Hearing on

"Digital Decision-Making: The Building Blocks of Machine Learning and Artificial Intelligence"

Senate Committee on Commerce, Science, & Transportation Subcommittee on Communications, Technology, Innovation, and the Internet

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Testimony of Victoria Espinel
President and CEO
BSA | The Software Alliance

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Good morning Chairman Wicker, Ranking Member Schatz, and members of the Subcommittee. My name is Victoria Espinel, and I am the President and CEO of BSA | The Software Alliance.

BSA is the leading advocate for the global software industry in the United States and around the world.[1] Our members are at the forefront of developing cutting-edge artificial intelligence (AI) and related software-enabled technologies and services that are having a significant impact on the US and global economy. I commend the Subcommittee for holding a hearing on this important topic, and I thank you for the opportunity to testify on behalf of BSA.

I. AI: Defining the Landscape

The term "artificial intelligence" often conjures images of all-knowing robots with physical and cognitive abilities far superior to those of their human creators. The actual AI services that are in the market today—and that BSA members provide—bear no resemblance to the sinister images of the future that consumers often see in the movies, with robots taking over big cities

[1] BSA's members include: Adobe, ANSYS, Apple, Autodesk, Bentley Systems, CA Technologies, CNC/Mastercam, DataStax, DocuSign, IBM, Microsoft, Oracle, salesforce.com, SAS Institute, Siemens PLM Software, Splunk, Symantec, Trimble Solutions Corporation, The MathWorks, Trend Micro and Workday.

and small towns.

Instead, they increasingly are becoming a foundational technology that drives many products and services that people use every day. Whether it is a personal digital assistant that helps consumers locate the nearest restaurant, a fraud detection monitoring service that prevents criminals from placing charges on credit cards, or a tool that helps teachers identify students with additional needs and develop personalized lesson plans, we increasingly rely on a diverse range of AI-enabled services every day.

But what is "AI"?

AIthough definitions of AI vary, one common description of AI is that it refers to machines that act intelligently in pursuit of human-defined objectives. At its core, AI is simply a tool. It includes a broad range of technologies, but the AI systems that BSA members largely provide assist in the analysis of enormous volumes of data to find connections that improve the quality and accuracy of human decision-making. Although some AI systems have a limited degree of autonomy, such as submarines that map the ocean bed and measure ocean currents, and others are minutely supervised, such as robot surgical tools assisting doctors with hip replacement surgeries, the vast majority provide advice and recommendations to humans rather than acting independently. AI makes possible important tasks that would otherwise be economically or physically infeasible, such as inspecting wind turbine blades or the interior of oil pipelines.

AI systems, like other software systems, use sophisticated algorithms. An algorithm is a set of instructions that processes various inputs and provides an output in a systematized way. The algorithms used in AI are particularly well-suited to analyzing massive volumes of data from

many different sources, and in identifying patterns across the enormous number of variables in such data that may interact in complex and unexpected ways. Through this analysis, AI systems can enhance perception, learning, reasoning, and decision-making, and improve the ability of people to solve complex and challenging problems.

The use of systems, including software, to help people solve complex problems is not new. Research into AI dates back many decades, but we have witnessed tremendous advances in AI capabilities over the past five to ten years. These advances have been fueled by a number of related developments, including the proliferation of technologies that generate vast amounts of data, the affordability of data storage, and ever-growing data processing capabilities.

BSA members have made significant investments in enhancing these data-driven technologies to develop innovative AI solutions for use across a broad range of applications in a wide variety of contexts.

II. AI Services Provide Substantial Benefits

Advances in AI and software-enabled data analytics are fueling job and economic growth in the United States and around the world, improving how businesses in every sector operate, and producing real societal gains. We must recognize that AI will change the skill sets needed for certain jobs. And while new, AI-related jobs will be created, there will be shifts in the labor market. And although we should be mindful of the need to ensure that AI is deployed fairly and responsibly, we should also recognize the potential of AI to make human decisions more accurate and less biased, and thereby to promote fairness and inclusiveness across all segments of society.

A. AI and Related Software Services Are Creating Jobs and Economic Growth

In high-tech and low-tech industries alike, the analysis of data has made businesses more agile, responsive, and competitive, boosting the underlying productivity of many key pillars of our economy.

