DAY ✔ ONE PROJECT

Advancing American AI through National Public-Private Partnerships for AI Research

Jim Kurose
Deborah Crawford

December 2020

Summary

The next administration should launch a national initiative to bring together academic and industry researchers and practitioners in a public-private partnership (PPP) to advance, at scale, the research foundations of artificial intelligence (AI) and its application in areas of economic advantage and national need. The National Public-Private Partnership in AI (NPPP-AI) Initiative would initially create 10 coordinated national AI R&D Institutes, each with 10-year lifetimes and jointly funded by industry partners and the U.S. government through its research agencies at $10M/year each (10x10x10).

NPPP-AI would accelerate future breakthroughs in AI foundations, enable a virtuous cycle between foundational and use-inspired research that would rapidly transition into practice innovations that contribute to U.S. economic and national security, as well as grow education and workforce capacity by linking university faculty and students with industry professionals, settings, and jobs.

Challenge and Opportunity

The past decade has witnessed a meteoric rise of AI in both importance and impact. The use of AI systems has already created a two trillion-dollar industry that is projected to grow to $15 trillion in 10 years. Vladimir Putin has famously stated that "[t]he one who becomes the leader in this sphere [AI] will be the ruler of the world." China has announced a plan to become the world leader in AI by 2030, with a domestic AI industry worth almost $150 billion. The stakes could hardly be higher.

The U.S. has benefitted tremendously from its early, ahead-of-the-curve investments in AI research in areas such as information retrieval, machine learning, and natural language processing, which have helped found and fuel major segments of the U.S. economy. But U.S. investment in basic science and technology research, including AI, has remained relatively flat, even as other nations have significantly ramped up their investments. China's share of global AI and financing by country from 2013 to 2018 was twice that of the U.S.[1] An acceleration of investment in AI research is needed, and should be grounded in two uniquely American strengths: the breadth and pre-eminence of U.S. research universities, and the depth, reach, and global leadership of U.S. industry. Center-scale investment would enable fundamental and use-inspired research requiring longer timeframes and larger-scale team research than those of existing 3- or 5-year smaller-scale research programs. The need for a public-private partnership

---

[1] Alsop, Thomas, 2020. "Share of global artificial intelligence (AI) investment and financing by country from 2013 to 1Q'18." https://www.statista.com/statistics/941446/ai-investment-and-funding-share-by-country/

in AI research has been articulated by AI research organizations,[2] in the U.S. government's 2019 National AI R&D Strategic Plan,[3] and in bi-partisan Congressional legislation such as The Endless Fronters Act (S. 3832) and The National Artificial Intelligence Initiative Act of 2020 (H.R. 6216). The time is ripe for bold national action on advancing AI research.

Plan of Action

The NPPP-AI R&D Institutes would collectively have a four-pronged mission:

- **Foundational AI Research**. Growing and sustaining American research leadership and capacity.
- **Translational AI Research**. Adapting and applying AI technologies in industry and government; enabling new and enhanced products, services, analytics, and productivity.
- **AI Education and Workforce**. Building a skilled, dynamic, and sustained workforce to ensure American economic and scientific competitiveness.
- **AI Infrastructure**. Leveraging cloud and open data resources to enable research and education at scale.
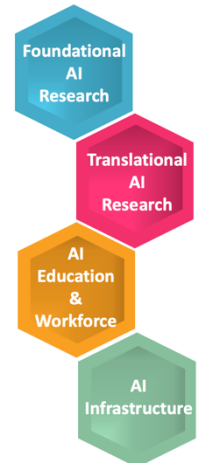
The inclusion of translational AI research extends potential industry partnerships beyond traditional technology companies into multiple industry sectors that can deliver AI-enabled breakthroughs: health, government, supply chain, automotive, finance, manufacturing, cybersecurity, and more.

