HARNESSING ARTIFICAL INTELLIGENCE

Harnessing Artificial Intelligence (AI) is a top DOD priority. With this course, you will understand the principles and limitations of AI systems, and the benefits and risks of using them in military operations.

LEARNING OBJECTIVES

- To understand the nature and history of AI systems.
- To understand the kinds of AI systems that exist, their military applications, their strengths, their vulnerabilities, their strategic value, and their risks.
- To understand the four bedrock principles of AI in the military and apply them to AI projects.
- To think critically about AI, distinguishing hype from reality.

LECTURES

Each session will be a 5-minute introduction, 30-minute lecture, and 15-minute Q&A covering varied aspects of Artifical Intelliigence, incluiding:

- What is AI?
- Classifying AI by Type of Learning
- Critical Domains
- Moving Forward/AI Futures

Course: CS4000 / Harnessing Artificial Intelligence
Quarter: Fall AY2020 (Sept. 2019)
Credits: 0-2
Scheduling: M+W 1200-1300, IN-122
Grading: Pass-Fail

For more information, contact Christine Beck, christine.l.beck.ctr@nps.edu

NAVAL POSTGRADUATE SCHOOL

CS4000
Harnessing
Artificial Intelligence

Moving Forward: AI in the DoD

Bret Michael

Professor
Computer Science and
Electrical & Computer Engineering

2 December 2019

Disclaimer

The views expressed herein are those of the presenter in his personal capacity and should not be construed as the official position of the Department of the Navy or the United States Government.

Gaining Competitive Advantage via AI

"Artificial intelligence is the future, not only for Russia, but for all humankind. It comes with colossal opportunities, but also threats that are difficult to predict. Whoever becomes the leader in this sphere will become the ruler of the world."

– Russian President Vladimir Putin

From speech on 1 Sept. 2017

https://www.rt.com/news/401731-ai-rule-world-putin/

China

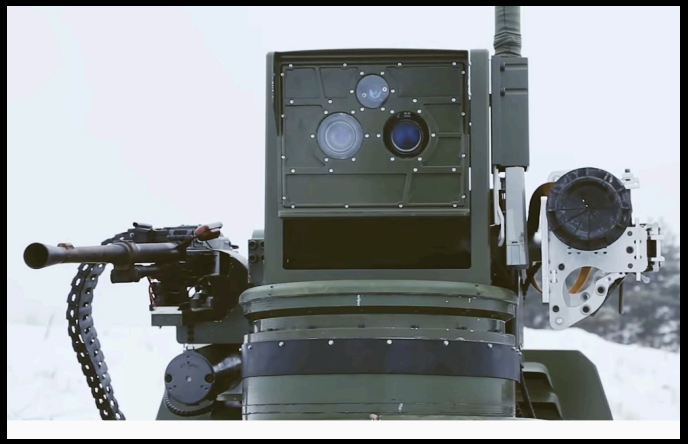
"Countries like China are making huge investments in AI and cyber. China's 2030 plan envisions a $1 trillion dollar artificial intelligence industry in China. They want to become a cyber superpower and are investing in their capital markets, universities, research centers, defense industry, and commercial software companies."

From Defense Innovation Board, "Software is Never Done: Refactoring the Acquisition Code for Competitive Advantage," working document, v3.3, 12 March 2019, p. 22.