The economic implications of the data revolution—and AI and related software solutions that leverage that data—are enormous. Economists predict that making better use of data could lead to a "data dividend" of $1.6 trillion in the next four years, and that data-enabled efficiency gains could add almost $15 trillion to global GDP by 2030.[2] In addition, experts predict that applications of AI technologies could grow the global economy by $7.1 to $13.17 trillion over the next eight years.[3]

AI systems are powered by software, which itself is a major engine of economic growth. In September, Software.org: the BSA Foundation released a study with data from the Economist Intelligence Unit (EIU) showing that the software industry alone contributed more than $1.14 trillion to US GDP in 2016—a $70 billion increase in just two years.[4] The study also showed that the software industry is a powerful job creator, supporting over 10.5 million jobs, with a

[2] *See* BSA, *What's the Big Deal With Data?* 14 (Oct. 2015), *available at* http://data.bsa.org/wp-content/uploads/2015/12/bsadatastudy_en.pdf. The potential of digital data to improve the healthcare system is substantial: some estimates predict that if the healthcare sector were to use data more effectively to drive efficiency and quality, the sector could save more than $300 billion every year. *See* James Manyika et al., *Big Data: The Next Frontier for Innovation, Competition, and Productivity,* McKinsey Global Institute (May 2011), *available at* http://www.mckinsey.com/insights/business_technology/big_data_the_next_frontier_for_innovation.

[3] *See Disruptive technologies: Advances that will transform life, business, and the global economy*, McKinsey Global Institute (May 2013), *available at* http://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/disruptive-technologies.

[4] Software.org: The BSA Foundation, *The Growing $1 Trillion Economic Impact of Software* 5 (Sept. 2017), *available at* https://software.org/wp-content/uploads/2017_Software_Economic_Impact_Report.pdf.

significant impact on job and economic growth in each of the 50 states.[5]

B. AI and Related Software Services Are Improving Every Industry

The benefits of AI are not limited to the software sector. In fact, AI innovation is stimulating growth across all industry sectors as businesses, big and small, use AI and related software services to improve supply chains, secure their networks, and evaluate how to improve their products and services. There are numerous examples of this positive impact across a wide swath of industries, for instance:

- ***Cybersecurity.*** AI tools are revolutionizing how we monitor network security, helping analysts parse through hundreds of thousands of security incidents per day to weed out false positives and identify threats that warrant further attention by network administrators. By automating responses to routine incidents and enabling security professionals to focus on truly significant threats, AI-enabled cyber tools are helping enterprises stay ahead of their malicious adversaries.[6]

[5] *Id.*

[6] For example, IBM's Watson for Cyber Security is a cybersecurity tool that can analyze 15,000 security documents per day—a rate essentially impossible for any individual to achieve. Watson's data processing capabilities enable analysts to more quickly identify incidents that require human attention. *See* IBM, *IBM Delivers Watson for Cyber Security to Power Cognitive Security Operations Centers* (Feb. 13, 2017), https://www-03.ibm.com/press/us/en/pressrelease/51577.wss; Jason Corbin, *Bringing the Power of Watson and Cognitive Computing to the Security Operations Center*, Security Intelligence (Feb. 13, 2017), https://securityintelligence.com/bringing-the-power-of-watson-and-cognitive-into-the-security-operations-center/?cm_mc_uid=70595459933115020631816&cm_mc_sid_50200000=1503364089&cm_mc_sid_52640000=1503365578. Splunk uses a similar model, with machine-learning algorithms conducting real-time analysis and processing of massive volumes of data from all sensors on a network to identify anomalies, feeding visualization tools that help network administrators efficiently triage security incidents. *See* David Braue, *Machine learning key to building a proactive security response: Splunk*, CSO Online (Aug. 20, 2015), https://www.cso.com.au/article/582483/machine-learning-key-building-proactive-security-response-splunk/. Microsoft's Windows 10 Anniversary Edition introduced AI-driven capabilities for automatically isolating suspicious network traffic pending adjudication by network administrators. *See* Chris Hallum, *Defense Windows clients from modern threats and attacks with Windows 10*, Channel 9 video content (Oct. 6, 2016), *available at* https://channel9.msdn.com/events/Ignite/2016/BRK2135-TS); "Intelligent Security: Using Machine Learning to Help Detect Advanced Cyber Attacks," https://www.microsoft.com/en-us/security/intelligence.

