EN3150 Pattern Recognition

Intake	2020 onwards	Specialization	Electronic and Telecommunication Engineering		
Semester	Code	Module Title	Credits	C/E/O	GPA/NGPA
	EN3150	Pattern Recognition	3	E	GPA
Hours/Week		Prerequisites and corequisites		Evaluation	%
Lecture	Lab./Tut.			CA	WE
2	2	None		70	30

Module Aim: To introduce the fundamental concepts and algorithms for machine learning with their applications.

Learning Outcomes

At the end of the module the student will be able to:

LO1	Explain the process of learning from data and related challenges.
LO2	Characterize a wide class of pattern recognition/machine learning (ML) algorithms by the underlying mathematical structures and limitations.
LO3	Demonstrate the utility of pattern recognition/ML algorithms with the help of publicly available software libraries and data sets.
LO4	Implement different pattern recognition/ML algorithms in a range of practical applications.
LO5	Build a simple convolutional neural network to perform classification.

Outline Syllabus

1.	**Introduction [2 hours]** Learning from data and related challenges, supervised vs unsupervised learning, model selection and bias-variance trade-off.	LO1, LO2
2.	**Linear Models for Regression [6 hours]** Linear regression models and least squares, subset selection, regularized linear models (e.g., Ridge, LASSO), prediction and related confidence intervals.	LO2 to LO4
3.	**Classification [6 hours]** Linear models of classification, discriminant functions, generative models, probabilistic discriminative models, optimal separating hyperplanes and SVM.	LO2 to LO4
4.	**Kernel Methods [4 hours]** Feature maps, representer theorem, kernels and kernel trick, kernel density estimation.	LO2 to LO4
5.	**Additive Models and Mixtures [4 hours]**	LO2 to LO4

	Tree based methods, boosting, ensemble methods, mixture of Gaussians, EM algorithm.	
6.	**Unsupervised Learning Techniques [2 hours]** Cluster analysis, principal components analysis, independent component analysis, multidimensional scaling.	LO2 to LO4
7.	**Deep Neural Networks [4 hours]** Introduction to neural networks (NN) and backpropagation, architecture of convolutional neural networks, implementing NN using frameworks, training neural networks and performance analysis.	LO2, LO3, LO5

Mapping of Learning Outcomes to Program Outcomes and Assessment Methods

LOs Covered	Assessments	PO-01	PO-02	PO-03	PO-04	PO-05	PO-06	PO-07	PO-08	PO-09	PO-10	PO-11	PO-12	PO-13	PO-14
LO1	A1, A2	H	H										H	H	
LO2	A1, A2	H	H										H	H	
LO3	A1, A2	H	H			H							H	H	
LO4	A1, A2	H	H			H							H	H	
LO5	A1	H	H	L		H							H	H	
Overall Contribution to POs		**H**	**H**	**L**		**H**							**H**	**H**	

Details on Assessment Methods

No.	Assessment Activity	%	LOs Covered	Comments
A1	Assignments	70%	LO1 to LO5	
A2	Final written examination	30%	LO1 to LO4	

Recommended Textbooks	C. M. Bishop, *Pattern Recognition and Machine Learning*, Springer NY, 2006.
Lecturer in Charge	Dr. M.T.U. Sampath K. Perera