The following actions would kickstart the development of the NPPP-AI:
- **Early stakeholder engagement and planning.** Convene a relatively small group of stakeholders from the executive branch (Office of Science and Technology Policy, agencies), Congress (relevant AI committees, National Security Commission on Artificial Intelligence), and industry (both AI technology developers and users). Identify value propositions for agencies, for industry, and for the nation. Identify incentives for industry, including tax or other incentives that could be enabled through legislation.
- **Identify existing models and lessons learned to date.** In 2019, the National Science Foundation (NSF) established the National AI Research Institutes program for five-year, $20M research institutes in both foundational and translational AI. The NPPP-AI would scale up such institutes by an order of magnitude. The Department of Energy's Quantum

[2] Gil, Yolanda and Selman, Bart. 2019. A 20-Year Community Roadmap for Artificial Intelligence Research in the U.S. Computing Community Consortium (CCC) and Association for the Advancement of Artificial Intelligence Research (AAAI), 94-96. https://cra.org/ccc/visioning/visioning-activities/2018-activities/artificial-intelligence-roadmap/
[3] National Science and Technology Council Select Committee on AI, 2019. "Strategy 8: Expand Public–Private Partnerships to Accelerate Advances in AI." In The National AI R&D Strategic Plan: 2019 Update. https://.nitrd.gov/pub/FNational-AI-RD-Strategy2019.pdf

Information Science Research Centers offer another model, also at smaller scale. Past agency experiences in PPP, particularly in computing and technology, should also inform NPPP-AI. The NSF Directorate for Computer and Information Science and Engineering (CISE) has experience with PPPs at smaller (e.g., $10M) scale, with the $100M Platforms for Advanced Wireless Research (PAWR) program being one of largest research PPPs to date.

Champions: Visible industry leaders, industry councils (e.g., Council on Economic Competitiveness, Silicon Valley Leadership group), and university organizations (e.g., the Association of Public and Land-grant Universities, the Association of American Universities, and the Council on Government Relations) could be forceful champions for NPPP-AI.

Budgetary Implications: 10 Institutes, at $10M/year over 10 years = $1B initial investment.

Conclusion

NPPP-AI would leverage two unique American strengths—the breadth and pre-eminence of U.S. research universities, and the depth, reach, and global leadership of U.S. industry—to ensure future U.S. leadership in a science and technology area of crucial national importance. NPPP-AI would accelerate future breakthroughs in AI foundations, enable a virtuous cycle between foundational and use-inspired research that would rapidly transition into practice innovations that contribute to U.S. economic and national security, and grow education and workforce capacity by linking university faculty and students with industry professionals, settings, and jobs.

Frequently Asked Questions

Why are Institutes needed? What can be accomplished at an Institute that can't already be accomplished through existing research and education funding mechanisms? What *happens* at an Institute?

NPPP-AI will create unique and stable environments for large multidisciplinary teams focused on specific areas of *long-term* foundational AI research and the translational application of AI in specific industry sectors, and will integrate their research and application missions with education. NPPP-AI Institutes would each have a long-term AI theme (whether a particular theme in AI research or translational application in a specific area). Existing research and education funding mechanisms focus primarily on more narrowly-scoped challenges, with teams of three or fewer faculty members. They are also typically shorter-term (e.g., three years), which is far too short a time for inter-disciplinary collaborations; sustained, focused investigations; or projects that require significant infrastructure, development, or dissemination. Perhaps most importantly, few existing R&D programs deeply engage industry researchers and practitioners together at scale. NPPP-AI R&D Institutes allow academic and industry participants to collaborate deeply over a sustained period of time, allowing researchers to move between industry and academia and leverage the unique resources (people, data, artifacts, and computational capabilities) and opportunities of each.

What might be the topics, themes and outcomes for these Institutes?