- ***Financial Services.*** AI is improving fraud detection by providing companies with real-time information that helps them identify and investigate different types of fraud, reducing the losses attributed to fraudsters by billions of dollars. In a matter of seconds, machine learning algorithms can generate a risk score for a transaction by parsing through large volumes of data about the vendor and the purchaser to determine the likelihood of fraud.[7] These tools are protecting consumers from the risk of fraudulent charges and from the frustration associated with "false declines."

- ***Agriculture.*** AI is helping farmers tackle some of the biggest issues they face, including declining crop yields and changing weather patterns, through precision farming, better data analysis, and improved operational efficiency. For instance, tools like computer vision and deep-learning algorithms are enabling farmers more effectively to process data for purposes of monitoring crop and soil health.[8]

- ***Manufacturing***. AI-enabled tools are also helping factory owners streamline their manufacturing processes and resolve problems common to most factories, such as inaccurate demand forecasting and capacity planning, unexpected equipment failures and downtimes, and supply chain bottlenecks. Predictive maintenance, for instance, allows manufacturers to achieve 60% or more reduction in unscheduled system downtime. Cameras powered by computer vision algorithms can fix product defects immediately and identify root causes of failure. AI thus enables manufacturers to reduce

[7] *See generally* Pablo Hernandez, *CA Technologies Uses AI Tech to Combat Online Fraud*, eSecurityPlanet, May 4, 2017, *available at* https://www.esecurityplanet.com/network-security/ca-technologies-uses-ai-tech-to-combat-online-fraud.html.

[8] *See* Kumba Sennaar, *AI in Agriculture – Present Applications and Impact*, techemergence (Nov. 17, 2017), https://www.techemergence.com/ai-agriculture-present-applications-impact/.

waste, shorten production periods, increase yields on production inputs, and improve both revenue and workplace safety.[9]

- ***Healthcare.*** AI technologies are already providing solutions that help save lives. A 2016 Frost & Sullivan report predicts that AI has the potential to improve health outcomes by 30 to 40 percent.[10] AI is helping fuel these improved health outcomes not by replacing the decision-making of healthcare professionals, but by giving these professionals new insights and new ways of analyzing and understanding the health data to which they have access. For example, AI tools are powering machine-assisted diagnosis and surgical applications are being used to improve treatment options and outcomes. Image recognition algorithms are helping pathologists more effectively interpret patient data, thereby helping physicians form a better picture of patients' prognosis.[11] The ability of AI to process and find patterns in vast amounts of data from disparate sources is also driving important progress in biomedical and epidemiological research.[12]

- ***Education.*** AI technologies offer tools for students, teachers, and administrators to help

[9] *See* Mariya Yao, *Factories Of The Future Need AI To Survive And Compete*, Forbes.com (Aug. 8, 2017), https://www.forbes.com/sites/mariyayao/2017/08/08/industrial-ai-factories-of-future/#2d7ab2fd128e.

[10] *See From $600 M to $6 Billion, Artificial Intelligence Systems Poised for Dramatic Market Expansion in Healthcare*, Frost & Sullivan (Jan. 5, 2016), https://ww2.frost.com/news/press-releases/600-m-6-billion-artificial-intelligence-systems-poised-dramatic-market-expansion-healthcare.

[11] *See e.g.*, Meg Tirrell, *From coding to cancer: How AI is changing medicine*, cnbc.com (May 11, 2017), https://www.cnbc.com/2017/05/11/from-coding-to-cancer-how-ai-is-changing-medicine.html.

[12] For instance, AI is helping biologists who are aiming to treat 100 molecular genetic diseases by 2025. *See* Splunk, *Machine Learning Helps Recursion Pharmaceuticals Treat Genetic Diseases* (Nov. 7, 2017), https://www.splunk.com/en_us/newsroom/press-releases/2017/splunk-machine-learning-helps-recursion-pharmaceuticals-treat-genetic-diseases.html. In another example, Microsoft researchers are also using AI and related technologies to better understand the behavior of cells and their interaction, which could ultimately help "debug" an individual's specific form of cancer and allow doctors to provide personalized cancer treatment. *See generally*, Microsoft, *Biological Computation*, https://www.microsoft.com/en-us/research/group/biological-computation/.

