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# Artificial Intelligence for Soldiers 2024: Experiences and Lessons Learned from the Inaugural Course

by Mark A Tschopp and Reginald L Hobbs

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# **Artificial Intelligence for Soldiers 2024: Experiences and Lessons Learned from the Inaugural Course**

**by Mark A Tschopp and Reginald L Hobbs**  
*DEVCOM Army Research Laboratory*

## REPORT DOCUMENTATION PAGE

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| <b>14. ABSTRACT</b><br>This final report highlights the work associated with the US Army Combat Capabilities Development Command Army Research Laboratory course, "Artificial Intelligence for Soldiers," held April 8–19, 2024. The report details the development of the course, its content, the inaugural participants, and the feedback received. The course aimed to enhance Soldiers' understanding of artificial intelligence (AI) and machine learning (ML) concepts, covering topics such as AI fundamentals, ML algorithms, neural networks, robotics, and human–machine integration. Participants, mostly mid-career officers and noncommissioned officers, reported significant improvements in their AI knowledge and confidence. The course effectively balanced theoretical foundations with practical demonstrations, earning high ratings from participants. Key suggestions for future iterations include targeting the right audience, providing pre-course materials, and expanding course content. The report concludes with a summary of feedback from the course and recommendations for future improvements. The significance of the course lies in its role in democratizing AI knowledge across the Army, preparing and educating the Army of the future to ensure strategic and operational advantages in upcoming military applications. |                                    |                                     |                                         |                                                                |                                               |
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## Executive Summary

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The US Army Combat Capabilities Development Command Army Research Laboratory recently conducted a 2-week resident Artificial Intelligence and Machine Learning (AI/ML) course at the Adelphi Laboratory Center (ALC) on behalf of Department of the Army Headquarters. Led by the authors (Dr Mark Tschopp and Dr Reginald Hobbs), the course aimed to expose Soldiers to fundamental AI/ML concepts relevant to the Army, attracting mid-career staff officers, senior noncommissioned officers, and warrant officers from various specialties across the Army. Course content covered essential topics such as AI fundamentals, ML, neural networks, robotics, and human-machine integration. Engagements with senior leaders and scientists, including BG Stephanie Ahern, Director of Futures and Concepts Center (FCC) Directorate of Concepts (DoC), and Ms Carla Crandall, Army Futures Command Staff Judge Advocate, both of whom reinforced Soldiers' understanding of AI contextually and ethically.

Additionally, Soldiers had the opportunity to witness AI-related basic research demonstrations during site tours at ALC, the Robotics Research Collaboration Campus at Graces Quarters, and the Information for Mixed Squad Laboratory at Aberdeen Proving Ground. Feedback from the course survey indicated overwhelmingly positive responses, with over 95% of participants agreeing that the course was excellent and over 95% strongly agreeing that the instructors were excellent.

One participant reflected on the experience:

Dr Tschopp and Dr Hobbs were phenomenal. The Major [Matthew Work] and the [FCC DoC Mr Chris Stolz] were great moderators and they lent a lot of perspective during the entire course. BG Stephanie Ahern was very personable and sincerely listened to the feedback of the students. I loved the course and it was encouraging to know that we have 1600 researchers pioneering the way ahead for the armed forces. With the outlook, skills, and knowledge gained from the course I have a significantly better understanding of the capabilities and limitations of AI. I intend to educate my organization and eventually build an "Intro to AI in the Armed Forces" presentation at some point to build a shared understanding with the rest of the brigade. Thank you, I am very thankful for the opportunity to participate in this course.

This summary highlights the course's development, feedback received, and proposed next steps for enhancing future offerings.



## **1. Introduction**

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### **1.1 Importance of AI Training for Soldiers in Modern Military Operations**

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In the ever-evolving landscape of modern military operations, the proliferation of data has reached unprecedented levels, inundating human operators and leaders with a deluge of information that can overwhelm the military decision-making processes of today. Within this complexity lies the extraordinary potential of artificial intelligence (AI) to serve as a formidable ally, not to supplant human tactical and strategic decision-making abilities, but to enhance and complement them. AI possesses the capability to swiftly analyze vast troves of data, distilling actionable insights in real-time. By swiftly processing and interpreting data streams, AI empowers military personnel to navigate the complex intricacies of the future operational environment with unparalleled precision and agility. Its ability to deliver pertinent information at the speed of relevance equips decision-makers with invaluable situational awareness, enabling them to make timely and informed choices crucial for mission success and operational effectiveness. Thus, in an era characterized by data saturation and complexity, the integration of AI into military operations emerges as an imperative, ensuring that human decision-makers are empowered with the tools necessary to navigate the challenges of the modern battlefield effectively.

### **1.2 Brief Overview of the Purpose and Objectives of the AI Course**

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The course content endeavors to orient learners to fundamental concepts within AI, particularly focusing on machine learning (ML) within the context of military operations. Participants will attain an intermediate understanding of diverse families of ML algorithms, their requisite training data, and the nuanced application and constraints of each. Distinguishing between handcrafted knowledge AI and machine learning AI approaches, the curriculum elucidates key factors propelling recent advancements in ML performance. Furthermore, participants will cultivate a rudimentary comprehension of neural networks and their operational mechanisms. Strategies for deploying AI across discrete and intricate datasets to address tactical, strategic, or logistical challenges will be imparted, along with adaptable tools and methodologies transferrable to varied organizational landscapes, including military environments.

The objectives of this course are multifaceted:

1. Empower Army officers to furnish senior leadership with data-driven decision-making capabilities previously inaccessible, thereby seizing opportunities that confer a competitive edge over adversaries.
2. Enable Army officers to conceive and steer strategies for harnessing data and algorithms to attain organizational objectives.
3. Enhance staff officers' acumen to identify untapped potential applications for AI, catering to both business and strategic exigencies.
4. Empower Army officers to offer pragmatic insights to US Army Combat Capabilities Development Command (DEVCOM) Army Research Laboratory (ARL) leaders, spotlighting scenarios where AI capabilities hold the potential for paradigm-shifting transformations.

This course is engineered to furnish participants with the requisite knowledge and proficiencies to adeptly harness AI in military contexts, fostering innovation and strategic acumen.

## **2. Course Development**

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### **2.1 Overview of the Course Development Process**

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The course development process commenced with the consolidation of multiple courses and instructors sourced from various divisions within the laboratory, aimed at amalgamating disparate materials into a cohesive 2-week curriculum. Initially, two 2-day courses were identified: one focusing on an introduction to ML and neural networks, and another elucidating the nexus between AI and military applications. Additionally, two scientists holding adjunct faculty positions at local universities were enlisted to impart knowledge on AI within a computer science framework, thereby forming the foundation of the course's content. The decision was made to bifurcate the course into two segments: one delving into the fundamentals of AI, and the other exploring its practical applications. Given the foundational nature of the ML course, it was slated for the first week, while the more application-centric human and AI course found its place in the second week, aligning with the applied focus of that phase. In the initial week, the itinerary included a day devoted to an overarching overview of AI, succeeded by the 2-day ML course, followed by a dedicated day on natural language processing, acknowledging the pivotal role of

large language models in contemporary contexts. To alleviate the content-heavy instructional days, interstitial days were interspersed, allowing participants to engage with AI scientists, witness demonstrations of potential future AI technologies, and gain insights into ongoing research endeavors. Notably, the inaugural “AI in Action” day of week one featured presentations by senior leaders elucidating how AI contributes to research in military information science, network science, and computational science, followed by laboratory visits to witness AI research firsthand and engage with scientists conducting research in AI-related domains (e.g., Fig. 1 shows some science demonstrations).



**Fig. 1** Pictures of the laboratory science demonstrations/briefs during the AI in Action portion of the course: (top) Dr Jade Freeman presents during the Cross Reality Common Operating Picture [XRCOP] program demonstration; (bottom) Dr Claire Bonial and Dr Adrienne Raglin present AI research in Content Understanding Branch

In the second week, the initial day was earmarked for delving into the applications of AI in robotics and autonomous systems, commencing with an overview of robotics and reinforcement learning and culminating in a visit to the robotics cam-

pus to interact with scientists and witness demonstrations of legged robotics and autonomous ground vehicles navigating complex terrain. This was succeeded by a 2-day course on AI and humans, featuring numerous scientists expounding on their research domains and how AI can augment human decision-making processes. The latter half of the second week encompassed diverse topics such as AI failures in the public domain, ethical and strategic considerations in AI, and the concept of responsible AI. Concurrently, participants engaged in capstone project preparations, culminating in the final delivery and presentation of these projects on the concluding day of the course, preceding a brief graduation ceremony. In addition to incorporating field trips to diversify the instructional aspects of the AI course, a capstone project was introduced to facilitate collaborative learning within team structures, enabling participants to synthesize course content, explore its relevance to Army applications, and engage in meaningful discussions. Furthermore, guest speakers, including chief scientists, senior leaders, and concept developers (see Fig. 2), were strategically integrated throughout the course to provide diverse perspectives on AI and its implications for the future Army. These multifaceted elements coalesced to create a comprehensive AI course, fostering not only a robust understanding of AI principles but also cultivating diverse perspectives on its role within the military landscape. The final course schedule is shown in Appendix A.



**Fig. 2 One of the guest speakers, Mr Christopher Stolz of Futures and Concepts Center (FCC), during the AI for Soldiers course**



## 2.2 Description of the Informational Packet

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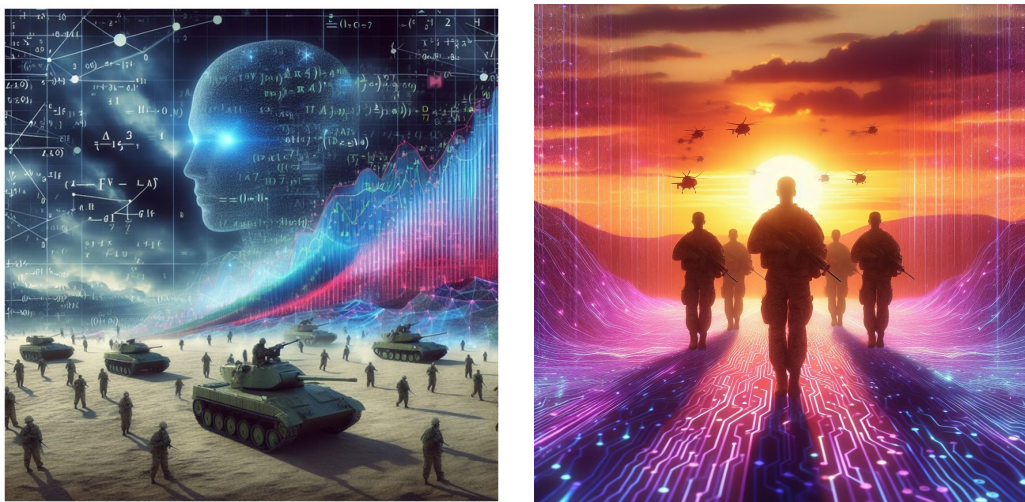
To introduce the Soldiers to the AI course, we developed a comprehensive informational document. The packet began with an overview of the course content and its objectives, providing participants with a clear understanding of what to expect. It included a general outline of the course, detailing the various topics that would be presented each day. For each topic, a brief description of the content to be covered was provided. The packet also featured short bios of the main instructors, along with contact information for several members of the organizing team. Additionally, it outlined the objectives of the capstone project and suggested potential questions for participants to consider throughout the course for inclusion in their final projects. Practical details such as travel information and logistics were also included. Finally, the packet listed supplementary materials for the course, including scientific publications, popular press articles on AI, relevant websites, and books on various aspects of AI.

To enhance the visual appeal of the informational packet, we used generative AI art for the front and back covers. Using Copilot, we generated multiple ideas for prompts that depicted Soldiers, AI, and future battlefield scenarios. The best prompts were then refined and used with a generative art application powered by DALL-E to create striking cover images (Fig. 3). An example of the prompt used to generate the image for the back cover:

Imagine a serene sunset scene where US Soldiers, their forms outlined in shadow, walk purposefully toward the horizon. The backdrop is a blend of warm oranges and purples, with the sun casting long shadows. However, instead of a traditional landscape, the ground beneath their feet is composed of intricate AI algorithms, neural networks, and lines of code. These digital pathways lead toward the vanishing point, symbolizing the Soldiers' journey into an AI-driven future.

These images not only served to attract attention but also symbolized the integration of AI into military contexts, aligning with the course's themes. The final informational packet is included in Appendix B.

## Artificial Intelligence for Soldiers Generative AI Art



(a) Front cover

(b) Back cover

**Fig. 3** Images of generative AI art generated for the (a) front and (b) back cover of the informational packet

### 3. Course Delivery

#### 3.1 Details about Course Delivery

Army G3/5/7 Headquarters, Department of the Army (HQDA) disseminated information about a broadening seminar in AI across various Army commands. Commands were asked to recommend officers for the 2-week course and have them apply by drafting a memo outlining their experience and how they might apply AI to their mission area. One Officer's memo illustrated the excitement and forward-thinking attitude toward the course:

Furthermore, I should be considered to attend the Artificial Intelligence Seminar because I utilized AI (ChatGPT) to help write this memorandum, demonstrating that I am constantly striving to be at the forefront of Artificial Intelligence technology.

Once all memos were received, HQDA selected 24 Officers to attend the course (Fig. 4). Further logistical details were then provided to the selected Officers to facilitate their attendance.

The course was conducted primarily through in-person instruction, although some guest speakers participated virtually. Instructional methods included lectures, labo-



**Fig. 4 AI for Soldiers cohort 2024**

ratory demonstrations, and briefings by scientists on their research. The course also featured guest speakers from various fields to provide different perspectives on AI.

Logistical challenges, such as coordinating travel for participants from different parts of the world and ensuring seamless integration of virtual and in-person elements, were effectively managed through planning and coordination with local and international units. The successful delivery of the course was a testament to the collaborative efforts of a large team of individuals from ARL, FCC, and HQDA (see Appendix C).

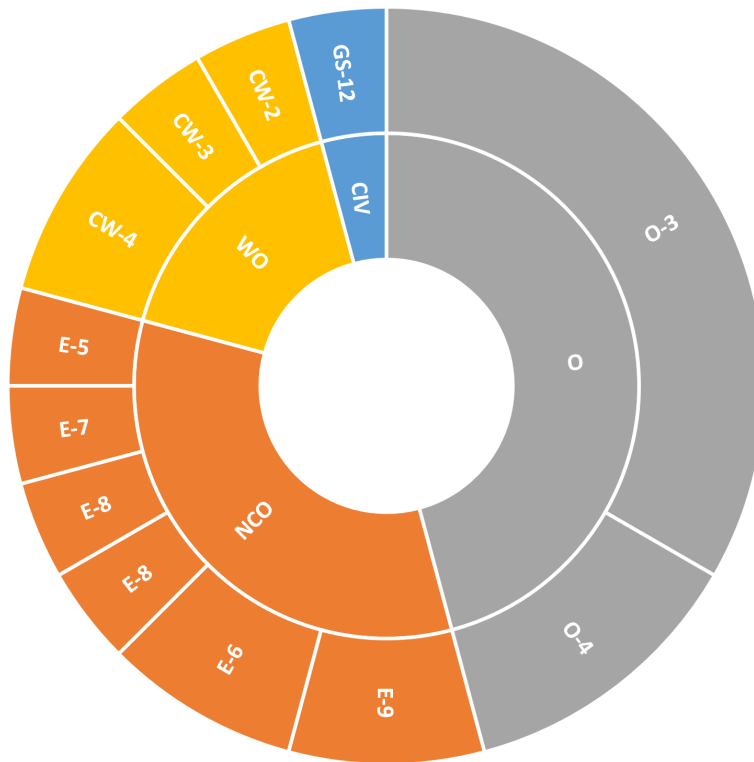
### **3.2 Overview of Soldier Locations and Organizations**

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This course featured 24 Soldiers aiming to enhance their understanding of AI and ML. Figure 5 displays a sunburst plot depicting the ranks and grades of the participants. The inner part of the sunburst plot shows the different categories of participants: Officer (O) (11), Noncommissioned Officer (NCO) (8), Warrant Officer (WO) (4), and Civilian (CIV) (1). The outer part of the sunburst plot illustrates the different grades for the various officers, ranging from mid-career to senior-career levels.

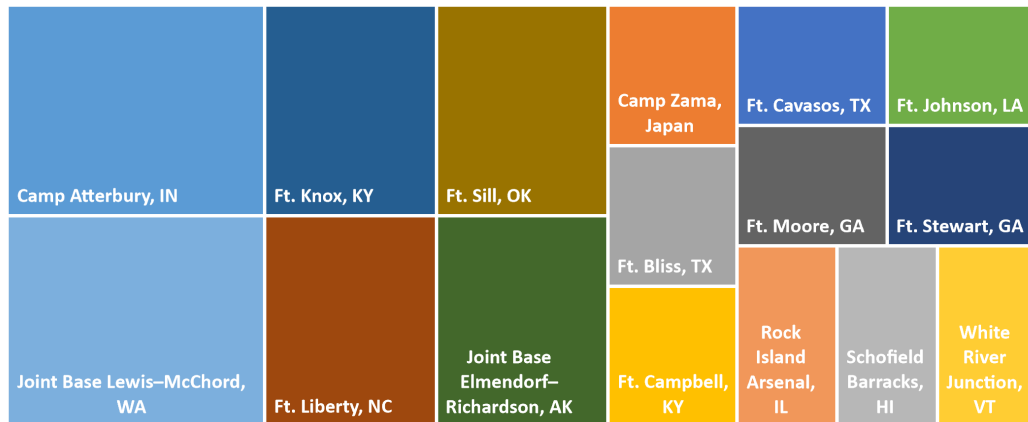
Figure 6 presents a tree map of the various bases and locations of the participants, with the relative areas of each tile corresponding to the number of participants from each base. In total, the 24 participants came from 16 different bases across 13 states, including one participant from Japan. Table 1 lists the different participants, their bases, and their job titles.

### Participant rank and grade



**Fig. 5** A sunburst plot showing the breakdown of participant rank and grade for Officer (O), Noncommissioned Officer (NCO), Warrant Officer (WO), and Civilian (CIV) along with their grades

### Participant locations



**Fig. 6** A treemap showing the participant bases and locations



**Table 1 Course participants, their organizations, and their roles**

| <b>Participants</b>   | <b>Base</b>                         | <b>Job title</b>                     |
|-----------------------|-------------------------------------|--------------------------------------|
| 1SG Randi Seney       | White River Junction, VT            | First Sergeant                       |
| CPT Fritz Dufresne    | Ft Moore, GA                        | Doctrine Writer                      |
| CPT Gabriel Croker    | Camp Atterbury, IN                  | Logistics Officer OC/T               |
| CPT Graben Parrish    | Joint Base Lewis–McChord, WA        | Data Systems Engineer                |
| CPT Jake Cary         | Ft Sill, OK                         | Brigade Assistant Staff Officer      |
| CPT John Bridgewater  | Ft Knox, KY                         | OC/T                                 |
| CPT Trevor Humphries  | Ft Campbell, KY                     | Strength Manager                     |
| CPT Vasily Tristinski | Ft Knox, KY                         | Team Leader                          |
| CPT William Anderson  | Ft Johnson, LA                      | Communications/Info Staff Officer    |
| CW2 Jason Langrehr    | Ft Stewart, GA                      | Targeting OC/T                       |
| CW3 Jacob Gibbons     | Joint Base Lewis–McChord, WA        | Information Protection Tech          |
| CW4 James Davis       | Joint Base Elmendorf–Richardson, AK | Division Targeting Officer           |
| CW4 Reginald Oliver   | Ft Cavazos, TX                      | Aviation Maintenance Officer         |
| Mr Josh Sutton        | Rock Island Arsenal, IL             | Information Technology Specialist    |
| MAJ Jared Moon        | Joint Base Elmendorf–Richardson, AK | Divison ORSA                         |
| MAJ Jason Hinds       | Schofield Barracks, HI              | Division ORSA                        |
| MAJ Paul Tolbert      | Camp Atterbury, IN                  | Brigade Chaplain OC/T                |
| MSG Tariq Aldamen     | Ft Liberty, NC                      | Information Systems                  |
| SFC Kevin MacAdam     | Camp Atterbury, IN                  | Operations Staff Officer             |
| SGM Carlos Walker     | Ft Liberty, NC                      | Army Reserve Affairs                 |
| SGM Chad Momerak      | Camp Zama, Japan                    | Army Reserve Affairs                 |
| SGT Jamison Kelly     | Joint Base Lewis–McChord, WA        | Data Engineer                        |
| SSG Jacolbe Miller    | Ft Bliss, TX                        | Information Systems Security Officer |
| SSG Joseph Correia    | Ft Sill, OK                         | Intelligence Analyst (NCOIC)         |

The participants of the AI course brought a rich diversity of positions, educational backgrounds, and domains of expertise, contributing to a multifaceted learning environment. Position titles ranged from Aviation Maintenance Officer, Doctrine Writer, Data Systems Engineer, and Strength Manager, to roles such as Brigade Chaplain Observer Coach/Trainer (OC/T), Team Leader, Targeting OC/T, Brigade Assistant Staff Officer, Intelligence Analyst, Information Systems Security Officer, Information Technology Specialist, First Sergeant, Officer or Noncommissioned Officer in Charge (OIC/NCOIC), Operations Research and System Analysis (ORSA) and more. Educational backgrounds were equally diverse, with degrees spanning BS in Finance, MBA in Engineering Leadership and Innovation Management, BA in Liberal Arts, MS in Organizational Leadership, MS in Computer Information

Systems, BS in Accounting, BS in Mathematics, BS in Mechanical Engineering, MS in Cybersecurity, and various others, including in-progress degrees in Computer Technology and Cybersecurity. The domains of expertise covered a broad spectrum, including data analytics, maintenance, sustainment, logistics, operating concepts, maneuver doctrine, data systems engineering, AI technologies, human resources optimization, predictive analysis, moral and ethical implications of AI, cyber risk assessment, Internet of Things devices and AI, artillery targeting, communications, sensor-to-shooter operations, software development, air defense battle systems management, counter unmanned aerial systems, and critical thinking and problem-solving. This diverse array of positions, educational backgrounds, and domain expertise ensured a comprehensive approach to understanding and applying AI within military contexts.

### **3.3 Capstone Team Assignment**

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The capstone teams were assigned using a systematic process designed to ensure a diverse mix of participants in each team. Figure 7 illustrates this assignment process. First, as shown on the left side of Fig. 7, the 24 participants were sorted by military personnel category (O, NCO, WO, CIV) and grade. Next, participants were iteratively assigned to one of four teams, ensuring a balanced distribution across all teams. The team names were chosen based on primary colors: red, yellow, blue, and green. Finally, as shown on the right side of Fig. 7, the capstone teams were organized by team name (color). This sorting method ensured that each team had a variety of military personnel categories and grades, fostering a diverse and balanced team composition. Additionally, participants were instructed to dress in civilian clothes to promote open discussion within capstone teams, minimizing the influence of rank and grade.

