GUJARAT TECHNOLOGICAL UNIVERSITY

Pattern Recognition & Machine Learning:
SUBJECT CODE: 3715414
M.E. (Embedded Systems) SEM-I

Type of course: Program Elective-II

Prerequisite:

Rationale: This course provides a concise introduction to the fundamental concepts in machine learning and some machine learning algorithms. Machine learning is widely used in automation and intelligent systems. Machine learning is needed for intelligent, sentient and self –aware machines.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Introduction of Pattern Recognition and machine learning** Problems, applications, design cycle, learning and adaptation, examples, Probability Distributions, Parametric Learning - Maximum likelihood and Bayesian Decision Theory- Bayes rule, discriminant functions, loss functions and Bayesian error analysis, Introduction to machine learning, Need for machine learning, Understanding machine learning, Making data driven decisions	8	15%
2	**Linear models:** Linear Models for Regression, linear regression, logistic regression Linear Models for Classification	8	15%
3	**Neural Network**: perceptron, multi-layer perceptron, back-propagation algorithm, error surfaces, practical techniques for improving back-propagation, additional networks and training methods, Adaboost, Deep Learning	8	20%
4	**Linear discriminant functions** - decision surfaces, two-category, multi-category, minimum squared error procedures, the Ho-Kashyap procedures, linear programming algorithms, Support vector machine	7	15%
5	**Algorithm independent machine learning** – lack of inherent superiority of any classifier, bias and variance, re-sampling for classifier design, combining classifiers	8	20%
6	**Unsupervised learning and clustering –** k-means clustering, fuzzy k-means clustering, hierarchical clustering	6	15%

Reference Books:

[1] C. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
[2] Tom Mitchell, "Machine Learning", First Edition, McGraw- Hill, 1997.

[3] Richard O. Duda, Peter E. Hart, David G. Stork, "Pattern Classification", 2nd Edition John Wiley & Sons, 2001.
[4] Dipanjan Sarkar, Raghav Ball, Tushar Sharma, "Practical Machine Learning with Python, Problem solving guide to building real world intelligent systems", Apress, 2018
[5] Ethem Alpaydin, "Introduction to Machine Learning", Second Edition, MIT Press
[6] Trevor Hastie, Robert Tibshirani, Jerome H. Friedman, "The Elements of Statistical Learning", 2nd Edition, Springer, 2009.

Course Outcomes:

At the end of this course, students should be able to …

- Understand need for machine learning
- Understand models for regression
- Understand linear discriminant functions
- Describe algorithm independent machine learning technqie
- Use machine learning algorithms for pattern recognition
- Understand unsupervised learning and clustering

List of Experiments:

1. Implement maximum likelihood algorithm
2. Implement Bayes classifier
3. Implement linear regression
4. Design a classifier using perceptron rule
5. Design a classifier using feedforward back-propagation and delta rule algorithms
6. Implement deep learning algorithm
7. Implement linear discriminant algorithm
8. Design a two class classifier using SVM
9. Design a multiclass classifier using SVM
10. Perform unsupervised learning

Teacher Guided Student Activity:

As a part of this activity students can perform following activities.

- Refer scholarly articles from well known journal/conferences such as IEEE, ELSEVIER, and SPRINGER etc. in the field of Image and Video Processing, Computer Vision
- Student can be assigned topics for seminars on some research topics.

Major Equipment/software:

- Python 2.7 with Scikit-learn

List of Open Source Software/learning website:

- Online machine learning course on NPTEL https://onlinecourses.nptel.ac.in/noc18_cs40
- Machine learning course on courser: https://www.coursera.org/learn/python-machine-learning