Subject Code: 01CT1519

Subject Name: Machine learning

B. Tech. Year – III (Semester V)

Objectives: Machine Intelligence concern with designing and developing of algorithms that allow machines, essentially computers, to evolve realistic or human like behavior based on the empirical data available. This course aims to discuss the building blocks of machine intelligence. The focus would be on how to develop algorithms that can automatically learn and recognize the complex pattern from the available date to make an intelligent decision which will be accepted to the users. Students are expected to learn the fundamental issues involved in designing algorithms for machine intelligence and pursue more insight towards understanding various machine learning algorithms.

Credits Earned: 04 Credits

Course Outcomes: After completion of this course, student will be able to:
1. Apply the fundamentals of probability theory and algebra to perceive the gist of supervised machine learning algorithms (Apply)
2. Understand and apply unsupervised algorithm for clustering (Understand)
3. Apply the concepts of dimensionality reduction, regularization and optimization in different real-world problems (Apply)
4. Evaluate various machine learning algorithms with appropriate evaluation metrices (Analyze)
5. Demonstrate training and testing of basic neural network models like CNN, RNN, LSTM, etc. (Apply)
6. Implement appropriate machine learning algorithms for the given case study (Evaluate)

Pre-requisite of course: Programming using Python, Linear Algebra, Probability

Teaching and Examination Scheme:

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial / Practical Marks		Total Marks
				E	I		V	T	
Theory	Tutorial	Practical		ESE	IA	CSE	Viva	Term Work	
3	0	2	04	50	30	20	25	25	150

Contents:

Unit	Topics	Contact Hours
1	**Introduction to machine learning** Machine Learning, Types, and Examples, Applications of Machine Learning,	3

	Machine Learning vs Statistical Modelling, Supervised vs Unsupervised Learning, Difference between Detection, Prediction and Generation	
2	**Data Understanding** Basic types of data, exploring structure of data, plotting and exploring numerical data, categorical data, Data Quality and Remediation, data preprocessing	2
3	**Performance measures** Importance of performance measurement, confusion matrix, Training Data Set, Testing Data Set, Validation Data Set, Overfitting, Underfitting, Bias, Variance	2
4	**Basics of Feature Engineering** Feature, Feature engineering, Feature transformation, feature extraction, Feature selection, Feature relevance and redundancy, correlation	3
5	**Supervised Learning Techniques** Linear Regression, Logistic Regression, Polynomial Regression, K-Nearest Neighbour, Decision Tree, Random Forest, Support Vector Machine, naïve Bayes	8
6	**Unsupervised Learning Techniques** K-Means Clustering, Hierarchical Clustering, Density-Based Clustering	5
7	**Dimensionality Reduction** Dimensionality reduction, Advantages of dimensionality reduction, Dimensionality Reduction using PCA	3
8	**Statistical Machine Learning** Concentration inequalities and generalization bounds, Feature maps and the "kernel trick", Theory of generalization, least-squares, Ridge and Lasso regularization	5
9	**Introduction to Artificial Neural Networks** Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Learning Strategy of ANN, Single Layer and Multi-Layer Feed Forward Networks, Back propagation	4
10	**Introduction to Deep Learning** Basic building blocks of deep neural network, Convolutional Neural Network, Recurrent Neural Network, Long, Short-Term Memory	7
	Total Hours	42

Suggested Text books / Reference books:

1. E Alpaydin, Introduction to Machine Learning, 2010 , MIT Press
2. S. Marsland, Machine Learning: an algorithmic perspective, 2009, CRC Press
3. R. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification, second edition, Wiley
4. P. A. Devijver and J. Kittler, Pattern Recognition: A Statistical Approach, 1982, Prentice Hall
5. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, 2016, MIT Press

Suggested Theory distribution:

The suggested theory distribution as per Bloom's taxonomy is as per follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process.

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyze	Evaluate	Create
15%	20%	30%	20%	10%	5%

Suggested List of Experiments:
1. To implement single variable Linear Regression
2. To implement multiple variable Linear Regression
3. To implement Logistic Regression and evaluate the performance
4. To implement Polynomial Linear Regression
5. To implement Naïve Bayes Algorithm
6. To implement Support Vector Machine
7. To implement K-Nearest Neighbor
8. To implement K-Means Clustering Algorithm
9. To implement DBScan Algorithm
10. To implement Hierarchical Algorithm
11. To implement Dimensionality Reduction using PCA
12. To implement Single layer Perceptron Learning algorithm
13. To implement Multi-layer Perceptron Learning algorithm
14. To implement different activation functions on dataset
15. To implement Kernel-Based Image Filtering technique
16. To implement the LSTM algorithm on recurrent neural network
17. To implement Convolutional neural Network Algorithm

Instructional Method:
1. The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.
2. The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.
3. Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.
4. Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory.

Supplementary Resources:

1. https://www.coursera.org/learn/machine-learning
2. https://in.udacity.com/course/machine-learning--ud262
3. https://www.udemy.com/machinelearning/
4. https://cognitiveclass.ai/courses/machine-learning-with-python/
5. https://cognitiveclass.ai/courses/machine-learning-r/
6. https://www.edx.org/learn/machine-learning

List of simulation software / IDEs:

1. PyCharm
2. Google Colab
3. Jupyter Notebook