efficient solutions. These advancements are crucial for deploying AI in critical sectors.
- **Economic and Societal Benefits:** Advances in both neuroscience and AI have profound implications for health, education, technology, and national security. A deeper understanding of the brain can lead to new treatments for neurological disorders, while more capable AI can drive innovation across industries.

Novel Mechanisms for Research Partnerships:

- **Interdisciplinary Centers:** Establish national centers that foster deep collaboration between AI researchers, neuroscientists, cognitive scientists, and engineers. These centers should encourage the sharing of data, tools, and expertise.
- **Shared Benchmarking Initiatives:** Develop common benchmarking tasks and datasets that bridge the gap between AI and neuroscience, allowing for the evaluation of AI models on tasks that probe brain-like cognitive abilities.
- **Open-Source Platforms:** Support the development of open-source software and hardware platforms that facilitate the integration of AI techniques into neuroscience research and the translation of neuroscientific insights into AI models.
- **Industry-Academia Consortia:** Create consortia that bring together academic researchers and industry partners to focus on specific challenges at the intersection of AI and brain research, fostering the translation of fundamental discoveries into practical applications.

By prioritizing AI research aimed at understanding the brain and leveraging this knowledge to inspire the next generation of AI, the Federal government can foster fundamental scientific discovery, secure long-term AI leadership, and drive innovation with significant societal and economic benefits.