CMR Institute of Technology, Bangalore			
Department(s): Information Science & Engineering			
Semester: 07	Section(s): A&B	Lectures/week: 03	
Subject: Machine Learning		Code: 17CS73	
Course Instructor(s): Mrs. Swathi.Y			
Course duration: 03 August 2020 – 21st Nov 2020			
Course Site: https://sites.google.com/a/cmrit.ac.in/swathi-ml/home			

MODULE 1 – INTRODUCTION AND CONCEPT LEARNING

1. Define Machine Learning. Explain with examples why machine learning is important.
2. Discuss some applications of machine learning with examples.
3. Explain how some disciplines have influenced the machine learning.
4. What is well- posed learning problems.
5. Describe the following problems with respect to Tasks, Performance and Experience:
    a. A Checkers learning problem
    b. A Handwritten recognition learning problem
    c. A Robot driving learning problem
6. Explain the steps in designing a learning systems in detail.
7. Explain different perspective and issues in machine learning.
8. Define concept learning and discuss with example.
9. Explain the General-to-Specific Ordering of Hypotheses
10. Write FIND-S algorithm and explain with example given below

Example	Sky	AirTemp	Humidity	Wind	Water	Forecast	EnjoySport
1	Sunny	Warm	Normal	Strong	Warm	Same	Yes
2	Sunny	Warm	High	Strong	Warm	Same	Yes
3	Rainy	Cold	High	Strong	Warm	Change	No
4	Sunny	Warm	High	Strong	Cool	Change	Yes

11. What are the key properties and complaints of FIND-S algorithm?
12. Define Consistent Hypothesis and Version Space.
13. Write LIST-THEN-ELIMINATE algorithm.
14. Write the candidate elimination algorithm and illustrate with example.
15. Write the final version space for the below mentioned training examples using candidate elimination algorithm.

Example – 1:

Origin	Manufacturer	Color	Decade	Type	Example Type
Japan	Honda	Blue	1980	Economy	Positive
Japan	Toyota	Green	1970	Sports	Negative
Japan	Toyota	Blue	1990	Economy	Positive
USA	Chrysler	Red	1980	Economy	Negative
Japan	Honda	White	1980	Economy	Positive
Japan	Toyota	Green	1980	Economy	Positive
Japan	Honda	Red	1990	Economy	Negative

Example – 2:

Size	Color	Shape	Class
Big	Red	Circle	No
Small	Red	Triangle	No
Small	Red	Circle	Yes
Big	Blue	Circle	No
Small	Blue	Circle	Yes

16.Explain in detail the Inductive Bias of Candidate Elimination algorithm.

MODULE 2 – DECISION TREE LEARNING

1. What is decision tree and decision tree learning?
2. Explain representation of decision tree with example.
3. What are appropriate problems for Decision tree learning?
4. Explain the concepts of Entropy and Information gain.
5. Describe the ID3 algorithm for decision tree learning with example
6. Give Decision trees to represent the Boolean Functions:
    a) A && ~ B
    b) A V [B && C]
    c) A XOR B
    d) [A&&B] V [C&&D]
7. Give Decision trees for the following set of 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

8. Consider the following set of training examples.

   a) What is the entropy of this collection of training example with respect to the target function classification?

   b) What is the information gain of a_2 relative to these training examples?

Instance	Classification	a_1	a_2
1	+	T	T
2	+	T	T
3	-	T	F
4	+	F	F
5	-	F	T
6	-	F	T

9. Identify the entropy, information gain and draw the decision trees for the following set of training examples

Gender	Car ownership	Travel cost	Income Level	Transportation (Class)
Male	0	Cheap	Low	Bus
Male	1	Cheap	Medium	Bus
Female	1	Cheap	Medium	Train
Female	0	Cheap	Low	Bus
Male	1	Cheap	Medium	Bus
Male	0	Standard	Medium	Train
Female	1	Standard	Medium	Train
Female	1	Expensive	High	Car
Male	2	Expensive	Medium	Car
Female	2	Expensive	High	Car

10. Discuss Hypothesis Space Search in Decision tree Learning.
11. Discuss Inductive Bias in Decision Tree Learning.
12. What are Restriction Biases and Preference Biases and differentiate between them.
13. Write a note on **Occam's** razor and minimum description principal.
14. What are issues in learning decision trees