students learn more effectively both within and outside of the classroom. AI programs can, for example, analyze a student's performance in a particular skill across subjects over the course of a year and automatically provide new content or specified learning parameters, offering students continual, individualized practice and feedback. They can also help teachers better understand student performance, quickly identify students that need particular attention, and develop lesson plans that customize instruction, content, pace, and testing to individual students' strengths and interests.[13] AI solutions also are helping administrators track attendance patterns and gain insights on student performance more broadly.[14]

C. AI Services Provide Tremendous Societal Benefits

The range of potential societal benefits from the use of AI services is equally vast. For example, AI solutions are at the heart of new devices and applications that improve the lives of people with disabilities, including helping people with vision-related impairments interpret and understand photos and other visual content.[15] This technology opens new possibilities for people with vision impairments to navigate their physical surroundings, giving them increased independence and greater ability to engage with their communities.

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[13] *See* Software.org: The BSA Foundation, *The Growing $1 Trillion Economic Impact of Software*, *supra* note 4, at 7; *see also* Daniel Faggella, *Examples of Artificial Intelligence in Education,* TechEmergence (Mar. 7, 2017), https://www.techemergence.com/examples-of-artificial-intelligence-in-education/.

[14] Benjamin Herold, *Are schools ready for the power and problems of big data?*, Education Week (Jan. 11, 2016), *available at* http://www.edweek.org/ew/articles/2016/01/13/the-future-of-big-data-and-analytics.html.

[15] For instance, Microsoft recently released an intelligent camera app that uses a smartphone's built-in camera functionality to describe to low-vision individuals the objects that are around them. *See* Microsoft, *Seeing AI*, https://www.microsoft.com/en-us/seeing-ai/.

AI is also helping governments improve constituent services in ways that save time, money, and lives. For example, cities are optimizing medical emergency response processes using AI-based systems, enabling them to more strategically position personnel and reduce both response times and the overall number of emergency trips.[16] AI is also helping to leverage data to improve disaster response and relief efforts, including after the 2015 earthquake in Nepal.[17]

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Whether it is detecting financial fraud, improving health outcomes, making American farmers more competitive, or enhancing government and emergency services, the impact of AI and related software services is already visible in every industry, in every state, and across the globe.

III. Fostering Consumer Trust in AI

Even as society gains from the substantial benefits that AI offers, we also recognize that there may be legitimate concerns about how AI systems are deployed in practice, which may also affect trust and confidence in AI. In particular, as people increasingly apply AI services in new contexts, questions may arise about how they operate, whether they treat people fairly and are free from improper bias, and their impact on jobs. Like many technologies, AI has an almost infinite range of beneficial uses, but we should also take appropriate steps to ensure that it is deployed responsibly. We recognize that responsible deployment of AI should instill consumer

[16] *See* Kevin C. Desouza, Rashmi Krishnamurthy, and Gregory S. Dawson, *Learning from public sector experimentation with artificial intelligence*, Brookings Institution (June 23, 2017), https://www.brookings.edu/blog/techtank/2017/06/23/learning-from-public-sector-experimentation-with-artificial-intelligence/.

[17] *See* Patrick Meier, *Virtual Aid to Nepal: Using Artificial Intelligence in Disaster Relief*, Foreign Affairs (June 1, 2015), *available at* https://www.foreignaffairs.com/articles/nepal/2015-06-01/virtual-aid-nepal.

confidence that these important issues will be appropriately addressed.

A. Enhancing Understanding of AI Systems

Building trust and confidence in AI-enabled systems is an important priority. In some instances, the complexity of these technologies, which are designed to identify patterns and connections that humans could not easily identify on their own, can make it challenging to explain how certain aspects of AI systems work. BSA members understand that, in order to promote trust, companies that build and deploy AI systems will need to provide meaningful information to enhance understanding of how these systems operate.

Indeed, ensuring that AI systems operate as intended and treat people fairly is an important priority. We are eager to participate in meaningful dialogues with other stakeholders about how best to accomplish that goal, and we welcome opportunities such as this one to help advance that dialogue. Currently, relevant technical tools and operational processes that could improve understanding and confidence in AI systems are still being developed, and it is an area of robust research. Although more work needs to be done, it is already clear that expectations are highly context-specific—and demands will vary based on this context. As we seek to address these important issues, we will aim to ensure that we remain sufficiently flexible to respond to concerns, and to adapt to the changing landscape as these emerging technologies, and potential solutions to new challenges, continue to evolve.