## Participant capstone team assignment

| NAME                  | RANK  | O   | GRADE | TEAM   | NAME                  | RANK  | O   | GRADE | TEAM   |
|-----------------------|-------|-----|-------|--------|-----------------------|-------|-----|-------|--------|
| GS-12 Josh Sutton     | GS-12 | CIV | GS-12 | RED    | SSG Jacolbe Miller    | SSG   | NCO | E-6   | BLUE   |
| SGT Jamison Kelly     | SGT   | NCO | E-5   | YELLOW | MSG Tariq Aldamen     | MSG   | NCO | E-8   | BLUE   |
| SSG Jacolbe Miller    | SSG   | NCO | E-6   | BLUE   | CPT Gabriel Croker    | CPT   | O   | O-3   | BLUE   |
| SSG Joseph Correia    | SSG   | NCO | E-6   | GREEN  | CPT Trevor Humphries  | CPT   | O   | O-3   | BLUE   |
| SFC Kevin MacAdam     | SFC   | NCO | E-7   | RED    | MAJ Jason Hinds       | MAJ   | O   | O-4   | BLUE   |
| 1SG Randi Seney       | 1SG   | NCO | E-8   | YELLOW | CW4 James Davis       | CW4   | WO  | CW-4  | BLUE   |
| MSG Tariq Aldamen     | MSG   | NCO | E-8   | BLUE   | SSG Joseph Correia    | SSG   | NCO | E-6   | GREEN  |
| SGM Carlos Walker     | SGM   | NCO | E-9   | GREEN  | SGM Carlos Walker     | SGM   | NCO | E-9   | GREEN  |
| SGM Chad Momerak      | SGM   | NCO | E-9   | RED    | CPT Graben Parrish    | CPT   | O   | O-3   | GREEN  |
| CPT Fritz Dufresne    | CPT   | O   | O-3   | YELLOW | CPT Vasily Tristinski | CPT   | O   | O-3   | GREEN  |
| CPT Gabriel Croker    | CPT   | O   | O-3   | BLUE   | MAJ Paul Tolbert      | MAJ   | O   | O-4   | GREEN  |
| CPT Graben Parrish    | CPT   | O   | O-3   | GREEN  | CW4 Reginald Oliver   | CW4   | WO  | CW-4  | GREEN  |
| CPT Jake Cary         | CPT   | O   | O-3   | RED    | GS-12 Josh Sutton     | GS-12 | CIV | GS-12 | RED    |
| CPT John Bridgewater  | CPT   | O   | O-3   | YELLOW | SFC Kevin MacAdam     | SFC   | NCO | E-7   | RED    |
| CPT Trevor Humphries  | CPT   | O   | O-3   | BLUE   | SGM Chad Momerak      | SGM   | NCO | E-9   | RED    |
| CPT Vasily Tristinski | CPT   | O   | O-3   | GREEN  | CPT Jake Cary         | CPT   | O   | O-3   | RED    |
| CPT William Anderson  | CPT   | O   | O-3   | RED    | CPT William Anderson  | CPT   | O   | O-3   | RED    |
| MAJ Jared Moon        | MAJ   | O   | O-4   | YELLOW | CW3 Jacob Gibbons     | CW3   | WO  | CW-3  | RED    |
| MAJ Jason Hinds       | MAJ   | O   | O-4   | BLUE   | SGT Jamison Kelly     | SGT   | NCO | E-5   | YELLOW |
| MAJ Paul Tolbert      | MAJ   | O   | O-4   | GREEN  | 1SG Randi Seney       | 1SG   | NCO | E-8   | YELLOW |
| CW3 Jacob Gibbons     | CW3   | WO  | CW-3  | RED    | CPT Fritz Dufresne    | CPT   | O   | O-3   | YELLOW |
| CW2 Jason Langrehr    | CW2   | WO  | CW-2  | YELLOW | CPT John Bridgewater  | CPT   | O   | O-3   | YELLOW |
| CW4 James Davis       | CW4   | WO  | CW-4  | BLUE   | MAJ Jared Moon        | MAJ   | O   | O-4   | YELLOW |
| CW4 Reginald Oliver   | CW4   | WO  | CW-4  | GREEN  | CW2 Jason Langrehr    | CW2   | WO  | CW-2  | YELLOW |

Fig. 7 Ordered list of rank and grades along with team assignments (left) along with the grouping by team (right) for the capstone projects team assignment

## 4. Course Content

In this section, we provide a comprehensive overview of the AI course content, organized by modules and the sequence of topics covered each day. Each module is crafted to provide Soldiers with a deep understanding of AI concepts, ML algorithms, and their applications in military contexts. Through a combination of instructional lectures, real-world examples, and discussions led by expert instructors, participants gain insights into various facets of AI, ranging from foundational principles to advanced techniques. Additionally, this section highlights the learning objectives associated with these modules, elucidating the key takeaways for Soldiers undergoing this educational experience. Furthermore, we include bios of the instructors and organizers to provide insights into their expertise and background.

## **4.1 AI Content**

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### **4.1.1 Day 1 (Module 1): Introduction to Artificial Intelligence, Part I**

AI Problem Solving. Welcome to the AI for Soldiers (AI4S) course! This first module sets the stage for the course, providing an introduction to AI, its history, and the foundational concepts that will be explored throughout the program. Module topics include:

- Evolution of Artificial Intelligence
- Intelligent Agents
- Fundamentals of Search and Adversarial Search (Games)

### **4.1.2 Day 1 (Module 2): Introduction to Artificial Intelligence, Part II**

Knowledge and Reasoning. This module explores the foundational aspects of AI, focusing on Knowledge and Reasoning. It delves into the design of intelligent agents capable of understanding and navigating a complex world through logical inferencing. Module topics include:

- Logical Agents and Inferencing
- Knowledge Representation
- Automated Decision Making

### **4.1.3 Day 2 (Module 3): Introduction to Machine Learning**

Machine learning here, machine learning there, machine learning everywhere! This module will tackle the concepts, the math, and the algorithms of ML for those that are slightly familiar, somewhat familiar, or not at all familiar with the topic. Module topics include:

- Data is the New Bacon: Introduction to Data
- Machine Learning Primer
- Machine Learning Basics

#### **4.1.4 Day 2 (Module 4): Introduction to Neural Networks**

This module dives into what makes up the standard neural network architecture, building on the introduction to ML. It explores how simple perceptron models can be expanded into “deep learning” neural networks. Module topics include:

- Neural Network Basics

#### **4.1.5 Day 3 (Module 5): Neural Networks Architectures for Images, Compression, and Generative AI**

This module looks at data in different forms, from images to unstructured text, and explores convolutional neural networks, autoencoders, and generative adversarial networks. Module topics include:

- AI/ML Real-World Examples
- Convolutional Neural Networks
- Autoencoders and Generative Adversarial Networks

#### **4.1.6 Day 3 (Module 6): Neural Networks Architectures for Sequences and Text**

This module explores sequence models and provides a brief introduction to natural language processing (NLP) models. Module topics include:

- Sequence Models
- Natural Language Processing
- Transformer Models

#### **4.1.7 Day 4 (Module 7): Introduction to Natural Language Processing**

This module explores the pivotal role of NLP in contemporary AI developments. Module topics include:

- Overview of Natural Language Processing
- Automated Speech Recognition
- Deep Learning for NLP

#### 4.1.8 Day 4 (Module 8): Practical Applications of NLP

This module explores various natural language processing tasks essential in modern AI applications, coupling theory and concepts with lab tours and interactions with scientists on the AI in Action science demonstration days (Fig. 8). Module topics include:

- Information Extraction
- Question Answering and Summarization
- Dialogue and Conversational Agents



**Fig. 8** Soldiers with Smokey, a legged robot (Vision 60 model), on one of the AI in Action science demonstration days

#### 4.1.9 Day 6 (Module 9): Artificial Intelligence and Robotics Integration

This module provides an introduction to the integration of AI and ML with robotics and autonomous systems, coupled with a tour of the Robotics Research Collaboration Campus (R2C2) at Grace's Quarters (Fig. 9). Module topics include:

- Introduction to Intelligent Robotics
- Behavior-Based Robotics



- Human–Robot Interaction
- Autonomous Systems for the Army
- Artificial Intelligence for Maneuver and Mobility



**Fig. 9 Unmanned ground vehicle and legged robotics demonstrations at Graces Quarters' Robotics Campus R2C2**

#### **4.1.10 Day 7 (Module 10): Humans and AI: Understanding AI in Military Environments**

This module covers the unique challenges and opportunities of employing AI with humans in military environments, kicked off with a human-bot exercise (Fig. 10). Module topics include:

- AI / Data Science Adversarial Brief
- Systemic Oversimplification Limits Potential for Human–AI Partnerships
- Trust and System Transparency
- Human-Guided Machine Learning for Command and Control and Battlefield Autonomy
- Course of Action Generative Pre-Trained Transformers (COA-GPT): Accelerated Course of Action Development in Military Operations
- Neuro-Inspired Intelligent Systems
- Re-envisioning Command and Control



**Fig. 10** AI human-bot exercise with Dr Amar Marathe and Dr Corde Lane to kick off the Humans and AI portion of the course



#### **4.1.11 Day 8 (Module 11): Humans and AI: AI Applications in Military Environments**

This module is intended to be very hands-on, consisting of a mixture of demonstrations and instruction, exploring the intersection between humans and AI in military environments. Module topics include:

- Information for Mixed Squads Laboratory Tour and Adaptive Aided Target Recognition
- Neuro-Inspired Intelligent Systems Demonstration
- Human-Guided Machine Learning for Platform Mobility
- Human-Guided Machine Learning for Command and Control
- Protein Design Wars: Implications of AIML in Protein Structure Prediction
- Human in the Loop Optimization of the Exo Boot Assistance Device
- Intelligent Weapon Systems for Dismounted Infantry

#### **4.1.12 Day 9 (Module 12): Ethical and Strategic Considerations in AI Deployment**

This module navigates the complex landscape of responsible AI deployment, delving into ethical considerations, biases, operational strategies, and global implications. Module topics include:

- Ethical Considerations in AI Deployment
- AI Biases and Fairness
- AI Ops
- AI Strategy
- Global Implications and Competition of AI

## 4.2 AI Learning Objectives

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The learning objectives for the course include:

- Understand the evolution and fundamental concepts of artificial intelligence.
- Learn about intelligent agents, knowledge representation, and logical inferencing.
- Explore various machine learning algorithms and their applications.
- Dive into neural network architectures and their practical implementations.
- Learn about natural language processing and see it in action.
- Understand the role of AI and machine learning in robotic platforms.
- Address the challenges of employing AI in military environments and understand the human–AI interaction.
- Analyze the ethical and strategic considerations in AI deployment.

## 4.3 Instructor and Organizer Bios

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### Dr Mark Tschopp

Dr Mark Tschopp is a research scientist within DEVCOM ARL. He has spent over a decade in research and development roles ranging from scientist to faculty to senior leader within General Motors Powertrain, the Air Force Research Laboratory (AFRL), Mississippi State University, and ARL. As a scientist, he is known for research on accelerated materials design using modeling and simulation, data science, ML, and design optimization, which has resulted in numerous highly cited publications in top peer-reviewed journals. He is a Fellow of American Society of Mechanical Engineering, a Fellow of American Society of Materials International, and an ARL Fellow (top 1.5% of ARL scientists)—the highest distinction for scientists within these organizations. He is passionate about sharing his knowledge and has developed a popular short course titled “Machine Learning for Everyone: May the Course Be with You” in 2021 that has now had over 2500 participants, receiving the 2022 ARL Honorary Award for Impactful Communication.

### **Dr Reginald Hobbs**

Dr Reginald L Hobbs has 40 years in the computer industry, including active duty in the US Air Force, serving as a defense contractor, and his current career as an Army computer scientist. Dr Hobbs has a bachelor's degree in Electronics from Chapman University and graduate degrees in Computer Science from the Georgia Institute of Technology. He is currently Chief of the Content Understanding Branch at DEVCOM ARL. He has research interests and experience in the areas of software engineering, natural language processing, AI, and cognitive science. Dr Hobbs has 50+ publications in multiple scientific disciplines and his work has been cited by researchers around the world.

### **Dr John Fossaceca**

Dr John Fossaceca is the Division Chief for the DEVCOM ARL's Science of Intelligent Systems Division, overseeing research in AI and ML for autonomous systems. With extensive industry experience including roles ranging up to Executive Vice President of Engineering and Vice President of Technology at companies Ultra-3eTI, Comtech Mobile Datacom, and Bell Laboratories, he led teams that modernized the US Army's satellite-based Blue Force tracking system and developed secure Wi-Fi technology accredited by the US Government. Dr Fossaceca holds bachelor's and master's degrees in electrical engineering from Manhattan College and Syracuse University, an MBA from Virginia Tech, and a PhD in systems engineering from the George Washington University. Dr Fossaceca's current interests lie in online continuous ML, applications of generative AI, and resilient autonomy. Dr Fossaceca is also deeply involved in academia, teaching graduate courses in AI, ML, Cryptography, Intrusion Detection, and Cybersecurity, and serving as a PhD research advisor.

### **Dr Brandon Perelman**

Dr Brandon Perelman is a research psychologist with DEVCOM ARL and is currently serving as the Program Manager for ARL's Human-Autonomy Teaming Essential Research Program. He is a graduate of Michigan Technological University's Applied Cognitive Science and Human Factors program and completed his dissertation under Dr Shane T Mueller. He completed his MS in experimental psychology at Saint Joseph's University and attended Sarah Lawrence College for his under-

graduate education. Following his undergraduate education, he served as a combat infantryman in the Israel Defense Forces, 50th Bn, Nahal Brigade. He is a former AFRL Daniel Repperger program fellow and a former employee of Applied Research Associates Inc., Cognitive Solutions Division (formerly Klein Associates), where he worked on projects for government customers including Intelligence Advanced Research Program Agency, AFRL, Army Research Institute, and the Federal Bureau of Investigation. His research at ARL focused on human-agent collaborative spatial decision-making in mixed-initiative systems, trust in autonomous systems, human-computer interaction, and multisensory cybernetics. His primary research interests include computational modeling and simulation, AI, human-agent teaming, spatial cognition, human-computer interaction, and decision-making.

### **Dr Joe Rexwinkle**

Dr Joe Rexwinkle (Fig. 11) is a biomedical engineer with DEVCOM ARL and is currently serving as the Team Lead for the Soldier-Guided Adaptation and Cross-Mission Team Evolution thrusts of ARL's Human-Autonomy Teaming Essential Research Program. He is a graduate of the University of Missouri with a PhD in Mechanical Engineering and a BS in Biomedical Engineering. His research at ARL has been generally focused on adaptive human control of autonomous systems, with prior research on brain-computer interfaces, shared situational awareness tools, and intuitive methods for training and adapting algorithms based on operator intent. His primary research interests include human-agent teaming, human-guided ML, AI, and methods for characterizing human intent.



**Fig. 11 Dr Joe Rexwinkle giving an overview talk for the Human and AI module**

## **5. Course Feedback**

The feedback from the participants of the AI course has been very positive, underscoring the value and impact of the training. A few particularly noteworthy comments encapsulate the enthusiasm and appreciation expressed by many attendees:

Dr Tschopp and Dr Hobbs were phenomenal. The Major [Matthew Work] and the [FCC DoC Chris Stolz] were great moderators and they lent a lot of perspective during the entire course. BG Stephanie Ahern was very personable and sincerely listened to the feedback of the students. I loved the course and it was encouraging to know that we have 1600 researchers pioneering the way ahead for the armed forces. With the outlook, skills, and knowledge gained from the course I have a significantly better understanding of the capabilities and limitations of AI. I intend to educate my organization and eventually build an “Intro to AI in the Armed Forces” presentation at some point to build a shared understanding with rest of the brigade. Thank you, I am very thankful for the opportunity to participate in this course.

---

I would recommend everyone in my organization to attend this course.

---

Please share with the ARL team and all the [subject-matter experts] that invested in us that I am thankful and appreciative of their work. I'm a parent of a 21-year-old and 18-year-old Soldier (and a 15-year-old future Soldier). The work ARL is doing may save my sons' lives down the road, thank you.

Additionally, some participants shared these thoughts in kudos letters to the instructors:

I wanted to take a moment to sincerely thank both of you for a phenomenal course. I can honestly say that, of all the courses I've attended in the Army, this one was one of my favorites. I wished there was more time in the course, and I hope that you two continue to be the primary instructors. Thanks for all you've done and continue to do!

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Thanks again for investing in us during the [AI for Soldiers course]. I was thoroughly impressed with the [subject-matter expertise] represented throughout our time together. It was humbling and inspiring at the same time.

---

I really appreciate your willingness to help beyond this course... It's been wonderful learning from you!

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I want to express my heartfelt thanks for the wonderful course you've conducted—it has been a truly enlightening experience, and I greatly appreciate it.

In this section, we will delve into the detailed feedback provided by the participants, highlighting the key aspects of the course that were most appreciated and the areas where improvements can be made.



## 5.1 AI for Soldiers Course Survey (Quantitative) Feedback

The course participants were asked to give anonymous course feedback, both quantitative (scale of 1 to 5, strongly disagree to strongly agree) on several statements and qualitative (“What did you think of the course? Anything else that you wish to add?”). A screenshot of the survey is shown in Fig. 12. The survey includes both their familiarity with AI coming into the course, followed by statements about the course that the participants were asked to give their agreement (or disagreement) with.

### AI for Soldiers Course Survey

**AI for Soldiers Course Survey**

Hi, Mark. When you submit this form, the owner will see your name and email address.

\* Required

**Quantitative feedback**

THIS COURSE NEEDS YOUR FEEDBACK! What do you think after going through the course? Click on some short disagree/agree/strongly agree statements and let us know from your perspective how this went - the comments section is your opportunity to be candid so please speak up!

1. How familiar were you with Artificial Intelligence coming into the course? (not at all, slightly familiar, moderately familiar, very familiar, extremely familiar) \*

|                                             | Not at all            | Slightly              | Somewhat              | Very                  | Extremely             |
|---------------------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| How familiar are you with machine learning? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

2. Statements about the course. Please answer your agreement (or disagreement) with the statements below, i.e., strongly disagree, disagree, neither, agree, strongly agree (1-5 scale). \*

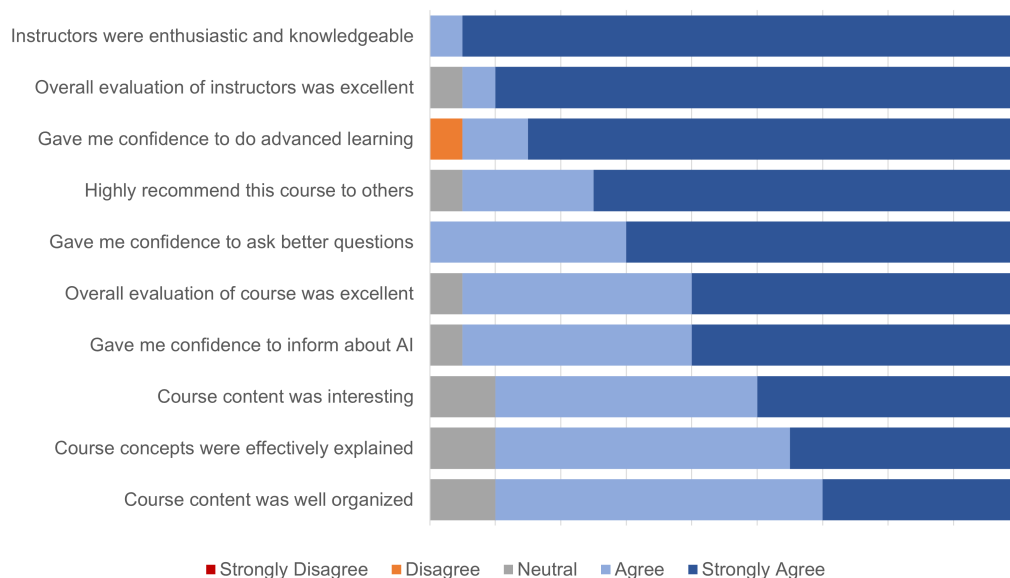
|                                                                                  | Strongly Disagree     | Disagree              | Neutral               | Agree                 | Strongly Agree        |
|----------------------------------------------------------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| The presentations and course materials were well organized                       | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| The presentations and course materials explained the course concepts effectively | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

**Fig. 12 AI for Soldiers course survey for gathering quantitative feedback from participants**

The 10 course evaluation statements reflect the course content, the instructors, and the participant’s confidence in AI and the breakdown for these are shown in Fig. 13. The feedback from the participants of the AI course has been overwhelmingly positive, underscoring the value and impact of the training. To gain genuine and insight-

ful feedback, we crafted our evaluation statements using strong and definitive language. By employing phrases like “excellent” instead of simply “good,” we aimed to capture a more nuanced and honest range of responses. This approach allowed us to better understand the participants’ true perceptions and the areas where the course excelled or could be improved. The highest ratings were for the “the instructors were enthusiastic and knowledgeable about the course material” and “my overall evaluation of the instructors is excellent” statements. The lowest score was for “the presentations and course materials were well organized,” which can be expected—this course was a pilot effort, so this can even be an encouraging score given that the majority still agreed or strongly agreed with the statement.

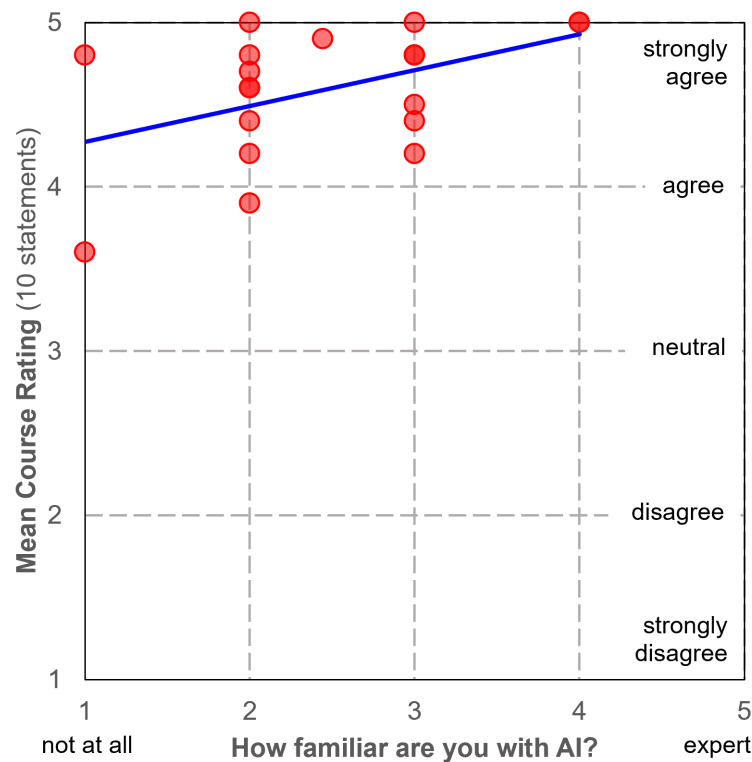
### AI for Soldiers Course Feedback



**Fig. 13 Anonymous course ratings for the AI for Soldiers 2024 course for different statements from 1 (strongly disagree) to 5 (strongly agree). The paraphrased statements that the participants were asked to evaluate are listed in the horizontal bar chart along with the corresponding average value (out of 5).**

To further examine the course feedback, Fig. 14 presents a scatter plot illustrating the relationship between participants’ familiarity with AI and their average course ratings. In this plot, categorical responses were converted into numerical values. Each red dot represents the average rating given by a participant across the 10 feedback statements, plotted against their response to the question, “How familiar are you with AI?” For one participant who did not answer this question, the average AI familiarity value was used. Several key observations can be made from this plot.

First, none of the participants described themselves as “experts in AI” (value of 5), and only a few selected that they were either “not at all familiar with AI” (1) or “very familiar with AI” (4). Consequently, the majority of participants identified themselves as “slightly familiar” (2) or “somewhat familiar with AI” (3). Second, the blue line in the plot indicates the trend in the data, showing that as familiarity with AI increased, participants tended to give higher course ratings. Notably, the mean response generally fell between “agree” and “strongly agree,” with only two exceptions. This indicates that the majority of participants rated the course very highly, reflecting its overall excellence.