Militarization of AI

AI algorithms aiding or supplanting human decision-making

U.S. Navy Phalanx weapons system. USN/Paul Kelly



Russian military armed robot. Russian Advanced Research Foundation via YouTube

Chinese military Marine Lizard amphibious tank

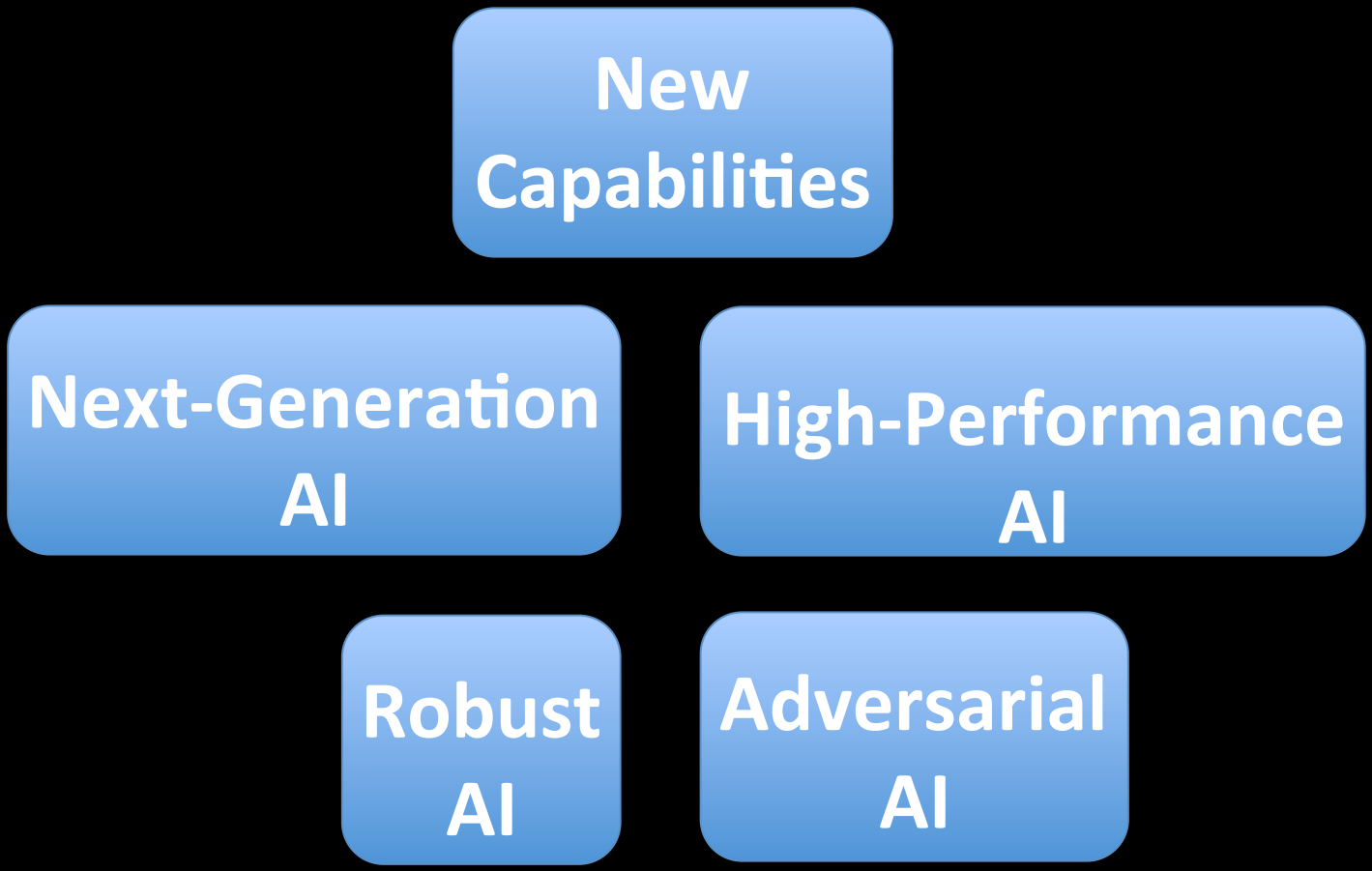
DoD Programs to Counter Threats

Some DARPA Examples

- Guaranteeing AI Robustness against Deception (GARD)
  - Counter adversarial machine learning
- Sea Hunter
  - Submarine-hunting autonomous warship
- Competency-Aware Machine Learning (CAML)
  - Trustworthy autonomous systems

