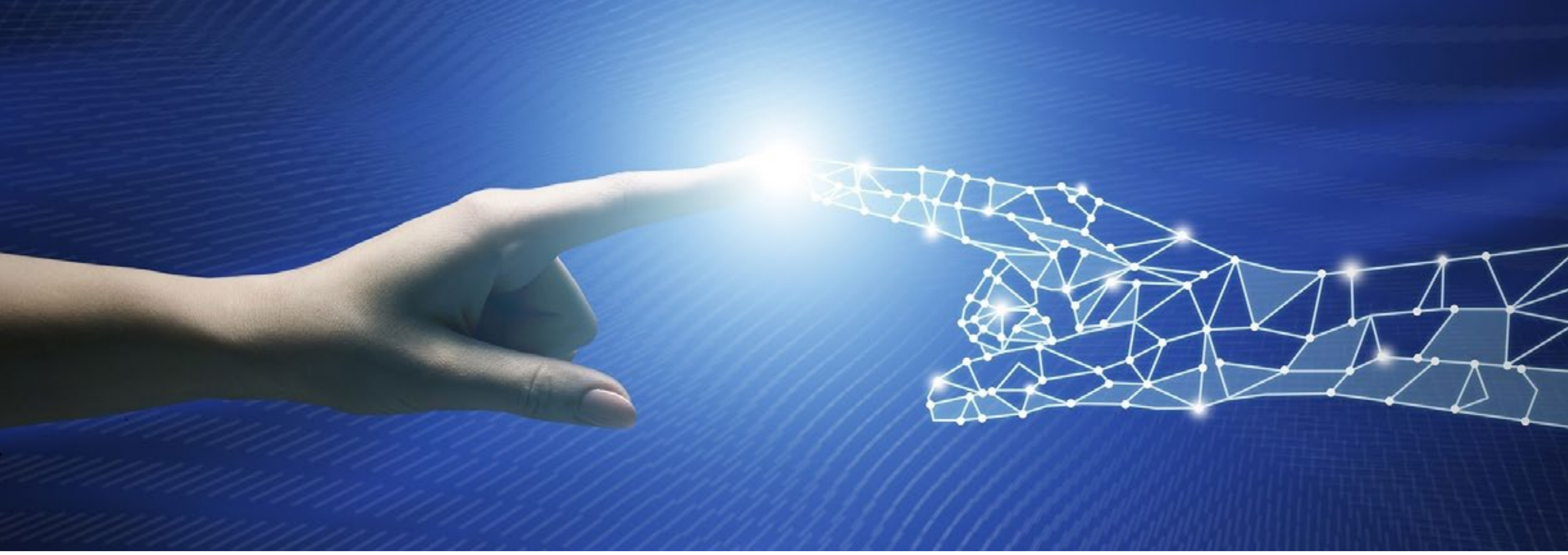

AI generated image. (Photo courtesy of U.S. Army)

How to Use Artificial Intelligence (AI) Capabilities?

By Chief Warrant Officer Three Travon Graves, 32d AAMDC AMD Systems Integrator

Christian Brose, author of *The Kill Chain: Defending America in the Future of High-Tech Warfare*, advocates that we, as a military and nation, must decide what machines can do versus what humans should do. He says that 45% of today's tasks within our society will be replaced with artificial intelligence (AI), and the number is considerably higher within the military. Research shows that since 2020, the time horizon for AI—the length of tasks AI will perform autonomously—has doubled every seven months. While an autonomous, AI-driven platform could deliver fuel to a platform safely and efficiently, a community strongly advises against an AI algorithm with the final authority to launch nuclear weapons. For most humans, relinquishing ethical decision making to computers is a hard pill to swallow but is one the Department of War (DoW) must face head-on. With deterrence being a large part of the great competition strategy, it is imperative that our military stays not only outfitted with the most disruptive technology but also has a modernization strategy forecast to mitigate adversarial surprises of the future. AI aims to create intelligent agents that can automate processes, enhance human capabilities, and solve problems more efficiently. The question remains: How can we leverage the advantages of artificial intelligence?

First, we must look deeper into AI and agree that the terms "artificial intelligence," "machine learning," and "deep learning" are often used interchangeably. **Figure 1** (next page) shows that machine learning and deep learning are considered subcomponents of AI. Due to the proliferation of AI and its applications, utilizing a proven framework to explain AI's utility is essential. That framework is the Heilmeier Catechism, created by George H. Heilmeier (former director of the Defense Advanced Research Projects Agency) to evaluate and guide research proposals effectively. These questions help clarify objectives, assess risks, and determine the potential effects of proposed projects. It consists of eight questions:

1. What are you trying to do?
2. How is it done today?
3. What is new about your approach?
4. Who cares?
5. What are the risks?
6. How much will it cost?
7. How long will it take?
8. And how do we assess its effectiveness?

It is appropriate to answer a few of these questions to provide an in-depth analysis of how we can exploit AI. The first question is, what are we trying to do? We must clearly define what we want from AI within the defense industry. The buzzwords that inundate the industry—such as quantum computing, edge computing, and large language models—create a pompous idea of AI. The Army and, more specifically, the Air Defense community of interest are ultimately determined to reduce the cognitive workload of operators by incorporating automated-decision aids. Mundane tasks that are easy to automate saturate operators on today's modern battlefield. The unfortunate loss of life in Syria at Tower 22 is attributed to a multitude of reasons, but operator saturation, which was indicated in preliminary findings, continues to be a factor. From recent lessons learned, the 32nd Army Air and Missile Defense Command's (AAMDC's) headquarters, for example, assessed that the cognitive workload for Forward Area Air Defense Command and Control (FAAD C2) operators within the base defense operations center (BDOC) was excessive, requiring the inclusion of automated decision aids such as AI to lighten the cognitive load. The warfighters in command centers, space-confined shelters, and dismounted scenarios operate in environments involving a myriad of digital and physical sensory information, which can potentially distract FAAD operators from their mission-essential tasks due to the high quantities of targets requiring immediate action to classify threats and deconflict the airspace.