**Fig. 14** Scatter plot of the mean course rating (from the 10 categories) vs. the familiarity with AI where the category responses were converted into 1 to 5 ratings (strongly disagree to strongly agree and not at all to expert, respectively)

For “What did you think of the course? Anything else that you wish to add?” section, there were quite a few comments. In addition to the ratings, the comments reflect that the course participants both learned about AI and its concepts in addition to enjoying the instructors and course structure. Some comments reflect opportunities to improve the course. Here are excerpts from the comments that are positive about the course:

1. "The course provided valuable foundational knowledge on AIs theoretical aspects, its potential applications, and future implications within the force."
2. "I would recommend everyone in my organization to attend this course."
3. "It was great. The order and flow was good."
4. "I very much enjoyed the material and am thankful for the opportunity to meet so many of the staff that work with the technology every day."
5. "Very well done making a complex topic accessible for many without a hard science background. I appreciate the care put into the course organization from the meal options to field trips to [subject-matter expert] engagements. Thank you for this investment in our professional development."
6. "Dr Tschopp and Dr Hobbs were phenomenal. The Major [Matthew Work] and the [FCC DoC Chris Stolz] were great moderators, and they lent a lot of perspective during the entire course. BG Stephanie Ahern was very personable and sincerely listened to the feedback of the students. I loved the course, and it was encouraging to know that we have 1600 researchers pioneering the way ahead for the armed forces. With the outlook, skills, and knowledge gained from the course I have a significantly better understanding of the capabilities and limitations of AI. I intend to educate my organization and eventually build an 'Intro to AI in the Armed Forces' presentation at some point to build a shared understanding with rest of the brigade. Thank you, I am very thankful for the opportunity to participate in this course."
7. "I found this course fun and interesting."
8. "Great course!"
9. "Great pilot effort. This type of material needs to be incorporated into Army [professional military education] in a condensed space to provide general awareness to future leaders."
10. "It was great with no [issues]."
11. "Great course. Honored to be selected to attend."
12. "The course was great to learn about how ARL is approaching and using AI in research [...] the knowledge and resources gained in this course will be used

in forming guidance on how to prepare for producing realistic expectations and guidance to the unit.”

13. “I strongly believe that this course should be offered at least twice annually to educate the force. Promoting awareness will be crucial to guarantee success within the force while implementing AI. I recommend keeping the business casual attire for the course.”
14. “The course was overall well put together and should continue.”
15. “Great course. Look forward to seeing this course evolve if the course is allowed to continue.”
16. “I am much more confident in the direction the Army is heading and very smart people are working on problems we are concerned with.”
17. “Please share with the ARL team and all the [subject-matter experts] that invested in us that I am thankful and appreciative of their work. I’m a parent of a 21-year-old and 18-year-old Soldier (and a 15-year-old future Soldier). The work ARL is doing may save my sons’ lives down the road, thank you.”
18. “I truly appreciate all the work and sacrifice that all of you do for the nation and putting this course together.”

The overwhelmingly positive feedback from our course participants underscores the value and impact of the AI4S course. Participants have expressed their appreciation for the foundational knowledge provided, the opportunity to engage with subject-matter experts, and the comprehensive organization of the course. The testimonials reflect a deep gratitude for the investment in their professional development and a recognition of the critical role that AI will play in the future of the armed forces. The heartfelt messages from our attendees highlight not only their personal growth but also their commitment to sharing this knowledge within their organizations, ensuring that the benefits of this course extend far beyond the classroom.

There were also some portion of the comments that reflect opportunities to improve the course. The majority of these comments came from participants that marked “Not at all familiar with AI” or “Slightly familiar with AI,” perhaps reflecting that those participants with little exposure to AI had different expectations of the course than those more familiar with AI. The following excerpts were pulled from their

comments and ordered in terms of their familiarity with AI (i.e., the first comments were the least familiar with AI and the last comments were the most familiar):

1. Math | Too much math, i.e., “My only critique is of the amount of math that was presented.”
2. Comprehension, i.e., “There was a lot of technical data that really didn’t make sense.”
3. Course Audience, i.e., “Split the course into two groups based on knowledge and experience with this information.” and “I hope this course will be geared to O-3 commanders and 1SGs/SGMs.”
4. Near-Term Applications of AI, i.e., “However, for future iterations, I would recommend incorporating a more in-depth exploration of current and evolving AI applications that could affect the force in the next four to eight years.”
5. IT | Network, i.e., “[Network] connectivity would have been great so we could do some instructor led practical work in Excel, Python, or GPT. Just to reinforce the lessons taught and break up some of the overwhelming (at times) [PowerPoint presentations].”
6. Pre-work | Read ahead, i.e., “More pretext would help. [...The math] is tough, but when you understand this level, it will help you understand the next levels of how it becomes easier.”
7. Course objective, i.e., “I still don’t really understand what the course objective was. I am better informed about AI/ML, and I will [definitely] advocate for ARL. If that was the objective that was a success.”
8. Specific Competency Breakouts | Competency Overview, i.e., “I wish that there was enough to have specific breakout sessions with the [ARL] competency of your choice to get a deeper understanding of AI subject matter with respect to the competency of interest. Additionally, I would have enjoyed each competency being represented during the course, especially weapon systems.”
9. AI tools, i.e., “I do wish that there was more tools that we can bring back to our commanders.”

10. Course prerequisite, i.e., “I would have an emphasis on a distance learning course for beginners and the in-person course for those with more experience.”
11. Hands-on AI applications, i.e., “More hands-on in AI applications.”

These constructive comments provide valuable insights into how we can further enhance the AI4S course. Addressing the feedback about the level of mathematical content, ensuring clarity in technical data, and tailoring the course to different levels of AI familiarity will help create a more inclusive learning environment. Incorporating more near-term AI applications, practical hands-on activities, and providing robust pre-course materials could also enhance participant engagement and learning outcomes. By embracing these opportunities for improvement, we can refine and develop the course to better meet the diverse needs and expectations of all participants, ultimately strengthening the impact and reach of AI education within the force.

## **5.2 AI for Soldiers Course Survey (Qualitative) Feedback**

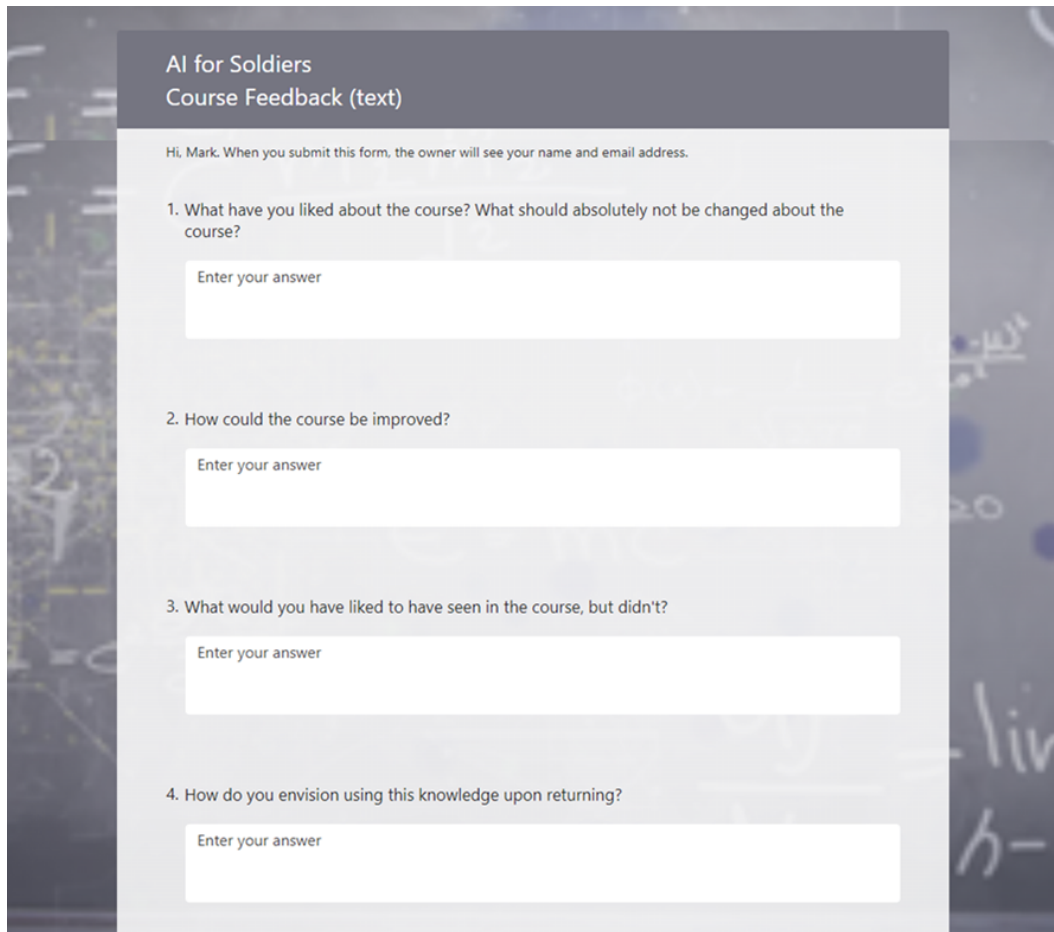
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The course participants were asked to give anonymous course feedback to a few questions where they were allowed to expand upon their thoughts on the course. A screenshot of the survey is shown in Fig. 15. The survey includes both their familiarity with AI coming into the course, followed by statements about the course that the participants were asked to give their agreement (or disagreement) with.

In this section, the feedback questions are presented in bold, followed by the supporting statements. The statements were categorized at the first level of the bulleted list, and the specific responses from participants are shown as quotations at the second level. The full comments for the course are given in Appendix D.



## AI for Soldiers Course Survey

A screenshot of a web-based survey form titled "AI for Soldiers Course Feedback (text)". The form is set against a background of a chalkboard with faint mathematical equations. It includes a header section with the title and a sub-header. Below this, a message states: "Hi, Mark. When you submit this form, the owner will see your name and email address." The survey consists of four numbered questions, each followed by a text input field with the placeholder "Enter your answer".

AI for Soldiers  
Course Feedback (text)

Hi, Mark. When you submit this form, the owner will see your name and email address.

1. What have you liked about the course? What should absolutely not be changed about the course?

Enter your answer

2. How could the course be improved?

Enter your answer

3. What would you have liked to have seen in the course, but didn't?

Enter your answer

4. How do you envision using this knowledge upon returning?

Enter your answer

**Fig. 15** Screenshot of the AI for Soldiers course survey for gathering qualitative (long text) feedback from participants

**What have you liked about the course? What should absolutely not be changed about the course?**

- **Scientists | Meeting with ARL Scientists**

- “I enjoyed the opportunity to meet with the scientists.”
- “All of the [subject-matter experts] were approachable and addressed us as fellow professionals albeit from different backgrounds.”
- “... the interactions with the researchers to give context to the information presented.”
- “The variety of people we interacted with, and the range of fields is eye opening.”

- “I truly like the diversity [of the scientists] within the course.”

- **Glimpse of the future of AI | Demonstrations | Learn about AI Research**

- “I enjoyed the opportunity [. . . to] learn about their research and how it will change the Army in the near future.”
- “. . . the potential that AI brings to the force is immeasurable for future generations.”
- “The demonstrations were helpful to see real world applications.”
- “The practical application of AI systems.”
- “Also enjoyed the philosophical discussions on the direction of AI and the possibilities in the future.”
- “The practical demonstrations of the AI applications currently being developed by [ARL] has to stay. To get an opportunity to see and discuss real-time applications (and limitations) makes it easier to correlate the material and transfer concepts to the students’ respective disciplines in order to advocate for AI in the students’ own professional spaces.”

- **Course structure | Course organization**

- “I loved the structure, starting from under the hood and seeing how it can be employed. I am much more suited to speak intelligently on the why, and why not for my commander.”
- “Overall, I enjoyed how highly informative and well organized the course was.”
- “I like the information on AI as a whole and the interactions with the researchers to give context to the information presented. I wouldn’t change anything about the course, I very much enjoyed it.”

- **Course content | Depth of Course Content**

- “The depth and level of knowledge was unsurpassed and for me as a warrant officer always needing to speak truths (why or why not) I feel armed and intelligent.”
- “The ML course was technical, but [it] was absolutely needed to provide a foundation in AI. Themes such as [recurrent neural networks] were

talked about in briefs from other presenters. The ML class helped us understand the other briefers and know what questions to ask.”

- “I truly like the diversity within the course on topics and scientists.”
- “I liked that the fact that the course was not only informative but very technical. Course construction made some assumptions that the student had a basic understanding of Excel, linear algebra, calculus, and statistics which allowed us to jump right into a deeper ML model environment.”

- **Relaxed Atmosphere | Learning Environment | Teaching Style**

- “The relaxed atmosphere. Yes, we had a goal to attain, but we had a pretty good time getting there. The Star Wars references, the jokes about AI, watching two guest speakers geek out over quantum computing [...] we were able to laugh and take everything in stride. If the overall goal of the class changes, then, of course, the content of the class will need to change as well, but the delivery very much needs to remain the same in my opinion.”
- “I appreciated the overall environment.”
- “I’ve really enjoyed the engaging teaching style of the course. The supportive atmosphere created by both Dr Tschopp and Dr Hobbs is commendable.”

- **Course location (ALC/APG)**

- “I would recommend maintaining the current course location, it allows invaluable opportunity for each of us to witness improvements firsthand.”
- “Keep part of in-person classes at ARL–Adelphi [Laboratory Center].”

- **Civilian attire**

- “Wearing civilian attire allowed us to be relaxed and fostered freedom of expression without rank getting in the way if we were in uniform.”

- **ARL and its role | AI in Action | Tours**

- “The off-site visits to ARL activities helped the class visualize the impact of ARL.”

- “Absolutely keep the trips to both locations.”
- “Any and all visual representation of robotics / equipment. Basically, all hands-on stuff keep.”
- “Visit to APG showed me things that I didn’t know we were researching.”
- “[Keep] tours of research facilities and demonstrations.”
- “[Keep] in-person, hands-on class at Graces Quarters and APG.”

- **Guest Speakers**

- “I absolutely will keep the guest speakers input during the agenda of the course.”

- **Audience | Size**

- “Keep course (in person) to 20–30 person for more hands-on experience.”

The participants expressed a strong appreciation for various aspects of the course, particularly the opportunity to engage with ARL scientists and witness AI research firsthand. They valued the practical demonstrations, the well-organized structure, and the depth of the course content, which provided a comprehensive understanding of AI’s potential applications. The relaxed and supportive learning environment, facilitated by knowledgeable instructors, was highlighted as a key factor in their positive experience. The in-person format, including site visits and the informal setting, fostered a collaborative atmosphere and allowed for meaningful interactions. The feedback underscores the course’s success in delivering an informative and engaging learning experience while also identifying areas for continued improvement to better serve future participants.

### **How could the course be improved?**

- **Target audience**

- “Broader targeted audience with more emphasis on individuals actually interested and passionate about the subject matter.”

- “Tailor the class to those with more foundational math and [science, technology, engineering, and mathematics] backgrounds.”

- **Tailored content**

- “Possibly provide a day to allow attendees to see more in-depth areas that they may be in.”
- “Possibly break the course into more narrow focus areas but go into more depth in each of those areas.”

- **Connectivity**

- “One of the big things for me was connectivity in the classroom. When I was feeling it was well above my head, I had to write things down to research later which prevented me to ask the questions I may have had.”
- “Having internet access would have helped (read ahead said it would be provided and we needed to bring [common access card (CAC)] enabled computers. That was not accurate).”
- “Having big classroom with internet connections will help.”

- **Math**

- “I’m sure everyone is going to mention the math here. Days 2 and 3 were a struggle for most. I do feel the math portion DOES need to be there; being educated on just how complex things are and how quickly they get that complicated does a lot to dispel the mysticism of AI and it helps those of us on the outside to be able to have a more intelligent conversation. However, the level of math required surpassed most of us in the class very quickly and the following hours were unproductive as we were already lost.”
- “The foundation part was helpful albeit too heavy on the mathematical details. Still, it was nice to recognize vocabulary when we got to the application field trips ([activation] functions, softmax, etc.).”
- “The course could be improved by reducing the amount of ‘numbers’ and expanding on AI applications. A great deal of the formulas and number driven data in some of the presentations was significantly above the level of understanding for most of the attendees.”

- “I might give a briefer explanation of the math.”
- “A shorter version of the math for the AI systems. One breakdown of the matrix math and then a summary of the differences between the different models. A pro and cons of the different models would have sufficed. I like math but found it difficult to stay attentive and once I stopped following the math I was simply riding along.”
- “Slightly less math. I understand the definitions and framework of how it works is important, though.”
- “. . . and less math.”
- **Too much PowerPoint**
  - “Maybe cut down on the PowerPoint a bit, some days I felt talked at from the visiting briefers.”
  - “The course can be improved with less PowerPoint.”
  - “Less PowerPoint, more hands-on time with AI systems.”
- **Audience participation**
  - “From a delivery standpoint, getting more audience participation during the foundations portion would be an improvement (have us play the wompus game rather than just lecturing on it.)”
- **Course pace | Time constraints**
  - “Due to the time constraints moving from subject to subject, some of the course material felt rushed and wasn’t able to talk with the instructors on specific topics or questions the group had. Overall, the course was very well structured for PowerPoint presentations but some days not for asking question of certain topics.”
  - “The course also felt very rushed and crammed. Yes, there was a lot of content, but there were many times that thoughtful discussion, lab demonstration, and content instruction was forced to be rushed based on the schedule. At times, students couldn’t ask questions about a concept they didn’t understand, simply because there was not enough time and we had to get to the next slide deck or speaker. There was certainly some felt frustration. This played out significantly in the NLP lab. The

timeline was so crunched that many of the presenters had to skip over slides or just end their brief prematurely. I felt that was not only a disservice to the students, but also the presenters who were there to show their work but also help us students understand their roles. I'm not saying to completely forego a timeline, but students will get lost very quickly once it becomes apparent the course is about getting through the slides, not 'getting through the students' skulls.'"

- **Meals**

- “Soldiers are not used to paying so much for meals/snacks. All we really need is coffee and water. With the hotel providing breakfast, there's no need for morning snacks (we could have brought fruit from the hotel if needed). It was odd that only those who paid could help themselves to coffee when ARL staff not involved in the course were helping themselves to the coffee that first week. To get around that, get with the Family Readiness Group to provide coffee/water/snacks as a fundraiser/donation.”
- “All that said, paying for the lunches allowed for engaging conversations with the [subject-matter experts] outside of class.”

- **Pre-course Learning | Slides ahead of time**

- “I personally like having the slides ahead of time so I can take notes on those specific slides as they're briefed.”
- “Pre-course information / learning: I would like a refresher of algebra terms and symbols to help us understand the formulas we are looking at. This doesn't need to be part of the course, but it would be great to have the resource before the course.”
- “I think providing a read ahead daily will allow students to be more engaged, prepared and developed discussion topics.”
- “An online primer would help tremendously. If students can go in knowing that to expect regarding the quantitative side of the course, it would significantly help with content reception. I think many were taken aback at how math-intensive the course became very early on and were not prepared.”

- **More info on ARL, DEVCOM, AFC**

- “I would also include a section on ARL’s mission, the greater DEVCOM and AFC role, [technology readiness levels], and process from research to fielding.”
- “I recommend investing more, if possible, on advertising about ARL, I believe integrating links (hyperlink), a PowerPoint or flyers into the most common website frequented by all DOD users will contribute on promoting awareness.”
- “Upon completion of any Soldier–AI experiment, I recommend using different platforms/magazines to highlight the amazing work being done at ARL. Utilizing university papers / newsletters would also help promote the academic side of ARL within the nation.”

- **Additional Skill Identifier (ASI)**

- “Being awarded an ASI after attending the course will attract more students especially the enlisted population which will serve as promotion points as well to further their careers. The ASI will help HRC and leaders to align the awardees on future AI assignments.”

- **Capstone Project time**

- “Increase the capstone projects time ahead of time letting students know for expectation management.”

- **Classified content**

- “Have a classified period of discussion to see what is being worked on in other echelons.”

- **Outside course activities**

- “It should incorporate museum visits on the weekend.”

Participants provided several constructive suggestions for improving the course, emphasizing the need for a more tailored approach to accommodate different levels of foundational knowledge, particularly in math and [science, technology, engineering, and mathematics] backgrounds. They suggested enhancing connectivity in the



classroom for better engagement and research opportunities during the course. Reducing the reliance on PowerPoint presentations and increasing hands-on activities and audience participation were also recommended to make the learning experience more interactive and engaging. Participants felt that the course pace could be adjusted to allow more time for in-depth discussions and interactions with instructors. Additionally, they proposed providing pre-course materials and daily slide previews to help students better prepare. Other suggestions included improving meal provisions, offering more information on ARL and related organizations, incorporating outside activities, and considering an ASI to recognize the course's value for career advancement. Overall, these insights highlight opportunities to enhance the course's accessibility, interactivity, and relevance to better meet the needs and expectations of its diverse audience.

### **What would you have liked to have seen in the course, but didn't?**

- **Nothing**

- “I didn't expect much from the beginning.”
- “I don't know that I really have an answer to this question. I didn't really have much in the way of expectations coming into the course, primarily because I had a limited understanding of AI to begin with. For me, I don't feel it was particularly lacking in any certain aspect.”
- “I believe the course showed a good balance of foundation, theory, application, and future projects.”

- **Project Maven**

- “We only spoke briefly on [Project] Maven which made me feel less intelligent on what is currently out there. I would have liked a class on where we are, what we can do, and then understand where we are going and how.”

- **Current applications of AI**

- “I believe it would have been beneficial to see firsthand the current applications of AI in practical context and to understand areas where enhancement could be made.”

- **Hands-on AI sessions**
  - “A few hands-on sessions to work with an AI directly, to help us understand the limitations and strengths.”
  - “More hands-on experience with AI applications in the course.”
  - “... and have more hands on during the length of the course.”
- **Roadmap of AI in the Army**
  - “Additionally, a detailed roadmap outlining the trajectory of AI development over the next 4–8 years is essential. Such a roadmap is imperative for the end user like us to actively contribute to shaping the future.”
- **More time for demonstration presenters**
  - “I would have liked to see the demonstrations for a longer time. The 30 min with each presenter was a little compact.”
- **Global perspective on AI**
  - “A projection of our competitor nations. I understand that would be highly speculative however I feel it help frame the situation.”
- **Best practices in Army for AI**
  - “Also, a breakdown of best practices when using AI systems for the Army.”
- **Data preparation**
  - “I would like to see different methods and ways to prepare our data for AI. AI needs accurate data and lots of it to learn. I would like to learn how we can start capturing this data now.”
- **More interaction with scientists | research area-specific scientists**
  - “I would like to interact more with the different scientists.”
  - “Depending on the attendees going to the course, it would be nice to see people dedicated to those fields.”
  - “If possible, more intersection with labs, scientists, and how research is conducted.”

- **Programming languages | large language models (LLMs) | databases**
  - “More familiarity with the programming languages used to fit and train models, as well as an overview of the database architecture that stores data behind LLMs.”
- **Two Courses**
  - “I recommend possibly having a level 2 or 3 course that will allow some students to be certified to teach the course which will impact more Soldiers rapidly on a larger scale. Especially approaching the train the trainer methodology.”
  - “With the amount and nature of the content, either make the course a little longer or split the course into two separate courses.  
Hypothetically, AI4S would remain the standard course which is an in-depth look at AI applications and associated [ARL] capabilities briefs, while ‘AI4S-Enhanced’ is more quantitatively intensive, encroaches on more ML application, and would afford a more inclusive experience with the competencies through specific break outs.  
AI4S—A greater focus on how leaders can use AI, not necessarily a deep dive into the nuts and bolts of AI/ML, but the breadth of [ARL] competencies and capabilities. This would give the students enough information to go back and advocate for AI in their formations.  
AI4S-E—A greater focus on the technical ‘under the hood’ construction of models and how to think through the creation of models that can be used to solve problems. This one could allow for more intimate engagement with a student’s preferred competency labs (i.e., a maximum of up to 3 chosen labs over the 2-week period chosen ahead of time by the student, then each lab has a 1–2 hour break out for in-depth discussion of their research and AI/ML integration, and how that could apply to the student’s discipline).”

Participants offered several valuable suggestions for enhancing the course by incorporating more interactive and practical elements. They expressed a desire for hands-on AI sessions to better understand the technology’s strengths and limitations, as well as more time with demonstration presenters for in-depth learning.

They highlighted the need for a detailed AI roadmap for the Army and more information on current AI applications and best practices. Additional interactions with scientists, especially in specific research areas, were also suggested to deepen their understanding. Participants recommended including global perspectives on AI and competitor nations, as well as programming languages and database architectures behind AI models. They proposed the idea of dividing the course into multiple levels to cater to different knowledge bases and provide more tailored content. Overall, these insights underscore the importance of practical application, comprehensive content, and tailored learning experiences in making the course more effective and engaging.