B. Preparing the Workforce for the Jobs of the Future

As AI services improve every industry, they will likely have a multi-dimensional impact on employment. The deployment of AI in the workplace will enable employees to focus on tasks

that are best suited to uniquely human skillsets, such as creativity, empathy, foresight, judgment, and other social skills. Although there appears to be no consensus on the precise impact AI will have on employment, there is broad recognition that widespread deployment of these technologies will create demand for new types of jobs, and that these jobs often will require skills that many workers today do not yet have.

Current estimates indicate the United States will not have enough workers to meet the predicted high demand for computer science-related jobs. For example, by 2020, the U.S. Bureau of Labor Statistics predicts that there will be 1.4 million computing jobs, but just 400,000 computer science students with the skills necessary to fill those jobs.[18] It is imperative that the United States takes steps now to ensure that we have a sufficient pipeline of workers with the skills needed to perform these new, high-quality jobs.

Yet even these estimates do not take into account the extent to which the use of AI may require new skills. Because AI services will likely be integrated across all sectors of the economy, the new jobs AI creates, and the new skills that will be needed, will reach beyond the tech sector, and will also likely extend to workers in both urban and rural areas. Indeed, many of these jobs will "look nothing like those that exist today," and will include "entire categories of new, uniquely human jobs" that will require "skills and training that have no precedents."[19] As a result, one key challenge that lies ahead is determining how to ensure that the US workforce has the skills necessary for the future.

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[18] *See* Allie Bidwell, *Tech Companies Work to Combat Computer Science Education Gap,* U.S. NEWS & WORLD REPORT, Dec. 27, 2013, *available at* https://www.usnews.com/news/articles/2013/12/27/tech-companies-work-to-combat-computer-science-education-gap.

[19] H. James Wilson, Paul R. Daugherty, Nicola Morini-Bianzino, *The Jobs that Artificial Intelligence will Create,* MIT Sloan Management Review (Mar. 23, 2017), *available at* https://sloanreview.mit.edu/article/will-ai-create-as-many-jobs-as-it-eliminates/.

BSA members are working hard to help address this challenge. BSA recognizes that this will require a multi-faceted solution, including cooperation with public and private stakeholders. We seek to identify opportunities and partnerships that focus on retraining the workforce with new skills, creating a pipeline of workers with skills to fill the next generation of jobs, increasing access to those jobs for skilled workers, and increasing deployment of cloud services, which facilitate employment and collaboration in different geographic regions.

Notably, BSA members already have begun helping workers and youth acquire new skills that will enable them to leverage AI systems.[20] BSA members offer several high-tech and business training programs, including at the high school level. Some programs target populations not traditionally associated with tech jobs, such as military veterans.[21] These initiatives illustrate just some of the ways in which AI-based employment concerns can be meaningfully addressed.

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[20] *See, e.g.*, Allen Blue, *How LinkedIn is Helping Create Economic Opportunity in Colorado and Phoenix* (Mar. 17, 2016), https://blog.linkedin.com/2016/03/17/how-linkedin-is-helping-create-economic-opportunity-in-colorado-and-phoenix; Markel Foundation, *Why Microsoft and the Markle Foundation are Working Together to Connect Workers with New Opportunities in the Digital* Economy, https://www.markle.org/microsoft. IBM, for instance, has established Pathways in Technology Early College High Schools (P-TECH Schools). P-TECH schools are innovative public schools that offer students the opportunity to earn a no-cost associates degree within six years in fields such as applied science and engineering—and to acquire the skills and knowledge necessary to pursue further educational opportunities or to step easily into well paying, high-potential informational technology jobs. IBM designed the P-TECH model to be both widely replicable and sustainable as part of an effort to reform career and technical education. *See* IBM, *IBM and P-TECH*, https://www-03.ibm.com/press/us/en/presskit/42300.wss. Likewise, Salesforce *offers* free high-tech and business skills training through Trailhead, its online learning platform, with the goal of preparing them for the estimated 3.3 million jobs created by the Salesforce economy worldwide from 2016 to 2022, nearly 1 million of which are forecasted to be in the United States. *See* International Data Corporation, *The Salesforce Economy Forecast: 3.3 Million New Jobs and $859 Billion New Business Revenue to Be Created from 2016 to 2022* (Oct. 2017), *available at* http://www.salesforce.com/assets/pdf/misc/idc-study-salesforce-economy.pdf; *see also* Gavin Mee, *How the Salesforce Economy is Driving Growth and Creating Jobs*, Oct. 24, 2017, *available at* https://www.salesforce.com/uk/blog/2017/10/idc-how-the-salesforce-economy-is-driving-growth-and-creating-jo; Gavin Mee, *Guest Blog: Gavin Mee, Salesforce - Evolving tech means change in digital skills*, TechUK (Apr. 26, 2017), *at* https://www.techuk.org/insights/opinions/item/10695-guest-blog-gavin-mee-salesforce-evolving-tech-means-change-in-digital-skills.

