

DEPARTMENT OF DEFENSE 2018 ARTIFICIAL INTELLIGENCE STRATEGY: Harnessing AI to Advance Our Security and Prosperity

The Department of Defense’s (DoD) Artificial Intelligence (AI) Strategy directs the DoD to accelerate the adoption of AI and the creation of a force fit for our time. A strong, technologically advanced Department is essential for protecting the security of our nation, preserving access to markets that will improve our standard of living, and ensuring that we are capable of passing intact to the younger generations the freedoms we currently enjoy.

AI is rapidly changing a wide range of businesses and industries. It is also poised to change the character of the future battlefield and the pace of threats we must face. We will harness the potential of AI to transform all functions of the Department positively, thereby supporting and protecting U.S. servicemembers, safeguarding U.S. citizens, defending allies and partners, and improving the affordability, effectiveness, and speed of our operations. The women and men in the U.S. armed forces remain our enduring source of strength; we will use AI-enabled information, tools, and systems to empower, not replace, those who serve

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U.S. Department of Defense (DoD)

Stakeholder(s):

Joint Artificial Intelligence Center (JAIC) :

Realizing this vision requires identifying appropriate use cases for AI across DoD, rapidly piloting solutions, and scaling successes across our enterprise. The 2018 DoD AI Strategy, summarized here, will drive the urgency, scale, and unity of effort needed to navigate this transformation. The Joint Artificial Intelligence Center (JAIC) is the focal point for carrying it out. As we systematically explore AI's full potential, study its implications, and begin the process of learning about its impact on defense, we will remain thoughtful and adaptive in our execution.

DoD AI Collaborators :

We cannot succeed alone; this undertaking requires the skill and commitment of those in government, close collaboration with academia and non-traditional centers of innovation in the commercial sector, and strong cohesion among international allies and partners. We must learn from others to help us achieve the fullest understanding of the potential of AI, and we must lead in responsibly developing and using these powerful technologies, in accordance with the law and our values.

Academia

Centers of Innovation :

Non-traditional centers of innovation in the commercial sector

Commercial Sector

International Allies

DoD Partners

American Public :

As stewards of the security and prosperity of the American public, we will leverage the creativity and agility of our nation to address the technical, ethical, and societal challenges posed by AI and leverage its opportunities in order to preserve the peace and provide security for future generations.

U.S. Service Members

U.S. Civilians Around the World

Vision

AI-enabled information, tools, and systems empower, not replace, those who serve to preserve the peace and provide security for future generations

Mission

To accelerate the adoption of AI and the creation of a force fit for our time.

Values

Security: Harnessing AI to Advance Our Security and Prosperity -- The U.S. Department of Defense (DoD) protects our nation by deterring war and winning the nation's wars when deterrence fails. In fulfilling this mission, we have always been at the forefront of technological advances to ensure an enduring competitive military advantage against those who threaten our security and safety.

Prosperity

Technological Advancement: Artificial intelligence (AI) is one such technological advance. AI refers to the ability of machines to perform tasks that normally require human intelligence – for example, recognizing patterns, learning from experience, drawing conclusions, making predictions, or taking action – whether digitally or as the smart software behind autonomous physical systems.

Transformation: AI is poised to transform every industry, and is expected to impact every corner of the Department, spanning operations, training, sustainment, force protection, recruiting, healthcare, and many others.

Improvement: With the application of AI to defense, we have an opportunity to improve support for and protection of U.S. service members, safeguard our citizens, defend our allies and partners, and improve the affordability and speed of our operations.

International Norms: Other nations, particularly China and Russia, are making significant investments in AI for military purposes, including in applications that raise questions regarding international norms and human rights.

Human Rights

International Order: These investments threaten to erode our technological and operational advantages and destabilize the free and open international order.

Strategic Positioning: The United States, together with its allies and partners, must adopt AI to maintain its strategic position, prevail on future battlefields, and safeguard this order.

Peace: We will also seek to develop and use AI technologies in ways that advance security, peace, and stability in the long run.

Ethics: We will lead in the responsible use and development of AI by articulating our vision and guiding principles for using AI in a lawful and ethical manner.

Freedom: The costs of not implementing this strategy are clear. Failure to adopt AI will result in legacy systems irrelevant to the defense of our people, eroding cohesion among allies and partners, reduced access to markets that will contribute to a decline in our prosperity and standard of living, and growing challenges to societies that have been built upon individual freedoms.

