ITE2011	Machine Learning	L	T	P	J	C
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Pre-requisite	**ITE1015**	**Syllabus version**				
		1.0				

Course Objectives:

- To introduce fundamental supervised and unsupervised learning algorithms, models and their corresponding applications
- To provide deep understanding of Bayesian decision theory, Multivariate Methods, and Clustering approaches.
- To educate about Decision Trees, Multilayer Perceptron, and Kernel Machines.

Expected Course Outcome:

1) Demonstrate the knowledge of fundamental elements and concepts related to Supervised, Unsupervised and Probably Approximately Correct Learning.
2) Apply the suitable Bayesian Decision Theory for various types of learning problems.
3) Develop the learning models and suitable solutions for Multivariate dataset.
4) Use and apply important methods in clustering for various real-world problems.
5) Apply the knowledge and skills for solving realistic and logical issues using decision trees.
6) Ability to work with multilayer perceptron model parameters and implementing the model successfully.
7) Develop improved machine learning methods, related kernel computing models and programming framework for practical applications.
8) Implement various solutions with the help of machine learning approaches for solving everyday problems.

Student Learning Outcomes (SLO):	**2, 4, 18**
[2]	Having a clear understanding of the subject related concepts and of contemporary issues
[4]	Having Sense-Making Skills of creating unique insights in what is being seen or observed (Higher level thinking skills which cannot be codified)
[18]	Having critical thinking and innovative skills

Module:1	**Basics**	**5 hours**

Definition-Machine Learning, Classification, Supervised/Unsupervised Learning, Probably Approximately Correct (PAC) Learning

Module:2	**Bayesian Decision Theory**	**6 hours**

Classification, Losses and Risks, Discriminant Functions, Utility Theory, Evaluating an Estimator: Bias and Variance, The Bayes' Estimator, Parametric Classification, Model Selection Procedures

Module:3	**Multivariate Methods**	**7 hours**
Multivariate Data - Parameter Estimation - Estimation of Missing Value - Multivariate Normal Distribution - Multivariate Classification - Multivariate Regression - Dimensionality Reduction- Factor Analysis - Multidimensional Scaling - Locally Linear Embedding		
Module:4	**Clustering**	**7 hours**
k-Means Clustering - Mixtures of Latent Variable Models - Hierarchical Clustering - Nonparametric Methods : Nonparametric Density Estimation - k-Nearest Neighbor Estimator - Nonparametric Classification - Smoothing Models		
Module:5	**Decision Trees**	**6 hours**
Univariate Trees - Pruning - Rule Extraction from Trees - Multivariate Trees - Linear Discrimination : Generalizing the Linear Model - Logistic Discrimination - Discrimination by Regression		
Module:6	**Multilayer Perceptrons**	**6 hours**
Neural Networks - Training a Perceptron - Learning Boolean Functions - Multilayer Perceptrons - Back propagation Algorithm - Training Procedures - Tuning the Network Size - Radial Basis Functions		
Module:7	**Kernel Machines**	**6 hours**
Optimal Separating Hyperplane - The Nonseparable Case: Soft Margin Hyperplane - v-SVM - Kernel Machines for Regression- One-Class Kernel Machines - Kernel Dimensionality Reduction.		
Module:8	**Contemporary issues:**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Ethem Alpaydi, Introduction to Machine Learning, Second Edition, The MIT Press, 2015.
Reference Books-	
1.	Russell and Norvig, Artificial Intelligence, Third Edition, Prentice Hall, 2015
2.	Mitchell, Tom, Machine Learning, Tata McGraw-Hill, 2017.

Recommended by Board of Studies	05-03-2016		
Approved by Academic Council	No. 40	Date	18-03-2016