[21] For example, the Splunk4Good initiative, which partners with non-profits, is helping military veterans and their families, along with youth, train for careers in technology, providing free access to Splunk licenses and its extensive education resources to help them attain marketable skillsets. *See* Splunk, *Splunk Trains Workforce of Tomorrow With Amazon Web Services, NPower, Wounded Warrior Project and Year Up*, (Sept. 26, 2017) https://www.splunk.com/en_us/newsroom/press-releases/2017/splunk-trains-workforce-of-tomorrow-with-amazon-web-services-npower-wounded-warrior-project-and-year-up.html.

IV. Opportunities for Congress and the Administration to Facilitate AI Innovation

As innovation in AI and related software services increasingly fuels growth in the global economy, countries around the world are taking steps to invest in education, research, and technological development to become a hub for AI innovation. For example, the UK government recently released an Industrial Strategy, which identifies putting the UK at the forefront of the AI and data revolution as one of four key strategies that will secure its economic future.[22] In the EU, the European Parliament recently issued a report on civil law rules regarding robotics, which highlights the opportunities robotics and AI offer and encourages investment in such technology so Europe can maintain leadership in this space.[23] Likewise, in Japan, the government recently issued a new strategy designed to strengthen collaboration between industry, the government, and academia on matters related to robotics, and also issued a report offering the first systematic review of AI networking issues in Japan.[24] In China, the government has issued a "Next Generation Artificial Intelligence Development Plan," which lays out objectives for AI development in China for the next 13 years and calls on China to become a global AI innovation center by 2030.[25]

In the United States, a flexible policy framework that facilitates responsible AI deployment and

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[22] *See* UK Secretary of State for Business, Energy and Industrial Strategy, *Industrial Strategy Building a Britain fit for the future* (Nov. 2017), *available at* https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/662541/industrial-strategy-white-paper-print-version.pdf.

[23] *See* European Parliament 2014-2019, *Resolution of 16 February 2017 with recommendations to the Commission on Civil Law Rules on Robotics*, Eur. Parl. Doc. P8_TA (2017)0051, http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//NONSGML+TA+P8-TA-2017-0051+0+DOC+PDF+V0//EN.

[24] *See* Fumio Shimpo, *Japan's Role in Establishing Standards for Artificial Intelligence Development*, Carnegie Endowment for International Peace (Jan 12.2017), http://carnegieendowment.org/2017/01/12/japan-s-role-in-establishing-standards-for-artificial-intelligence-development-pub-68311.

[25] *See* Elsa Kania, *China's Artificial Intelligence Revolution*, The Diplomat (Jul. 27, 2017), *available at* https://thediplomat.com/2017/07/chinas-artificial-intelligence-revolution/.

increased investment will be key to preserving U.S. global economic competitiveness. An essential part of that effort will be ensuring the ability to access data, and to transfer that data seamlessly across borders, which are vital for AI to flourish. It also will be important to support investment in AI-related education, workforce development, and research. To that end, there are several steps that Congress and the Administration could take to spur AI innovation and continued economic growth.

A. Pass OPEN Government Data Act

First, Congress should pass the OPEN Government Data Act. This legislation, which the House recently passed as Title II of the Foundations for Evidence-Based Policymaking Act, recognizes that government-generated data is a national resource that can serve as a powerful engine for creating new jobs and a catalyst for economic growth. To that end, the OPEN Government Data Act would require agencies to make non-sensitive government data more open, available, and usable for the general public. Making such data more readily available will improve government transparency, promote government efficiency, and foster innovation of data-driven technologies such as artificial intelligence.