### **How do you envision using this knowledge upon returning?**

- **Leverage connections within ARL and FCC**
  - “The connections and contacts will be valuable to ask questions and present our requirements for research.”
  - “Having the ability to create a network after this course is very beneficial professionally and personally.”
  - “The network aspect is probably one of the biggest takeaways.”
- **Shape how to prepare and implement future AI Technologies**
  - “As a [subject-matter expert] for targeting, I believe there is some concern within my own field that AI will replace us and give us a whole new identity, whether good or bad, my goal is to reach out to our senior leaders at the Army targeting center to inform them about ARL and the studies of AI within ARL. Which we as targeteers should be embracing the concept and getting out in front of that narrative early. This will allow us as a [subject-matter expert] to shape how we will implement AI into the overall targeting methodology. Tag will be ‘AI will not replace you . . . Someone using AI will.’”
- **Future learning | use in Officer Professional Development (OPD)**
  - “Well, I’m certainly going to leverage this material in future AI OPDs.”
  - “Taking a deeper dive into AI product design and how I can begin programming simple python tools to help improve my daily professional workflows.”

- **Importance of data | Data analysis**
  - “... and understanding the importance of data.”
  - “Focus on sharing this knowledge to improve data analysis for strategic planning and to enhance surveillance capabilities across the team.”
- **Use AI tools | AI products | AI Applications**
  - “Having been exposed to this course, I intend to personally engage AI more at home and work.”
  - “I intend on working with [Artificial Intelligence Innovation Center] AI2C to implement some of their AI tools and work alongside their data engineers to increase my unit’s performance of the tasked mission.”
  - “I will influence my team to invest into Army [AI] applications and programs training and to utilize that knowledge more efficiently.”
- **Advise Commanders**
  - “Being able to advise commanders, ‘while this is a great idea, technology is not there, or it is, and it is being worked as we speak.’”
  - “Provide commander information on how to prepare the units for AI.”
- **Educate organization | Honest broker | AI Awareness**
  - “I am going to educate my organization on the foundations of AI, some of the ‘good, the bad, the ugly,’ some of the great ways they can leverage it in their duties and educate them on the ethics/regulations surrounding the use in the military.”
  - “Able to explain the totality of what AI encompasses.”
  - “Being a smarter monkey with the machine gun. By that I mean educating my unit on what is happening with the data and providing guidance for using AI systems in a safe way.”
  - “Being an honest broker.”
  - “... mostly I’m looking to leverage this knowledge to look out for future opportunities and screen against what seems to be too good to be true.”
  - “Provide knowledge and recommendations when screening vendors offering ‘AI’ solutions.”

- “Upon my return to my unit, I will utilize this knowledge to promote awareness of Artificial Intelligence. Especially, highlighting the capabilities, limitations, and future concepts.”
- “Informing others of the opportunities is another positive.”
- “Giving exercises and [leadership professional development], giving access to future AI/ML courses provided to Army.”

- **Dispel AI myths | Realistic expectations of AI**

- “To, again, dispel the mysticism around AI. First Army Command is adamant that AI be implemented ASAP to assist in their mission. I have a high-level understanding of what they want to use it for and the [Enhanced Tactical Inferencing (ETI)] system demonstrated on 12 April could, I think, be adapted to fill that role. That system is still in development, however, and leadership believes we will be able to simply hire a few extra bodies, have a couple civilians take a class on Python, and we’ll be good to go. This class and the information provided will serve to set a more realistic expectation going forward and allow us to better direct resources in the immediate future until the technology is fully available.

That said, what I think [First Army headquarters] would like to see is a system to ingest unit data, assess readiness, and assist in deployment decisions based on criteria provided to the system. The ETI system is anticipated to perform exactly that function when it is eventually completed.”

- “Better understanding of what AI is. Possible will debunk some ‘myths of AI.’”
- “Continue to advocate for the realistic use of AI while advising on its realistic uses and limitations.”

Upon returning, participants envision utilizing their newly acquired AI knowledge in several impactful ways. They plan to leverage connections within ARL and FCC for research inquiries and networking benefits. They intend to shape the preparation and implementation of future AI technologies, particularly within their specific fields, by informing senior leaders and advocating for AI integration. Many foresee

using this knowledge for future learning and incorporating it into OPD sessions. There is a strong emphasis on understanding the importance of data and improving data analysis for strategic planning. Participants also plan to engage more with AI tools and applications both personally and within their units. Advising commanders on the feasibility and preparedness for AI implementation is another key aspect. Educating their organizations on AI fundamentals, ethics, and realistic expectations, while dispelling myths, is a priority. Overall, they aim to enhance AI awareness, advocate for its realistic use, and provide guidance for utilizing AI systems effectively and safely.

### **5.3 Feedback During Senior Leader Sessions**

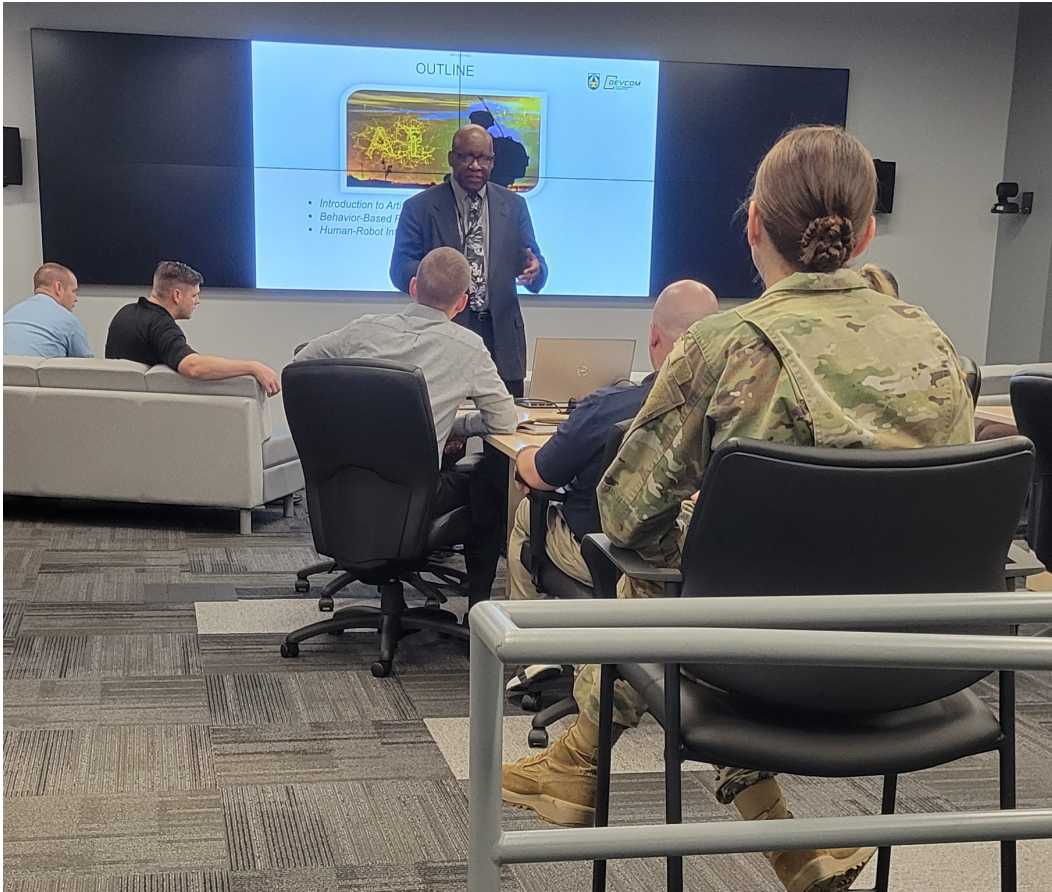
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After Week 1, BG Stephanie Ahern visited with the participants to gather feedback about the course (Fig. 16). She posed the question below and the participants' feedback is paraphrased. Overall, participants in the course gleaned insights into various aspects of AI, including its limitations, hands-on applications, mechanics, data requirements, modularity, and ethical considerations. They have been surprised by the limitations of AI systems and the amount of resources required for training. Hands-on experiences, such as AI in Action, have been particularly engaging, sparking interest in real-world applications like targeting. Many have appreciated delving into the mechanics behind AI algorithms and the importance of data quality. Understanding AI has been deemed crucial for articulating unit needs and defining AI system requirements. There is anticipation for discussions on near-term AI applications and AI ethics, as well as curiosity about emerging technologies like quantum networks. However, concerns persist regarding AI fears and the need for education campaigns to address them, as well as the challenge of scaling AI expertise and tools within the Army. Participants were eager to continue exploring these topics and gaining practical insights in Week 2 of the course. The following responses are paraphrased and categorized from notes taken during the senior leader discussions.

**What have you learned? What are you looking forward to? Or hope to learn in Week 2?**

- **Limitations of AI**

- “I am surprised at all the limitations of these AI systems.”
- “AI is not a universal solution. It is only as good as the developers and



**Fig. 16** Army senior leader, BG Stephanie Ahern of FCC (back to picture), attends the AI for Soldiers course to share her insights on artificial intelligence, to gather feedback from Soldiers and to listen to Dr Hobbs' (speaker) lecture on AI and robotics

the data. The year 2040 is a long time away, so what are the AI solutions in the next 5 years?"

- **Hands-on Applications**

- “I really enjoyed the AI in Action science demonstrations. Seeing the laboratory and scientists and science demonstrations was great.”
- “I am interested in real-world applications of targeting using AI.”

- **Mechanics behind AI | the AI math**

- “It is interesting to see what’s under the hood of AI and ML algorithms.”
- “This course gives a jumping off point for the math of machine learning and artificial intelligence. I am interested to learn the state of AI now.”



- “I learned that ‘with enough matrix math, you can describe anything.’”
- “It was interesting to understand the backend of these algorithms.”
- “I would like to see a deeper look into the code.”
- **AI Chatbots**
  - “One possible application is using AI with counseling services. I am looking forward to hearing about AI Ethics.”
- **Amount of work for AI Systems | AI Data**
  - “AI takes a lot of hardware for training and a lot of data. The number of resources needed for some of these algorithms is surprising.”
  - “It’s only as good as the data using to train the AI. We need to fix the data now!”
  - “You need good data to insert into machine learning models.”
- **AI Modularity**
  - “The modularity of AI is interesting. I’m curious how multiple signals or information streams like radar and EW can be used. I am interested in how to synchronize these data streams and put it all together for the end user.”
- **AI Knowledge**
  - “Understanding AI will help to articulate what our unit needs and to define the requirements for AI systems.”
  - “This course helps with articulating what AI is and what AI isn’t.”
- **Near-term AI | AI2C**
  - “I am interested in how we can apply AI systems in the near term.”
  - “How realistic is it for various applications? I can see this being applied to a number of repetitive tasks in administration and packages, etc.”
  - “AI2C—what are Soldiers actually doing in AI?”
- **Quantum Network**

- “The potential of quantum networks are too good to be true. The vision of AI in the future for communications looks promising.”
- **AI Ethics**
  - “I am looking forward to hearing from the staff judge advocate on AI ethics.”
- **AI fears**
  - “There is a reluctance to accept risk with respect to our networks.”
  - “Junior-to-mid career Soldiers are not there now with respect to AI. How does the Army initiate an education campaign with respect to AI? How do we scale this? The Army needs to have people skilled in AI to understand it. How do we then get skilled AI people the AI tools that they need?”
  - “How do we introduce AI into the Army and affect policy on AI?”

At the end of Week 2, each of the capstone teams shown in Fig. 17 delivered their AI4S capstone presentations. Here was some feedback from BG Stephanie Ahern after the capstone projects:

1. Expressing gratitude for everyone’s participation: “Awesome. Greetings from Kansas and I’m really glad to hear that people weren’t miserable at the end of two weeks.”
2. Appreciation for the organization and execution of the event: “So I appreciate the laughing and I was able to hear a good chunk of the discussion this morning. Thank you all for making time for this. Please make sure to thank your leaders for allowing you to make time and then for the DEVCOM ARL team just like immense thanks for putting this together.”
3. Emphasizing the importance of ethics discussions and broader implications of AI beyond lethality: “I’m really thankful that the ethics discussion yesterday was helpful. There is one theme that I just wanted to reinforce. The one thing I would want to make sure to reinforce coming out of this is that obviously AI can help out with so many things in addition to the lethality that we’re going to need by 2040 . . . [but] I do want it to continue to reinforce that part of what the military as a profession does is to employ lethal force.”

4. Encouraging understanding of AI capabilities and limitations: “I really appreciate the added understanding of what is AI and the point that it’s only as accurate as the data that’s put into it. What are its strengths and what are its weaknesses? And how do we increasingly understand what we as humans are good at?”
5. Thanking participants and urging feedback for future improvement: “I really thank you for the time and effort that you’ve put into it. I look forward to seeing you all in other walks of lives. Please provide feedback so that we can have more people going through this to be able to get access to the information and the understanding so that we can all be more capable by 2040.”

### Artificial Intelligence for Soldiers Capstone Teams



**Fig. 17 Capstone teams for the AI for Soldiers course**

The course concluded with a graduation ceremony where Dr Patrick Baker, ARL Director, presented course completion certificates to the participants and a challenge coin as recognition of this special achievement for the Soldiers. Figure 18 shows some participants receiving their challenge coins and certificates of completion (an example of certificate is in Appendix E).

## Artificial Intelligence for Soldiers Graduation



**Fig. 18** Participants receiving the challenge coin and certificate of completion from ARL Director, Dr Patrick Baker, for the AI for Soldiers course

## 6. Impact and Future Directions

### 6.1 Assessment of Course Impact on Participants' Knowledge and Skills

The assessment of the course's impact on participants' knowledge reveals significant advancements in their understanding and confidence in using AI. Initially, the majority of students classified themselves as only slightly familiar (2 out of 5) or somewhat familiar (3 out of 5) with AI, averaging a 2.4 rating. Throughout the course, participants expressed surprise at the critical importance of data for AI, the current limitations of AI solutions for the Army, and the brittleness and failures that persist in AI systems, even those from leading companies.

The course's content effectively catered to varying interests among participants. Many found the foundational modules particularly beneficial, appreciating the opportunity to delve into the underlying mechanics of AI, even when the material was complex. The science demonstrations and interactions with scientists were also highly valued, providing practical insights and real-world applications of AI technology. The combination of theoretical foundations and applied science was well-received, highlighting the course's balanced approach to teaching AI.

Participants' enhanced understanding of AI was evident in their capstone presentations, where they articulated the current state of AI technology and proposed its potential applications within Army systems. This newfound confidence was further reflected in their improved ratings on statements about their ability to ask the right questions about AI and their readiness to tackle more advanced AI topics.

The feedback from participants was overwhelmingly positive, with specific praise for the comprehensive nature of the course. However, suggestions for improvement included a desire for more hands-on sessions, deeper dives into coding, and a clearer roadmap for future AI developments within the Army. These insights underscore the course's success in elevating participants' knowledge and the areas where future iterations can be refined to better meet their needs.

## **6.2 Discussion on Potential Long-term Benefits for the Army**

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The increasing integration of AI across various military applications necessitates that all personnel, not just AI practitioners, become knowledgeable and adept in AI-related concepts and technologies. The exposure of this select group of Soldiers to AI through the course is a critical step toward democratizing AI awareness and competence throughout the Army. While this in-person course alone cannot reach the entire military, it can complement broader efforts to scale AI training across the Army (e.g., courses through AI2C and Chief Digital and Artificial Intelligence Office [CDAO]). Diverse learning methods, including in-person courses, online modules, and hands-on workshops, should be part of the arsenal for fostering widespread AI literacy.

As these Soldiers advance to leadership positions, their understanding of AI will become progressively more vital for strategic decision-making and operational effectiveness. Furthermore, the connections and networks established during the course,

including interactions with ARL instructors and scientists, are invaluable. These relationships provide participants with ongoing access to the latest developments in AI and a support system for addressing future AI-related challenges. This network will facilitate continuous learning and collaboration, enabling these future leaders to stay informed about emerging AI technologies and their potential applications within the Army. By fostering such a knowledgeable and connected group, the Army is better positioned to leverage AI advancements and maintain a competitive edge in future operations.

### **6.3 Suggestions for Future Iterations and Improvement**

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#### **Target the Right Audience**

To ensure participants can fully benefit from the course, it is recommended to target individuals with some experience or background in [science, technology, engineering, and mathematics] fields or those with a willingness to learn. Setting expectations about the mathematical content of the course could help prospective participants decide if it suits their interests. Feedback indicated that participants with a higher familiarity with AI prior to the course tended to rate the course more positively. For example, the lowest feedback score came from a participant who rated their initial familiarity with AI as “not at all,” while the highest scores were from those who were “slightly familiar,” “moderately familiar,” or “very familiar” with AI.

#### **Develop Pre-work, Read-ahead Materials, and Exercises**

Several participants suggested that having pre-course materials, such as readings or exercises, would enhance understanding and preparedness. While some materials and links were provided beforehand, emphasizing their importance and necessity could improve participants’ readiness and overall experience.

#### **Improve Wi-Fi Connectivity**

Many participants experienced issues with Wi-Fi connectivity, which hindered their ability to look up information and answer questions during the course. Improving Wi-Fi access would support real-time learning and research, thereby enhancing participants’ understanding of course content. To address this, it is recommended to include an exercise on Day 1 that requires participants to connect to the Wi-Fi. This would ensure that everyone finds the Wi-Fi and obtains access upfront, leveraging our facility’s Wi-Fi access for government use and allowing any troubleshooting to

be done early in the course.

### **Enhance the Math of Machine Learning and Artificial Intelligence**

Participants had mixed feelings about the mathematical content of the course. While some found it interesting to see the inner workings of AI algorithms, others felt overwhelmed. A balanced approach could be to reduce some of the mathematical content but retain enough to satisfy those interested in the technical aspects. This would make the course more accessible without losing its depth.

### **Increase Discussion to Break Up Instruction**

Incorporating more group discussions and interactive exercises throughout the day, rather than just at the end, could help break up the PowerPoint-heavy instruction sessions. This approach would encourage active participation and reinforce learning through collaboration and dialogue.

### **Adjust Course Pace**

Planning more group activities and discussions during instructional portions can help maintain engagement. For laboratory demonstrations, allocating more time for demos and briefings would allow for thorough exploration and questioning. Setting a cap on presentation times can ensure that there is ample opportunity for questions and in-depth discussions, addressing instances where a 10-min brief extended into a 45-min Q&A session.

### **Allocate More Time for Capstone Projects**

Setting aside more dedicated time during the course for capstone projects is essential. Adequate scheduling for these projects ensures thorough preparation and presentation, as demonstrated by one team that exceeded their allotted time by 15 min.

### **Expand Course Content**

Participants expressed interest in several additional topics:

- **AI in the Army:** Including a guest speaker from AI2C could provide valuable insights, as many participants were keen to learn about AI2C's initiatives. Although AI2C was contacted previously, they were unable to participate this time.
- **Global Perspective on AI:** Adding content about AI development in other

nations could offer a broader understanding of the field.

- **Army Research Laboratory:** Providing a more in-depth overview of ARL would be beneficial, as many participants sought a deeper understanding of its work and contributions.

By addressing these suggestions, the course can be refined to better meet the needs and expectations of its participants, ultimately enhancing their learning experience and the course's overall effectiveness.

## 7. Conclusion

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The AI4S course conducted by ARL has significantly enhanced the participants' understanding and confidence in using AI technologies. Initially, most participants had limited familiarity with AI, but the course effectively expanded their knowledge, particularly regarding the importance of data, current limitations, and the complexities of AI systems. The combination of theoretical foundations and practical demonstrations was well-received, and participants' capstone presentations reflected their improved grasp of AI concepts and applications. This report highlights the course's success in elevating participants' knowledge and provides a roadmap for future improvements and expansions.

The course has laid a strong foundation for democratizing AI knowledge across the Army. However, the need for more targeted audience selection, pre-course materials, balanced mathematical content, increased group discussions, better-paced sessions, and expanded course content were identified as key areas for improvement. Addressing these suggestions will further enhance the effectiveness and accessibility of future courses.

Moving forward, the connections and networks established during the course will provide ongoing support and knowledge sharing, ensuring that the Army remains at the forefront of AI advancements. By continuously refining and expanding AI education initiatives, the Army can leverage AI technologies to maintain a strategic and operational advantage in future operations.



## **Appendix A. AI for Soldiers Detailed Schedule**

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This appendix appears in its original form, without editorial change.