Human Centricity: AI will benefit both the Department and the Nation -- The Strategy directs that we will use AI in a human-centered manner to:

Support: Support and protect U.S. servicemembers and civilians around the world. We will incorporate AI into decisionmaking and operations to reduce risk to fielded forces and generate military advantage.

Maintenance: AI can help us better maintain our equipment, reduce operational costs, and improve readiness.

Cost Reduction

Readiness

Law of War: Incorporating AI also has the potential to enhance our implementation of the Law of War. By improving the accuracy of military assessments and enhancing mission precision, AI can reduce the risk of civilian casualties and other collateral damage.

Protection: Protect our country and safeguard our citizens. AI will be used to protect the safety and security of U.S. citizens and to enable a stronger defense of U.S. critical infrastructure.

Prediction: Specifically, AI can enhance our ability to predict, identify, and respond to cyber and physical threats from a range of sources, strengthening the defense of the homeland from attack and discouraging attempts to disrupt U.S. infrastructure such as financial networks, electric grids, election processes, and medical systems.

Response

Efficiency: Create an efficient and streamlined organization. The ability of AI to reduce inefficiencies from manual, laborious, data-centric tasks will be harnessed across the Department with the objective of simplifying workflows and improving the speed and accuracy of repetitive tasks. These changes have the potential to shift human attention to higher-level reasoning and judgment, which remain areas in which the human role is critical. Become a pioneer in scaling AI across a global enterprise. We recognize the tremendous utility of AI to a wide range of capabilities. To realize this potential fully, we must pioneer AI approaches across the full scale of our global defense enterprise in a manner that is Joint and interoperable with interagency, allied, and coalition partners. Specifically, DoD will identify and implement new organizational approaches, establish key AI building blocks and standards, develop and attract AI talent, and introduce new operational models that will enable DoD to take advantage of AI systematically at enterprise scale.

1. Capabilities

Delivering AI-enabled capabilities that address key missions.

We will launch a set of initiatives to incorporate AI rapidly, iteratively, and responsibly to enhance military decision-making and operations across key mission areas. Examples include improving situational awareness and decision-making, increasing the safety of operating equipment, implementing predictive maintenance and supply, and streamlining business processes. We will prioritize the fielding of AI systems that augment the capabilities of our personnel by offloading tedious cognitive or physical tasks and introducing new ways of working... We will use AI to provide next-generation capabilities that increase the effectiveness of U.S. forces and support Department-wide reform efforts by addressing critical operational and business challenges. Our delivery approach will involve launching a sequence of initiatives to incorporate AI rapidly and iteratively and to experiment with new operating concepts, and then harvesting lessons to create repeatable processes and systems that allow all elements of the Department to do the same. We will prioritize the fielding of AI systems that augment the capabilities of our personnel by offloading tedious cognitive or physical tasks and introducing new ways of working. This will require iterative, interdisciplinary development of the technology in close collaboration with users and will demand early study of the cognitive and physical work that can be improved with AI. There are numerous AI applications that could improve our day-to-day operations or yield strategic advantages, many of which are currently in development across the Department. Example areas in which we will apply AI are described below.

1.1. Situational Awareness & Decision-Making

Improving situational awareness and decision-making.

AI applied to perception tasks such as imagery analysis can extract useful information from raw data and equip leaders with increased situational awareness. AI can generate and help commanders explore new options so that they can select courses of action that best achieve mission outcomes, minimizing risks to both deployed forces and civilians.

1.2. Safety

Increasing safety of operating equipment.

AI also has the potential to enhance the safety of operating aircraft, ships, and vehicles in complex, rapidly changing situations by alerting operators to hidden dangers.

1.3. Maintenance & Supply

Implement predictive maintenance and supply.

We will use AI to predict the failure of critical parts, automate diagnostics, and plan maintenance based on data and equipment condition. Similar technology will be used to guide provisioning of spare parts and optimize inventory levels. These advances will ensure appropriate inventory levels, assist in troubleshooting, and enable more rapidly deployable and adaptable forces at reduced cost.

Stakeholder(s):

Defense Innovation Unit (DIU) :
PREDICTIVE MAINTENANCE APPLICATIONS SUPPORTING OUR FORCES AND DRIVING EFFICIENCIES — The Defense Innovation Unit (DIU) and the U.S. Air Force are working together and with the JAIC to produce prototypes of Predictive Maintenance solutions and to scale successes. These commercially developed AI-based applications have the

potential to predict more accurately maintenance needs on equipment, such as the E-3 Sentry, F-16 Fighting Falcon, F-35 Lightning II, and Bradley Fighting Vehicle, thereby improving availability and reducing costs.