Sea Hunter.
U.S. Department of Defense

DARPA AI Focus Areas



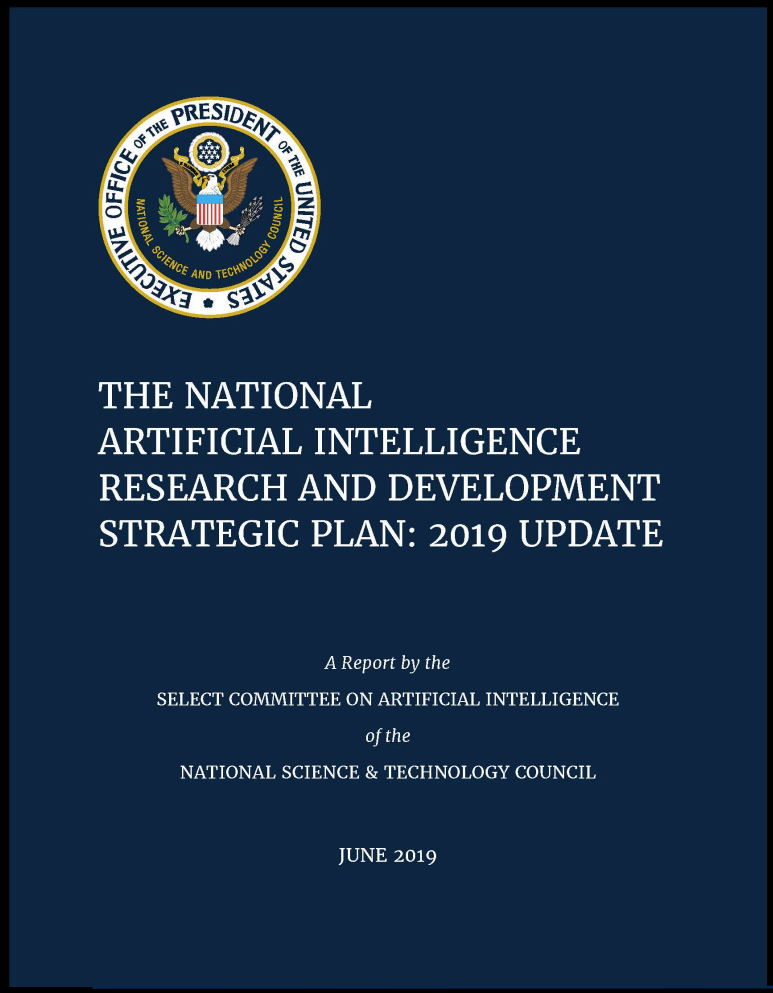
Adapted from: https://www.darpa.mil/work-with-us/ai-next-campaign