# Week 1 | Foundations of Artificial Intelligence and Machine Learning

|                     | Monday, April 8, 2024                                                             |                                                      | Tuesday, April 9, 2024                               |                                                                | Wednesday, April 10, 2024                            |                                                          | Thursday, April 11, 2024                                       |                                                          | Friday, April 12, 2024                                         |                                                          |               |                                                                |                   |                                            |
|---------------------|-----------------------------------------------------------------------------------|------------------------------------------------------|------------------------------------------------------|----------------------------------------------------------------|------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------------|----------------------------------------------------------|---------------|----------------------------------------------------------------|-------------------|--------------------------------------------|
|                     | What                                                                              | Where                                                | What                                                 | Where                                                          | What                                                 | Where                                                    | What                                                           | Where                                                    | What                                                           | Where                                                    |               |                                                                |                   |                                            |
| 8:00 AM - 8:15 AM   | Arrival                                                                           | ALC 5th Floor<br>Conference<br>Room, 516             | Guest Speaker:<br>Dr. David Stepp, ARL               | ALC NSRL<br>Network<br>Science<br>Research<br>Laboratory       | Module 5<br>Machine Learning 101<br>Dr. Mark Tschopp | ALC NSRL<br>Network<br>Science<br>Research<br>Laboratory | Module 7<br>Natural Language<br>Processing<br>Dr. Reggie Hobbs | ALC NSRL<br>Network<br>Science<br>Research<br>Laboratory | Competency<br>Overview:<br>MIS, NCCS, EMSS                     | ALC NSRL<br>Network<br>Science<br>Research<br>Laboratory |               |                                                                |                   |                                            |
| 8:15 AM - 8:30 AM   | AI4Soldiers Course                                                                |                                                      | Module 3<br>Machine Learning 101<br>Dr. Mark Tschopp |                                                                |                                                      |                                                          |                                                                |                                                          | Morning Break                                                  | Module 5<br>Machine Learning 101<br>Dr. Mark Tschopp     | Morning Break | Module 7<br>Natural Language<br>Processing<br>Dr. Reggie Hobbs | AI in Action: MIS | ALC Laboratory<br>Demo Day<br>Various Labs |
| 8:30 AM - 8:45 AM   | Introduction                                                                      |                                                      |                                                      |                                                                |                                                      |                                                          |                                                                |                                                          |                                                                |                                                          |               |                                                                |                   |                                            |
| 8:45 AM - 9:00 AM   | Dr. Mark Tschopp                                                                  |                                                      |                                                      |                                                                |                                                      |                                                          |                                                                |                                                          |                                                                |                                                          |               |                                                                |                   |                                            |
| 9:00 AM - 9:15 AM   | Module 1<br>Intro to AI<br>Dr. Reggie Hobbs                                       |                                                      |                                                      |                                                                |                                                      |                                                          |                                                                |                                                          |                                                                |                                                          |               |                                                                |                   |                                            |
| 9:15 AM - 9:30 AM   |                                                                                   |                                                      |                                                      |                                                                |                                                      |                                                          |                                                                |                                                          |                                                                |                                                          |               |                                                                |                   |                                            |
| 9:30 AM - 9:45 AM   |                                                                                   |                                                      |                                                      |                                                                |                                                      |                                                          |                                                                |                                                          |                                                                |                                                          |               |                                                                |                   |                                            |
| 9:45 AM - 10:00 AM  |                                                                                   |                                                      |                                                      |                                                                |                                                      |                                                          |                                                                |                                                          |                                                                |                                                          |               |                                                                |                   |                                            |
| 10:00 AM - 10:15 AM | Morning Break                                                                     |                                                      |                                                      |                                                                |                                                      |                                                          |                                                                |                                                          |                                                                |                                                          |               |                                                                |                   |                                            |
| 10:15 AM - 10:30 AM | Module 1<br>Intro to AI<br>Dr. Reggie Hobbs                                       |                                                      | Module 3<br>Machine Learning 101<br>Dr. Mark Tschopp |                                                                | Module 5<br>Machine Learning 101<br>Dr. Mark Tschopp |                                                          | Guest Speaker:<br>Dr. James Uplinger, ARL                      |                                                          | Module 7<br>Natural Language<br>Processing<br>Dr. Reggie Hobbs |                                                          |               |                                                                |                   |                                            |
| 10:30 AM - 10:45 AM |                                                                                   |                                                      |                                                      |                                                                |                                                      |                                                          |                                                                |                                                          |                                                                |                                                          |               |                                                                |                   |                                            |
| 10:45 AM - 11:00 AM |                                                                                   |                                                      |                                                      |                                                                |                                                      |                                                          |                                                                |                                                          |                                                                |                                                          |               |                                                                |                   |                                            |
| 11:00 AM - 11:15 AM |                                                                                   |                                                      |                                                      |                                                                |                                                      |                                                          |                                                                |                                                          |                                                                |                                                          |               |                                                                |                   |                                            |
| 11:15 AM - 11:30 AM |                                                                                   |                                                      |                                                      |                                                                |                                                      |                                                          |                                                                |                                                          |                                                                |                                                          |               |                                                                |                   |                                            |
| 11:30 AM - 11:45 AM |                                                                                   |                                                      |                                                      |                                                                |                                                      |                                                          |                                                                |                                                          |                                                                |                                                          |               |                                                                |                   |                                            |
| 11:45 AM - 12:00 PM | Lunch Break                                                                       |                                                      | Emmerman<br>Lab<br>4F031                             | Lunch Break                                                    | Emmerman<br>Lab<br>4F031                             | Lunch Break                                              | Emmerman<br>Lab<br>4F031                                       | Lunch Break                                              | Emmerman<br>Lab<br>4F031                                       |                                                          |               |                                                                |                   |                                            |
| 12:00 PM - 12:15 PM |                                                                                   |                                                      |                                                      |                                                                |                                                      |                                                          |                                                                |                                                          |                                                                |                                                          |               |                                                                |                   |                                            |
| 12:15 PM - 12:30 PM |                                                                                   |                                                      |                                                      |                                                                |                                                      |                                                          |                                                                |                                                          |                                                                |                                                          |               |                                                                |                   |                                            |
| 12:30 PM - 12:45 PM |                                                                                   |                                                      |                                                      |                                                                |                                                      |                                                          |                                                                |                                                          |                                                                |                                                          |               |                                                                |                   |                                            |
| 12:45 PM - 1:00 PM  |                                                                                   |                                                      |                                                      |                                                                |                                                      |                                                          |                                                                |                                                          |                                                                |                                                          |               |                                                                |                   |                                            |
| 1:00 PM - 1:15 PM   | Intro to FCC<br>Guest Speakers<br>(FCC):<br>BG Stephanie Ahern<br>Mr. Chris Stolz | Module 4<br>Machine Learning 101<br>Dr. Mark Tschopp | Module 6<br>Machine Learning 101<br>Dr. Mark Tschopp | Module 8<br>Natural Language<br>Processing<br>Dr. Reggie Hobbs |                                                      |                                                          |                                                                |                                                          |                                                                |                                                          |               |                                                                |                   |                                            |
| 1:15 PM - 1:30 PM   |                                                                                   |                                                      |                                                      |                                                                |                                                      |                                                          |                                                                |                                                          |                                                                |                                                          |               |                                                                |                   |                                            |
| 1:30 PM - 1:45 PM   |                                                                                   |                                                      |                                                      |                                                                |                                                      |                                                          |                                                                |                                                          |                                                                |                                                          |               |                                                                |                   |                                            |
| 1:45 PM - 2:00 PM   |                                                                                   |                                                      |                                                      |                                                                |                                                      |                                                          |                                                                |                                                          |                                                                |                                                          |               |                                                                |                   |                                            |
| 2:00 PM - 2:15 PM   | Afternoon Break                                                                   | Module 4<br>Machine Learning 101<br>Dr. Mark Tschopp | Module 6<br>Machine Learning 101<br>Dr. Mark Tschopp | Module 8<br>Natural Language<br>Processing                     |                                                      |                                                          |                                                                |                                                          |                                                                |                                                          |               |                                                                |                   |                                            |
| 2:15 PM - 2:30 PM   |                                                                                   |                                                      |                                                      |                                                                |                                                      |                                                          |                                                                |                                                          |                                                                |                                                          |               |                                                                |                   |                                            |
| 2:30 PM - 2:45 PM   |                                                                                   |                                                      |                                                      |                                                                |                                                      |                                                          |                                                                |                                                          |                                                                |                                                          |               |                                                                |                   |                                            |
| 2:45 PM - 3:00 PM   |                                                                                   |                                                      |                                                      |                                                                |                                                      |                                                          |                                                                |                                                          |                                                                |                                                          |               |                                                                |                   |                                            |
| 3:00 PM - 3:15 PM   | Module 2<br>Intro to AI<br>Dr. Reggie Hobbs                                       | Module 4<br>Machine Learning 101<br>Dr. Mark Tschopp | Module 6<br>Machine Learning 101<br>Dr. Mark Tschopp | Module 8<br>Natural Language<br>Processing                     |                                                      |                                                          |                                                                |                                                          |                                                                |                                                          |               |                                                                |                   |                                            |
| 3:15 PM - 3:30 PM   |                                                                                   |                                                      |                                                      |                                                                |                                                      |                                                          |                                                                |                                                          |                                                                |                                                          |               |                                                                |                   |                                            |
| 3:30 PM - 3:45 PM   |                                                                                   |                                                      |                                                      |                                                                |                                                      |                                                          |                                                                |                                                          |                                                                |                                                          |               |                                                                |                   |                                            |
| 3:45 PM - 4:00 PM   |                                                                                   |                                                      |                                                      |                                                                |                                                      |                                                          |                                                                |                                                          |                                                                |                                                          |               |                                                                |                   |                                            |
|                     | Capstone Team                                                                     | Capstone Team                                        | Capstone Team                                        | Capstone Team                                                  |                                                      |                                                          |                                                                |                                                          |                                                                |                                                          |               |                                                                |                   |                                            |

## Week 2 | Applications of Artificial Intelligence and Machine Learning

|                     | Monday, April 15, 2024                                                                     |                                                                               | Tuesday, April 16, 2024                                                        |                                                          | Wednesday, April 17, 2024                                                      |                                                                               | Thursday, April 18, 2024                                                      |                                               | Friday, April 19, 2024                                      |                                               |
|---------------------|--------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|--------------------------------------------------------------------------------|----------------------------------------------------------|--------------------------------------------------------------------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------|-----------------------------------------------|-------------------------------------------------------------|-----------------------------------------------|
|                     | What                                                                                       | Where                                                                         | What                                                                           | Where                                                    | What                                                                           | Where                                                                         | What                                                                          | Where                                         | What                                                        | Where                                         |
| 8:00 AM - 8:15 AM   | Module 9<br>Reinforcement<br>Learning & Robotics<br>Dr. Reggie Hobbs<br>Dr. John Fossaceca | ALC<br>AVL VisLab<br>Attached to<br>NSRL                                      | Guest Speaker                                                                  | ALC NSRL<br>Network<br>Science<br>Research<br>Laboratory | Travel to APG<br>Building 520<br>(in transit)                                  |                                                                               |                                                                               | ALC<br>5th Floor<br>Conference<br>Room<br>516 | Guest Speaker:<br>Mr. Karl Kappra, ARL<br>Research Business | ALC<br>5th Floor<br>Conference<br>Room<br>516 |
| 8:15 AM - 8:30 AM   |                                                                                            |                                                                               | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments |                                                          |                                                                                |                                                                               | Guest Speaker                                                                 |                                               | Guest Speaker                                               |                                               |
| 8:30 AM - 8:45 AM   |                                                                                            |                                                                               |                                                                                |                                                          | Morning Break                                                                  | Morning Break                                                                 |                                                                               |                                               |                                                             |                                               |
| 8:45 AM - 9:00 AM   |                                                                                            |                                                                               | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments |                                                          |                                                                                |                                                                               | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments |                                               | APG<br>Building 520                                         |                                               |
| 9:00 AM - 9:15 AM   |                                                                                            |                                                                               |                                                                                |                                                          | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments |                                                                               |                                               |                                                             |                                               |
| 9:15 AM - 9:30 AM   |                                                                                            |                                                                               | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments |                                                          |                                                                                |                                                                               | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments |                                               | APG<br>Building 520                                         |                                               |
| 9:30 AM - 9:45 AM   | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments             | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments |                                                                                | APG<br>Building 520                                      | Morning Break                                                                  | Morning Break                                                                 |                                                                               |                                               |                                                             |                                               |
| 9:45 AM - 10:00 AM  |                                                                                            |                                                                               | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments |                                                          |                                                                                |                                                                               | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments | APG<br>Building 520                           | Morning Break                                               | Morning Break                                 |
| 10:00 AM - 10:15 AM | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments             | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments |                                                                                | APG<br>Building 520                                      | Morning Break                                                                  | Morning Break                                                                 |                                                                               |                                               |                                                             |                                               |
| 10:15 AM - 10:30 AM |                                                                                            |                                                                               | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments |                                                          |                                                                                |                                                                               | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments | APG<br>Building 520                           | Morning Break                                               | Morning Break                                 |
| 10:30 AM - 10:45 AM | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments             | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments |                                                                                | APG<br>Building 520                                      | Morning Break                                                                  | Morning Break                                                                 |                                                                               |                                               |                                                             |                                               |
| 10:45 AM - 11:00 AM |                                                                                            |                                                                               | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments |                                                          |                                                                                |                                                                               | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments | APG<br>Building 520                           | Morning Break                                               | Morning Break                                 |
| 11:00 AM - 11:15 AM | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments             | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments |                                                                                | APG<br>Building 520                                      | Morning Break                                                                  | Morning Break                                                                 |                                                                               |                                               |                                                             |                                               |
| 11:15 AM - 11:30 AM |                                                                                            |                                                                               | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments |                                                          |                                                                                |                                                                               | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments | APG<br>Building 520                           | Morning Break                                               | Morning Break                                 |
| 11:30 AM - 11:45 AM | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments             | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments |                                                                                | APG<br>Building 520                                      | Morning Break                                                                  | Morning Break                                                                 |                                                                               |                                               |                                                             |                                               |
| 11:45 AM - 12:00 PM |                                                                                            |                                                                               | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments |                                                          |                                                                                |                                                                               | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments | APG<br>Building 520                           | Morning Break                                               | Morning Break                                 |
| 12:00 PM - 12:15 PM | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments             | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments |                                                                                | APG<br>Building 520                                      | Morning Break                                                                  | Morning Break                                                                 |                                                                               |                                               |                                                             |                                               |
| 12:15 PM - 12:30 PM |                                                                                            |                                                                               | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments |                                                          |                                                                                |                                                                               | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments | APG<br>Building 520                           | Morning Break                                               | Morning Break                                 |
| 12:30 PM - 12:45 PM | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments             | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments |                                                                                | APG<br>Building 520                                      | Morning Break                                                                  | Morning Break                                                                 |                                                                               |                                               |                                                             |                                               |
| 12:45 PM - 1:00 PM  |                                                                                            |                                                                               | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments |                                                          |                                                                                |                                                                               | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments | APG<br>Building 520                           | Morning Break                                               | Morning Break                                 |
| 1:00 PM - 1:15 PM   | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments             | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments |                                                                                | APG<br>Building 520                                      | Morning Break                                                                  | Morning Break                                                                 |                                                                               |                                               |                                                             |                                               |
| 1:15 PM - 1:30 PM   |                                                                                            |                                                                               | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments |                                                          |                                                                                |                                                                               | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments | APG<br>Building 520                           | Morning Break                                               | Morning Break                                 |
| 1:30 PM - 1:45 PM   | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments             | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments |                                                                                | APG<br>Building 520                                      | Morning Break                                                                  | Morning Break                                                                 |                                                                               |                                               |                                                             |                                               |
| 1:45 PM - 2:00 PM   |                                                                                            |                                                                               | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments |                                                          |                                                                                |                                                                               | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments | APG<br>Building 520                           | Morning Break                                               | Morning Break                                 |
| 2:00 PM - 2:15 PM   | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments             | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments |                                                                                | APG<br>Building 520                                      | Morning Break                                                                  | Morning Break                                                                 |                                                                               |                                               |                                                             |                                               |
| 2:15 PM - 2:30 PM   |                                                                                            |                                                                               | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments |                                                          |                                                                                |                                                                               | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments | APG<br>Building 520                           | Morning Break                                               | Morning Break                                 |
| 2:30 PM - 2:45 PM   | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments             | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments |                                                                                | APG<br>Building 520                                      | Morning Break                                                                  | Morning Break                                                                 |                                                                               |                                               |                                                             |                                               |
| 2:45 PM - 3:00 PM   |                                                                                            |                                                                               | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments |                                                          |                                                                                |                                                                               | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments | APG<br>Building 520                           | Morning Break                                               | Morning Break                                 |
| 3:00 PM - 3:15 PM   | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments             | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments |                                                                                | APG<br>Building 520                                      | Morning Break                                                                  | Morning Break                                                                 |                                                                               |                                               |                                                             |                                               |
| 3:15 PM - 3:30 PM   |                                                                                            |                                                                               | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments |                                                          |                                                                                |                                                                               | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments | APG<br>Building 520                           | Morning Break                                               | Morning Break                                 |
| 3:30 PM - 3:45 PM   | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments             | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments |                                                                                | APG<br>Building 520                                      | Morning Break                                                                  | Morning Break                                                                 |                                                                               |                                               |                                                             |                                               |
| 3:45 PM - 4:00 PM   |                                                                                            |                                                                               | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments |                                                          |                                                                                |                                                                               | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments | APG<br>Building 520                           | Morning Break                                               | Morning Break                                 |
|                     | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments             | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments |                                                                                | APG<br>Building 520                                      | Morning Break                                                                  | Morning Break                                                                 |                                                                               |                                               |                                                             |                                               |
|                     |                                                                                            |                                                                               | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments |                                                          |                                                                                |                                                                               | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments | APG<br>Building 520                           | Morning Break                                               | Morning Break                                 |
|                     | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments             | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments |                                                                                | APG<br>Building 520                                      | Morning Break                                                                  | Morning Break                                                                 |                                                                               |                                               |                                                             |                                               |
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|                     | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments             | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments |                                                                                | APG<br>Building 520                                      | Morning Break                                                                  | Morning Break                                                                 |                                                                               |                                               |                                                             |                                               |
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|                     | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments             | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments |                                                                                | APG<br>Building 520                                      | Morning Break                                                                  | Morning Break                                                                 |                                                                               |                                               |                                                             |                                               |
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|                     | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments             | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments |                                                                                | APG<br>Building 520                                      | Morning Break                                                                  | Morning Break                                                                 |                                                                               |                                               |                                                             |                                               |
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|                     |                                                                                            |                                                                               | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments |                                                          |                                                                                |                                                                               | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments | APG<br>Building 520                           | Morning Break                                               | Morning Break                                 |
|                     | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments             | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments |                                                                                | APG<br>Building 520                                      | Morning Break                                                                  | Morning Break                                                                 |                                                                               |                                               |                                                             |                                               |
|                     |                                                                                            |                                                                               | Module 10<br>Humans And AI:<br>Understanding AI<br>in Military<br>Environments |                                                          |                                                                                |                                                                               | Module 11<br>Humans And AI:<br>AI Applications in<br>Military<br>Environments | APG<br>Building 520                           |                                                             |                                               |

## **Appendix B. AI for Soldiers Course Information Package**

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This appendix appears in its original form, without editorial change.

# Artificial Intelligence for Soldiers



**Prompt:** [Microsoft Bing Image Creator] Envision a surreal battlefield landscape where algorithms and equations replace traditional tanks and soldiers. Graphs, matrices, and decision trees form the terrain, while military officers navigate this abstract warzone. A giant AI brain hovers ominously in the sky, controlling the chaos.

# Artificial Intelligence for Soldiers

## Course Overview

**Course Title:** Artificial Intelligence for Soldiers

**Target Audience:** Mid-career Army staff officers with no coding background, holding undergraduate degrees, seeking to enhance their understanding of Artificial Intelligence (AI) and Machine Learning (ML).

**Course Capacity:** Up to 25 students per class, with a minimum of 20 participants required.

**Preferred Format:** In-person course over a two-week schedule.

**Funding:** Travel and TDY costs funded by HQDA, DCS G3/5/7 DAMO-SSF.

### Course Content:

This course aims to orient learners to concepts within artificial intelligence and the sub-group of machine learning as it pertains to the Army. Participants will gain intermediate knowledge of the different families of machine learning algorithms, training data needed for each, and the appropriate application and limitations of each. The curriculum covers handcrafted knowledge AI versus machine learning AI approaches and explains key factors driving recent improvements in machine learning performance. Additionally, participants will develop a basic understanding of neural networks and how they work. Strategies for applying AI to discrete and complex data sets to solve business, strategic, or logistical problems will be provided, with tools and strategies synthesizable to novel situations in diverse organizational settings, including military environments.

### Objectives:

- Enable Army officers to provide senior leaders with data-driven decision-making abilities previously unavailable, allowing them to seize opportunities that provide a competitive advantage over adversaries.
- Enable Army officers to understand and direct approaches for leveraging data and algorithms to achieve their goals.
- Increase staff officers' ability to determine potential, previously unconsidered applications for business and strategic decision-makers.
- Enable Army officers to provide real-world perspectives to ARL leaders on problems where AI capabilities could yield transformational change.

This course is designed to equip participants with the knowledge and skills needed to effectively utilize AI in military contexts, fostering innovation and strategic decision-making.



# ARTIFICIAL INTELLIGENCE FOR SOLDIERS

## FOUNDATIONS OF ARTIFICIAL INTELLIGENCE / MACHINE LEARNING

| DAY 1                                                                                             | DAY 2                                                                                             | DAY 3                                                                                             | DAY 4                                                                                               | DAY 5                                                                                                                           |
|---------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| WELCOME                                                                                           |                                                                                                   |                                                                                                   |                                                                                                     |                                                                                                                                 |
| MODULE<br>1<br>  | MODULE<br>3<br>  | MODULE<br>5<br>  | MODULE<br>7<br>  | <b>AI</b><br>in<br>ACTION<br><b>ALC</b><br> |
| CAPSTONE<br>SCENARIO                                                                              |                                                                                                   |                                                                                                   |                                                                                                     |                                                                                                                                 |
| MODULE<br>2<br> | MODULE<br>4<br> | MODULE<br>6<br> | MODULE<br>8<br> |                                                                                                                                 |

## APPLICATIONS OF ARTIFICIAL INTELLIGENCE / MACHINE LEARNING

| DAY 6                                                                                                                                                                                                               | DAY 7                                                                                                                                                                      | DAY 8                                                                                                                                                                                      | DAY 9                                                                                                 | DAY 10                       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|------------------------------|
| MODULE<br>9<br>                               | MODULE<br>10<br>                                                                        | <br>MODULE<br>11<br> | MODULE<br>12<br> | CAPSTONE<br>FEEDBACK         |
| <b>AI</b><br>in<br>ACTION<br><b>R2C2</b><br>  | <br> | <b>AI</b><br>in<br>ACTION<br><b>APG</b><br>                                                             | CAPSTONE<br>PREP                                                                                      | COURSE<br>FEEDBACK           |
|                                                                                                                                                                                                                     |                                                                                                                                                                            |                                                                                                                                                                                            |                                                                                                       | FINAL<br>CAPSTONE<br>PROJECT |
|                                                                                                                                                                                                                     |                                                                                                                                                                            |                                                                                                                                                                                            |                                                                                                       | AI4SOLDIERS<br>GRADUATION    |

## Course Schedule

|       | <b>Monday</b><br>April 8<br>(Day 1)                                           | <b>Tuesday</b><br>April 9<br>(Day 2)                                | <b>Wednesday</b><br>April 10<br>(Day 3)                                     | <b>Thursday</b><br>April 11<br>(Day 4)                                      | <b>Friday</b><br>April 12<br>(Day 5)                    |
|-------|-------------------------------------------------------------------------------|---------------------------------------------------------------------|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------|---------------------------------------------------------|
| AM    | <b>Module 1:</b><br>AI Introduction I<br>AI History and<br>Applications       | <b>Module 3:</b><br>Introduction to<br>Data and<br>Machine Learning | <b>Module 5:</b><br>Neural Networks<br>Architectures I:<br>CNN, AE, GANs    | <b>Module 7:</b><br>Introduction to<br>Natural Language<br>Processing (NLP) | <b>AI in Action:</b><br>Lab Tours and<br>Demonstrations |
| PM    | <b>Module 2:</b><br>AI Introduction II<br>+ Introductions \<br>Team Scenarios | <b>Module 4:</b><br>Introduction to<br>Neural Networks              | <b>Module 6:</b><br>Neural Networks<br>Architectures II:<br>Sequences & NLP | <b>Module 8:</b><br>Practical<br>Applications of<br>NLP in AI/ML            |                                                         |
| Where | ALC 5 <sup>th</sup> Floor                                                     | ALC NSRL                                                            | ALC NSRL                                                                    | ALC NSRL                                                                    | ALC                                                     |
| Leads | RH, CS/MW                                                                     | MT                                                                  | MT                                                                          | RH                                                                          | RH, JF, MT                                              |

### Week 1: Foundations of Artificial Intelligence and Machine Learning

- Day 1: Understanding AI Concepts and Fundamentals
  - Morning Session: Introduction to AI and its Applications
  - Afternoon Session: Team Introductions and Scenarios
- Day 2: Machine Learning Basics to Neural Networks: How They Work
  - Morning Session: Introduction to Machine Learning
  - Afternoon Session: Introduction to Neural Networks
- Day 3: Advanced Machine Learning Algorithms: How They Work
  - Morning Session: Neural Networks Architectures for Images, Compression, Generative AI
  - Afternoon Session: Neural Networks Architectures for Sequences and Text
- Day 4: Natural Language Processing and AI/ML
  - Morning Session: Introduction to Natural Language Processing (NLP)
  - Afternoon Session: Practical Applications of NLP in AI/ML
- Day 5: Artificial Intelligence for the Future (ALC Demonstrations/Tours)
  - *AI in Action: Lab Tours and Demonstrations*



| Monday<br>April 15<br>(Day 6) |                                                                         | Tuesday<br>April 16<br>(Day 7)                                                | Wednesday<br>April 17<br>(Day 8)                                                                 | Thursday<br>April 18<br>(Day 9)                                                  | Friday<br>April 19<br>(Day 10)                                       |
|-------------------------------|-------------------------------------------------------------------------|-------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|----------------------------------------------------------------------|
| AM                            | Module 9:<br>AI and Robotics<br>Integration                             | Module 10:<br>Humans & AI:<br>Understanding<br>AI in Military<br>Environments | Module 11:<br>Humans & AI:<br>AI Applications<br>in Military<br>Environments<br><br>AI in Action | Module 12:<br>Responsible AI<br>and AI Ethics, AI<br>Bias, Addressing<br>AI Bias | AI Capstone and<br>Course Feedback,<br>Capstone<br>Final Preparation |
| PM                            | AI in Action:<br>Robotics<br>Research<br>Collaboration<br>Campus (R2C2) |                                                                               |                                                                                                  | AI Capstone<br>Project<br>Prep                                                   | AI Capstone<br>Project<br>Presentations,<br>Graduation<br>Ceremony   |
| Where                         | Graces Quarters                                                         | ALC NSRL                                                                      | APG                                                                                              | ALC 5 <sup>th</sup> Floor                                                        | ALC 5 <sup>th</sup> Floor                                            |
| Lead                          | JF, JW, RH                                                              | BP, JG                                                                        | BP, JG                                                                                           | RH, MT                                                                           |                                                                      |

## Week 2: Practical Applications of AI in Military Contexts

- Day 6: Robotics and Autonomy 101
  - Morning Session: AI and Robotics Integration
  - ***AI in Action: Robotics Research Collaboration Campus (R2C2)***
- Day 7: Humans and AI: Humans in Complex Systems
  - Understanding AI in Military Environments
- Day 8: Humans and AI: Humans in Complex Systems
  - AI Application in Military Environments
  - ***AI in Action: Lab Tours and Demonstrations***
- Day 9: Ethical and Strategic Considerations in AI deployment
  - Morning Session: Responsible AI and AI Ethics
  - Afternoon Session: Addressing AI Bias and AI Capstone Project Planning
- Day 10 (Final): AI Capstone Project Presentations and Graduation Ceremony
  - Morning Session: Feedback and Final Preparation
  - Afternoon Session: AI Capstone Project Presentations and Graduation Ceremony

## Program Module Abstracts

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### Day 1 (Module 1)

#### **INTRODUCTION TO ARTIFICIAL INTELLIGENCE, Part I**

Room: ALC, 5<sup>th</sup> Floor Conference Room

Instructor(s): Dr. Reggie Hobbs

AI Problem Solving. Welcome the Artificial Intelligence for Soldiers course! This first module sets the stage for the course, providing an introduction to artificial intelligence, its history, and the foundational concepts that will be explored throughout the program.