We would like to thank Ranking Member Schatz for his tireless work as an original sponsor of the OPEN Government Data Act. We are hopeful that the Senate will act soon to secure its final passage into law.

B. Support Efforts to Promote Digital Trade and Facilitate Data Flows

We also urge Congress and the Administration to continue supporting efforts to expand digital trade. Indeed, the new digital data economy, which increasingly relies on AI and related software services, will benefit from a globally recognized system for digital trade that facilitates cross-border data flows and establishes clear rules, rights, and protections. There are several opportunities for Congress and the Administration to lead in this area.

First, the ongoing NAFTA discussions provide an important opportunity to modernize the trade agreement, which was initially negotiated when digital services were in their infancy. We are encouraged that the Administration has made it an objective to seek to prohibit market access barriers to digital trade, including restrictions on data transfers, data localization mandates, and technology transfer requirements.

Second, another key priority is ensuring that transatlantic trade continues to thrive. In particular, we appreciate Congress's and the Administration's leadership on issues relating to the EU-U.S. Privacy Shield, which both protects privacy and facilitates data transfers between the EU and United States. We encourage your continued support as the Administration proceeds with its ongoing successful implementation of the framework.

Third, as other countries seek to modernize their trade policies, the Administration should engage key global partners to ensure that new trade initiatives facilitate data-driven innovation and protect against market access barriers for e-commerce and digital trade.

C. Invest in AI research, education, and workforce development

Unlocking the full promise of AI technologies also requires a long-term strategy of investing in education, workforce development, and research. Because human beings ultimately drive the success of AI, supporting education, training, and research is essential to extracting the maximum level of benefit that AI technologies offer.

As an initial matter, Congress and the Administration should ensure that education programs are developing human talent more effectively. Broadly speaking, this means that Congress and the Administration should support science, technology, engineering, and mathematics (STEM) education at all levels. It also means creating and supporting programs that help educate researchers and engineers with expertise in AI, as well as specialists who apply AI methods for specific applications and users who operate those applications in specific settings.[26] For researchers and engineers, these programs should include training in computer science, statistics, mathematical logic, and information theory, and for specialists, they should focus on software engineering and related applications.[27]

Congress and the Administration should also support the development of new and innovative ways to ensure the U.S. workforce is prepared for the jobs of the future. Because AI will generate new jobs in categories both known and unforeseen, we need to develop thoughtful and effective approaches to equip the US workforce with the skills necessary to seize the opportunities these new technologies create and to optimize the role of AI in modern life.

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[26] *See* U.S. Executive Office of the President, *Preparing for the Future of Artificial Intelligence*, National Science and Technology Council Committee on Technology 26 (Oct. 2016), *available at* https://obamawhitehouse.archives.gov/sites/default/files/whitehouse_files/microsites/ostp/NSTC/preparing_for_the_future_of_ai.pdf.

[27] *See id.*

Continued scientific research is essential to fully tapping the potential of AI technology. Congress and the Administration should therefore also promote both public and private sector research to help ensure that the United States remains a leader in this space. The US government should invest in the types of "long-term, high-risk research initiatives" in which the commercial sector may be reluctant to invest. In the past, such R&D investments have led to "revolutionary technological advances…[such as] the Internet, GPS, smartphone speech recognition, heart monitors, solar panels, advanced batteries, cancer therapies, and much, much more."[28] Congress and the Administration should also adopt policies that incentivize private-sector R&D, including by expanding access to financing.

Passing the OPEN Government Data Act, supporting efforts to promote digital trade and facilitate cross-border data flows, and investing in AI research, education, and workforce development will be critical to maximizing the opportunities AI presents and helping to ensure that the United States maintains leadership in AI innovation and deployment, even as other nations increase their own efforts to take advantage of the possibilities that AI offers.

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We appreciate Congress's leadership on the important issue of facilitating AI innovation and its responsible deployment. Thank you and I look forward to your questions.

[28] *See* The National Artificial Intelligence Research and Development Strategic Plan (Oct. 2016), *available at* https://www.nitrd.gov/PUBS/national_ai_rd_strategic_plan.pdf.