CS 6301 MACHINE LEARNING

OBJECTIVES:

- To understand the need for machine learning for various types of problem solving
- To know the mathematics involved in various machine learning algorithms
- To study the various supervised, semi-supervised and unsupervised learning algorithms in machine learning
- To learn about probabilistic models in machine learning
- To have a glimpse of the latest developments in machine learning

CS 6301 MACHINE LEARNING	L	T	P	EL	TOTAL CREDITS
	3	0	4	3	6

MODULE I :	L	T	P	EL
	6	0	4	3

Learning – Types of Machine Learning – Supervised Learning - The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning- Concept Learning task – Concept Learning as Search - Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm

SUGGESTED ACTIVITIES :

- EL – Fundamentals of Predictive Analytics, Study of tools for data mining like WEKA, KNIME, Rapidminer, etc
- Practical – Study of tools like WEKA, KNIME and the UCI repository datasets

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Quizzes

MODULE II :	L	T	P	EL
	3	0	4	3

Neural Networks – Perceptron – Linear Separability – Linear Regression

SUGGESTED ACTIVITIES :

- In-class activity – practical problems and the need for machine learning algorithms
- EL – Working with tools and standard data sets
- Practical - Implementation of the Candidate Elimination Algorithm

SUGGESTED EVALUATION METHODS:

- Tutorial problems
- Assignment problems
- Practical demonstrations

MODULE III :	L	T	P	EL

	3	**0**	**4**	**3**
The Multi-Layer Perceptron – Back Propagation of Error-Multi-layer Perceptron in Practice – Deriving Back Propagation – Applications of MLP				
SUGGESTED ACTIVITIES : ● Flipped classroom and activity ● EL – Applications of MLP ● Practical – Implementation of the Neural Network perceptron algorithm and enhancing it to other variations ● Proposal for Mini Project				
SUGGESTED EVALUATION METHODS: ● Tutorial problems ● Assignment problems ● Approval of Mini project based on the reference papers, abstract and design				
MODULE IV :	**L**	**T**	**P**	**EL**
	3	**0**	**4**	**3**
Radial Basis Function Network - Concepts –Training - Interpolation and Basis Functions – Solutions using RBF				
SUGGESTED ACTIVITIES : ● Flipped Class room ● EL –Applications of RBF Networks ● Practical – Implementation of Multi-layer Perceptron				
SUGGESTED EVALUATION METHODS: ● Tutorial problems ● Assignment problems ● Practical demonstrations				
MODULE V :	**L**	**T**	**P**	**EL**
	3	**0**	**4**	**3**
Dimensionality Reduction –Linear Discriminant Analysis-Principal Component Analysis-Factor Analysis-Independent Component Analysis-Locally Linear Embedding-Isomap				
SUGGESTED ACTIVITIES : ● EL – Probabilistic PCA and Factor analysis concepts ● Practical –Implementation of Independent Component Analysis(ICA) algorithm ● Practical – Mini-project design completion				
SUGGESTED EVALUATION METHODS: ● Tutorial problems ● Assignment problems ● Practical demonstrations				
MODULE VI:	**L**	**T**	**P**	**EL**
	6	**0**	**4**	**3**
Probabilistic Learning-Gaussian Mixture Models-Nearest Neighbor Models-Support Vector Machines-Optimal Separation-Kernels-The Support Vector Machine Algorithm-Extensions to the SVM				
SUGGESTED ACTIVITIES : ● EL – Application of SVM, Nearest Neighbor concepts and other regression models on various datasets ● Practical –Implementation of Support Vector Machines with various kernel models, Nearest Neighbor models				

- Continuation of mini project, minimum 40% implementation

SUGGESTED EVALUATION METHODS:
- Tutorial problems
- Assignment problems
- Practical demonstration of algorithms and mini project

MODULE VII:	**L**	**T**	**P**	**EL**
	3	**0**	**4**	**3**

Evolutionary Learning-The Genetic Algorithm-Genetic Operators-Using Genetic Algorithms-Genetic Programming - Applications

SUGGESTED ACTIVITIES :
- Flipped Classroom for applications
- EL – Applications of Evolutionary algorithms
- Practical – Implementation of GA, Continuation of mini-project

SUGGESTED EVALUATION METHODS:
- Tutorial problems
- Assignment problems
- Practical demonstrations

MODULE VIII	**L**	**T**	**P**	**EL**
	3	**0**	**4**	**3**

Reinforcement Learning – Markov Decision Processes - Values-The difference between SARSA and Q-Learning