Module Topics:

- Evolution of Artificial Intelligence – This topic explains the fundamentals of artificial intelligence, providing definitions and discussing the disciplines contributing to AI.
- Intelligent Agents – An introductory discussion explores the nature of intelligent agents, examining their capabilities and roles within AI systems.
- Fundamentals of Search and Adversarial Search (Games) – Participants delve into algorithmic problem-solving approaches, exploring how agents find solutions through search algorithms. The module also covers adversarial search strategies, particularly in competitive environments where conflicting goals exist, often illustrated through game scenarios.

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### Day 1 (Module 2)

#### **INTRODUCTION TO ARTIFICIAL INTELLIGENCE, Part II**

Room: ALC, 5<sup>th</sup> Floor Conference Room

Instructor(s): Dr. Reggie Hobbs

Knowledge and Reasoning. This module explores the foundational aspects of AI, focusing on Knowledge and Reasoning. It delves into the design of intelligent agents capable of understanding and navigating a complex world through logical inferencing. Additionally, various techniques for representing real-world knowledge within AI systems are covered, enabling effective problem-solving and decision-making in uncertain or limited data environments. Through this module, participants gain essential insights into the cognitive processes underlying intelligent behavior in artificial systems.

Module Topics:

- Logical Agents and Inferencing – This topic delves into the design of intelligent agents capable of forming representations of complex environments, utilizing inferencing to derive new representations, and deducing next steps based on the updated internal model.
  - Knowledge Representation – Participants will receive an overview of techniques employed by AI systems to represent diverse facts about the real world in a format conducive to reasoning and problem-solving.
  - Automated Decision Making – This topic explores rule-based approaches that enable agents to make decisions even when faced with limited or uncertain data.
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## Day 2 (Module 3)

### INTRODUCTION TO MACHINE LEARNING

Room: ALC, NSRL (Network Science Research Laboratory)

Instructor(s): Dr. Mark Tschopp

Machine learning here, machine learning there, machine learning everywhere! This module will tackle the concepts, the math, and the algorithms of machine learning for those that are slightly familiar, somewhat familiar, or not at all familiar with the topic. Starting at the very beginning with the simplest machine learning algorithms such as linear and logistic regression, this module will embark on describing the many concepts important for understanding what goes on inside machine learning algorithms, arguably the “engine” that powers many advances today in artificial intelligence. To describe the algorithms and concepts further, this module uses Microsoft Excel to show the underlying math that permeates machine learning.

#### Module Topics:

- Data is the New Bacon. A fun intro and overview of the importance of data within machine learning and artificial intelligence. Pop culture anecdotes, data analysis & visualization, data science and ML, data ethics and privacy, data-driven decision making, the future of data!
- Machine Learning Primer. A gentle introduction to machine learning concepts including a simple supervised machine learning example. The topics covered include:
  - 2-day ML course structure,
  - why machine learning AI,
  - types of machine learning (supervised vs unsupervised),
  - the simple math of (supervised) machine learning, and
  - a simple dog-cat example.
- Machine Learning Basics. All the important machine learning concepts needed to understand neural networks and deep learning, without the neural networks. The topics covered include:
  - regression and classification,
  - linear regression,
  - loss and cost functions,
  - gradient descent and optimization,
  - logistic regression,
  - variance vs bias tradeoff,
  - regularization, and
  - training set, dev set, test set.

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## Day 2 (Module 4)

### INTRODUCTION TO NEURAL NETWORKS

Room: ALC, NSRL (Network Science Research Laboratory)

Instructor(s): Dr. Mark Tschopp

These days, whenever someone says, “Don’t worry, I’m using machine learning,” it usually means that they are using some sort of neural network architecture (and quite possibly that you should worry). Building on the introduction to machine learning (Module 3), this module dives into what makes up the standard neural network architecture. Many of the concepts introduced for simple algorithms are very similar to the concepts used within neural networks, with a few deviations. This module will explore how simple

perceptron models—the building blocks of neural networks—can be copied multiple times to make up a layer of nodes and can then be expanded into multiple layers to make “deep learning” neural networks. This module sets the stage for the more complex neural network architectures that to be covered on Day 3.

Module Topics:

- **Neural Network Basics.** The basic concepts within conventional neural networks, building upon those learned from linear/logistic regression. The topics covered include:
  - deep learning,
  - perceptron,
  - increased complexity of simple neural networks (hidden layer, multiple nodes),
  - forward propagation and backpropagation,
  - activation functions,
  - optimization methods,
  - initialization and regularization,
  - Excel and python examples.

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### Day 3 (Module 5)

## **NEURAL NETWORKS ARCHITECTURES FOR IMAGES, COMPRESSION, and GENERATIVE AI**

Room: ALC, NSRL (Network Science Research Laboratory)

Instructor(s): Dr. Mark Tschopp

Data doesn't always come in nice data tables with clear inputs and outputs. This module starts to look at data that comes in much different forms: from images to unstructured text. First, a fun talk about when machine learning goes wrong, i.e., real-world applications that have failed in big ways and have been publicized through various media outlets. Then, a look at how some unstructured data, like text and categories can be transformed into structured data for ingestion into machine learning models. This module will then tackle 1) how convolutional neural networks take on image data, 2) how autoencoders compress and decompress data, and 3) how generative adversarial networks take advantage of two competing neural networks to produce fake data that is almost as good as the real data.

Module Topics:

- **AI/ML Real-World Examples.** A fun and informative deep dive into the good, the bad, and the ugly of AI have been publicized via various media outlets. From AI defeating Gary Kasparov to Alpha Go to Amazon's Sexist hiring algorithm to adversarial-perturbed 3D printed turtles to Microsoft's chatbot-turned-racist Tay.ai, this section is an entertaining and concerning look at AI in the wild.
- **Feature Encoding.** As a precursor to looking at unstructured text data, this section is a brief look at how categories can be turned into numerical features for ingestion into machine learning models. The topics covered include:
  - label (ordinal) encoding,
  - one-hot encoding and dummy encoding,
  - target mean encoding, and
  - dealing with overfitting in target mean encoding.

- **Convolutional Neural Networks.** When dealing with data in the form of images and videos and signals, convolutional neural networks take advantage of local information around a specific point, identifying local patterns and relationships. The topics covered include:
  - what are convolutions,
  - convolutional neural network building blocks,
  - filters in hidden layers and saliency maps,
  - different CNN models and ImageNet,
  - advanced architectures (Inception, ResNet),
  - transfer learning,
  - reinforcement learning with CNNs,
  - simple Python examples.
- **Autoencoders and Generative Adversarial Networks.** Neural networks can also be used to compress the dimensionality of data (encode), to expand data into higher dimensions (decode), and to generate new fake data (GANs). The topics covered include:
  - autoencoders and stacked autoencoders,
  - regularization in autoencoders—variational autoencoders,
  - latent space in autoencoders,
  - anomaly detection and autoencoders,
  - generative adversarial networks concepts, and
  - deepfakes.

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### Day 3 (Module 6)

## NEURAL NETWORKS ARCHITECTURES FOR SEQUENCES AND TEXT

Room: ALC, NSRL (Network Science Research Laboratory)

Instructor(s): Dr. Mark Tschopp

OpenAI's ChatGPT took the world by storm. Less impressive language models were released prior to this, but these were quickly pulled offline based off of user feedback. But how do you take an entire corpus of digitized text from books, from the Internet, and from other sources and use it to train billions of parameters for a model that converses intelligently with a diverse set of users all over the world? This module explores sequence models and provides a brief introduction to what's happening under the hood of some of the simpler natural language processing models.

### Module Topics:

- **Sequence Models.** When data is in the form of sequences where context is important, sequence models can use that adjoining information to improve the predictions. The topics covered include:
  - anomaly detection example for time series (sequence),
  - one-to-many, many-to-one, many-to-many model examples,
  - recurrent neural networks,
  - gated recurrent unit models,
  - long/short term memory models,
  - an example in Excel,
  - cross-validation for sequences, and
  - text-to-image network examples—Dall-E, Bing Image Creator, Midjourney.

- Natural Language Processing. When the data is an enormous corpus of text, like every digitized book ever or the entire Internet, natural language processing combined with neural network architectures is a powerful tool. The topics covered include:
    - the basics of NLP,
    - Allen NLP—question-answer models, masked language models,
    - structured data versus language,
    - words-to-numbers—the embedding vectors,
    - word similarity,
    - co-occurrence matrices,
    - GloVe global (word) vector and its properties, and
    - Word2Vec—skipgram and continuous bag of words.
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### Day 4 (Module 7)

## INTRODUCTION TO NATURAL LANGUAGE PROCESSING

Room: ALC, NSRL (Network Science Research Laboratory)

Instructor(s): Dr. Reggie Hobbs

Natural Language Processing (NLP) has emerged as a defining moment in the trajectory of artificial intelligence. This module explores the pivotal role NLP plays in contemporary AI developments.

#### Module Topics:

- Overview of Natural Language Processing – This topic delves into how intelligent systems leverage natural language to interact with humans and learn from textual data. It includes a brief explanation of the fundamental components of natural language.
  - Automated Speech Recognition – Participants will gain insights into the methods and techniques enabling intelligent systems to recognize and transcribe spoken language into text.
  - Deep Learning for NLP – The module discusses the application of deep neural networks in various language tasks, capturing the intricate structure of natural language from training data. Additionally, it provides an overview of the transformer architecture, which, in conjunction with abundant data and high-performance computing resources, has facilitated the development of large language models and the emergence of Generative AI capabilities.
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### Day 4 (Module 8)

## PRACTICAL APPLICATIONS OF NLP

Room: ALC, NSRL (Network Science Research Laboratory)

Instructor(s): Dr. Reggie Hobbs

Natural Language Tasks. This module explores various natural language processing tasks essential in modern AI applications.

#### Module Topics:

- Information Extraction - Participants will delve into the use of computer systems to automatically extract structured information from unstructured or semi-structured machine-readable documents. This process enables computation on previously unstructured data and supports automated reasoning about the logical form of input data.

- Question Answering and Summarization – This topic provides an overview of computational linguistic approaches that generate phrases, sentences, and paragraphs in response to user queries in natural language. These techniques facilitate focused information retrieval across documents.
- Dialogue and Conversational Agents – Participants will gain insights into intelligent systems designed to communicate directly with humans using natural language. The module covers aspects such as tracking verbal transactions, determining speaker intent, handling ambiguity, and addressing uncertainty arising from vague input.

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## Day 6 (Module 9)

### **ARTIFICIAL INTELLIGENCE AND ROBOTICS INTEGRATION**

Room: ALC & Graces Quarters

Instructor(s): Dr. Reggie Hobbs, Dr. John Fossaceca

This module provides an introduction to the integration of artificial intelligence and machine learning with robotics and autonomous systems. The module also includes a briefing about the R2C2 at Grace's Quarters, followed by a tour of the facilities and demonstrations of autonomous platforms.

Module Topics:

- Introduction to Intelligent Robotics: Participants will be introduced to the fundamental concepts and principles of intelligent robotics.
- Behavior Based Robotics: The module explores the principles behind behavior-based robotics, focusing on the design and implementation of robotic behaviors.
- Human-Robot Interaction: Participants will examine the various aspects of human-robot interaction, including communication modalities and interface design.
- Autonomous Systems for the Army: This topic covers the deployment and application of autonomous systems within military contexts, with a focus on Army operations.
- Artificial Intelligence for Maneuver and Mobility (AIMM): Participants will learn about the role of artificial intelligence in enhancing maneuverability and mobility in military settings.

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## Day 7 (Module 10)

### **HUMANS AND AI: UNDERSTANDING AI IN MILITARY ENVIRONMENTS**

Room: ALC, NSRL (Network Science Research Laboratory)

Instructor(s): Dr. Jeremy Gaston, Dr. Amar Marathe, Dr. Brandon Perelman, Dr. Andrea Krausman, Dr. Nick Waytowich, Dr. Vinicius Goecks, Dr. David Boothe, Dr. Kaleb McDowell, Dr. Joe Rexwinkle

AI-enabled software, robotic and autonomous systems (RAS), and machine learning have the potential to fundamentally transform the ways in which war is fought on the future battlefield. Recent successes in the areas of self-driving cars and generative AI have once again fueled aspirations for a sleeker, faster, and more capable future force that is more lethal and survivable than the current state of the art. The modern battlefield will also be transformed by AI-enabled decision support tools, that will assist commanders with command and control, targeting, planning, and battlefield visualization. This module will cover the unique challenges and opportunities of employing AI in military environments.

However, there are challenges that are unique to the military environment that RAS and AI-enabled systems must overcome:

- Military operations, compared with civilian use cases, typically occur in widely varying austere, unstructured environments that present challenges for RAS.
- During military operations, the enemy gets a vote too: both RAS and AI-enabled decision support tools must be adaptable to mitigate adversarial action against machine intelligence.
- Military operations frequently occur in environments with denied, degraded, intermittent, or limited data transfer, leading to a great deal of uncertainty in the data feeding machine and human decision-making.

#### Module Topics:

- AI / Data Science Adversarial Brief: Novel attack surfaces for AI (Dr. Amar Marathe)
- Systemic Oversimplification Limits Potential for Human-AI Partnerships: Current challenges in AI development and a framework for improving collaboration (Dr. Brandon Perelman)
- Trust & System Transparency (Dr. Andrea Krausman or Dr. Jessie Chen)
- Human-Guided Machine Learning for Command and Control and Battlefield Autonomy (Dr. Nick Waytowich)
- COA-GPT: Generative Pre-Trained Transformers for Accelerated Course of Action Development in Military Operations (Dr. Vinicius Goecks)
- Neuro-Inspired Intelligent Systems (Dr. David Boothe)
- Re-envisioning Command and Control (Dr. Kaleb McDowell)

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### Day 8 (Module 11)

## **HUMANS AND AI: AI APPLICATIONS IN MILITARY ENVIRONMENTS**

Room: Aberdeen Proving Ground, Building 520

Instructor(s): Dr. Jeremy R Gaston, Dr. Joe Rexwinkle, Dr. David Boothe, Dr. Nicholas Waytowich, Dr. Brian Cesar-Tondreau, Dr. Vinicius Goecks, Dr. Meagan Small, Dr. Cortney Bradford, and Dr. Jon Touryan

AI, autonomy, and robotics on the modern battlefield intersects and interacts with humans in a variety of ways. Military decision makers generally understand that these future systems will team with humans to enable humans to make better decisions, more quickly, and generate battlefield effects more safely. In addition, however, there are other less obvious intersections between humans and AI. Scientists and engineers learn from biological systems how to create new forms of AI with leap-ahead capabilities and can learn to optimize the behavior of AI systems from human behavior. This module is intended to be very hands-on, consisting of a mixture of demonstrations and instruction.

#### Module Topics:

- Information for Mixed Squads Laboratory Tour & Adaptive Aided Target Recognition (Dr. Joe Rexwinkle)
- Neuro-Inspired Intelligent Systems Demonstration (Dr. David Boothe)
- Human-Guided Machine Learning for Platform Mobility (Dr. Nicholas Waytowich; Dr. Brian Cesar-Tondreau)
- Human Guided Machine Learning for Command and Control (Dr. Vinicius Goecks)
- Protein Design Wars: Implications of AIML in Protein Structure Prediction. (Dr. Meagan Small)
- Human in the Loop Optimization of the Exo Boot Assistance Device (Dr. Cortney Bradford)
- Intelligent Weapon Systems for Dismounted Infantry (Dr. Jon Touryan)



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## Day 9 (Module 12)

# ETHICAL AND STRATEGIC CONSIDERATIONS IN AI DEPLOYMENT

Room: ALC, 5<sup>th</sup> Floor Conference Room

Instructor(s): Dr. Reggie Hobbs, Dr. Mark Tschopp, guest speakers

This module navigates the complex landscape of responsible AI deployment, delving into ethical considerations, biases, operational strategies, and global implications. Participants will explore the intersection of AI technology with societal values, ethical frameworks, and strategic decision-making processes. By examining diverse perspectives and case studies, this module equips learners with the knowledge and tools necessary to navigate the ethical and strategic challenges inherent in AI deployment.

### Module Topics:

- **Ethical Considerations in AI Deployment:** This topic explores the ethical dilemmas surrounding the development and deployment of AI technologies, including issues of fairness, transparency, accountability, and privacy.
  - **AI Biases and Fairness:** Participants will examine the concept of AI biases and their implications for fairness and equity in decision-making processes, along with strategies to mitigate bias in AI systems.
  - **AI Ops:** The module covers operational strategies and best practices for managing AI projects, including model development, deployment, monitoring, and maintenance.
  - **AI Strategy:** Participants will gain insights into the formulation and implementation of AI strategies within organizations, considering factors such as competitive advantage, innovation, and risk management.
  - **Global Implications and Competition of AI:** This topic explores the geopolitical implications of AI development and deployment, including economic competitiveness, national security concerns, and international collaborations and competitions.
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## Program Instructors

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### **DR. MARK TSCHOPP**

Dr. Mark Tschopp is a research scientist within ARL's Army Research Directorate. He has spent over a decade in R&D roles ranging from scientist to faculty to senior leader within GM Powertrain, the Air Force Research Laboratory, Mississippi State University, and the Army Research Laboratory (ARL). As a scientist, he is known for research on accelerated materials design using modeling and simulation, data science, machine learning, and design optimization, which has resulted in numerous highly cited publications in top peer-reviewed journals. He is a Fellow of ASME (mechanical engineering), a Fellow of ASM International (materials science) and an ARL Fellow (top 1.5% of ARL scientists) – the highest distinction for scientists within these organizations. He is passionate about sharing his knowledge and has developed a popular short course titled "Machine Learning for Everyone: May the Course Be with You" in 2021 that has now had over 2500 participants, receiving the 2022 ARL Honorary Award for Impactful Communication.

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### **DR. REGGIE HOBBS**

Dr. Reginald L. Hobbs has 40 years in the computer industry, including active duty in the US Air Force, serving as a defense contractor, and his current career as an Army computer scientist. Dr. Hobbs has a bachelor's degree in Electronics from Chapman University and graduate degrees in Computer Science from the Georgia Institute of Technology. He is currently Chief of the Content Understanding Branch at DEVCOM Army Research Laboratory. He has research interests and experience in the areas of software engineering, natural language processing, artificial intelligence, and cognitive science. Dr. Hobbs has 50+ publications in multiple scientific disciplines and his work has been cited by researchers around the world.

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### **DR. JOHN FOSSACECA**

Dr. John Fossaceca is the Division Chief for the U.S. Army Research Laboratory's Science of Intelligent Systems Division (SISD), overseeing research in AI & Machine Learning for autonomous systems. With extensive industry experience including roles ranging up to Executive VP of Engineering and VP of Technology at companies Ultra-3eTI, Comtech Mobile Datacom, and Bell Laboratories, he led teams that modernized the U.S. Army's satellite-based Blue Force tracking system and developed secure Wi-Fi technology accredited by the U.S. Government. Dr. Fossaceca holds bachelor's and master's degrees in electrical engineering from Manhattan College and Syracuse University, an M.B.A. from Virginia Tech, and a Ph.D. in systems engineering from the George Washington University. Dr. Fossaceca's current interests lie in online continuous machine learning, applications of generative AI, and resilient autonomy. Dr. Fossaceca is also deeply involved in academia, teaching graduate courses in Artificial Intelligence, Machine Learning, Cryptography, Intrusion Detection, and Cybersecurity, and serving as a Ph.D. research advisor.

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## **DR. BRANDON PERELMAN**

Dr. Brandon Perelman is a research psychologist with DEVCOM Army Research Laboratory and is currently serving as the Program Manager for ARL's Human-Autonomy Teaming Essential Research Program. He is a graduate of Michigan Technological University's Applied Cognitive Science & Human Factors program and completed his dissertation under Dr. Shane T. Mueller. He completed his MS in experimental psychology at Saint Joseph's University and attended Sarah Lawrence College for his undergraduate education. Following his undergraduate education, he served as a combat infantryman in the Israel Defense Forces, 50th Bn, Nahal Brigade. He is a former Air Force Research Laboratory Daniel Repperger program fellow and a former employee of Applied Research Associates Inc., Cognitive Solutions Division (formerly Klein Associates), where he worked on projects for government customers including IARPA, AFRL, ARI, and the FBI. His research at ARL has focused on human-agent collaborative spatial decision-making in mixed-initiative systems, trust in autonomous systems, human-computer interaction, and multisensory cybernetics. His primary research interests include computational modeling and simulation, artificial intelligence, human-agent teaming, spatial cognition, human-computer interaction, and decision-making.

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## **DR. JOE REXWINKLE**

Dr. Joe Rexwinkle is a biomedical engineer with DEVCOM Army Research Laboratory and is currently serving as the Team Lead for the Soldier-Guided Adaptation and Cross-Mission Team Evolution thrusts of ARL's Human-Autonomy Teaming Essential Research Program. He is a graduate of the University of Missouri with a PhD in Mechanical Engineering and a BS in Biomedical Engineering. His research at ARL has been generally focused on adaptive human control of autonomous systems, with prior research on brain-computer interfaces, shared situational awareness tools, and intuitive methods for training and adapting algorithms based on operator intent. His primary research interests include human-agent teaming, human-guided machine learning, artificial intelligence, and methods for characterizing human intent.

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## AI Program Contacts

| AI for Soldiers Program Team |                                    |     |
|------------------------------|------------------------------------|-----|
| Name                         | Email                              | Org |
| Dr. Mark Tschopp             | mark.a.tschopp.civ@army.mil        | ARL |
| Dr. Reggie Hobbs             | reginald.l.hobbs2.civ@army.mil     | ARL |
| Dr. John Fossaceca           | john.m.fossaceca.civ@army.mil      | ARL |
| Dr. Brandon Perelman         | brandon.s.perelman.civ@army.mil    | ARL |
| Dr. Joe Rexwinkle            | joe.t.rexwinkle.civ@army.mil       | ARL |
| Mr. Jeff Westrich            | jeffrey.r.westrich.civ@army.mil    | ARL |
| Mr. Chris Oliver             | christopher.m.oliver4.civ@army.mil | ARL |
| Dr. Greg Brill               | gregory.n.brill.civ@army.mil       | ARL |
| Mr. Christopher Stolz        | christopher.p.stolz.civ@army.mil   | FCC |
| MAJ Matthew Work             | matthew.c.work.mil@army.mil        | FCC |
| Mr. Karl Kappra              | karl.a.kappra.civ@army.mil         | ARL |
| Dr. Jeremy Gaston            | jeremy.r.gaston.civ@army.mil       | ARL |
| Mr. Deitrich Wiegmann        | dietrich.wiegmann.civ@army.mil     | ARL |

## Group AI Capstone Project

The Artificial Intelligence for Soldiers course facilitates the knowledge process by offering an unclassified scenario for student teams to formulate how machine learning and artificial intelligence concepts can potentially be used in the future. The objective/task for the scenario is purposely left open-ended for the teams to formulate where there might be an opportunity based on the skillsets of the team.

