UE21CS352A: Machine Intelligence

No. of Credits: 5 **# of Slots: 112**

Class #	Chapter Title / Reference Literature	Topics to be Covered	% Of Portion Covered	
			Absolute	Cumulative
Unit 1 : Introduction, Search Algorithms ,Classification with Decision Trees and Performance Metrics			23.21	23.21
1	T1 : Chapter 1 - 1.1	Introduction to AI and ML		
2	T1 : Chapter 2 – 2.1, 2.3, 2.4,2.5	Intelligent Agents and its Types		
3	Slides on PESU Academy Portal	Machine Learning and its Models		
4	T2: Chapter2 – 2.1- 2.2	Concept Learning: Introduction, A Concept Learning Task, Concepts of Hypotheses		
5	T2: Chapter2 – 2.3- 2.4,2.7	Concept Learning: Concept Learning as Search, Find-S:Finding a Maximally Specific Hypothesis, Version Space, Inductive Bias		
6-7	**Lab Component**	**Understanding basics of PyTorch, Tools related to MI (Self Study)**		
8	Slides on PESU Academy Portal	Performance Metrics-Accuracy, Precision, Recall		
9	Slides on PESU Academy Portal	Performance Metrics-Sensitivity, Specificity, AUC, RoC		
10	Slides on PESU Academy Portal	Bias Variance Decomposition		
11	T2: Ch 3 3.1, 3.2, 3.3	Decision Tree Learning: Introduction, Decision Tree Representation, Appropriate Problems for Decision Tree Learning		
12	T2: Ch 3 3.4	The Basic Decision Tree Learning Algorithm- ID3 Algorithm for Classification, Entropy and Gain calculations		
13	T2: Ch 3 3.5, 3.6	Hypothesis Space Search in Decision Tree Learning, Inductive Bias in Decision Tree Learning		
14	T2: Ch 3 3.7(3.7.1,3.7.2)	Issues in Decision Tree Learning – Avoiding Overfitting the Data, Solutions to Overfitting, Incorporating Continuous-Valued Attributes		
15-16	**Lab Component**	**Decision Tree Classifier- Build a Decision Tree Classifier for the given data.**		

17	T2: Ch 3, Slides on PESU Academy Portal	Solving a numerical problem on Decision Trees, Decision Boundary for Decision Trees(X-Y axis)		
18	Slides on PESU Academy Portal	Introduction to Linear Regression, Linear Regression using Gradient Descent		
19	Slides on PESU Academy Portal	Solving a numerical problem on Linear Regression		
20	Slides on PESU Academy Portal	Issues with Linear Regression, Introduction to Logistic Regression		
21	Slides on PESU Academy Portal	Solving a numerical problem on Logistic Regression		
22	T2: Ch 8 -8.1, 8.2 (8.2.1,8.2.2) pg. 230-236	Instance-Based Learning: k-Nearest Neighbor Algorithm (Classification)		
23	Slides on PESU Academy Portal	Instance-Based Learning: k-Nearest Neighbor Algorithm(Regression)		
24	T2: Ch 8 Pg. 230-236, Slides on PESU Academy Portal	Sample problems on Weighted kNN, Decision Boundary for kNN		
25-26		**Assignment 1 (Written/ Practical) on** Linear Regression or Logistic Regression		
Unit 2: Supervised Learning with ANN, Introduction to Deep Learning Techniques				
27	T2: Ch 4 4.1-4.3 pg. 81-85	Artificial Neural networks: Introduction		
28	T2: Ch 4 4.4 pg. 86-94	Perceptrons – implementing LOGIC gates		
29	T2 Ch 4 4.5(4.5.1-4.5.3 excluding case 1 and case 2) pg. 95-101	Multi-layer Networks and Back-Propagation	19.64	42.85
30	T2 Ch 4 4.5(4.5.1-4.5.3 excluding case 1 and case 2) pg. 95-101	Back-Propagation Derivation		
31	Slides on PESU Academy Portal	Activation functions (Step, Sigmoid, Tanh, ReLU, Leaky ReLU, Softmax)		

