NIRMA UNIVERSITY

Institute:	Institute of Technology, School of Technology
Name of Programme:	MTech CSE, MTech CSE (Data Science)
Course Code:	6CS203CC22
Course Title:	Applied Machine Learning
Course Type:	Core
Year of Introduction:	2022-23

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Course Learning Outcomes (CLO):

At the end of the course, the students will be able to –

1. explain statistical methods as the basis of the machine learning domain (BL2)
2. identify the learning algorithms for appropriate applications (BL3)
3. analyse machine learning techniques to solve problems in applicable domains (BL4)
4. evaluate algorithms based on different metrics and parameters. (BL5)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	**Introduction to AML:** Motivation and Applications, importance of Data Visualisation, Basics of Supervised and Unsupervised Learning, Significance of Model Training	03
Unit-II	**Regression Techniques:** Basic concepts and applications of Regression, Simple Linear Regression – Gradient Descent and Normal Equation Method, Multiple Linear Regression, Non-Linear Regression, Linear Regression with Regularization, Hyper-parameters tuning, and Loss Functions	14
Unit-III	**Classification Techniques:** Naïve Bayes Classification, Fitting Multivariate Bernoulli Distribution, Gaussian Distribution and Multinomial Distribution, K-Nearest Neighbours, Decision trees. **Support Vector Machines**: Hard Margin and Soft Margin, Kernels and Kernel Trick, Evaluation Measures for Classification Techniques	10
Unit-IV	**Model Evaluation:** Bias, Variance, Cross-validation, Precision-Recall, ROC Curve, Out-of-Bag metric, the evaluation metric for regression	03
Unit-V	**Artificial Neural Networks:** Biological Neurons and Biological Neural Networks, Perceptron Learning, Activation Functions, Multilayer Perceptrons, Back-propagation Neural Networks, Competitive Neural Networks, Regularization	08

Unit-VI	**Clustering**: K-means Clustering Algorithm, Expectation Maximization, Convergence, Application of K-means, Gaussian Mixture Models: EM for GMM	04
Unit- VII	**Advanced Concepts:** Basics of Semi-Supervised and Reinforcement Learning, PCA, Linear Discriminant Analysis, Introduction to Deep Learning.	03

Self-Study:

The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

Suggested Readings/ References:

1. Tom Mitchell, Machine Learning, McGraw Hill
2. C. Bishop, Pattern Recognition and Machine Learning, Springer
3. R. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification and Scene Analysis, Wiley
4. Kishan Mehrotra, Chilukuri Mohan, and Sanjay Ranka, Elements of Artificial Neural Networks, Penram International
5. Rajjan Shinghal, Pattern Recognition, Techniques and Applications, OXFORD
6. Athem Ealpaydin, Introduction to Machine Learning, Prentice Hall.

Suggested List of Experiments:

Sr. No.	Name of Experiments/Exercises	Hours
1	Introduction to Python and Numpy	02
2	Introduction to Pandas, Matplotlib and Sklearn	02
3	Simple and Multiple Linear Regression using Gradient Descent and normal Equation Methods (without using sklearn or equivalent library for both)	04
4	Linear Regression with Regularization (without using sklearn or equivalent library) and Simple and Multiple Linear Regression with and without regularization using Sklearn	02
5	Naïve-Bayes – Multivariate Bernoulli, Multinomial and Gaussian using sklearn	04
6	Decision Trees – ID3, C4.5 using sklearn	02
7	Support Vector Classification using sklearn	04
8	AND gate using Perceptron Learning (self-implementation)	04
9	Ex-OR Gate/any other problem using Backpropagation Neural Networks (self-implementation)	04
10	K-means clustering using sklearn.	02