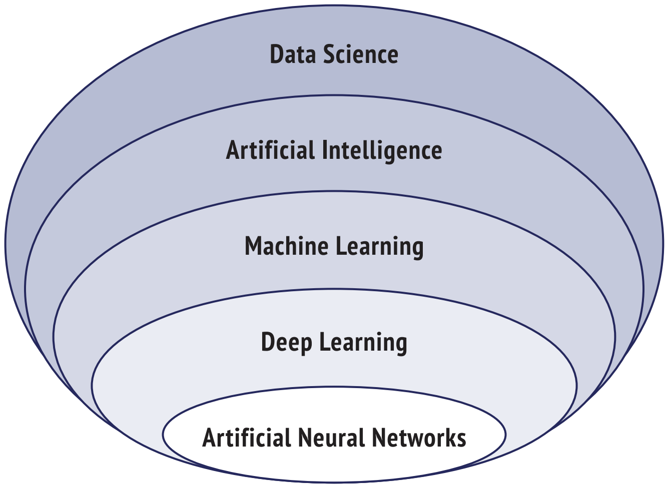

Figure 1. AI includes the sub-fields of Machine Learning (ML) and Deep Learning (DL).

The question then becomes: How do we translate human cognition to AI and when should machines be the decision makers? A structured framework for AI implementation, guided by the Heilmeier Catechism, will ensure a careful and effective integration of AI into our defense strategies. We need to identify what characteristics of a human expert matter or what attributes significantly affect what humans agree to be trustworthy. Researchers are working to determine quantifiable values to place on human decision-making characteristics and what it means to measure these attributes while identifying consistencies written into AI software applications. This is a complex science, and models must be trained and characterized with large amounts of data analysis to produce a scoring value used as a framework that aligns with what humans believe to be trusted ethical decisions. The University of Southern California's School of Engineering, through its Information Sciences Institute, stands at the cutting edge of artificial intelligence research. Their pioneering approach builds around a "three-pillar" framework that seeks to advance AI's capabilities systematically.

The first pillar focuses on rule development, establishing the foundational principles and guidelines that govern intelligent systems. The second pillar emphasizes the importance of statistical analysis, requiring advanced computational resources to leverage techniques like deep learning and reinforcement learning. These methods enable machines to learn from large datasets and improve through experience. The final pillar, contextual awareness, is about enabling AI to understand and perceive its environment, allowing it to make more informed and contextually appropriate decisions. Together, these pillars represent a comprehensive approach to advancing the next generation of AI technologies. There are also physics-informed machine-learning methods, a relatively new branch of AI that integrates mathematical physics models with data-driven learning. These methods introduce observational, inductive, or learning biases into the traditional data-driven, machine-learning process to steer or constrain learning to consistent solutions. Observational biases allow the training of an AI system to converge on solutions that adhere to underlying physics-based requirements. Policymakers and developers will have to look deeper than what we simply write in code and embrace an anthropomorphic lens.

Lastly, any solution must be an innovative approach that leverages the latest available commercial technologies to synthesize multi-domain information, thus enabling a faster decision-making process. This will encompass capabilities such as intelligent declutter, auto slewing for identification cameras, intelligent-shot data analysis (such as counter swarm at the push of a button), and the ability to intelligently cue additional sensors for discrimination-leveraging, emission-signature parameters to strengthen track classification. This solution must incorporate physics-informed machine learning with a quantifiable framework of ethical decision making that extrapolates into AI applications. From there, a scalable transition from what humans should do to what machines can do includes making critical decisions that assist in closing the kill chain through kinetic and non-kinetic effects.

In an era of renewed, great power competition, AI is the central arena. Failing to integrate intelligent agents to automate logistics, enhance our warfighters' capabilities, and accelerate decision making is to cede the future battlefield to our adversaries. Therefore, the DoW's task is to aggressively pursue AI's efficiencies while deliberately architecting systems that preserve human authority over critical ethical choices. This dual approach is the only path to creating a modernized force capable of deterring conflict and mitigating the technological surprises that will undoubtedly define the next generation of warfare.

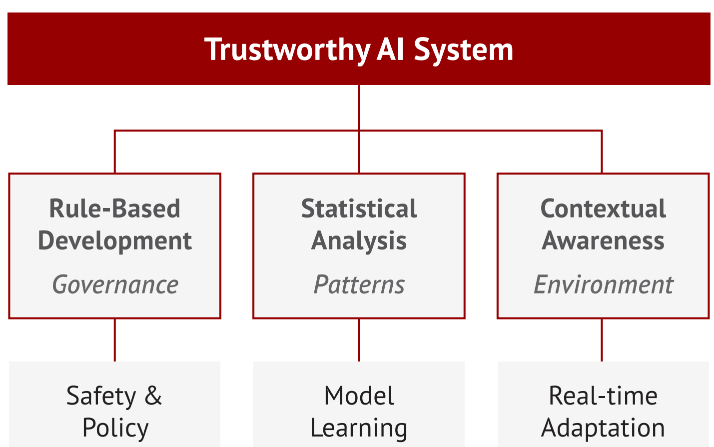

Figure 2. Three pillars that support a systematic approach to advancing AI.

CW3 Travon Graves is an Air Missile Defense System Integrator currently assigned to 32d AAMDC. He has served in roles ranging from short-range Air Defense to his current role as an AMD planner and JICO. Additionally, he is the deputy for 32d's Task Force 32 Innovation and Strategy Team.