U.S. Air Force

1.4. Business Processes

Streamline business processes.

AI will be used with the objective of reducing the time spent on highly manual, repetitive, and frequent tasks. By enabling humans to supervise automated tasks, AI has the potential to reduce the number and costs of mistakes, increase throughput and agility, and promote the allocation of DoD resources to higher-value activities and emerging mission priorities.

2. Scaling

Scale AI's impact across DoD through a common foundation that enables decentralized development and experimentation.

One of the U.S. military's greatest strengths is the innovative character of our forces. It is likely that the most transformative AI-enabled capabilities will arise from experiments at the "forward edge," that is, discovered by the users themselves in contexts far removed from centralized offices and laboratories. Taking advantage of this concept of decentralized development and experimentation will require the Department to put in place key building blocks and platforms to scale and democratize access to AI. This includes creating a common foundation of shared data, reusable tools, frameworks and standards, and cloud and edge services. In parallel, we will take steps to ready existing processes for AI application through digitization and smart automation. Taken together, these enterprise-wide changes promote the spread of adaptable problem-solving using AI, increase the rate of experimentation and speed of delivery, and streamline the scaling of successful AI prototypes.

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3. Workforce

Cultivate a leading AI workforce.

Stakeholder(s)

AI Workforce

DoD Workforce :

PLANNED AI TRAINING PROGRAMS FOR THE DEFENSE WORKFORCE — DoD recognizes the need to educate our workforce to navigate the AI era. We are leveraging the rise of digital content, including MOOCs (massive open online courses), e-books, and online videos, to provide employees with curated learning experiences, and augmenting this with classroom instruction from AI experts in industry and at top U.S. universities.

Senior Leaders :

This AI training will provide: Senior leaders with an understanding of what AI can do for defense, how to create organizational AI strategies, and how to make appropriate

resource allocation decisions for improved technological incorporation ...

Mid-Level Leaders :

This AI training will provide: mid-level leaders with knowledge for directing AI projects, resource allocation, and progress tracking, and for developing technical backgrounds for successful AI project deliveries ...

Technical Staff :

This AI training will provide: technical staff with knowledge of comprehensive AI technologies for solution incorporation.

The transformative and rapidly advancing nature of AI requires that the Department adapt its culture, skills, and approaches. To succeed, we will encourage rapid experimentation, and an iterative, risk-informed approach to AI implementation. We will cultivate the talent of our existing workforce by investing in providing comprehensive AI training, while simultaneously bringing critical AI skills into service by recruiting and partnering with world-class AI talent... The transformative and rapidly advancing nature of AI requires that the Department adapt its culture, cultivate new skills, and streamline approaches to develop, attract, and partner with AI talent. We will introduce new functions, high-impact rotational programs, and expanded leadership opportunities, ensuring we recruit, train, promote, and retain a leading AI workforce. This includes the following areas of further development and implementation.

3.1. Opportunity

Offer the chance to make an impact.

DoD offers opportunities to develop cutting-edge AI applications to meet some of the Nation's most difficult and most consequential challenges, leveraging the latest technology to create positive real-world impact for U.S. forces and the society and freedoms that we defend.

3.2. Training & Talent

Provide comprehensive AI training and cultivating workforce talent.

We will invest in developing the skills of our existing workforce and ensuring their career progression. The DoD workforce will have access to curated AI training programs designed to help them keep pace with AI developments in the private sector, accelerate the achievement of expertise, and give personnel the knowledge they need to adapt to new roles in the future. These AI training programs will be made widely available, from junior personnel to AI engineers to senior leaders, and will leverage digital content combined with tailored instruction from leading experts.

3.3. Skills & Service

Bring critical AI skills into service.

We will use streamlined, non-traditional pathways to bring worldclass AI talent into service and expand access to outside expertise. This will complement our existing workforce with roles such as machine learning

engineers, data engineers, data scientists, and AI product managers, in order to form a modern, agile, AI-advantaged workforce with a deep passion for addressing the world's most pressing challenges.

3.4. Culture

Build a culture that embraces experimentation.

We are building a culture that welcomes and rewards appropriate risk-taking to push the art of the possible: rapid learning by failing quickly, early, and on a small scale. Although embracing disruptive approaches will not be easy, doing so is imperative for implementing and adopting AI – which requires running experiments daily, iterating based on user feedback, measuring results, and continuously adapting

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4. Partnerships

Engage with commercial, academic, and international allies and partners.