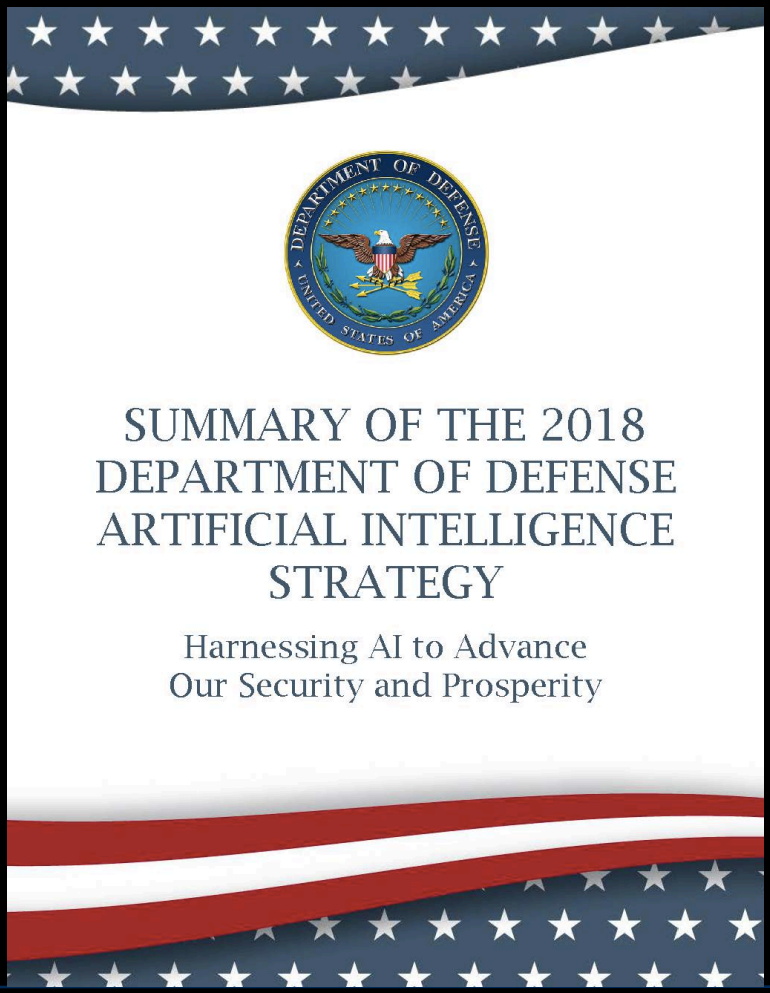
Leveraging Weaponized AI

Some examples:

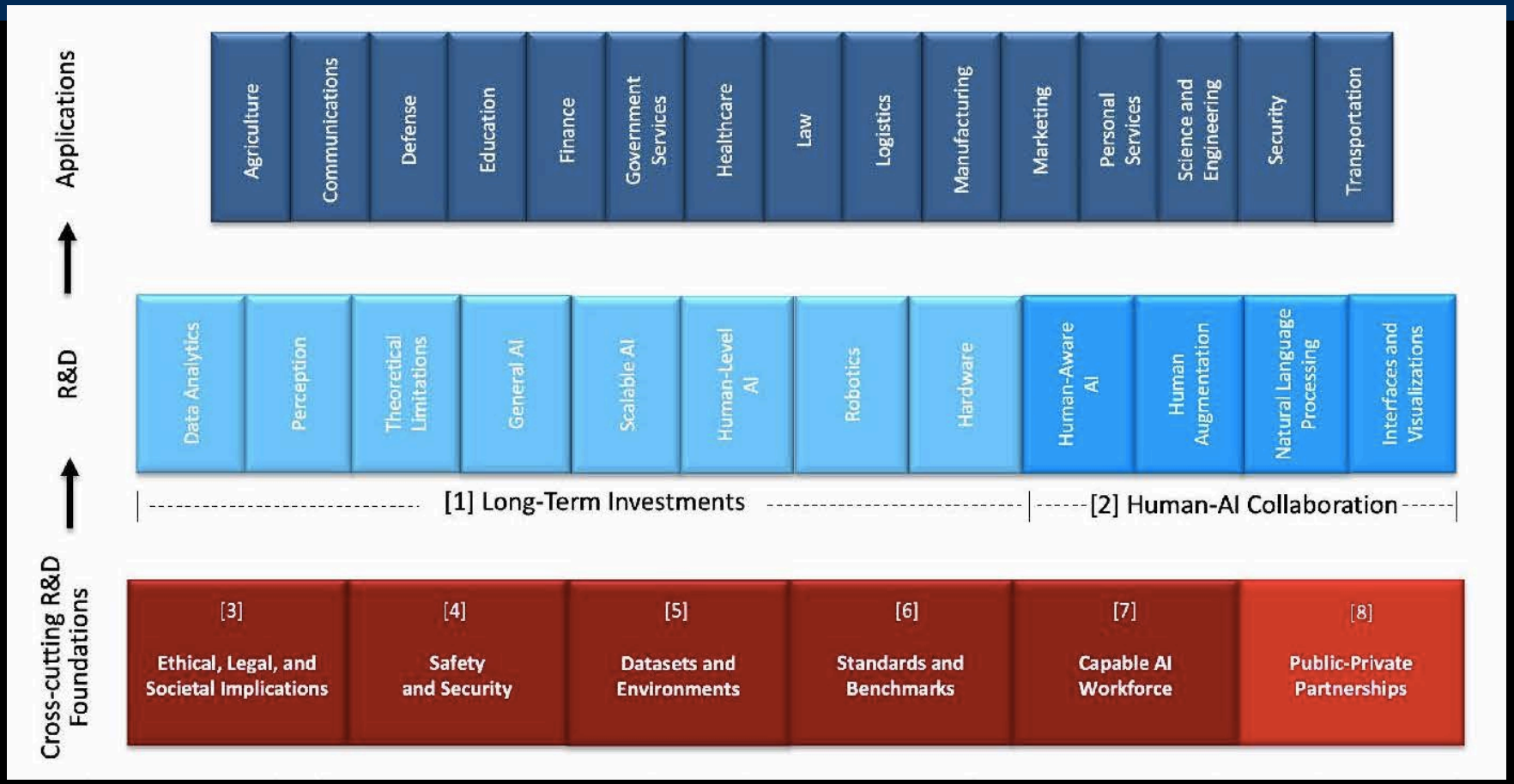
- Selecting and engaging military targets autonomously
  - Intelligent lethal drones
- Automating and optimizing *maskirovka*
  - Asymmetric political warfare (e.g., influence campaigns)

