Spring 2022 Machine Learning Tentative Course Plan

Instructor: Dr. Arif Mahmood

Lecture #	Topics Covered	Quiz/ Homework/ Programming Assignments
1	Introduction to ML and its applications, basic terminology	
2	K- Nearest Neighbor, Gradient Descent Linear Regression	
3	Gradient Descent, Classification Vs Regression, Hands on Exercise: plotting functions of one, two variables and how to compute gradient descent of one variable signal using Numpy	Quiz 1
4	Solving Linear regression using Gradient Descent, Logistic regression, Linear Regression hands on exercise	Programming Assignment 1 (Regression)
5	Prior Probabilities, Class-Conditional Probabilities, Posterior Probabilities, Bayes Rule	Quiz 2
6	Gaussian Residuals Models, L2 and L1 regularization, LASSO	Homework 1
7	Non-Linear Decision Surfaces, Introduction to Neural Network, Activation functions, forward pass, backward pass	Quiz 3
8	Neural Network Backpropagation: hands on Example using pen and paper	Project Ideas Submission
9	Multi-layer neural network, multi-class classification, Cost function and its gradient descent, Stochastic Gradient descent, Optimizers, regularization, learning curves Hands on exercise**:** Basics of Pytorch, Neural Network for image classification using MNIST dataset	HW2
10	Overfitting, Model capacity, How neural networks see? Deep neural networks. Hands on Exercise: Deep Neural network	Quiz 4

	for image classification using MNIST dataset	
11	Some deep CNNs: LeNET, AlexNet, Feature detection, sobel filter, Blob detection, Convolution layer, FC Layer	Programming Assignment 2 (Neural Networks)
12	Performing Convolutions using pen and paper, Training CNN, Digit classification using CNN	
13	Understanding ConvNets, what does a neuron do in Convnet? Typical backpropagation, Guided backpropagation, Gradient Ascent	Quiz 03
14	Discriminative vs Generative Models, Naive Bayes, Logistic regression	HW3
15	MID TERM EXAM	
16	Multivariate Gaussian, Gaussian Bayes Classifier, K-means	Programming Assignment 3 (Convolution Neural Network)
17	Dimensionality Reduction, PCA, Autoencoders	
18	Graphs basics and Spectral Clustering	Programming Assignment 4 (PCA)
19	Graph Neural Networks: Graph Shift Operator, Graph Signal, Graph Convolution	Class Quiz 04
20	Graph Neural Networks: Graphs revision, Graph frequency response, Graph frequency response of graph filters	Programming Assignment 5 (GNN)
21	Decision tree	
22	Decision tree continued, Random Decision Forests (RDF)	Programming Assignment 6 (RDF)
23	Knowledge Distillation	Quiz 5
24	Anomaly Detection using dictionaries and Autoencoders	**HW4**
25	Weakly supervised video anomaly detection	Quiz 6
26	Human Pose Estimation	

27	Reinforcement Learning	Quiz 7
28	Image Generators and Pose transfer	Project Progress report + Project Term paper
29	Attention is all you need	HW5
30	Vision transformers	