

Fourth Industrial Revolution (4IR) Summer School

Advanced Machine Learning and Deep Learning

Period	30 Hours 7:30 am to 11:30 pm
Location	College of Petroleum Engineering and Geoscience
Instructor	Dr. Irfan Ahmad irfanics@kfupm.edu.sa Building 22 – Room 325
Office Hour	By appointment

Description: This course provides a thorough grounding in a wide range of machine learning methods, for classification, regression, conditional probability estimation, clustering, dimensionality reduction, and reinforcement learning. We will gain an intuitive understanding of these methods, get a hands-on experience implementing machine learning systems for real world problems. We will also use Google Colab for implementing our machine learning solutions.

Pre-requisites:

Module 1: Python Programming

Module 2: Data Preparation

Module 3: Data Science

Module 4: Machine Learning

Course Objectives and Outcomes:

The objectives of this course are:

1. Describe and apply various machine learning algorithms, and
2. Evaluate and compare various machine learning algorithms.

After completion of this course, the learner shall be able to:

1. Identify various properties of machine learning algorithms.
2. Describe some machine learning techniques.
3. Write programs that implement specific machine learning algorithms.
4. Develop a working solution for a problem using machine learning techniques.
5. Describe basics and latest advances in machine learning algorithms.

Reference Material

- Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. 1st Edition, MIT Press, 2012.
- Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, Foundations of Machine Learning, second edition, The MIT Press
- Ethem Alpaydin. *Introduction to Machine Learning*. 3rd Edition, MIT Press, 2014.
- Yaser S. Abu-Mostafa, Malik Magdon-Ismail, and Hsuan-Tien Lin. *Learning from Data*. 1st Edition, AMLBook Publishers, 2012.
- Andrew Ng. *Machine Learning Yearning*. 1st Edition, 2018.
- Slides and handouts.

Topics:

Following is a tentative list of topics that will be covered during the course:

- Introduction to machine learning: Taxonomy of machine learning
- Supervised Learning
 - ✓ Generative Models
 - ✓ Linear Regression and Classification, Training and Regularization
 - ✓ Decision Tress
 - ✓ Ensemble methods: Bagging, Boosting, and Random Forest
- **Deep Learning:**
 - ✓ Neural networks
 - ✓ Backpropagation algorithm
 - ✓ Autoencoders
 - ✓ CNNs
 - ✓ RNNs
- Reinforcement learning
 - ✓ Markov decision processes (MDPs)
 - ✓ Bellman equations
 - ✓ Value iteration and policy iteration
 - ✓ Q-learning algorithm
 - ✓ Value function approximation
 - ✓ Policy search. Reinforce

Duration: (30-40 hours)

Means:

- Lectures
- In-class examples
- Hands-On problem solving
- Quizzes

Required:

- Hardware: Laptop with multiple cores.
- Software: Python with Jupyter notebook (better to install Anaconda distribution), or Google Colab.

Tentative Schedule:

Introduction + Fundamentals	Day 1
Generative Models	Day 2 + Day 3
Decision Trees + Ensembles	Day 4
Artificial Neural Networks	Day 5
CNNs	Day 6
RNNs	Day 7
KNIME + ML Advices	Day 8
Reinforcement Learning	Day 9 + Day 10