Two types of NPPP-AI R&D Institutes can be envisioned:
- Foundational AI R&D Institutes would enable large, multidisciplinary academic/industry research teams to address long-term AI challenges such as fair and trustworthy AI, assistive robotics, or representation learning. These are challenges that industry (largely) does not address, that require larger-scale interdisciplinary teams and systems, and that will provide the foundation for growing and sustaining long-term U.S. leadership in AI. The Institutes would provide for a long-term flow of new ideas, approaches, people, and artifacts into multiple industry sectors through industry, government, and university collaboration (e.g., via internships and externships); provide an environment for the development and stewardship of open community resources; and serve as a nexus for relevant community-driven AI Challenges.
- Translational AI R&D Institutes would adapt and apply AI technologies in industry and government in high-payoff areas with economic and societal impact such as healthcare, education, agriculture, and supply-chain management. These areas, which are beyond the traditional ICT/AI industry segments, also demand large-scale, long-term, collaborative, interdisciplinary teams. In supply-chain management, for example, research in AI, the Internet of Things (IoT), robotics, and real-time and predictive data analytics is needed for optimized end-to-end capacity planning, improved productivity,

and higher quality in safe work environments. Outcomes would include prototype systems at scale and the translation and adaptation of cutting-edge AI research into industry products and service.

All institutes have a core educational and workforce development mission as well, creating a pipeline for an AI-enabled workforce by preparing students from K-12 through Ph.D., along with adult retraining.

Why 10 x 10 x 10?

Ten initial NPPP-AI R&D Institutes would be split between foundational and translational themes. The AI research community roadmap (Gil and Selman 2019, 94-96) lists approximately a dozen high-impact theme areas, although specific themes for NPPP-AI R&D Institutes would be chosen with significant federal agency and industry partner input. The National Science Foundation's two flagship center-scale programs—Science and Technology Centers (STCs) and Engineering Research Centers (ERCs)—operate at a funding level and lifespan similar to that of the envisioned NPPP-AI R&D Institutes, and similarly address science and engineering challenges that require the advantages of scope, scale, duration, equipment, and facilities. Each NSF center typically has a 10-year lifecycle (with intermediate reviews), and an annual budget of roughly $5M (which has remained essentially constant for decades). An annual budget of approximately $10M for an NPPP-AI R&D Institute reflects the present-days costs of tackling national challenges at scale, and aligns with the funding level advocated in (Gil and Selman 2019, 94-96).

Aren't AI PPPs already happening, for example with the National Science Foundation (NSF) AI institutes?

NSF's National AI Research Institutes provide a foundation and model on which to build NPPP-AI. NSF has shown great vision in engaging other federal agencies and (in the second year of solicitations) four industry partners. But NSF's program is significantly smaller in scale than the vision for NPPP-AI in terms of funding per institute, industry participation, and time horizon; and it was launched using only existing NSF funding. Larger-scale and longer-term industry-partnership-oriented focus is needed to meet the national challenge in AI development and to complement the traditional grants that have been the core of NSF-sponsored basic research. NSF, with the additional funding provided by NPPP-AI, is the appropriate government agency for coordinating NPPP-AI Institutes.

What is the value proposition for industry? Why would they want to participate?

For translational NPPP-AI institutes, the value proposition is to enable AI-savvy faculty, students, and entrepreneurs to apply AI to:
- increase productivity and profits;
- create new services, products, and revenue streams;

- access state-of-the-art AI knowledge;
- adopt and integrate AI tools and infrastructure; and
- ensure a robust flow of ideas, people, artifacts into multiple industry sectors.

For foundational NPPP-AI institutes, the value proposition for industry engagement is to grow and sustain U.S. leadership in long-term, fundamental AI research, which will in turn power future generations of products and services. Specifically, the foundational NPPP-AI institutes will push forward on foundational, long-term challenges that industry (largely) does not address, and provide an industry-perspective into the "virtuous cycle" of use-inspired foundational research. NPPP-AI institutes will have robust educational programs, that will prepare students from K-12 through Ph.D., along with adult retraining for careers at the human-technology frontier in industry and in academia.

More broadly, the 2012 National Research Council report, *Continuing Innovation in Information Technology*[4] draws a line from fundamental research in information technology conducted in industry and at universities, to the introduction of entirely new product categories that ultimately became billion-dollar industries. AI is already a multi-billion dollar industry founded on, and fueled by, past research advances; NPPP-AI will ensure those research advances and their applications continue into the future, with positive impact on the U.S. economy and on people's lives.

What are other countries doing?