National and DoD AI Strategies





Crosscutting R&D Foundations



Source: The National Artificial Intelligence R&D Strategic Plan: 2019 Update, p. 6
Available at: https://www.nitrd.gov/pubs/National-AI-RD-Strategy-2019.pdf

National and DoD AI Strategies

"The DOD AI strategy directly supports every aspect of the National Defense Strategy."

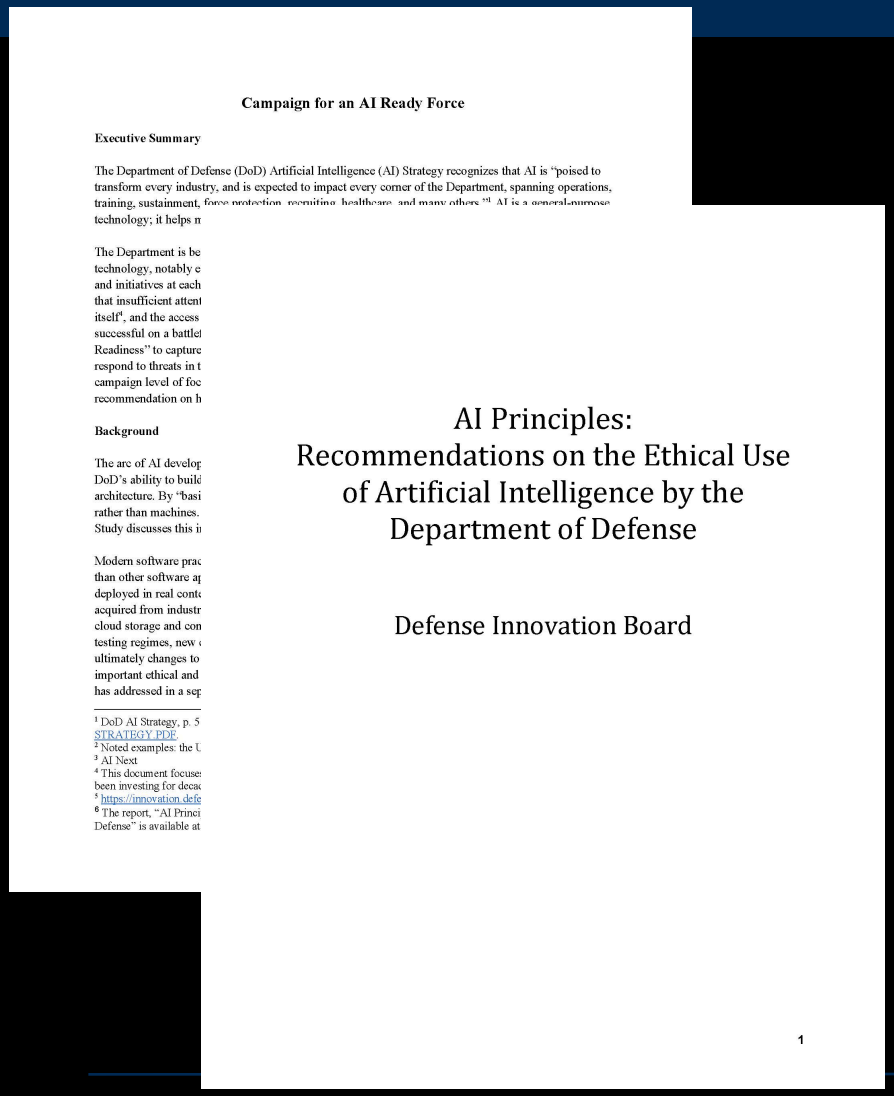
Mr. Dana Deasy, DoD Chief Information Officer

Defense Innovation Unit

"DIU engages across [DOD] on AI and makes its commercial knowledge in relationships with potential vendors available to any of the services, service labs and components."

