COURSE TITLE	**MACHINE LEARNING**
COURSE CODE	**01CT1519**
COURSE CREDITS	**4**

Objective:

1 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.

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

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	**Introduction to machine learning** Machine Learning, Types, and Examples, Applications of Machine Learning,, Machine Learning vs Statistical Modelling, Supervised vs Unsupervised Learning, Difference between Detection, Prediction and Generation	3
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

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Contents : Unit	Topics	Contact Hours
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 List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Experiment 1** To implement single variable Linear Regression	2
2	**Experiment 2** To implement multiple variable Linear Regression	2
3	**Experiment 3** To implement Logistic Regression and evaluate the performance	2
4	**Experiment 4** To implement Polynomial Linear Regression To implement Polynomial Linear Regression	2

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Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
5	**Experiment 5** To implement Naïve Bayes Algorithm	2
6	**Experiment 6** To implement Support Vector Machine	2
7	**Experiment 7** To implement K-Nearest Neighbor	2
8	**Experiment 8** To implement K-Means Clustering Algorithm	2
9	**Experiment 9** To implement DBScan Algorithm	2
10	**Experiment 10** To implement Hierarchical Algorithm	2
11	**Experiment 11** To implement Dimensionality Reduction using PCA	2
12	**Experiment 12** To implement Single layer Perceptron Learning algorithm	2
13	**Experiment 13** To implement Multi-layer Perceptron Learning algorithm	2
14	**Experiment 14** To implement different activation functions on dataset	2
15	**Experiment 15** To implement Kernel-Based Image Filtering technique	2
16	**Experiment 16** To implement the LSTM algorithm on recurrent neural network	2
17	**Experiment 17** To implement Convolutional neural Network Algorithm	2
Total Hours		**34**

Textbook :

1 Pattern Classification, R. O. Duda, Wiley, 2001

2 Pattern Recognition: A Statistical Approach, P. A. Devijver, Prentice Hall, 1982

3 Deep Learning, Ian Goodfellow, MIT Press, 2016

References:

1 Machine Learning: an algorithmic perspective, Machine Learning: an algorithmic perspective, S. Marsland, CRC Press, 2009

2 Introduction to Machine Learning, Introduction to Machine Learning, E Alpaydin, MIT Press, 2010

Suggested Theory Distribution:

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

Distribution of Theory for course delivery					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
15.00	20.00	30.00	20.00	10.00	5.00

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/

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