Tutorials

Analysis Fundamentals
Mr. Ken Amster

This set of lectures provides an overview of warfare analysis fundamentals. It has four parts. The first, Analysis 101, is a refresher on the basic approach to planning and conducting warfare analysis. The second part is the presentation of a case study, the purpose being to encourage the audience to ask the hard, analytic questions, with the goal of reinforcing some of the skills presented in Analysis 101. The third part is another case study. The purpose of this is to offer one way to present a study so the audience learns as much as possible in a short time. The last part, is an example of one approach, using "tried and true" techniques to provide decision makers with critical knowledge regarding mission capabilities, technical risks, costs, and schedule and how they are interrelated. The total time for these four parts is about 3 hours, not including breaks.

Art of Successful Analysis
Trip Barber

This presentation provides specific recommendations for analytic project leaders on how to organize, execute, and deliver briefings on analytic projects done for senior national security leaders in ways that lead to successful outcomes supporting well-informed decisions by those leaders. It is based on lessons learned across 25 years of leading analytic projects in the Pentagon and 7 years of doing this in private industry. It identifies five steps in the end-to-end process of delivering useful analysis to decision-makers, from focusing the key question through podium style in delivering the end-of-project briefing to a senior audience, and it describes the order and methods by which these steps should be done.

Antifragility and Future Conflict
Mr. Bill Buppert

Operations research needs to acquaint itself with the limits of modeling and the pitfalls of insufficient and misguided asymmetrical evidentiary bars. Antifragility offers not only an explanatory framework of black swan events but creates opportunities for organizations to build themselves from the ground up to be adaptable and resilient in the face of crisis and conflict.

This tutorial will introduce the novice to the concepts of antifragility and how the model may create new ways of looking at future conflict, achieve adaptive frameworks, improve conflict forecasting and better explain ways to build military organizations that respond to violence and capability degradation in a way that parallels the stressor strength improvement in complex systems.

This brief will discuss how the adoption of antifragility models to template conflict dynamics and build resilient learning organizations that improve with stress optimizes the western ability to survive peer and near-peer conflicts in the future. Problem structuring methods (PSM), morphological analysis and other operations research methodologies will be used to tackle the wicked problem sets in antifragility.

Quickly Comparing Machine Learning Methods
Tom Donnelly

Through example analyses, you'll see how to build better predicting and more robust models with a range of machine learning techniques. The approaches shown will help answer questions like:

1. With so many machine learning methods, how can I find the best candidate approaches quickly?
2. How can I prevent overfitting and better trust my models - for both large and small data sets?
3. How can I find the dominant factors quickly, especially when there are hundreds of factors?
4. How can I find the best predicting model?
5. How can I find a potentially more interpretable model with confidence intervals?
6. How can I add confidence intervals to any model?
7. How can I visually compare multiple machine learning methods?
8. How can I do multiple model trade-space analysis or optimization?
9. How can I guard against extrapolation in high dimensional factor space?
10. How can I use a sensor stream of highly correlated data to make better predictions?

Featured methods will include different types of regression, neural networks, decision trees, ensemble modeling, and functional data analysis. You will also see how to use graphical and statistical comparison techniques to help choose the "best" predictive model. This presentation is for engineers and researchers interested in learning how machine learning techniques can help them use the data they have today to better predict tomorrow.

Data Science in the Cloud: Accelerating the Machine Learning Lifecycle through Amazon SageMaker
Michael Liu

Today, organizations have access to an ever-increasing amount of data. To leverage this growing collection of data, projects require machine learning (ML) capabilities to scale and deliver insights to the workforce. In this tutorial, attendees will gain hands-on experience in the end-to-end lifecycle for building and deploying machine learning models on various forms of data such as text and imagery. The tutorial will leverage Amazon SageMaker, a fully managed end-to-end machine learning service that enables data scientists, developers, and machine learning experts to quickly build, train, and host machine learning models at scale. Attendees will go through hands-on exercises that will take them through setting up an ML environment, preparing data for machine learning, performing model training via distributed training and automated hyperparameter optimization, and deploying models trained for inference. Attendees walk away from the tutorial with the tools needed to train ML models, giving them the capability to deploy production capable models. Cloud enthusiasts are welcome to join to gain a better understanding of the cloud and the opportunities to perform machine learning and analytics at scale.