Stakeholder(s)

Commercial Partners

Academic Partners

International Allies

Defense Innovation Unit (DIU) :

PRODUCTIVE PRIVATE PARTNERSHIPS: DEFENSE INNOVATION UNIT — The Defense Innovation Unit (DIU) is a fast-moving government entity that accelerates the

adoption of commercial technology into the U.S. military to strengthen national security. DIU works with companies to prototype commercial solutions against DoD problems. Contracts are typically awarded in less than 90 days. Since it was established in 2016, DIU has awarded nearly 100 prototype contracts across a variety of areas, including several AI projects. Of these, several were transferred to the Military Departments and Services to increase capability, reduce costs, and improve efficiency.

Strong partnerships are essential at every stage in the AI technology pipeline, from research to deployment and sustainment. We will work with academia and industry to help address global challenges of significant societal importance, and make funding available to entice our best academics to invest in long-term research relevant to defense and remain in the business of educating the next generation of AI talent. We will enhance partnerships with U.S. industry to align civilian AI leadership with defense challenges while evolving our crucial international alliances and partnerships abroad. Further, we will engage with and contribute to the global open-source community to identify and advance emerging technologies and applications... We recognize that strong partners are crucial at every stage in the technology pipeline, from research to deployment and sustainment. Today, the U.S. private sector and academic institutions are at the forefront of modern AI advances. To ensure continued prosperity and the capacity to align their AI leadership with critical defense challenges, we are committed to strengthening the private sector and academia while bridging the divide between non-traditional centers of innovation, such as the AI startup community, and the defense mission. To accomplish this, we will do the following.

4.1. Global Challenges

Form open mission initiatives focused on global challenges.

We will form open AI missions with academia and industry that will contribute to addressing global challenges of significant societal importance, such as operationalizing AI for humanitarian assistance and disaster relief for wildfires, hurricanes, and earthquakes. We will bring our data, domain expertise, and real-world problems to these public-private partnerships, and combine efforts with a wide range of actors to produce inspiring AI technology that benefits society beyond the benefit of fulfilling our core defense mission. These open missions will challenge a broad community to advance the state of AI and learn how to operationalize the technologies on an integrated basis across domestic and international organizations. They will contribute to the development of thousands of new AI experts needed for public service over the next decade and spur future AI progress across multiple sectors.

4.2. Academic Partnerships & AI Innovation Districts

Strengthen academic partnerships and seed new AI innovation districts.

For academia, we will make longer-term, stable funding available to entice our best academics to invest in long-term research relevant to critical DoD areas and remain in the business of educating the next generation of AI talent. This entails increasing investment through existing channels, such as DARPA/IARPA and the Military Service Research Laboratories, and sponsoring long-term discoveries relevant to the Department. It also involves stimulating the development of geographic concentrations of interconnected companies and institutions in AI. Strong and stable academic partnerships clustered in this manner will provide benefits to the Department, industry, and national competitiveness.

Stakeholder(s):**Academic Partners****AI Innovation Districts****DARPA****IARPA****Military Service Research Laboratories****4.3. U.S. Industry***Enhance partnership with U.S. industry.*

Engaging with and strengthening the AI technology ecosystem requires us to experiment with a range of partnership models. These include bold new AI initiatives with large industrial partners, small start-ups, and venture capital firms. In addition, we will take steps to make it easier for members of the AI community to engage with the Department, for example, by working to accelerate critical partnership processes and lower administrative barriers. We will also establish a centralized AI portal for potential partners that details key processes, topics of interest, and contacts in order to streamline contracting, acquisition, and on-boarding processes.

Stakeholder(s):**U.S. Industry****4.4. International Alliances & Partnerships***Evolve international alliances and partnerships.*

An extended network of mutually beneficial alliances and partnerships provides a durable means of overcoming global AI challenges, deterring aggression, and supporting stability through cooperation. Foreign allies and partners offer critical perspectives and talent that can be leveraged through personnel exchanges, combined portfolio planning, and the deepened interoperability and trust that comes from collaborative AI development and deployment.

Stakeholder(s):**International Allies****International Partners****4.5. Open Source***Engage with the open source community.*

The open-source community is a vibrant global incubator of talented individuals and transformative ideas. We will contribute our data, challenges, research, and technologies to this community and engage with the open-source ecosystem as a vehicle for attracting talent, identifying and advancing new AI technologies that can transform defense, and broadening our accessible technology base.