Mr. Michael Brown, Director, Defense Innovation Unit

Defense Innovation Board



Campaign for an AI Ready Force

Executive Summary

The Department of Defense (DoD) Artificial Intelligence (AI) Strategy recognizes that 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."[1] AI is a general-purpose technology; it helps m

The Department is be
technology, notably e
and initiatives at each
that insufficient attent
itself[4], and the access
successful on a battlef
Readiness" to capture
respond to threats in t
campaign level of foc
recommendation on h

Background

The arc of AI develop
DoD's ability to build
architecture. By "basi
rather than machines.
Study discusses this i

Modern software prac
than other software ap
deployed in real conte
acquired from industr
cloud storage and con
testing regimes, new
ultimately changes to
important ethical and
has addressed in a sep

[1] DoD AI Strategy, p. 5
STRATEGY.PDF.
[2] Noted examples: the U
[3] AI Next
[4] This document focuse
been investing for decad
[5] https://innovation.defe
[6] The report, "AI Princi
Defense" is available at

AI Principles:
Recommendations on the Ethical Use of Artificial Intelligence by the Department of Defense

Defense Innovation Board

1

Multiple ongoing studies with periodic publication of interim results

Joint Artificial Intelligence Center

DEPUTY SECRETARY OF DEFENSE
1010 DEFENSE PENTAGON
WASHINGTON, DC 20301-1010

JUN 27 2018

MEMORANDUM FOR CHIEF MANAGEMENT OFFICER OF THE DEPARTMENT OF DEFENSE
SECRETARIES OF THE MILITARY DEPARTMENTS
CHAIRMAN OF THE JOINT CHIEFS OF STAFF
UNDER SECRETARIES OF DEFENSE
CHIEFS OF THE MILITARY SERVICES
CHIEF, NATIONAL GUARD BUREAU
COMMANDERS OF THE COMBATANT COMMANDS
GENERAL COUNSEL OF THE DEPARTMENT OF DEFENSE
DIRECTOR OF COST ASSESSMENT AND PROGRAM EVALUATION
INSPECTOR GENERAL OF THE DEPARTMENT OF DEFENSE
DIRECTOR OF OPERATIONAL TEST AND EVALUATION
CHIEF INFORMATION OFFICER OF THE DEPARTMENT OF DEFENSE
ASSISTANT SECRETARY OF DEFENSE FOR LEGISLATIVE AFFAIRS
ASSISTANT TO THE SECRETARY OF DEFENSE FOR PUBLIC AFFAIRS
DIRECTOR OF NET ASSESSMENT
DIRECTORS OF DEFENSE AGENCIES
DIRECTORS OF DOD FIELD ACTIVITIES

SUBJECT: Establishment of the Joint Artificial Intelligence Center

The 2018 National Defense Strategy (NDS) foresees that ongoing advances in artificial intelligence (AI) "will change society and, ultimately, the character of war." To preserve and expand our military advantage and enable business reform, we must pursue AI applications with boldness and alacrity while ensuring strong commitment to military ethics and AI safety. A new approach is required to increase the speed and agility with which we deliver AI-enabled capabilities and adapt our way of fighting.

