Computer Engineering / Information Technology
Course List for Major Degree
Track: Machine Learning
MOOCS Platform: NPTEL/SWAYAM

Sr No	Course Name	Teaching Scheme	Institute Offering Course	Name of Professor/ Resource Person	Credits
1	Practical Machine Learning with Tensor Flow	4hrs/week	IITM & Google	Prof. Balaraman Ravindran, Prof. Ashish Tendulkar	4
2	Introduction to Machine Learning	4hrs/week	IITM	Prof. Balaraman Ravindran	4
3	Data Analytics with Python	4hrs/week	IIT Roorkee	Prof. A. Ramesh	4
4	Reinforcement Learning	4hrs/week	IIT Madras	Prof. Balaraman Ravindran	4
5	Deep Learning	4hrs/week	IIT KGP	Prof. Prabir Kumar Biswas	4

Detailed Syllabus

Course 1: Practical Machine Learning with Tensor Flow

Module 1: Getting started with TensorFlow

Module 2: Overview of Machine Learning (Process and Techniques, Demonstration of ML concepts with Deep Playground)

Module 3: Data Input and Preprocessing with TensorFlow

Module 4: Machine Learning Model Building

Module 5: Prediction with TensorFlow

Module 6: Monitoring and evaluating models using Tensorboard

Module 7: Advance TensorFlow (Building custom models - CNNs, Scaling up for large datasets)

Module 8: Distributed training with hardware accelerators

Course 2: Introduction to Machine Learning

Module 0: Probability Theory (Recap), Linear Algebra (Recap), Convex Optimization (Recap)

Module 1: Introduction: Statistical Decision Theory - Regression, Statistical Decision Theory - Classification, Bias Variance

Module 2: Linear Regression, Multivariate Regression, Subset Selection, Shrinkage Methods, Principal Component Regression, Partial Least squares

Module 3: Linear Classification, Logistic Regression, LDA

Module 4: Perceptron, SVM

Module 5: Neural Networks - Introduction, Early Models, Perceptron Learning, Neural Networks - Backpropagation, Neural Networks - Initialization, Training & Validation, Parameter Estimation

Module 6: Decision Trees, Regression Tree, Decision Trees - Stopping Criterion & Pruning, Loss functions, Decision Trees - Categorical Attributes, Multiway Splits, Missing Values, Decision Trees - Instability, Example, Evaluation Measures-1

Module 7: Bootstrapping & Cross Validation, Class Evaluation Measures, ROC curve, MDL, Ensemble Methods - Bagging, Committee Machines and Stacking, Ensemble Methods - Boosting

Module 8: Gradient Boosting, Random Forests, Multi-class Classification, Naive Bayes, Bayesian Networks

Module 9: Undirected Graphical Models, HMM, Variable elimination, belief propagation

Module 10: Partitional Clustering, Hierarchical Clustering, Birch Algorithm, CURE Algorithm, Density-based Clustering

Module 11: Gaussian Mixture Models, Expectation Maximization

Module 12: Learning Theory, Introduction to Reinforcement Learning + Optional videos (RL framework and TD Learning, Solution Methods and Applications)

Course 3: Data Analytics with Python

Module 1: Introduction to data analytics and Python fundamentals

Module 2: Introduction to probability

Module 3: Sampling and sampling distributions

Module 4: Hypothesis testing

Module 5: Two sample testing and introduction to ANOVA

Module 6: Two-way ANOVA and linear regression

Module 7: Linear regression and multiple regression

Module 8: Concepts of MLE and Logistic regression

Module 9: ROC and Regression Analysis Model Building

Module 10: X 2 Test and introduction to cluster analysis

Module 11: Clustering analysis

Module 12: Classification and Regression Trees (CART)

Course 4: Reinforcement Learning

Module 1: Introduction

Module 2: Bandit algorithms – UCB, PAC

Module 3: Bandit algorithms –Median Elimination, Policy Gradient

Module 4: Full RL & MDPs

Module 5: Bellman Optimality

Module 6: Dynamic Programming & TD Methods

Module 7: Eligibility Traces

Module 8: Function Approximation

Module 9: Least Squares Methods

Module 10: Fitted Q, DQN & Policy Gradient for Full RL

Module 11: Hierarchical RL

Module 12: POMDPs

Course 5: Deep Learning

Module 1: Introduction to Deep Learning, Bayesian Learning, Decision Surfaces

Module 2: Linear Classifiers, Linear Machines with Hinge Loss

Module 3: Optimization Techniques, Gradient Descent, Batch Optimization

Module 4: Introduction to Neural Network, Multilayer Perceptron, Back Propagation Learning

Module 5: Unsupervised Learning with Deep Network, Autoencoders

Module 6: Convolutional Neural Network, Building blocks of CNN, Transfer Learning

Module 7: Revisiting Gradient Descent, Momentum Optimizer, RMSProp, Adam

Module 8: Effective training in Deep Net- early stopping, Dropout, Batch Normalization, Instance Normalization, Group Normalization

Module 9: Recent Trends in Deep Learning Architectures, Residual Network, Skip Connection Network Fully Connected CNN etc.

Module 10: Classical Supervised Tasks with Deep Learning, Image Denoising, Semanticd segmentation Object Detection etc.

Module 11: LSTM Networks

Module 12: Generative Modeling with DL, Variational Autoencoder, Generative Adversarial Network