Some questions that may be useful in discussions:

- A. Objective and Impact of AI Implementation.
  - a. How would this objective/task be approached without AI/ML, and what is the current state of the art?
  - b. How could AI/ML improve predictions and decision-making speed?
  - c. Could AI fundamentally alter strategy or direction, and if so, how?
- B. Data Considerations.
  - a. What data is available for training, and how reliable is it?
  - b. Which features are most relevant, and how can missing or noisy data be managed?
  - c. How can data collection and model validation be conducted effectively?
  - d. Is there a discrepancy between training and real-world data, and if so, how can it be identified?
- C. Algorithm Selection and Implementation.
  - a. Which ML algorithms are suitable for the problem, and why?
  - b. How do we balance complexity and interpretability? (hint: think variance vs bias tradeoff)
  - c. Can algorithms be scaled effectively, and how do we defend against adversarial attacks or failures?
  - d. Are there tradeoffs between speed and accuracy?
  - e. Can pre-trained models be used, and how?
- D. Human-AI Interaction.
  - a. How can user interfaces effectively communicate AI capabilities and limitations?
  - b. How can user feedback be incorporated to improve AI performance?
  - c. What strategies can build trust between users and AI systems to increase useability of AI systems?
  - d. What educational resources are needed for users to understand and interact with AI effectively?
  - e. How can AI systems augment human decision-making while respecting human autonomy?
  - f. How could Soldiers at different echelons employ AI to meet their goals?
- E. Ethical and Risk Considerations.
  - a. What ethical concerns and risks are associated with AI implementation?
  - b. How can potential harmful outcomes be addressed, and who is responsible?
  - c. What privacy and security concerns need to be addressed?
  - d. How can AI systems be held accountable for their actions? If not AI, who is accountable?
  - e. What measures can mitigate potential biases or risks?

It is envisioned that there will be time each day towards the end of the day for teams to meet and discuss the various concepts learned throughout the day and how they may apply to the objective/task/scenario chosen.

## Travel Instructions

### Location/Arrival

The Combat Capabilities Development Command (DEVCOM) Army Research Laboratory (ARL) is a large government-owned research facility, one of the main performers and funders of foundational research for the Army. The venue for the course is DEVCOM ARL's Adelphi Laboratory Center (ALC)—its headquarters and one of the ARL research campuses. This facility is located 12 miles north of Washington, DC in Adelphi, MD.

Adelphi Laboratory Center (ALC)  
2800 Powder Mill Road  
Hyattsville, MD 20783

There are two major Airports within the region: Ronald Reagan-Washington National Airport (DCA), and Baltimore/Washington International Airport (BWI). BWI has less traffic to navigate in and out of, but DCA is closer to the facility. A third option is Dulles (IAD), VA.

- BWI to ALC: 25.1 miles (about 30 minutes)
- DCA to ALC: 16.1 miles (about 40 minutes)
- IAD to ALC: 32.5 miles (about 40 minutes)

Please contact ground transportation for transport to the Home2Suites hotel in Silver Spring, MD. If possible, coordinate your arrival time to link up with those Soldiers designated as authorized rental carpool drivers.

**Registration/Check-in.** On Day 1, proceed to ARL's Adelphi Laboratory Center (ALC). ***There is another large event happening in Week 1, so leave plenty of time to get to the facility.*** Upon entering the facility, we have set up a registration table where participants can check in, receive badges and/or lanyards, check to make sure that name is listed correctly (for certificates), and can pay for daily meals. The program begins with a welcome ceremony at the main campus ARL classroom of 8 April 24 at 0800.

Participants are expected to arrange for travel to and from ALC before and after class. For those driving, there are parking lots located outside of the laboratory. Participants will need to show their CAC card to security to enter the gate. Upon entering the campus, take the first right and then parking should be on the right. The main building is right across the street.

For days that give another location, participants should still meet at ALC at the designated start time (0800 AM ET), where transportation will use a 44-person bus. This occurs twice: at Graces Quarters and Aberdeen Proving Ground in week 2.

### Meal and Lodging Information

Morning and afternoon snacks, box lunches will be provided at a cost. ALC also has a cafeteria with other options, which may take additional time. Please let us know if there are any food allergies.

Plan to arrive at the hotel, NLT 2000 EST, 7 Apr 2024. A block of rooms has been reserved under "Army AI Conference" at Home2Suites:

Home2Suites by Hilton  
1701 Elton Road  
Silver Spring, MD 20903

## Technology Requirements

You must have a laptop or other device that is CAC enabled for the program.

Wi-Fi will be provided by ARL during each day in the classroom. Wi-Fi is available at the Home2Suites but is not guaranteed to support high-speed connections.

The AI capstone project, in particular, may require a laptop with access to Microsoft PowerPoint for final presentation.

## Assignments and Assessments

For assignments and assessments, the primary requirement for successful completion of the course is the submission of:

- the final course feedback,
- and the delivery of the AI capstone project presentation.

The deadline for the AI capstone project presentation is the final day of the course, prior to the graduation ceremony. To aid in the completion of the AI capstone project and course feedback, each soldier will be provided with a notebook to track notes and thoughts throughout the duration of the course.

## Feedback Mechanism

On the last day, participants will be asked to provide feedback for the course: what they thought worked well, what didn't work well, what suggestions they have for improving the course. This information is critical to improving the course in the future.

## Support Resources (optional)

Who is ARL? AI2C?

- Who is ARL? [DEVCOM Army Research Laboratory – The Army's foundational research laboratory](#)
- Who is AI2C? [Home \(crmforce.mil\)](#)
- Who is CDAO? [CDAO - Chief Digital and Artificial Intelligence Office \(ai.mil\)](#)
- Who is FCC? [FUTURES AND CONCEPTS CENTER \(army.mil\)](#)

There are a number of optional reading assignments:

1. [Understanding AI Technology](#), Allen, 2020. (20 pages)
2. [How to Become a Centaur](#), Case, 2018. (13 pages)
3. [Cognitive Warfare](#), du Cluzel, 2020. (45 pages)
4. [Systemic Oversimplification Limits the Potential for Human-AI Partnerships](#), Metcalfe, Perelman, Boothe, & McDowell, 2021. (19 pages)
5. [Marines fooled a DARPA robot by hiding in a cardboard box while giggling and pretending to be trees](#), Tangalakis-Lippert, 2023. (2 pages)
6. [Making an Invisibility Cloak: Real World Adversarial Attacks on Object Detectors](#), Wu, Lim, Davis, & Goldstein, 2020. (16 pages)
7. [Expert Edition: Delivering on Artificial Intelligence's Potential](#), multiple contributing authors. (33 pages)
8. [What are Brain Networks?](#) Sughrue, 2022. (6 pages)
9. [Neuromorphic Artificial Intelligence Systems](#), Ivanov, Chezhegov, Kiselev, Grunin, & Larionov, 2022. (20 pages)
10. [How to Prepare for Rapidly Evolving Technology: Focus on Adaptability](#). Pollard, Files, Oiknine, & Dalangin, 2022. (19 pages)

These relevant websites may provide exercises and further information:

1. [A Neural Network Playground](#)
2. [AllenNLP — Allen Institute for AI](#)
3. [ChatGPT](#) (explain it like I'm 5)
4. [3Blue1Brown](#) (great Neural Networks Videos!)
  - a. But what is a Neural Network,
  - b. gradient descent, how neural networks learn,
  - c. analyzing our neural network,
  - d. what is backpropagation really doing,
  - e. backpropagation calculus
5. [Welcome to the Artificial Intelligence Incident Database](#)
6. [Machine Learning | Google for Developers](#)
7. [Machine Learning | Coursera](#)



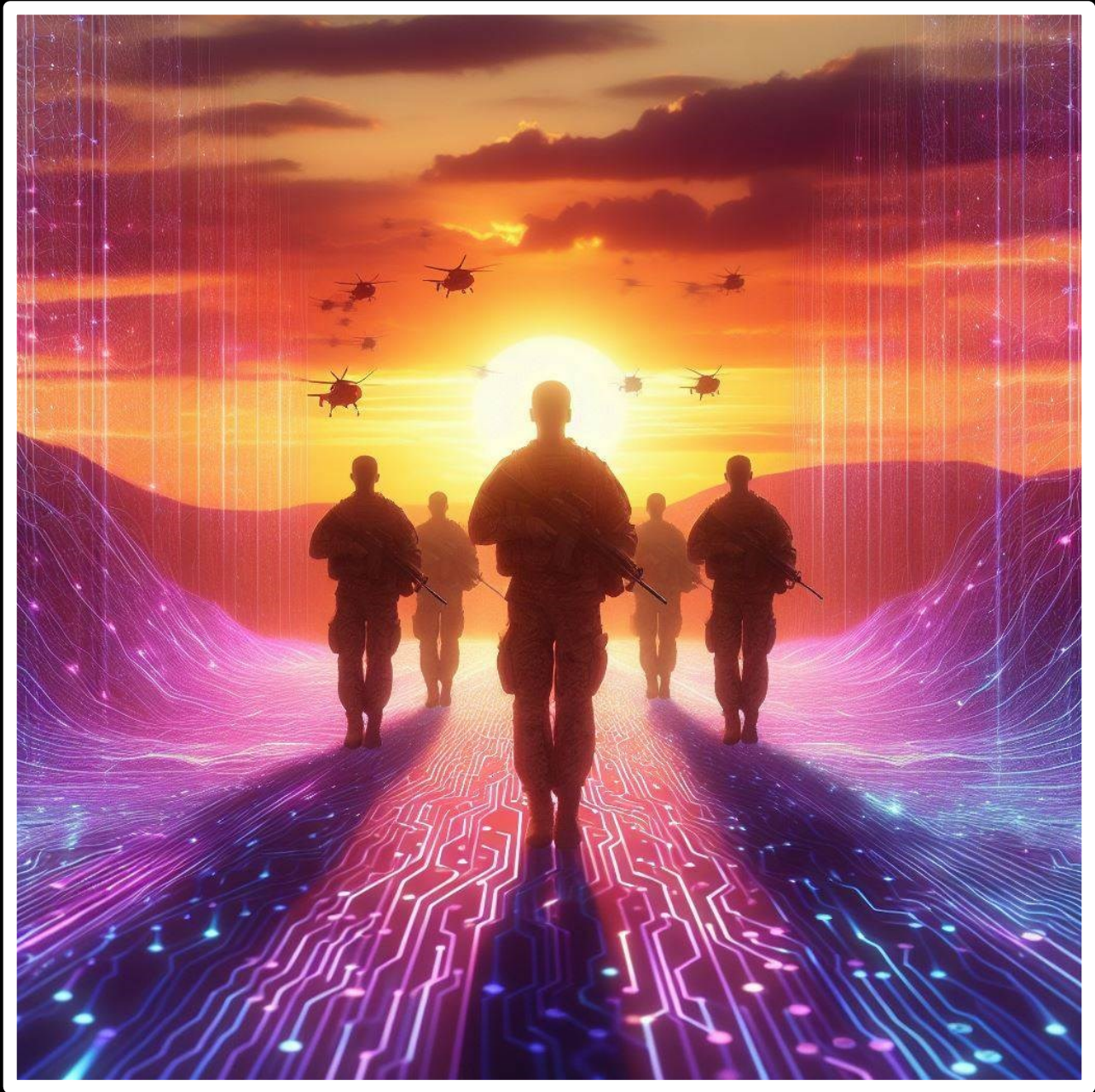
**OPTIONAL.** Don't stop there. Did you know that there are a number of books that discuss all different aspects of AI in the past, present, and future? Here is a list of AI Books that may be enjoyable reads, or if you like listening to the audiobooks.

- Army of None, Paul Scharre
  - Is it autonomous or just autonomy? This book dives into the growing military interest in autonomous weapon systems and autonomy on the battlefield, as well as the global implications of military autonomy.
- Four Battlefields, Paul Scharre
  - Power in the age of artificial intelligence. A look forward at what the future of AI may look like in military contexts.
- Genius Makers, Cade Metz
  - The history of AI since its early days, the ups, the downs, the hype, and the rapid emergence of capabilities over the last 15 years. Excellent.
- How Google Works, Eric Schmidt, Johnathan Rosenberg, Alan Eagle
  - A look at Google in the early days of the company and how Google captured the “Smart Creatives” (i.e., focused on talent acquisition & management) in order to build one of the largest companies in the world.
- The Age of AI, Henry Kissinger, Eric Schmidt, Daniel Huttenlocher
  - Former CEO of Google, Eric Schmidt, teams up with Henry Kissinger to take a peek at the future, termed the Age of AI for its growing importance.
- Chip Wars, Chris Miller
  - Incredible. This book is a detailed history of the semiconductor industry and its importance in the world, especially given the growing importance of AI. The global competition through time in this realm is fascinating and this book explains the major players, from industry to Taiwan, US, China, Japan, Russia, etc.
- LikeWars, PW Singer, Emerson Brooking
  - Outstanding read on the history of information warfare, centering around the use and misuse of social media by citizens, democracies, and authoritarian regimes.
- Homo Deus, Yuval Noah Harari
  - A long read but definitely worth it. This book looks at the future of humanity based on both the past history of humanity through time and the growing importance of AI to lay out what may be in store in the future.
- AI 2041, Kai-Fu Lee, Chen Qiufan
  - Very interesting. This book is separated into a number of fascinating short stories that look into what AI capabilities may lead to in the future. Very “Black Mirror”-esque for those that have seen the Netflix series.
- Surveillance State, Josh Chin, Liza Lin
  - Wow! Very interesting read on the history of surveillance technologies in China with a major focus on the history of Xinjiang and the CCPs treatment of the Uyghur minority (officially determined by US as genocide). This book is an eye-opening look at China's increasing use of AI in surveillance technologies to control their citizens and how China is exporting this technology to other countries looking to do the same.
- Human Compatible, Stuart Russell
  - An author of one of the most used textbooks on artificial intelligence explores how and why programming AI systems is so much more difficult than the average person may

think. How do you teach AI to do what's best for humanity and not destroy it when giving a superintelligent system an ill-defined goal?

- White Sun War, Mick Ryan
  - After doing countless research on the military side of history of China and Taiwan, this book chooses to examine a hypothetical future war between China and Taiwan, set in 2028, that explores not only military strategy but the changing battlefield under future AI and autonomy capabilities.
- Fancy Bear Goes Phishing, Scott J Shapiro
  - What is the history of cybersecurity? This book tackles some of the biggest cyber-attacks since the inception of the internet along with the individuals behind it.
- The Algorithm, Hilke Schellmann
  - how has AI affected hiring practices, privacy and monitoring on the job, firing of employees? Furthermore, how do these algorithms handle diversity and disabilities? Are they even legal? This book examines the concerning side of AI integration into human resources.
- Interesting books that explore the underlying information and biases within data & models
  - Weapons of Math Destruction, Cathy O'Neill
  - Everybody Lies, Seth Stephens-Davidowitz
  - Superfreakonomics, Steven Levitt, Stephen Dubner
  - Freakonomics, Steven Levitt, Stephen Dubner
- More of a science fiction person? (Re-)read a classic or a newer book on AI, robotics, surveillance, government, etc.
  - The Naked Sun, Isaac Asimov ("AI in alien civilizations. 3 rules of robotics")
  - Machines Like Me, Ian McEwan ("AI and robotics")
  - 1984, George Orwell ("big brother")

# Artificial Intelligence for Soldiers



**Prompt:** [Microsoft Bing Image Creator] Imagine a serene sunset scene where US soldiers, their forms outlined in shadow, walk purposefully toward the horizon. The backdrop is a blend of warm oranges and purples, with the sun casting long shadows. However, instead of a traditional landscape, the ground beneath their feet is composed of intricate AI algorithms, neural networks, and lines of code. These digital pathways lead toward the vanishing point, symbolizing the soldiers' journey into an AI-driven future.

## **Appendix C. AI for Soldiers Team**

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The following table details the team for the AI4S course.

**Table C-1 AI for Soldiers team**

| <b>Name</b>            | <b>Org</b> | <b>Role</b>                                                              |
|------------------------|------------|--------------------------------------------------------------------------|
| LTC Ben Choe           | HQDA       | Point of Contact, HQDA G3/5/7                                            |
| Dr Donald Ellwood      | HQDA       | Point of Contact, HQDA G3/5/7                                            |
| Dr Mark Tschopp        | ARL        | Overall Lead, AI4Soldiers Course, Instructor/Moderator                   |
| Dr Reggie Hobbs        | ARL        | Overall Lead, AI4Soldiers Course, Instructor/Moderator                   |
| Mr Christopher Stolz   | FCC        | Lead (FCC), AI4Soldiers Course                                           |
| MAJ Matthew Work       | FCC        | Lead (FCC), AI4Soldiers Course                                           |
| Dr John Fossaceca      | ARL        | Lead, Robotics / Graces Quarters; Speaker, Robotics and Autonomy         |
| Dr Joe Rexwinkle       | ARL        | Lead, Humans and AI; Speaker, Novel Attack Surfaces for AI   AI Failures |
| Dr Brandon Perelman    | ARL        | Lead, Humans and AI                                                      |
| Mr Jeff Westrich       | ARL        | Lead, Graces Quarters Tour                                               |
| Mr Chris Oliver        | ARL        | Support, AI4Soldiers Course                                              |
| Mr Karl Kappra         | ARL        | Support, AI4Soldiers Course, Guest Speaker                               |
| Dr Greg Brill          | ARL        | Support, AI4Soldiers Course                                              |
| Dr Jeremy Gaston       | ARL        | Support, AI4Soldiers Course                                              |
| Mr Deitrich Wiegmann   | ARL        | Guest Speaker, MIS Competency                                            |
| Dr Romeo del Rosario   | ARL        | Guest Speaker, EMSS Competency, AI applied to RF and Electronics         |
| Dr Brian Rivera        | ARL        | Guest Speaker, NCCS Competency                                           |
| BG Stephanie Ahern     | FCC        | Guest Speaker                                                            |
| Dr Patrick Baker (SES) | ARL        | Guest Speaker, Graduation Ceremony                                       |
| Dr David Stepp         | ARL        | Guest Speaker, Army Research Office and AI                               |
| Dr James Uplinger      | ARL        | Guest Speaker, Convolutional Neural Networks                             |
| Ms Carla Crandall      | AFC        | Guest Speaker, AI Ethics, Law Attorney                                   |
| Dr Jade Freeman        | ARL        | Speaker, AI in Action, Cross-Reality COP (XRCOP)                         |
| Mr Michael Landes      | ARL        | Speaker, AI in Action, Cross-Reality COP (XRCOP)                         |
| Mr Michael Lee         | ARL        | Speaker, AI in Action, Cross-Reality COP (XRCOP)                         |
| Mr Tim Gregory         | ARL        | Speaker, AI in Action, Cross-Reality COP (XRCOP)                         |
| Mr Theron Trout        | ARL        | Speaker, AI in Action, Cross-Reality COP (XRCOP)                         |
| Dr Claire Bonial       | ARL        | Speaker, AI in Action, Conversational AI                                 |
| Dr Adrienne Raglin     | ARL        | Speaker, AI in Action, ETI Artificial Reasoning Framework                |
| Mr Mark Mittrick       | ARL        | Speaker, AI in Action, ETI Artificial Reasoning Framework                |
| Mr John Richardson     | ARL        | Speaker, AI in Action, ETI Artificial Reasoning Framework                |
| Ms Somiya Metu         | ARL        | Speaker, AI in Action, ETI Artificial Reasoning Framework                |

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**Table C-1 (continued from previous page)**

| <b>Name</b>             | <b>Org</b> | <b>Role</b>                                                                                                                              |
|-------------------------|------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Dr Justine Rawal        | ARL        | Speaker, AI in Action, ETI Artificial Reasoning Framework                                                                                |
| Dr Erin Zaroukian       | ARL        | Speaker, AI in Action, ETI Artificial Reasoning Framework                                                                                |
| Mr Prabhat Kumar        | ARL        | Speaker, AI in Action, ETI Artificial Reasoning Framework                                                                                |
| Mr Matt Ziemann         | ARL        | Speaker, AI in Action, Adaptive Low Probability of Detection Radar Waveform Design with Generative Deep Learning                         |
| Mr Lam Nguyen           | ARL        | Speaker, AI in Action, AI/ML processing for Synthetic Aperture Radar                                                                     |
| Dr Brent Kraczek        | ARL        | Speaker, AI in Action, Deep neural network sensitivity to varied radar waveform properties                                               |
| Dr Michael Lee          | ARL        | Speaker, AI in Action, Machine Learning for Classification and Signal Restoration                                                        |
| Dr Frederica Nelson     | ARL        | Speaker, AI in Action, Vehicle Protection Research                                                                                       |
| Dr Priya Narayanan      | ARL        | Speaker, Graces Quarters, Legged Robotics Intro                                                                                          |
| Mr Mason Russell        | ARL        | Speaker/Demo, Graces Quarters, Legged Robot Demo                                                                                         |
| Dr Jason Gregory        | ARL        | Speaker/Demo, Graces Quarters, Unmanned Ground Vehicle, Autonomy Stack Intro, Warthog Demonstration                                      |
| Dr Corde Lane (ST)      | ARL        | Speaker, Humans and AI                                                                                                                   |
| Dr Amar Marathe         | ARL        | Speaker, Humans and AI, Human AI Partnerships for Army Applications   Oversimplifications in Human–AI Partnerships                       |
| Mr Ralph Brewer         | ARL        | Speaker, Humans and AI, Assessment of Human–Machine Integration Performance                                                              |
| Dr Vinicius Goecks      | ARL        | Speaker, Humans and AI, COA-GPT: Generative Pre-trained Transformers for Accelerated Course of Action Development in Military Operations |
| Dr Nick Waytowich       | ARL        | Speaker, Humans and AI, Human-Guided Machine Learning for Command and Control and Battlefield Autonomy                                   |
| Dr David Boothe         | ARL        | Speaker, Humans and AI, Neuro-Inspired Spatial Reasoning                                                                                 |
| Dr Kaleb McDowell       | ARL        | Speaker, Humans and AI, Re-Envisioning Command and Control                                                                               |
| Dr Cortney Bradford     | ARL        | Speaker, Humans and AI, AI for Exo-Boot                                                                                                  |
| Ms Sabrina Sullivan     | UIC        | Speaker, Humans and AI, AI for Exo-Boot                                                                                                  |
| Dr Meagan Small         | ARL        | Speaker, Humans and AI, AI for Protein Design                                                                                            |
| Dr Brian Cesar-Tondreau | ARL        | Speaker, Humans and AI, Human-Guided ML for Command and Control and Human-Guided ML for Platform Mobility                                |
| Mr Bill Maslin          | ARL        | Speaker, Humans and AI, Intelligent Squad Weapons                                                                                        |
| Dr Andrew Tweedell      | ARL        | Speaker, Humans and AI, Intelligent Squad Weapons                                                                                        |
| Dr Jon Touryan          | ARL        | Speaker, Humans and AI, Intelligent Squad Weapons                                                                                        |

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**Table C-1 (continued from previous page)**

| <b>Name</b>           | <b>Org</b> | <b>Role</b>                                       |
|-----------------------|------------|---------------------------------------------------|
| Dr Philip Crowell     | ARL        | Speaker, Humans and AI, Intelligent Squad Weapons |
| Dr Louis Dankovich    | ARL        | Speaker, Humans and AI, Intelligent Squad Weapons |
| Mr Paul Riggs         | ARL        | Speaker, Humans and AI, Intelligent Squad Weapons |
| Mr Paul Sabbagh       | ARL        | Speaker, Humans and AI, Intelligent Squad Weapons |
| Mr Thomas Rohaly      | ARL        | Speaker, Humans and AI, Intelligent Squad Weapons |
| Mr Tim Mermagen       | ARL        | Speaker, Humans and AI, Intelligent Squad Weapons |
| Mr Osben Toulson      | ARL        | Speaker, Humans and AI, Intelligent Squad Weapons |
| Mr Richard Diego      | ARL        | Speaker, Humans and AI, Intelligent Squad Weapons |
| Mr Jared Deighton     | ARL        | Speaker, Humans and AI, Neuro-Inspired AI         |
| Mr Wyatt Mackey       | UTK        | Speaker, Humans and AI, Neuro-Inspired AI         |
| Ms Lauren Paddy       | ARL        | Support, ALC                                      |
| Ms Linda Pecilunas    | ARL        | Support, ALC                                      |
| Ms Maria Cortez       | ARL        | Support, ALC                                      |
| Ms Mary Anderson      | ARL        | Support, ALC                                      |
| Ms Paula Bonham       | ARL        | Support, ALC                                      |
| Ms Shalonda Jackson   | ARL        | Support, ALC                                      |
| Mr Michael Schueckler | ARL        | Support, ALC (A/V)                                |
| Mr Mario Preti        | ARL        | Support, ALC (IT)                                 |
| Ms Kathy Zubey        | ARL        | Support, ALC (Marketing)                          |
| Mr Michael Milton     | ARL        | Support, ALC (Safety)                             |
| Mr Michael Carr       | ARL        | Support, ALC (Security)                           |
| Ms Lisa Scott         | ARL        | Support, ALC (NSRL)                               |
| Ms Cheryl Skibicki    | ARL        | Support, ALC (LabOps)                             |
| Mr Cliff Bell         | ARL        | Support, APG (Logistics)                          |
| Ms Laura Snyder       | ARL        | Support, APG (Security)                           |
| Mr Fred Thompson      | ARL        | Support, APG (LabOps)                             |
| Ms Rachel Crespo      | ARL        | Support, Graces Quarters                          |
| Mr Michael Blevins    | ARL        | Support, Graces Quarters / APG (Bus)              |
| Mr Michael Smith      | ARL        | Support, Graces Quarters / APG (Bus)              |

## **Appendix D. Course Feedback Comments**

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In the course surveys, there were multiple questions asking for feedback in the form of long text. For each of the questions, the question will be bolded and the participants' responses will be given. In a few cases, an addition or change was added to the response for clarity with an [] surrounding the added/edited words.

