B.E. COMPUTER SCIENCE AND ENGINEERING FOURTH YEAR FIRST SEMESTER EXAM 2019

Machine Learning

Time: Three hours | Full Marks: 100

*Answer any **FIVE** questions.*

1. Develop a decision tree classifier. Show the training phase by computing all necessary steps using ID3 algorithm. Using the trained model, predict label for the test instance: (Outlook=*Sunny,* Temperature=*Cool,* Humidity=*High,* Wind=*Strong*).

PlayTennis: training examples

Day	Outlook	Temperature	Humidity	Wind	PlayTennis
D1	Sunny	Hot	High	Weak	No
D2	Sunny	Hot	High	Strong	No
D3	Overcast	Hot	High	Weak	Yes
D4	Rain	Mild	High	Weak	Yes
D5	Rain	Cool	Normal	Weak	Yes
D6	Rain	Cool	Normal	Strong	No
D7	Overcast	Cool	Normal	Strong	Yes
D8	Sunny	Mild	High	Weak	No
D9	Sunny	Cool	Normal	Weak	Yes
D10	Rain	Mild	Normal	Weak	Yes
D11	Sunny	Mild	Normal	Strong	Yes
D12	Overcast	Mild	High	Strong	Yes
D13	Overcast	Hot	Normal	Weak	Yes
D14	Rain	Mild	High	Strong	No

20 marks

2. Derive Backprogation algorithm used for training Artificial Neural Networks. Comment on the justification of the name "*backpropagation*" algorithm.

20 marks

3. **a)** Explain the basic principle of gradient descent search procedure in the context of training a linear unit perceptron model. Comment on why it is named so. What is the drawback of gradient descent search procedure?

b) What is the biological motivation behind Artificial Neural Networks? Is it possible to implement XOR function using a single perceptron? If yes, explain how? if no, explain Why? Design an ANN to implement XOR function.

(5 + 2 +3) + (2 + 3 +5) =**20 marks**

4. **a)** What is difference between lazy learner and eager learner? Give examples.
b) *NASA* wants to be able to discriminate between the species: Martians (M) and Humans (H) based on the following characteristics: Green$\in${*0, 1*}, Legs$\in${*2, 3*}, Height$\in${*0, 1*}, Smelly$\in${*0, 1*}. Our available training set (S) is as follows:

Example number	*Green*	*legs*	*Height*	*Smelly*	**Class**
1	0	3	0	1	M
2	1	2	1	0	M
3	1	3	1	0	M
4	0	2	0	1	M
5	1	3	1	0	M
6	0	2	1	1	H
7	0	2	0	0	H
8	0	2	1	0	H
9	1	2	0	0	H
10	0	2	1	1	H

Consider the training data given in the above table and assume K=1, and develop K-NN classifier to predict the classes of the test instances: <*green=1, legs=3, height= 0, smelly=1*> and <*green=0, legs=3, height= 1, smelly=1*>. Show with necessary calculations how K-NN predicts the class labels for these two test instances. If the value K is changed and set K=3, does it affect the classification of the above mentioned test instances? Show also the necessary calculations.

2+ (8 + 10)= **20 marks**

5.
a) Explain (with examples) the following performance measures for machine learning algorithms
i. ***Accuracy*** ii. ***Error rate*** iii. ***True positive rate*** iv. ***False positive rate*** v. ***F-measure***

b) Discuss *K-means* clustering algorithm with an example. Why is it called "*K-means*"?

10 + (8+2) =**20 marks**

6. a)What is the difference between supervised and unsupervised machine learning? Give examples.

b) Compare and contrast decision tree learning algorithm and Artificial neural networks.

c) In decision learning, what is the significance of entropy and information gain? What is the intuition behind the *reduced error pruning* algorithm applied to dealing with overfitting in decision tree learning.

4 + 6 + (5 +5) = **20 marks**

7. a) Differentiate (with suitable examples) among *hypothesis function*, *target function* and *hypothesis space*.
b) Write short notes on the following

i. Handling continuous attributes in decision tree learning
ii. Handling missing attributes in decision tree learning

6+ (7 + 7) = **20 marks**