

GSAW 2021 Tutorial L:

Demystifying Machine and Deep Learning

Overview:

Last year's GSAW tutorial on Demystifying Machine Learning was very well received. The students were engaged and very interested in the topics and methodology covered. We presented details on applications of Machine Learning and Deep Learning and the students were clearly interested in learning more about this subject since they are beginning to encounter it regularly in their work. This year, in a condensed format, we plan to expound on these topics and present more detailed information on the algorithms and examples of the different aspects of Machine Learning, especially Deep Learning and Neural Networks, which is becoming more popular but equally misunderstood. We have found that there is a lot of misconceptions surrounding these topics so we want to further demystify it for both folks that are new to the field as well as students that may have explored areas of these technology. Machine Learning, Deep Learning and Artificial Intelligence are all hot topics for their potential to extract actionable information from the data.

Course outline:

- What is Machine Learning
- Types of Machine Learning
- Hype versus reality
- Languages and technologies
- Machine Learning
- Supervised Learning
- Unsupervised Learning
- Projections and forecasting – lessons learned
- Deep Learning
- What is it?
- Neural networks and their different flavors
- Recurrent neural networks
- Convolutional neural networks
- Building a neural network
- Reinforcement Learning
- Pros and cons
- Advances in Machine Learning and where it is going in the future
- Spiking neural networks
- On-board satellite processing

Instructors: Joseph Coughlin, The Aerospace Corporation and Rohit Mital, KBR

Biographies:

Mr. Coughlin is a Senior Space Domain Awareness Systems Engineer at Aerospace Corporation working on projects to improve the utilization of sensors and their data. He has been instrumental in bringing operational analytics and machine learning technologies to the analysis of data for the SDA mission and for monitoring system performance. He has spent over 30 years working science and systems engineering tasks for a wide variety of customers. He received a Master's degree in Astrophysical, Planetary and Atmospheric Physics from the University of Colorado.

Mr. Mital is the Chief Technology Officer at KBR. He has over 25 years of experience in developing and delivering high-performance, scalable, complex software systems and solutions. He currently leads KBR Innovations Labs, which is developing solutions in Agile/DevOps, Big Data, Machine Learning and Blockchain technologies. He has Master's degrees in Electrical Engineering and Mathematics.

Description of Intended Students and Prerequisites:

Tutorial is designed for a non-technical as well as a technical audience. Tutorial is for those interested in how Machine Learning and Deep Learning can be used for SDA and ground system applications and a desire to learn the details of how Artificial Intelligence can be implemented for data exploitation. No prerequisites are needed.

What can Attendees Expect to Learn:

- What Machine Learning can really provide versus the hype.
- How to use Machine Learning for SDA and Ground Systems applications and when not to use it
- Details on Machine Learning algorithms, such as supervised and unsupervised learning, to enable students to understand the benefits for using one versus another.
- What the bounds are of what Artificial Intelligence and Deep Learning can realistically do for data exploitation.
- What is Deep Learning and what are Neural Networks and how would you build one
- Emerging topics in Artificial Intelligence, such as Reinforcement Learning