Machine Learning: An Empirical Approach
(Master online Course in Machine Learning)

Abstract:

Machine learning has emerged as a very powerful tool in Data Science. With ML techniques, computational systems can adaptively improve their performances using experimental data to train. This allows construction of algorithms that can learn from and make predictions based on data. Machine learning is a demanding discipline and is presently used to extract information from data in a variety of fields. This course is designed to prepare students to work in the Data Science disciplines using ML techniques, introduce existing ML algorithms and develop such algorithms. The course will provide practical experience and case studies based on real data. It covers examples from different disciplines- physics, astronomy, biology, neuroscience, finance etc. The course also covers an introduction on deep learning. The course will provide an extensive introduction to the current graduate course in ML (CS229) and will complement that course. A practical and hands-on course in machine and deep learning is not currently offered at UCR. During this course guest lecturers will be invited to give lectures on practical aspects of machine learning.

Syllabus

WEEK 1
Background and Introduction
Historical Development of machine learning
Applications of Machine Learning
What we learn in this course
Python Programming- installation on Window or Mac platforms

WEEK 2
Basic linear algebra
Review of statistics and probability theory
Matrix formulation and calculation of least squares
Multivariate Calculus
Partial Derivative Gradients
Gradient Descent

WEEK 3
Multivariate statistics
Joint distributions
Mean vectors, variance-covariance matrices
Conditional distributions, marginal distributions
 Multivariate normal distributions and their basic properties

WEEK 4
Regressions
Linear, Multiple and polynomial Regressions
Ridge Regression
Over-fitting
Regularization

WEEK 5
Case Studies and Applications of regressions

WEEK 6
Classifications
K-Nearest Neighbors
Logistic regression
Naïve Bayes
Support Vector Machine

WEEK 7
Case Studies and applications of classifications

WEEK 8
Advanced topics in Machine Learning
Cross validation
Receiver Operating Characteristic (ROC) curves
P-R Curves
Principle Component Analysis (PCA)

WEEK 9
Deep Learning
Neural Nets
Artificial Neural Nets
Convolutional Neural Nets
Stochastic Gradient Descent (SGD)
Multi-layer networks
Back propagation
Deep Neural Networks

Books:

Book 1: Data Science from Scratch- Joel Grus
Book 2: Machine Learning: A Probabilistic Perspective Kevin Murphy
Book 3: Machine Learning 1st Edition Tom Mitchel McGraw Hill

Week 1:
Book 1 Chapters 1, 2, 3
Book 2 Chapter 1

Week 2:
Book 1: Chapters 6, 7, 8

Week 3:
Book 2: Chapter 2, 4

Week 4:
Book 2: Chapter 7

Week 5:
A combination of practical examples and research topics by guest lecturers

Week 6:
Book 2: Chapter 10
Book 3L Chapter 4

Week 7:
A combination of practical examples and research topics by guest lecturers

Week 8:
Book 2: Chapter 12, 13

Week 9:
Book 2: Chapter 28
Book 3: Chapter 4