32	Slides on PESU Academy Portal	Various Optimizers(GD, SGD, Momentum-based, Adagrad, RMSprop, Adam)		
33-34	**Lab Component**	**Implementation of Simple Artificial Neural Networks**		
35	Mitesh Khapra slides on CNN & T3: Ch 6 (Demystifying Convolutional Networks)	Introduction to Deep Learning, Introduction to Convolutional Neural Network(CNN)		
36		CNN-Introduction to Convolution Operation and Pooling- Max pooling, Average pooling		
37		CNN- Parameter Calculation, Problems on Parameter Calculation		
38-39	**Lab Component**	**Building a Classification Model for the given dataset using CNN**		
40		Introduction to Recurrent Neural Network		
41		RNN- Vanishing and Exploding Gradient		
42		Variants of RNN : LSTM		
43		Variants of RNN : GRU		
44		Introduction to Large Language Models(LLM)		
45-46		**Assignment 2 (Written/Practical) on** RNN or LSTM		
47-48		**Revision for ISA1(Units 1 and 2)**		
Unit 3: SVM, Boosting and Stochastic Models				
49	T4 Ch 3 pg.38-53	Support Vector Machines – Margin and Maximization and the Primal Form		
50	T4 Ch 4 pg.54-59	SVM - The Lagrangian Dual and its Solution(Hard Margin Classification ONLY)		
51	T4 Ch 4 pg.54-59	SVM - Soft Margin(Classification ONLY)		
52	T4 Ch 6 pg.72-81	SVM – Kernel Trick Kernel functions: Linear, polynomial (Derivation only for linear function).		
53		Sample problems on SVM		
54-55	**Lab Component**	**Support Vector Machines -Implement a Support Vector Machine Classifier for the given dataset**		
56	Slides on PESU Academy Portal	Combining Weak Learners	22.32	65.18
57	R3: pg. 129-131 (Slides on PESU Academy Portal)	Improving Performance: Bagging and Boosting		
58	Slides on PESU Academy Portal	Improving Performance with Gradient Boost		
59	Slides on PESU Academy Portal	Random Forest		
60		Basics of Probability		

61	T2: Ch 6 pg. 154-166, pg. 170-171,174-176	Bayesian Learning – Bayes Theorem, Maximum likelihood, Bayes Optimal Classifier		
62-63	T2: Ch6 – pg. 177-183	Naïve Bayes Classifier and Text Classification.		
64-65	**Lab Component**	**Build a Text Classifier using Naïve Bayes Algorithm**		
66-67	R4: Chapter 9, pg. 286-289 (Slides on PESU Academy Portal)	Expectation maximization Algorithm		
68-69	R4: Chapter 9, pg. 289-292(Slides on PESU Academy Portal)	Gaussian Mixture Models		
70-71	**Lab Component**	**GMM Program**		
72-73		**Assignment 3 (Written/Practical) on Bagging or Boosting or Random Forest**		
Unit 4: HMM, Unsupervised Learning ,Dimensionality Reduction and Genetic Algorithms, PSO				
74	R2: Ch 15 pg. 363- 366 (Slides on PESU Academy Portal)	Hidden Markov Models – Discrete Markov Processes		
75	R2: Ch15 – pg. 367- 373(Slides on PESU Academy Portal)	Hidden Markov Models – 3 Basic Problems	34.82	100
76	R2: Ch15 – pg. 373-375(Slides on PESU Academy Portal)	Learning the State Sequence		
77	R2: Ch15 – pg. 373-375(Slides on PESU Academy Portal)	Learning the Parameters		