How to Leverage Text, Image, and Social Interaction Data for OSINT Analysis: A Hands-On Tutorial
Dr. Onur Savas
Regina Kaya Catipon
Dr. Lisa Scott Holt
Mr. Adam Lind

Open-source intelligence (OSINT) is the collection and analysis of publicly available (PAI) information, such as online activity on social media. A recent example of OSINT analysis include the real-time tracking

of Russian military equipment at the Ukrainian border through Twitter and Telegram posts. While the array of data that can be collected from the digital information environment (such as text, image, and social interactions) is powerful, it can also be overwhelming. AI/ML approaches like NLP, computer vision, and network graph models can help operators meet the challenges of large-scale data collection and analysis.

In our tutorial, we will use case studies to walk through example OSINT methodologies such as PAI collection and geo-spatial analysis. We will then demonstrate how AI/ML analytics like topic modeling, sentiment analysis, image classification, social interaction graphs, and bot behavioral analytics can help to improve workflow efficiency. Participants will walk away with an understanding of how to gain better insight by applying AI/ML analytics to PAI. Note: OSINT collection and analysis will be demonstrated on SCRAAWL.

A Gentle Introduction to Battlefield AI and Autonomy for Non-Technical Beginners
Mr. Jerry L. Schlabach
Mr. Bill Buppert

Modern Artificial Intelligence (AI) and Machine Learning (ML) are disruptive technologies that have recently blossomed under the market leadership of the U.S. commercial sector. The U.S. Government, its military competitors, and the global defense industry are racing to militarize these newly refreshed technologies, which ironically owe much of their contemporary existence to U.S. Defense research from previous decades. Future autonomous systems will certainly leverage and weaponize AI/ML technologies, which in turn will likely revolutionize warfare. In response to substantial positive feedback from a set of tutorials, presentations, and special sessions in 2019 through 2021, this tutorial consolidates those presentations to provide a solid conceptual overview for non-technical beginners. This extended session will:

- Define and characterize the various levels of military autonomous systems with respect to AI/ML capabilities, human direction, and human trust.

- Dispel and re-characterize many common misperceptions about AI/ML and battlefield autonomy, to include the likely technical, moral, and operational limits to weaponization.

- Introduce, at a very high level, the AI and ML fields, with focused example applications.

- Explain the extraordinary dependency of modern Deep-Learning ML upon the acquisition and conditioning of large amounts of training data (or synthetic models).

- Frame the likely military utility of integrating AI/ML into military systems at the various levels of the cognitive domain (Bloom's Taxonomy). Identify which cognitive tasks are likely to remain with humans, and which are candidates for machine reasoning.

- Highlight and discuss select OR analytic implications from battlefield AI/ML integration with respect to traditional paradigms such as Commander's Intent and decision-making.

- Outline select AI/ML issues related to the future of warfare.

Jerry Schlabach is an Engineering Fellow in the Operations Research Department at Raytheon Missile Systems in Tucson, who also co-chairs the newest MORS Working Group (#35), "AI and Autonomous

Systems." He has a Master's degree in Computer Science (AI) from the University of Illinois at Urbana-Champaign, as well as a Bachelor's degree in Physics from the United States Military Academy at West Point. In addition to a 22-year Army career in Military Intelligence, he has over 20 years' experience at integrating AI into C4ISR prototypes. Jerry will be asking the other WG-35 co-chairs to co-present, with color commentary, this special session to provide a broader perspective for understanding the impact of AI/ML on future battlefields.

Human Factors Aspects of Visual Cognition
Dr. Paul Thompson

This tutorial treats some of the Human Factors aspects of visual cognition that are important in designing effective data visualizations in defense planning and analysis. We review some of the characteristics of human visual processing, illustrate how to leverage them to design effective data displays, and show examples that fail to account for these factors. We draw material from several of fields of study, including Cognitive Psychology, Visual Analytics, Scientific Visualization, Exploratory Data Analysis, and Statistics.