Machine Learning - 15CS73 Question Bank

Module 1- Introduction to ML and Concept Learning

Introduction to Machine Learning (Chapter 1)

1. Define Machine Learning. Discuss with examples why machine learning is important.
2. Discuss with examples some useful applications of machine learning.
3. Explain how some areas/disciplines that influenced the machine learning.
4. What do you mean by a well–posed learning problem? Explain the important features that are required to well–define a learning problem.
5. Define learning program for a given problem. Describe the following problems with respect to Tasks, Performance and Experience: a. Checkers Learning Problems
   b. Handwritten Recognition Problem
   c. Robot Driving Learning Problem
6. Describe in detail all the steps involved in designing a learning system.
7. Discuss the perspective and issues in machine learning.

Concept Learning (Chapter 2)

8. Define Concept and Concept Learning. With example explain how the Concept Learning task determines the Hypothesis for given target concept.
9. Discuss Concept learning as search with respect to General to specific ordering of hypothesis.
10. Describe Find S Algorithm. What are the properties and complaints of Find S.
11. Illustrate Find S Algorithm over *EnjoySport* concept. Training instances 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

12. Define Consistent *Hypothesis* and *Version Space*. With example explain Version Space and Representation of version Space.
13. Describe List the Eliminate Algorithm.
14. Explain the candidate elimination algorithm.

15. Trace Candidate-Elimination algorithm on the following data.

a)

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

b)

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

c)

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

16. Explain the inductive biased hypothesis space, unbiased learner and the futility of Bias Free Learning. Describe the three types of learner.

17. What is the role of a function approximation algorithm? How does learner system estimate training values and adjusts weights while learning?

18. Describe in brief: Version spaces and Candidate –Elimination Algorithm.

19. Define Inductive Learning Hypothesis.

20. Describe Inductive Systems and Equivalent Deductive Systems

21. Rank the following three types of leaners according to their biases: a. Rote Learner

b. Candidate Elimination Learner

c. Find S Learner.

Module 2- Decision Tree Learning

Decision Tree Learning (Chapter 3)

1. Explain the following with examples: a. Decision Tree,
   b. Decision Tree Learning
   c. Decision Tree Representation.

2. What are appropriate problems for Decision tree learning? OR
   What are the characteristics of the problems suited for decision tree learning?
3. Explain the concepts of entropy and information gain.
4. Describe the ID3 algorithm for decision tree learning with example.

OR

What is the procedure of building Decision tree using ID3 with Gain and Entropy. Illustrate with example.

OR

What do you mean by Gain and Entropy? How is it used to build the Decision tree in algorithm? Illustrate using an example.

5. 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]

6. 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 A2 relative to these training examples?

Instance	Classification	A1	A2
1	+	T	T
2	+	T	T
3	-	T	F
4	+	F	F
5	-	F	T
6	-	F	T

7. Discuss Hypothesis Space Search in Decision tree Learning.

8. Discuss Inductive Bias in Decision Tree Learning. Differentiate between two types of biases. Why prefer Short Hypotheses?

9. What are issues in decision tree learning? Explain briefly How are they overcome? a. Discuss the following issues in detail:
   a. Avoiding overfitting in Decision Trees
   b. Incorporating Continuous valued attributes
   c. Handling Training Examples with Missing attribute values.
   d. Handling Attributes with Different costs.

10. Other solved examples in the class.

Module 3- Artificial Neural Networks
Artificial Neural Networks (Chapter 4)

1. What is Artificial Neural Network?

2. What are the types of problems in which Artificial Neural Network can be applied.

3. Write a note on Representational Power of Perceptron

4. What is linearly in separable problem? Design a two-layer network of perceptron to implement a) X OR Y b) X AND Y

5. Explain the concept of a Perceptron with a neat diagram.

6. Discuss the Perceptron training rule.

7. Define Delta Rule.

8. Under what conditions the perceptron rule fails and it becomes necessary to apply the delta rule

9. What do you mean by Gradient Descent?

10. Derive the Gradient Descent Rule.

11. What are the conditions in which Gradient Descent is applied.

12. What are the difficulties in applying Gradient Descent.

13. Explain the importance of Stochastic Gradient Descent

14. Differentiate between Gradient Descent and Stochastic Gradient Descent

15. Differentiate between Gradient Descent and Perceptron training rule.

16. Derive the Backpropagation rule considering the training rule for Output Unit weights and Training Rule for Hidden Unit weights

17. Write the algorithm for Back propagation.

18. Explain how to learn Multilayer Networks using Backpropagation Algorithm.

19. What is Squashing Function?

20. Briefly explain the following with respect to Backpropagation a) Convergence and Local Minima of MLP

b) Representational Power of Feedforward Networks

c) Generalization, Overfitting, and Stopping Criterion

Module 4- Bayesian Learning

Bayesian Learning (Chapter 6)

1. Define (i) Prior Probability (ii) Conditional Probability (iii) Posterior Probability

2. Define Bayesian theorem? What is the relevance and features of Bayesian theorem? Explain the practical difficulties of 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 have this cancer. Determine whether the patient has Cancer or not using MAP hypothesis.

4. Explain Brute force Bayes Concept Learning

5. Define MAP hypothesis. Derive the relation for h_{MAP} using Bayesian theorem.

6. What are Consistent Learners?

7. Discuss Maximum Likelihood and Least Square Error Hypothesis.

8. Describe Maximum Likelihood Hypothesis for predicting probabilities.

9. Describe the concept of MDL. Obtain the equation for h_{MDL}

10. What is conditional Independence?

11. Explain Naïve Bayes Classifier with an Example.

12. Explain the Gradient Search to Maximize Likelihood in a neural Net.

13. What are Bayesian Belief nets? Where are they used?

14. Explain Bayesian belief network and conditional independence with example.

15. Explain the concept of EM Algorithm. Discuss what are Gaussian Mixtures.

MODULE-5 : EVALUATION HYPOTHESIS, INSTANCE BASED LEARNING, REINFORCEMENT LEARNING

1. Explain the basic definitions of sampling theory.
2. Explain the binomial distribution in detail.
3. Explain the nominal distribution in detail.
4. What is instance based learning?
5. **Define Central Limit Theorem**