SUGGESTED ACTIVITIES :
- Flipped Classroom for applications
- EL – Applications of Evolutionary algorithms
- Practical – Continuation of mini-project

SUGGESTED EVALUATION METHODS:
- Tutorial problems
- Assignment problems
- Practical demonstrations

MODULE IX	**L**	**T**	**P**	**EL**
	3	**0**	**4**	**3**

Learning with Trees-Using Decision trees-Constructing Decision Trees-Classification and regression trees-Classification example-Decision by committee: Ensemble Learning-Boosting-Bagging-Random Forests-Different ways to combine classifiers

SUGGESTED ACTIVITIES :
- EL – Applications of Decision tree, CART
- Practical –Implementation of Decision Trees, Bagging, Boosting and EM algorithms Continuation of mini-project

SUGGESTED EVALUATION METHODS:
- Tutorial problems
- Assignment problems
- Practical demonstrations, Mini project 80% completion

MODULE X	**L**	**T**	**P**	**EL**
	3	**0**	**4**	**3**

Unsupervised Learning-The K-Means Algorithm-Vector Quantization-The self-organizing feature map				
SUGGESTED ACTIVITIES : ● Combinations of in Class & Flipped class rooms ● EL –K-Means algorithm applications ● Practical - Implementations of K-Means algorithm				
SUGGESTED EVALUATION METHODS: ● Tutorial problems ● Assignment problems ● Practical demonstrations				
MODULE XI	**L**	**T**	**P**	**EL**
	3	**0**	**4**	**3**
Deep learning introduction – CNN – RNN				
SUGGESTED ACTIVITIES : ● EL – Survey of deep learning network models ● Practical – Mini-project demonstration				
SUGGESTED EVALUATION METHODS: ● Mini project final evaluation				

OUTCOMES:

Upon completion of the course, the students will be able to

- Differentiate between supervised, unsupervised, semi-supervised machine learning approaches
- Choose and implement classification or regression algorithms for an application using an open source tool
- Implement probabilistic, discriminative and generative algorithms for an application and analyze the results
- Use a tool to implement typical clustering algorithms for different types of applications
- Create potential solutions for real time applications using machine learning techniques

TEXT BOOKS

1. Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
2. Tom M Mitchell, “Machine Learning”, McGraw Hill Education, 2013.

REFERENCES:

1. Peter Flach, “Machine Learning: The Art and Science of Algorithms that Make Sense of Data”, First Edition, Cambridge University Press, 2012.
2. Jason Bell, “Machine learning – Hands on for Developers and Technical Professionals”, First Edition, Wiley, 2014.
3. Ethem Alpaydin, “Introduction to Machine Learning”, Third Edition, Adaptive Computation and Machine Learning Series, MIT Press, 2014.

EVALUATION METHOD:

Category of Course	Continuous Assessment	Mid – Semester Assessment	End Semester

Theory Integrated with Practical	**15(T) + 25 (P)**	**20**	**40**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									
CO2	✓	✓	✓	✓	✓				✓			✓
CO3	✓	✓	✓	✓	✓				✓		✓	✓
CO4	✓	✓	✓	✓	✓				✓			✓
CO5	✓	✓	✓	✓	✓				✓		✓	✓

CS6302 PROGRAMMING PARADIGMS

Prerequisites for the course: Data Structures and Algorithms

OBJECTIVES:

- To introduce the major programming paradigms with the principles and the techniques involved in the design and implementation of modern programming languages
- To introduce the framework for specifying and reasoning about programming languages
- To analyse a given program from the perspective of good programming practices
- To compare and contrast the range of programming paradigms
- To evaluate programming language features critically with respect to the way they support good software engineering practices
- To discuss the appropriateness of the use of a given programming paradigm within a given environment

CS6302 PROGRAMMING PARADIGMS	**L**	**T**	**P**	**EL**	**CREDITS**
	3	**0**	**0**	**3**	**4**

OBJECTIVES:

MODULE I :	**L**	**T**	**P**	**EL**
	3	**0**	**0**	**5**

The art of Language design – Programming language spectrum - Compilation and Interpretation– Evaluation of Programming languages

SUGGESTED ACTIVITIES :

- Activity based learning - brain storming quizzes and puzzles of programming languages

SUGGESTED EVALUATION METHODS:

- Quizzes

MODULE II :	**L**	**T**	**P**	**EL**
	4	**0**	**0**	**5**

Languages – Syntax and Semantics of language C-lite - Names – Types – Type Systems - Binding – Scope – Static – Dynamic – Abstract Data types

SUGGESTED ACTIVITIES :

- Using peer learning- Interaction and group discussion about data types