Stakeholder(s):**Open Source Community**

5. Ethics & Safety

Lead in military ethics and AI safety.

The Department will articulate its vision and guiding principles for using AI in a lawful and ethical manner to promote our values. We will consult with leaders from across academia, private industry, and the international community to advance AI ethics and safety in the military context. We will invest in the research and development of AI systems that are resilient, robust, reliable, and secure; we will continue to fund research into techniques that produce more explainable AI; and we will pioneer approaches for AI test, evaluation, verification, and validation. We will also seek opportunities to use AI to reduce unintentional harm and collateral damage via increased situational awareness and enhanced decision support. As we improve the technology and our use of it, we will continue to share our aims, ethical guidelines, and safety procedures to encourage responsible AI development and use by other nations... During this upcoming AI-based technological transition, we will lead in complying with international and domestic law, upholding and promoting our Nation's values, and strengthening our partnerships with other nations. As part of our strong commitment to ethics, humanitarian considerations, and both near- and long-term AI safety, we will take the following actions.

5.1. Principles

Develop AI principles for defense.

The Department will articulate its vision and guiding principles for AI ethics and safety in defense matters. We will consult with a wide range of experts and advisors from across academia, the private sector, and the international community to learn as much as possible from past insights and existing approaches to AI ethics and safety. We will also continue to undertake research and adopt policies as necessary to ensure that AI systems are used responsibly and ethically. One example of existing guidance is DoD Directive 3000.09, issued in 2012, which establishes guidelines to minimize the probability and consequences of failure in autonomous and semiautonomous weapon systems that could lead to unintended engagements. The Directive requires that autonomous and semi-autonomous weapon systems be designed to allow commanders and operators to exercise appropriate levels of human judgment over the use of force. Among other things, the Directive also requires realistic and rigorous testing and clear human-machine interface, as well as appropriate training for commanders and operators, so that those weapons function as anticipated in realistic operational environments against adaptive adversaries

5.2. Resilience, Reliability & Security

Investing in research and development for resilient, robust, reliable, and secure AI.

In order to ensure DoD AI systems are safe, secure, and robust, we will fund research into AI systems that have a lower risk of accidents; are more resilient, including to hacking and adversarial spoofing; demonstrate less unexpected behavior; and minimize bias. We will consider "emergent effects" that arise when two or more systems interact, as will often be the case when introducing AI to military contexts. To foster these characteristics in deployed systems in both military and civilian contexts, we will pioneer and share novel approaches to testing, evaluation, verification, and validation, and we will increase our focus on defensive cybersecurity of hardware and software platforms as a precondition for secure uses of AI.

5.3. Explainability

Continuing to fund research to understand and explain AI-driven decisions and actions.

We will continue funding research and development for “explainable AI” so users can understand the basis of AI outputs. This will help users understand, appropriately trust, and effectively manage AI systems.

5.4. Transparency

Promote transparency in AI research.

We will actively and continuously engage in an open dialogue and internationally collaborative research agenda concerning AI ethics, resilience, robustness, reliability, and security to reduce the chance of misperception, miscalculation, or accidents. This will promote responsible behavior.

Stakeholder(s):

DARPA :

ADDRESSING KEY RESEARCH CHALLENGES IN AI: DEFENSE ADVANCED RESEARCH PROJECTS AGENCY (DARPA) — DARPA is an agency that makes pivotal investments in breakthrough technologies for national security. Over its 60-year history, DARPA has played a leading role in the creation and advancement of AI technologies. DARPA is now funding research into AI that can explain its de-

cision-making rationale to humans, which is critical for enabling humans to understand, appropriately trust, and effectively manage AI systems. This research is one component of a multi-year campaign called AI Next, which provides research investments aimed at transforming computers from specialized tools to partners in problem-solving.

5.5. Guidelines

Advocate for a global set of military AI guidelines.

We will engage in dialogue and articulate our vision for ethical and safe military AI use to the broadest-possible audience. To do this, we will build strong channels for military-to-military dialogue as well as exchanges among DoD, the private sector, academia, allies and partners, and the global AI community. Within the Department, we will continue operating in accordance with the law of war, and we will demonstrate responsible use of AI in accordance with our nation’s values.

5.6. Civilian Casualties & Collateral Damage

Use AI to reduce the risk of civilian casualties and other collateral damage.

We will seek opportunities to use AI to enhance our implementation of the Law of War. AI systems can provide commanders more tools to protect non-combatants via increased situational awareness and enhanced decision support.

Administrative Information

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