Toward this end, the DoD Chief Information Officer (CIO) will establish a Joint Artificial Intelligence Center (JAIC) with the overarching goal of accelerating the delivery of AI-enabled capabilities, scaling the Department-wide impact of AI, and synchronizing DoD AI activities to expand Joint Force advantages. The Director of the JAIC will report to the DoD CIO. The JAIC will enable the Military Departments and Services, Joint Staff, Combatant Commands (CCMDs), Office of the Secretary of Defense (OSD), and other DoD Components, to swiftly introduce new capabilities and effectively experiment with new operational concepts in support of DoD's warfighting missions and business functions. The JAIC will achieve this goal by:

- Guiding the execution of National Mission Initiatives (NMI), large-scale efforts to apply AI to a cluster of closely related, urgent, joint challenges. NMIs will be

OSD008412-18/CMD010577-18

epartments and Services, Joint Staff,
n owners;

o establish a Department-wide common
the tools, shared data, reusable
ble rapid delivery and Department-wide

nt, and with industry, academia, and
ght critical needs, solve problems of
technologies for DoD missions; and

levant organizations to develop a
development and delivery.

ack within 30 days with a list of initial
Y18 and FY19 resourcing plans, and
oped in consultation with the Military
nd should include the Algorithmic
vill be transitioned to the JAIC. The
(Comptroller) and the DoD Chief
initiate the stand-up of the JAIC and

uation, in coordination with the DoD
ond, during the upcoming Program and
ation of the initial NMIs; initiation of
aboration with industry or academia, as
of government and with our
dards, ethics, and safeguards necessary

oD components to execute new AI
work. DoD and OSD components
AIC upon initiation of new AI
initiative that totals more than
D is creating Department-wide
investments in AI mature. The JAIC
s as a means of synchronizing efforts
ense for Research and Engineering will
, systems, and concepts that support AI

curity are of the essence. I expect all
cessary to make rapid enterprise-wide

2

Lt. Gen. John N.T. "Jack" Shanahan, Director, JAIC

Office of Naval Research

Naval Research Enterprise AI Taxonomy

Reasoning	Generation of inferences based on data, knowledge and context
Human-Inspired Intelligence (understanding and modeling)	Algorithms and architectures that are derived from human cognitive processes, and emulate them
Machine Learning	Algorithms and architectures that autonomously learn patterns in data or can be trained to learn a task
Perception	Algorithms and architectures developed to perform feature analytics of complex sensor data and to classify, identify and infer intent of entities and recognize situations
Collaboration, Interaction, and social intelligence	Interfaces that enable effective collaboration between warfighters and intelligent systems
Planning	Algorithms and architectures that support the development and selection of courses of action
Machine-to-Machine Coordination and Distributed Intelligence	Algorithms, communication protocols and architectures that enable distributed interactive analysis, reasoning and decision-making
Knowledge Representation and Management	Structuring data, knowledge, beliefs and uncertainty to support inferences that may not be explicitly stated within data, and then perform tasks or operations based on those inferences

Private Sector Enabling Arms Race

Companies are the main driver behind advances in AI

- AI technology developed for commercial use is being repurposed for military use
- Industry is assisting governments weaponize AI

Achieving a Decisive Advantage

China

United States

Russia

Incremental innovation

Transformative innovation

A Commonality, but …

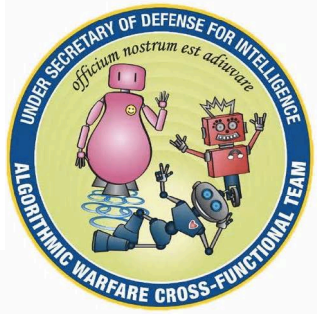
All three great powers leverage collaboration with industry to try to achieve strategic advantage

Encourage industry to participate

Require/Direct industry to participate

(Un)cooperation

Project Maven



The New York Times

Goggle Will Not Renew Pentagon Contract That Upsets Employees

By Disuke Wakabayashi and Scott Shane June 1, 2018

Microsoft Says It Will Sell Pentagon Artificial Intelligence and Other Advanced Technology

By David E. Sanger Oct. 26, 2018

Risks

Use of AI-based technology in combat systems considered to be riskier than in non-combat systems

Need to consider ethics, cultural acceptance, and trustworthiness

Uneven Playing Field

- Differences existing in:
  - Abiding by international norms
    - Willingness to purposely operate in gray areas of law
  - Cultural acceptance
    - Willingness to invest in and adopting militarized AI

Summary

- Adoption of AI to transform DoD operations and maintaining strategic advantage across mission sets
- DoD sees partnering with industry and academia as key to innovation