**Course Syllabus**

**Module 1: Foundations of Data Science - 5 weeks, 12.5 hours**

* Week 1 - Linear Algebra for Data Science
* Week 2 - Linear Algebra (Eigenvalues & Eigenvectors, PCA, SVD)
* Week 3 - Probability (Distributions, Central Limit Theorem, Hypothesis Testing)
* Week 4 - Optimization (Gradient Descent, Constrained Optimization)
* Week 5 - Optimization (Gradient Descent, Constrained Optimization)

**Module 2: Machine Learning - Foundations and Algorithms - 10 weeks, 25 hours**

* Week 6 - Intro to ML, Bayesian Decision Theory
* Week 7 - Classification - KNN, Logistic Regression
* Week 8 - Linear Regression - Ridge/LASSO
* Week 9 - Recap K-NN; Bias Variance tradeoff, cross-validation/ model selection
* Week 10 - Evaluation methods (ROC, AUC, F-measure, etc.)
* Week 11 - Naive Bayes, Decision tree
* Week 12 - Ensemble Methods: Bagging, Random Forest
* Week 13 - Perceptron, Support Vector Machines
* Week 14 - Clustering motivation, K-means/Hierarchical, GMM
* Week 15 - Dimensionality reduction, Association Rule Mining

**Module 3: Machine Learning - Use Cases - 6 weeks, 15 hours**

Industry Experts

* Week 16-21

**Module 4: Deep Learning - Foundations and Algorithms - 11 weeks, 27.5 hours**

* Week 22 and Week 23 - Artificial Neural Networks

a. Artificial Neuron

b. Multilayer Perceptron

c. Universal Approximation Theorem

d. Backpropagation in MLPs

e. Backprop on general graphs

* Week 24 and Week 25 - Optimization in Neural Networks

a. Gradient Descent and its variants

b. Momentum, Adam, etc

c. Batch Normalization

d. Basics of Hyperparameter optimization

* Week 26 and Week 27 - CNN

a. Introduction

b. CNN Operations

c. CNN Training

d. Illustrative Example (“Hello World”) - MNIST digit classification

e. Image Recognition-SoTA model(s)

f. Object detection/localization - SoTA model(s)

g. Semantic segmentation -SoTA model(s)

* Week 28, Week 29, Week 30

a. Generative Adversarial Network - GAN

b. Generative Artificial Intelligence - Gen AI

c. Transformers d. Large Language Models - LLM

* Week 31 - RNN/LSTM Week 32 - Explainable ML

**Module 5: Deep Learning use cases - 6 weeks, 15 hours**

Industry Experts

* Week 33 - 38 Capstone Project - Coordinated by Institute