Public-private partnerships have different meanings in different countries. But many countries are establishing national centers for AI research. The European Union's 2018 strategic plan for AI states: "A new research and innovation partnership on AI will be set up, to foster collaboration between academia and industry in Europe and to define a common strategic research agenda on AI." China is planning to build a $2.1 billion technology park for the development of artificial intelligence in Beijing. Canada is creating "interconnected nodes of scientific excellence" in Edmonton, Montréal and Toronto. Australia is establishing a "national centre of excellence for artificial intelligence" in Melbourne.

Is there support for the notion of PPPs in AI in recent national reports?

The CRA/CCC 20-Year *Community Roadmap for Artificial Intelligence Research* (referenced above) calls for "National AI Research Centers: multi-university centers with affiliated institutions, focused on pivotal areas of long-term AI research (e.g., integrated intelligence, trust, and responsibility), with decade-long funding" as well as "Mission-Driven AI Laboratories: living laboratories for AI development in targeted areas of great potential for societal impact." The

---

[4] National Academies of Sciences, Engineering, and Medicine, 2020. Information Technology Innovation: Resurgence, Confluence, and Continuing Impact. National Academy Press. https://www.nap.edu/catalog/25961/information-technology-innovation-resurgence-confluence-and-continuing-impact

2019 NSTC *National AI R&D Strategic Plan,* recommends that the government "[e]xpand public-private partnerships to accelerate advances in AI. Promote opportunities for sustained investment in AI R&D and for transitioning advances into practical capabilities," citing the many advantages of PPPs. The 2019 *Interim Report of the National Security Commission on AI* notes "the government has an opportunity to apply a broad regional lens to partnerships with academia and industry. Canada, for example, has taken a nationwide approach by spreading AI research centers across Edmonton. Toronto and Montreal."[5] More broadly, a 2020 report by the American Association of Arts and Sciences has noted that "America's standing as an innovation leader" relies upon "establishing a more robust national Government-University-Industry research partnership."[6]

---

[5] The National Security Commission on Artificial Intelligence, 2019. 26. Interim Report.
https://drive.google.com/a/nscai.org/file/d/153OrxnuGEjsUvlxWsFYauslwNeCEkvUb/view?usp=sharing
[6] American Academy of Arts and Sciences Committee on New Models for U.S. Science & Technology Policy, 2020. The Perils of Complacency: America at a Tipping Point in Science & Engineering. An Update to
Restoring the Foundation: The Vital Role of Research in Preserving the American Dream.
https://www.amacad.org/publication/perils-of-complacency

About the Authors

Jim Kurose is Distinguished University Professor of Computer Science and Associate Chancellor for Partnerships and Innovation at the University of Massachusetts Amherst. From 2015 to 2019, Jim served as an Assistant Director at the National Science Foundation (NSF), where he led the Directorate of Computer and Information Science and Engineering. While at NSF, Jim also served as co-chair of the National Science and Technology Council subcommittees on Networking and Information Technology Research and Development, Machine Learning and AI, and Open Science. In 2018, he also served as Assistant Director for Artificial Intelligence at the White House Office of Science and Technology Policy. He is a member of the National Academy of Engineering and a Fellow of the Association for Computing Machinery and the Institute of Electrical and Electronics Engineers.

Deborah Crawford is the Vice Chancellor for Research at the University of Tennessee Knoxville (UT). Deborah previously served as vice president for research, innovation and economic impact at George Mason University, president and executive director of the International Computer Science Institute, a not-for-profit research institution in Berkeley, California, and senior vice provost for research at Drexel University in Philadelphia. She worked at the National Science Foundation (NSF) for 17 years, where she held a number of executive leadership positions and where she served as the agency's liaison to the National Science and Technology Council, the Office of Science and Technology Policy and the National Institutes of Health. Her leadership contributions at NSF were recognized twice with Presidential Rank Awards.

About the Day One Project

The Day One Project is dedicated to democratizing the policymaking process by working with new and expert voices across the science and technology community, helping to develop actionable policies that can improve the lives of all Americans, and readying them for Day One of the next presidential term. For more about the Day One Project, visit dayoneproject.org.