GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3161710
Semester – VI
Subject Name: Artificial Intelligence and Machine Learning

Type of course: Core Engineering

Prerequisite: Knowledge of engineering mathematics, basics of algorithms, simulation know- howon Matlab/ Scilab or other equivalent software

Rationale: AI ML is very useful in Industry 4.0. Machine Learning enables IT systems to recognize patterns on the basis of existing algorithms and data sets and to develop adequate solution concepts. Therefore, in Machine Learning, artificial knowledge is generated on the basis of experience.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	2	3	70	30	30	20	150

Content:

S. N.	Content	Total Hrs	% Weigh tage
1	**Artificial Intelligence** - Overview, Supervised and unsupervised learning, Learning task, instances, features, labels, reward/loss, training, testing	02	5
2	**Gradient Descent and Linear Algebra** Model representation, cost function, mathematics of gradient descent, gradient descent intuition, gradient descent for linear regression, matrix, vector, transpose matrix, matrix multiplication, and matrix multiplication properties, inverse of matrix.	04	15
3	**Multiple features gradient descent** Multiple features, gradient descent calculations for multiple features, features and polynomial regression, normal equations, linear regression with multiple variables.	04	15
4	**Classification** Overview of classification: setup, training, test, validation dataset, over fitting. Classification families: linear discriminative, non-linear discriminative, decision trees, probabilistic (conditional and generative), nearest neighbor and Logistic regression.	04	10
5	**Support Vector Machine** Max margin motivation: low density, high stability, Margin geometry to primal SVM formulation for separable training data, Dual formulation and role of alpha in a form of sparse local regression, Inseparable data, slack variables, hinge loss, upper bound on 0/1 training loss Handling non-linear regression by lifting data points to higher dimension	06	20

6	**Dimensionality reduction** Curse of dimensionality, Principal Component Analysis, Latent Semantic Analysis	04	10
7	**Artificial Neural Network** Model representation, working of neurons, back propagation algorithm, adjusting parameters, multiclass classification, bias value, random and Gaussian initialization of parameters, final implementation of ANN	04	10
8	**Unsupervised learning** Mixture model and Expectation maximization, K-Means Clustering, Distance based clustering, Density based clustering techniques	02	5
9	**Ensemble learning** Random forest, Adaboost	02	5
10	**Gradient Descent with large data set** Stochastic gradient descent, mini batch gradient descent, stochastic gradient descent convergence	02	5

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
14	**14**	**14**	**14**	**07**	**07**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Text Books

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach," *3rd edition, Prentice Hall*

2. Tom Mitchell, "Machine Learning", *McGraw-Hill,1997*

3. EthemAlpaydin, "Introduction to Machine Learning", *PHI,2005*

4. Bishop, C., "Pattern Recognition and Machine Learning:," *Berlin: Springer-Verlag, 2006*

Reference Books/Courses

1. K.P. Soman, R. Longonathan and V. Vijay, "Machine Learning with SVM andOther Kernel Methods", *PHI-2009*
2.. T. Hastie, R. Tibshirani, and J. Friedman, "The Elements of Statistical Learning" *2009*
3.Pattern recognition and machine learning by Christopher Bishop, Springer Verlag,2006.
4.Understanding Machine Learning. Shai Shalev-Shwartz and Shai Ben David. Cambridge University Press. 2017

Andrew Ng course on Machine Learning, Coursera.

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Course Outcomes: Students will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Understand Artificial Intelligence and its approaches	
CO-2	Solving problems using Artificial Intelligence	
CO-3	Understand Supervised, unsupervised and semi supervised machine learning algorithm	
CO-4	Apply Gradient descent and linear algebra for problem solving	
CO-5	Apply support vector machine in development of algorithm	

List of Practical:

*(Followingpracticals are recommended but they are not limited for modifications and or alterations by the faculty member/s teaching the particular subject. The use of MATLAB or SCILAB or equivalent software is suggested.***)**

1. Implementation of gradient descent with single variable
2. Implementation of gradient descent with multiple variables.
3. Implementation of linear and polynomial regression.
4. Implementation of logistic regression or binary classification.
5. Implementation of SVM with simple features.
6. Implementation of ANN using back propagation.
7. Learning basic library of python for machine learning to be used in Raspberry PI
8. Loading of SVM in raspberry PI
9. Decision making on the basis of input data on raspberry PI.
10. Implementing K-Means clustering algorithm.
11. Implementation of Principal component analysis.

Design based Problems (DP)/Open Ended Problem:

Major Equipment/Software: Raspberry pie, Python, MATLAB **,** LabVIEW

List of Open Source Software/learning website:

http://vlab.co.in/
www.isa.org
http://nptel.ac.in/video.php
http://www.idc-online.com/