78	R2: Ch15 – pg. 375-378(Slides on PESU Academy Portal)	Baum-Welch Algorithm		
79	Slides on PESU Academy Portal	Problems on Hidden Markov Models		
80-81	**Lab Component**	**Hidden Markov Model (HMM)- Implement the Viterbi algorithm for decoding a sequence of observations to find the most probable sequence of internal states that generated the observations.**		
82-92		Hackathon		
93	R3: Ch10: pg. 207- 217, Ch 11: pg.224-234, Ch 12: pg. 248-260 (Slides on PESU AcademyPortal)	Unsupervised Learning: Hierarchical vs. Non- Hierarchical Clustering		
94	R3: Ch10: pg. 207- 217, Ch 11: pg.224-234, Ch 12: pg. 248-260 (Slides on PESU AcademyPortal)	Unsupervised Learning: Agglomerative and Divisive Clustering		
95	R1: Chapter 9, pg.424-430	k-Means Clustering, Simple problems on k-Means Clustering, Bisecting k-Means, Issues with k-Means Clustering.		
96	R1: Chapter 9, pg. 439	k-Means as special case of Expectation Maximization		
97-98	**Lab Component**	**Implementation of K-Means Clustering**		

99	R1: Chapter 12, pg. 559-570 (Slides on PESU Academy Portal)	Dimensionality Reduction Techniques –Introduction, Techniques Available, Principal Component Analysis(PCA)- Introduction to PCA and its Applications, Principal Components		
100	Slides on PESU Academy Portal	Problems on PCA		
101	Slides on PESU Academy Portal	Dimensionality Reduction Techniques – Introduction to SVD and its Applications, SVD		
102	Slides on PESU Academy Portal	Problem on SVD, Relationship between PCA and SVD		
103	T2: Ch 9 - 9.1, 9.2	Genetic Algorithms – Representing Hypothesis, Genetic Operators		
104	T2: Ch 9 - 9.2, 9.3	Fitness Function and Selection Methods, Crossover, Mutation		
105	T2: Ch 9	Simple Applications of the Genetic Algorithm, Application of GA in Decision tree, Genetic Algorithm based Clustering		
106	T2: Ch7.1-7.4,Ch9	Solving Single Objective Optimization problems using GA, Using GA to emulate Gradient Descent/Ascent		
107	Slides on PESU Academy Portal	Weight Determination, Clustering, Introduction to PSO		
108	Slides on PESU Academy Portal	Application of PSO in Single Objective optimization problems.		
109-110		**Assignment 4 (Written/Practical) on** PCA or Genetics Algorithm or PSO		
111-112	**Revision for ISA2(Units 3 and 4)**			

Literature:

Book Type	Code	Title and Author	Publication info		
			Edition	Publisher	Author
Text Book	T1	1. Artificial Intelligence: A Modern Approach (3rd Edition), Stuart Russel and Peter Norvig,	3rd	Wiley India	Stuart Russel and Peter Norvig,
Text Book	T2	Machine Learning, Tom Mitchell, McGraw Hill Education (India), 2013.		McGraw Hill Education (India)	Tom Mitchell
Text Book	T3	Hands-on Deep Learning Algorithm with Python - Sudharshan Ravi Chandiran		Packt Publishing Limited	Sudharshan Ravi Chandiran

Text Book	T4	Support Vector Machines Succinctly by Alexandre Kowalczyk		Syncfusion	Alexandre Kowalczyk
Reference Book	R1	“Pattern Recognition and Machine Learning”, ChristopherBishop,Springer(2ndPrinting), 2011		Springer (2nd Printing), 2011	Christopher Bishop
	R2	Introduction to Machine Learning Second Edition by Ethem Alpaydin	2nd	The MIT Press	Ethem Alpaydin
	R3	Machine Learning in Action by Peter Harrington, First Edition, Manning 2021	1st	Manning (2021)	Peter Harrington
	R4	“Machine Learning: The Art and Science of AlgorithmsthatMakeSenseofData”, Peter Flach, Cambridge University Press(2012).		Cambridge University Press (2012)	Peter Flach