MODULE 3 – ARTIFICIAL NEURAL NETWORKS

1. What is Artificial Neural Network?
2. Explain appropriate problem for Neural Network Learning with its characteristics.
3. Explain the concept of a Perceptron with a neat diagram.
4. Explain the single perceptron with its learning algorithm.
5. How a single perceptron can be used to represent the Boolean functions such as AND, OR
6. Design a two-input perceptron that implements the boolean function A $\Lambda \neg$ B. Design a two-layer network of perceptron's that implements A XOR B.
7. Consider two perceptrons defined by the threshold expression $w_0 + w_1x_1 + w_2x_2 > 0$. Perceptron A has weight values

   $w_0 = 1, w_1=2, w_2=1$

   and perceptron B has the weight values

   $w_0 = 0, w_1=2, w_2=1$

   True or false? Perceptron A is more-general than perceptron B.
8. Write a note on (i) Perceptron Training Rule (ii) Gradient Descent and Delta Rule
9. Write Gradient Descent algorithm for training a linear unit.
10. Derive the Gradient Descent Rule
11. Write Stochastic Gradient Descent algorithm for training a linear unit.
12. Differentiate between Gradient Descent and Stochastic Gradient Descent
13. Write Stochastic Gradient Descent version of the Back Propagation algorithm for feedforward networks containing two layers of sigmoid units.
14. Derive the Back Propagation Rule
15. Explain the followings w.r.t Back Propagation algorithm
    - Convergence and Local Minima
    - Representational Power of Feedforward Networks
    - Hypothesis Space Search and Inductive Bias
    - Hidden Layer Representations
    - Generalization, Overfitting, and Stopping Criterion

MODULE 4 –BAYESIAN LEARNING

1. Define Bayesian theorem? What is the relevance and features of Bayesian theorem? Explain the practical difficulties of Bayesian theorem.
2. Define is Maximum a Posteriori (MAP) Maximum Likelihood (ML) Hypothesis. Derive the relation for h_{MAP} and h_{ML} using Bayesian theorem.

3. Consider a medical diagnosis problem in which there are two alternative hypotheses: 1. that the patient has a particular form of cancer (+) and 2. That the patient does not (-). A patient takes a lab test and the result comes back positive. The test returns a correct positive result in only 98% of the cases in which the disease is actually present, and a correct negative result in only 97% of the cases in which the disease is not present. Furthermore, .008 of the entire population has this cancer. Determine whether the patient has Cancer or not using MAP hypothesis.
4. Explain Brute force Bayes Concept Learning
5. What are Consistent Learners?
6. Discuss Maximum Likelihood and Least Square Error Hypothesis
7. Describe Maximum Likelihood Hypothesis for predicting probabilities.
8. Explain the Gradient Search to Maximize Likelihood in a Neural Net
9. Describe the concept of MDL. Obtain the equation for h_{MDL}
10. Explain Naïve Bayes Classifier with an Example
11. What are Bayesian Belief nets? Where are they used?
12. Explain Bayesian belief network and conditional independence with example
13. Explain the concept of EM Algorithm.
14. Consider the following set of training examples. Classify a data instance <Red, Domestic, SUV> using Naïve Bayes classifier with m-estimate.

	Color	Type	Origin	Category
1	Red	Sports	Domestic	Yes
2	Red	Sports	Domestic	No
3	Red	Sports	Domestic	Yes
4	Yellow	Sports	Domestic	No
5	Yellow	Sports	Imported	Yes
6	Yellow	SUV	Imported	No
7	Yellow	SUV	Imported	Yes
8	Yellow	SUV	Domestic	No
9	Red	SUV	Imported	No
10	Red	Sports	Imported	Yes

MODULE 5

1. What is Reinforcement Learning?
2. Explain the Q function and Q Learning Algorithm.
3. Describe K-nearest Neighbour learning Algorithm for continues valued target function.
4. Discuss the major drawbacks of K-nearest Neighbour learning Algorithm and how it can be corrected
5. Define the following terms with respect to K - Nearest Neighbour Learning :

i) Regression ii) Residual iii) Kernel Function.

6.Explain Q learning algorithm assuming deterministic rewards andactions?

7.Explain the K – nearest neighbour algorithm for approximating a discrete – valued functionf : Hn→ V with pseudo code

8. Explain Locally Weighted Linear Regression.

9.Explain CADET System using Case based reasoning.

10. Explain the two key difficulties that arise while estimating the Accuracy of Hypothesis.

11.Define the following terms

a. Sample error b. True error c. Random Variable

d. Expected value e. Variance f. standard Deviation

12. Explain Binomial Distribution with an example.

13. Explain Normal or Gaussian distribution with an example.