**What did you think of the course? Anything else that you wish to add?**

1. "The course provided valuable foundational knowledge on AI's theoretical aspects, its potential applications, and future implications within the force. However, for future iterations, I would recommend incorporating a more in-depth exploration of current and evolving AI applications that could affect the force in the next four to eight years. We have to start small getting each and every leader and Soldier [cognizant] of the impacts of AI and build that trust between leaders and AI capabilities."
2. "I would recommend everyone in my organization to attend this course."
3. "It was great. The order and flow was good. More pretext would help in that, hey this is the math that is tough, but when you understand this level, it will help you understand the next levels of how it becomes easier. As I mentioned, connectivity would have been great so we could do some instructor led practical work in Excel, Python, or GPT. Just to reinforce the lessons taught and break up some of the overwhelming (at times) PowerPoints. I want to dig in and try it myself."
4. "My only critique is of the amount of math that was presented. I very much enjoyed the material and am thankful for the opportunity to meet so many of the staff that work with the technology every day."
5. "Very well done making a complex topic accessible for many without a hard science background. I appreciate the care put into the course organization from the meal options to field trips to [subject-matter expert] engagements. Thank you for this investment in our professional development."
6. "Dr Tschopp and Dr Hobbs were phenomenal. The Major and the FCC DoC were great moderators and they lent a lot of perspective during the entire course. BG Ahern was very personable and sincerely listened to the feedback of the students. I loved the course and it was encouraging to know that we

have 1600 researchers pioneering the way ahead for the armed forces. With the outlook, skills, and knowledge gained from the course I have a significantly better understanding of the capabilities and limitations of AI. I intend to educate my organization and eventually build an 'Intro to AI in the Armed Forces' presentation at some point to build a shared understanding with rest of the brigade. Thank you, I am very thankful for the opportunity to participate in this course."

7. "I found this course fun and interesting however I still don't really understand what the course objective was. I am better informed about AIML and I will [definitely] advocate for ARL. If that was the objective that was a success."
8. "Great course!"
9. "Great pilot effort. This type of material needs to be incorporated into Army [professional military education] in a condensed space to provide general awareness to future leaders."
10. "There was a lot of technical data that really didn't make sense. Split the course into two groups based on knowledge and experience with this information."
11. "It was great with no issue. More hands-on in AI applications."
12. "I wish that there was enough [time] to have specific breakout sessions with the [ARL] competency of your choice to get a deeper understanding of AI subject matter with respect to the competency of interest. Additionally, I would have enjoyed each competency being represented during the course, especially weapon systems."
13. "Great course. Honored to be selected to attend. I hope this course will be geared to O-3 commanders and 1SGs/SGMs."
14. "The course was great to learn about how ARL is approaching and using AI in research. I do wish that there was more tools that we can bring back to our commanders. However, the knowledge and resources gained in this course will be used in forming guidance on how to prepare for producing realistic expectations and guidance to the unit."

15. "I strongly believe that this course should be offered at least twice annually to educate the force. Promoting awareness will be crucial to guarantee success within the force while implementing AI. I recommend keeping the business casual attire for the course."
16. "The course was overall well put together and should continue."
17. "Great course. Look forward to seeing this course evolve if the course is allowed to continue."
18. "I would have an emphasis on a distance learning course for beginners and the in-person course for those with more experience."

**What have you liked about the course? What should absolutely not be changed about the course?**

1. "I enjoyed the opportunity to meet with the scientists and to learn about their research and how it will change the Army in the near future."
2. "I loved the structure, starting from under the hood and seeing how it can be employed. I am much more suited to speak intelligently on the why, and why not for my commander. The depth and level of knowledge was unsurpassed and for me as a warrant officer always needing to speak truths (why or why not) I feel armed and intelligent."
3. "The relaxed atmosphere. Yes, we had a goal to attain, but we had a pretty good time getting there. The Star Wars references, the jokes about AI, watching two guest speakers geek out over quantum computing [...] we were able to laugh and take everything in stride. If the overall goal of the class changes then, of course, the content of the class will need to change as well, but the delivery very much needs to remain the same in my opinion."
4. "Overall, I enjoyed how highly informative and well organized the course was, the potential that AI brings to the force is immeasurable for future generations. I would recommend maintaining the current course location, it allows invaluable opportunity for each of us to witness improvements firsthand."
5. "I appreciated the overall environment. All of the [subject-matter experts] were approachable and addressed us as fellow professionals albeit from dif-

ferent backgrounds. Wearing civilian attire allowed us to be relaxed and fostered freedom of expression without rank getting in the way if we were in uniform.”

6. “I like the information on AI as a whole and the interactions with the researchers to give context to the information presented. I wouldn’t change anything about the course, I very much enjoyed it.”
7. “The demonstrations were helpful to see real world applications.”
8. “The practical application of AI systems.”
9. “The offsite visits to ARL activities helped the class visualize the impact of ARL. Also enjoyed the philosophical discussions on the direction of AI and the possibilities in the future. ”
10. “I’ve really enjoyed the engaging teaching style of the course. The supportive atmosphere created by both Dr Tschopp and Dr Hobbs is commendable. Absolutely keep the trips to both locations.”
11. “I liked that the fact that the course was not only informative but very technical. Course construction made some assumptions that the student had a basic understanding of Excel, linear algebra, calculus, and statistics which allowed us to jump right into a deeper machine learning model environment.  
  
The practical demonstrations of the AI applications currently being developed by [ARL] has to stay. To get an opportunity to see and discuss real-time applications (and limitations) makes it easier to correlate the material and transfer concepts to the students’ respective disciplines in order to advocate for AI in the students’ own professional spaces.”
12. “Any and all visual representation of robotics / equipment. Basically all hands on stuff keep.”
13. “Visit to APG showed me things that I didn’t know we were researching. The ML course was technical, but was absolutely needed to provide a foundation in AI. Themes such as [recurrent neural networks] were talked about in briefs from other presenters. The ML class helped us understand the other briefers and know what questions to ask.”

14. “I truly like the diversity within the course on topics and scientists. I absolutely will keep the guest speakers input during the agenda of the course.”
15. “Tours of research facilities and demonstrations.”
16. “The variety of people we interacted with and the range of fields is eye-opening.”
17. “Three points:
  - Keep in-person, hands-on classes at Graces Quarters and APG.
  - Keep part of in-person classes at ARL–Adelphi [Laboratory Center].
  - Keep course (in person) to 20–30 person for more hands on experience.”

### **How could the course be improved?**

1. “It should incorporate museum visits on the weekend.”
2. “One of the big things for me was connectivity in the classroom. When I was feeling it was well above my head, I had to write things down to research later which prevented me to ask the questions I may have had.”
3. “I’m sure everyone is going to mention the math, here. Days 2 and 3 were a struggle for most. I do feel the math portion DOES need to be there; being educated on just how complex things are and how quickly they get that complicated does a lot to dispel the mysticism of AI and it helps those of us on the outside to be able to have a more intelligent conversation. However, the level of math required surpassed most of us in the class very quickly and the following hours were unproductive as we were already lost.”
4. “Due to the time constraints moving from subject to subject, some of the course material felt rushed and wasn’t able to talk with the instructors on specific topics or questions the group had. Overall, the course was very well structured for PowerPoint presentations but some days not for asking questions of certain topics.”
5. “The foundation part was helpful albeit too heavy on the mathematical details. Still it was nice to recognize vocabulary when we got to the application field trips ([activation] functions, softmax, etc). From a delivery standpoint,

getting more audience participation during the foundations portion would be an improvement (have us play the wompus game rather than just lecturing on it). On the logistics side, Soldiers are not used to paying so much for meals/snacks. All we really need is coffee and water. With the hotel providing breakfast, there's no need for morning snacks (we could have brought fruit from the hotel if needed). It was odd that only those who paid could help themselves to coffee when ARL staff not involved in the course were helping themselves to the coffee that first week. To get around that, get with the Family Readiness Group to provide coffee / water / snacks as a fundraiser/donation. Having internet access would have helped (read ahead said it would be provided and we needed to bring CAC enabled computers. That was not accurate.) I personally like having the slides ahead of time so I can take notes on those specific slides as they're briefed. All that said, paying for the lunches allowed for engaging conversations with the [subject-matter experts] outside of class."

6. "The course could be improved by reducing the amount of 'numbers' and expanding on AI applications. A great deal of the formulas and number driven data in some of the presentations was significantly above the level of understanding for most of the attendees."
7. "I might give a briefer explanation of the math."
8. "A shorter version of the math for the AI systems. One breakdown of the matrix math and then a summary of the differences between the different models. A pro and cons of the different models would have sufficed. I like math but found it difficult to stay attentive and once I stopped following the math I was simply riding along."
9. "Maybe cut down on the Power Point a bit, some days I felt talked at from the visiting briefers. I would also include a section on ARL's mission, the greater DEVCOM and AFC role, [technology readiness levels], and process from Research to fielding."
10. "Having big classroom with internet connections will help."
11. "An online primer would help tremendously. If students can go in knowing [what] to expect regarding the quantitative side of the course, it would sig-

nificantly help with content reception. I think many were taken aback at how math-intensive the course became very early on and were not prepared.

The course also felt very rushed and crammed. Yes, there was a lot of content, but there were many times that thoughtful discussion, lab demonstration, and content instruction was forced to be rushed based on the schedule. At times, students couldn't ask questions about a concept they didn't understand, simply because there was not enough time and we had to get to the next slide deck or speaker. There was certainly some felt frustration.

This played out significantly in the NLP lab. The timeline was so crunched that many of the presenters had to skip over slides or just end their brief prematurely. I felt that was not only a disservice to the students, but also the presenters who were there to show their work but also help us students understand their roles.

I'm not saying to completely forego a timeline, but students will get lost very quickly once it becomes apparent the course is about getting through the slides, not 'getting through the students' skulls.' Hope that helps!"

12. "Slightly less math. I understand the definitions and framework of how it works is important, though."
13. "Pre-course information / learning: I would like a refresher of algebra terms and symbols to help us understand the formulas we are looking at. This doesn't need to be part of the course, but it would be great to have the resource before the course."
14. "The course can be improved with less powerpoint. I think providing a read ahead daily will allow students to be more engaged, prepared and developed discussion topics. Increase the capstone projects time ahead of time letting students know for expectation management."
15. "Broader targeted audience with more emphasis on individuals actually interested and passionate about the subject matter."
16. "Possibly provide a day to allow attendees to see more in depth areas that they may be in."
17. "Four points:

- Less powerpoint, more hand-on time with AI systems.
- Tailor the class to those with more foundational math and [science, technology, engineering, and mathematics] backgrounds.
- Possibly break the course into more narrow focus areas but go into more depth in each of those areas.
- Have a classified period of discussion to see what is being worked on in other echelons.”

**What would you have liked to have seen in the course, but didn’t?**

1. “I didn’t expect much from the beginning.”
2. “We only spoke briefly on [Project Maven] which made me feel less intelligent on what is currently out there. I would have liked a class on where we are, what we can do, and then understand where we are going and how.”
3. “I don’t know that I really have an answer to this question. I didn’t really have much in the way of expectations coming into the course, primarily because I had a limited understanding of AI to begin with. For me, I don’t feel it was particularly lacking in any certain aspect.”
4. “I believe it would have been beneficial to see firsthand the current applications of AI in practical context and to understand areas where enhancement could be made. Additionally, a detailed roadmap outlining the trajectory of AI development over the next 4-8 years is essential. such a roadmap is imperative for the end user like us to actively contribute to shaping the future.”
5. “I’ll use this box as free response not necessarily connected to the question:
  - (a) What is “intelligence?” We first need to understand intelligence in order to understand the ‘artificial’ form of it. Have we pigeon holed our paradigm by calling it AI to begin with?
  - (b) AI developments appears to be connected to the ‘brain’ but how does that relate to the ‘mind’ (or does it?) What is the difference and how does that change our paradigm of what AI can/should do?
  - (c) Definitions on difference between ‘laws,’ ‘ethics’ and ‘morals.’ My understanding is that ‘ethics’ relate to a specific ‘profession.’ So you’ve got medical ethics for the medical field; ethics for the legal field, etc.



We speak about the ‘Profession of Arms’ and military ethics. But each of these professions will have a different ethic when it comes to its employment of AI. How does that alter the evolution of AI?

- (d) Can AI even be ethical/unethical? I think AI is best understood as ‘a-ethical’ similar to amoral rather than moral or immoral.
  - (e) One concern I have with the data used for AI is who is labeling the data and their implicit/explicit biases? Anecdotally, data is collected and labeled by grad students at universities. Universities are more and more reflecting a single political view and the students are often activists. Does this come through with their labeling of data? I’m thinking of the Jan 2023 stories of ChatGPT refusing to provide poems extolling the virtue of Trump but had no problem doing that for Biden. Wouldn’t do that for DeSantis either. Why did it only impact one political perspective? That erodes trust in the parts that I don’t understand.
  - (f) Related, I’m concerned about the social engineering that could be done with AI by having mostly one political persuasion labeling the data. Related, how is AI and the LLM impacted when fed data from the ‘soft sciences’ that lack the academic rigor of the more math based fields and again shape society in a more ideological bent (social hot button issues based more on ideology than scientific fact).
  - (g) If human brains develop mental illness, then does modeling AI on human brains open it up to the same issues (AI goes homicidal / suicidal similar to how human brains do)? Would that be hallucinations or is that more of the distinction between ‘brain’ and ‘mind?’”
6. “I believe the course showed a good balance of foundation, theory, application, and future projects.”
  7. “I would have liked to [have] seen the demonstrations for a longer time. The 30 min with each presenter was a little compact.”
  8. “A projection of our competitor nations. I understand that would be highly speculative however I feel it help frame the situation.  
Also, a breakdown of best practices when using AI systems for the Army.”
  9. “A few hands on sessions to work with an AI directly, to help us understand the limitations and strengths.”

10. “More hands-on experience with AI applications in the course and less math.”
11. “With the amount and nature of the content, either make the course a little longer or split the course into two separate courses.

Hypothetically, AI4S would remain the standard course which is an in-depth look at AI applications and associated [ARL] capabilities briefs, while “AI4S-Enhanced” is more quantitatively intensive, encroaches on more ML application, and would afford a more inclusive experience with the competencies through specific break outs.

AI4S—A greater focus on how leaders can use AI, not necessarily a deep dive into the nuts and bolts of AI/ML, but the breadth of [ARL] competencies and capabilities. This would give the students enough information to go back and advocate for AI in their formations.

AI4S-E—A greater focus on the technical ‘under the hood’ construction of models and how to think through the creation of models that can be used to solve problems. This one could allow for more intimate engagement with a student’s preferred competency labs (i.e., a maximum of up to 3 chosen labs over the 2-week period chosen ahead of time by the student, then each lab has a 1–2 hour break out for in-depth discussion of their research and AI/ML integration, and how that could apply to the student’s discipline).”

12. “I would like to see different methods and ways to prepare our data for AI. AI needs accurate data and lots of it to learn. I would like to learn how we can start capturing this data now.”
13. “I would like to interact more with the different scientists and have more hands on during the length of the course.”
14. “More familiarity with the programming languages used to fit and train models, as well as an overview of the database architecture that stores data behind LLMs.”
15. “Depending on the attendees going to the course, it would be nice to see people dedicated to those fields.”
16. “If possible, more intersection with labs, scientists, and how research is conducted.”

### **How do you envision using this knowledge upon returning?**

1. "I will influence my team to invest into Army applications and programs training and to utilize that knowledge more efficiently."
2. "Being an honest broker, and understanding the importance of data. Being able to advise commanders, 'while this is a great idea, technology is not there, or it is and it is being worked as we speak.'"
3. "To, again, dispel the mysticism around AI. First Army Command is adamant that AI be implemented asap to assist in their mission. I have a high level understanding of what they want to use it for and the ETI system demonstrated on 12 April could, I think, be adapted to fill that role. That system is still in development, however, and leadership believes we will be able to simply hire a few extra bodies, have a couple civilians take a class on Python, and we'll be good to go. This class and the information provided will serve to set a more realistic expectation going forward and allow us to better direct resources in the immediate future until the technology is fully available.

That said, what I think [First Army headquarters] would like to see is a system to ingest unit data, assess readiness, and assist in deployment decisions based on criteria provided to the system. The ETI system is anticipated to perform exactly that function when it is eventually completed."

4. "As a [subject-matter expert] for targeting, I believe there is some concern within my own field that AI will replace us and give us a whole new identity, whether good for bad, my goal is to reach out to our senior leaders at the army targeting center to inform them about ARL and the studies of AI within ARL. Which we as targeteers should be embracing the concept and getting out in front of that narrative early. This will allow us as a [subject-matter expert] to shape how we will implement AI into the overall targeting methodology. Tag will be 'AI will not replace you ... Someone using AI will.'"
5. "Having been exposed to this course, I intend to personally engage AI more at home and work. Please share with the ARL team and all the [subject-matter experts] that invested in us that I am thankful and appreciative of their work. I'm a parent of a 21-year-old and 18-year-old Soldier (and a 15-year-old future Soldier). The work ARL is doing may save my sons' lives down the road, thank you."

6. "I am going to educate my organization on the foundations of AI, some of the 'good, the bad, the ugly,' some of the great ways they can leverage it in their duties, and educate them on the ethics/regulations surrounding the use in the military."
7. "Able to explain the totality of what AI encompasses."
8. "Being a smarter monkey with the machine gun.  
By that I mean educating my unit on what is happening with the data and providing guidance for using AI systems in a safe way."
9. "Well I'm certainly going to leverage this material in future AI OPDs :). Mostly I'm looking to leverage this knowledge to look out for future opportunities and screen against what seems to be too good to be true."
10. "Focus on sharing this knowledge to improve data analysis for strategic planning and to enhance surveillance capabilities across the team."
11. "Taking a deeper dive into AI product design and how I can begin programming simple python tools to help improve my daily professional workflows. Also, I [intend] on working with AI2C to implement some of their AI tools and work alongside their data engineers to increase my unit's performance of the tasked mission."
12. "Better understanding of what AI is. Possible will de-bunk some 'myths of AI.'"
13. "Four points:
  - Provide knowledge and recommendations when screening vendors offering 'AI' solutions.
  - Provide commander information on how to prepare the units for AI.
  - The connections and contacts will be valuable to ask questions and present our requirements for research.
  - I am much more confident in the direction the Army is heading and very smart people are working on problems we are concerned with."
14. "Upon my return to my unit, I will utilize this knowledge to promote awareness of Artificial Intelligence. Especially, highlighting the capabilities, limi-

tations, and future concepts. Having the ability to create a network after this course is very beneficial professionally and personally.”

15. “Continue to advocate for the realistic use of AI while advising on its realistic uses and limitations.”
16. “The network aspect is probably one of the biggest takeaways. Informing others of the opportunities is another positive.”
17. “Giving exercises and [leadership professional development], giving access to future AI/ML courses provided to Army.”

## **Appendix E. AI for Soldiers Certificate**

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This appendix appears in its original form, without editorial change.

SAMPLE

# ARTIFICIAL INTELLIGENCE FOR SOLDIERS

This Certificate of Completion is Awarded to

**PARTICIPANT**

[Participant's Full Name] has successfully completed the 80-hour Artificial Intelligence for Soldiers course. The course, offered by DEVCOM Army Research Laboratory and the Futures and Concepts Center, provides Soldiers with knowledge of foundational artificial intelligence (AI) concepts and future AI capabilities for the Army. Participants gain insights into AI technologies, enabling them to provide senior leaders with data-driven decision-making abilities to solve business, strategic, or logistical problems within military contexts.

April 8-19, 2024

BG Stephanie R. Ahern  
Director of Concepts  
Futures and Concepts Center

Course Date

Dr. Patrick J. Baker  
Director  
Army Research Laboratory



## List of Symbols, Abbreviations, and Acronyms

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|        |                                                  |
|--------|--------------------------------------------------|
| AFC    | Army Futures Command                             |
| AFRL   | Air Force Research Laboratory                    |
| AI     | artificial intelligence                          |
| AI2C   | Artificial Intelligence Innovation Center        |
| AI4S   | Artificial Intelligence for Soldiers             |
| ALC    | Adelphi Laboratory Center                        |
| APG    | Aberdeen Proving Ground                          |
| ARL    | <a href="#">Army Research Laboratory</a>         |
| ASI    | Additional Skill Identifier                      |
| CAC    | common access card                               |
| CDAO   | Chief Digital and Artificial Intelligence Office |
| CIV    | Civilian                                         |
| COA    | Course of Action                                 |
| COP    | Common Operating Picture                         |
| DEVCOM | US Army Combat Capabilities Development Command  |
| DoC    | Directorate of Concepts                          |
| DOD    | Department of Defense                            |
| ETI    | Enhanced Tactical Inferencing                    |
| FBI    | Federal Bureau of Investigation                  |
| FCC    | Futures and Concepts Center                      |
| GPT    | generative pre-trained transformer               |



|       |                                          |
|-------|------------------------------------------|
| HQDA  | Headquarters, Department of the Army     |
| LLM   | large language model                     |
| ML    | machine learning                         |
| NCO   | Noncommisioned Officer                   |
| NCOIC | Noncommisioned Officer in Charge         |
| NLP   | natural language processing              |
| O     | Officer                                  |
| OC/T  | Observer Coach/Trainer                   |
| OIC   | Officer in Charge                        |
| OPD   | Officer Professional Development         |
| ORSA  | Operations Research and Systems Analysis |
| R2C2  | Robotics Research Collaboration Campus   |
| UIC   | University of Illinois at Chicago        |
| UTK   | University of Tennessee at Knoxville     |
| WO    | Warrant Officer                          |
| XR    | cross reality                            |
| XRCOP | Cross Reality Common Operating Picture   |