

Machine Learning Exam Questions

Birla Institute of Technology & Science, Pilani	
Work-Integrated Learning Programmes Division	
First Semester 2016-2017	
Mid-Semester Test (EC-2 Regular)	
Course No.	: IS ZC464
Course Title	: MACHINE LEARNING
Nature of Exam	: Closed Book
Weightage	: 35%
Duration	: 2 Hours
Date of Exam	: 25/09/2016 (FN)
No. of Pages = 1	
No. of Questions = 3	

Note:

1. Please follow all the Instructions to Candidates given on the cover page of the answer book.
2. All parts of a question should be answered consecutively. Each answer should start from a fresh page.
3. Assumptions made if any, should be stated clearly at the beginning of your answer.

- Q.1. Answer the following questions [4 × 3 = 12]
- (a) Describe the meaning of 'best hypothesis' in the context of function approximation in machine learning.
 - (b) What is Bayes' theorem? How is it significant in machine learning?
 - (c) Explain MAP technique used in learning? Give example.
 - (d) Explain the role of 'error' in prediction of target value given the test data. Also explain the role of training in prediction.

- Q.2. Answer the following questions [7 + 7 = 14]
- (a) The chances of children in primary schools in villages dropping (D) their studies are high due to various reasons. The major factors are lack of basic needs of children at home (N) and lack of infrastructure (I) such as school building and availability of teachers who can teach well and motivate student. The statistics collected as the joint probabilities are given in the following table.

	I		~ I	
	N	~N	N	~N
D	0.098	0.022	0.06	0.02
~D	0.018	0.062	0.32	0.4

Use Bayes' theorem to compute the posterior probability $P(D | N)$ using the given joint probabilities. Explain all steps of calculation. [Note: A calculation without the correct expression will not be given credit.]

- (b) Consider a linear model of the form

$$h(x; W) = w_0 + \sum_{i=1}^n w_i \phi_i(x)$$

where $\langle w_0, w_1, \dots, w_n \rangle$ is the vector of parameters and is represented as W . The function $\phi_i(x); i = 1, 2, \dots, n$ are the basis functions. Explain the significance of the parameters W in linear regression. Comment on the parameters W in the context of approximating data using a straight line.

- Q.3. Answer the following questions [5 + 4 = 9]
- (a) What do you understand by entropy? Calculate the entropy for the following data.

Symbols->	A	B	C	D	E
Probability->	0.20	0.15	0.10	0.35	0.20

- (b) What is the significance of attribute selection in decision tree based learning? Explain with an appropriate example.

Machine learning exam questions are a critical component of evaluating a student's understanding and proficiency in this rapidly evolving field. As machine learning continues to revolutionize various industries, the demand for skilled professionals is at an all-time high. Therefore, it is essential for educators to design effective exam questions that not only assess knowledge but also encourage critical thinking and practical application. This article will explore various types of machine learning exam questions, effective strategies for crafting them, and provide examples to aid both educators and students.

Types of Machine Learning Exam Questions

Machine learning exam questions can be broadly categorized into several types, each serving a different purpose in evaluating student knowledge and skills:

1. Multiple Choice Questions (MCQs)

MCQs are a popular choice for machine learning assessments as they allow for efficient grading and can cover a broad range of topics. These questions typically consist of a stem (the question) and several answer options, including one correct answer and several distractors.

Example MCQ:

What is the primary purpose of a loss function in machine learning?

- A) To measure the accuracy of a model
- B) To estimate the performance of a model
- C) To quantify the difference between predicted and actual outcomes
- D) To optimize model parameters

Correct Answer: C

2. True/False Questions

True/False questions are straightforward and can be used to test basic knowledge and concepts in machine learning.

Example True/False Question:

Support Vector Machines (SVM) can only be used for classification tasks.

- True
- False

Correct Answer: False (SVM can also be used for regression tasks)

3. Short Answer Questions

Short answer questions require students to provide concise responses, allowing them to demonstrate their understanding of specific concepts.

Example Short Answer Question:

Define overfitting in the context of machine learning.

Expected Answer: Overfitting occurs when a machine learning model learns the training data too well, capturing noise and outliers, which leads to poor generalization on unseen data.

4. Essay Questions

Essay questions encourage students to explore topics in depth and articulate their understanding in a structured format.

Example Essay Question:

Discuss the trade-offs between bias and variance in machine learning models, and explain how they affect model performance.

5. Practical and Coding Questions

These questions assess a student's ability to apply machine learning concepts through coding tasks or real-world problem-solving scenarios.

Example Practical Question:

Given a dataset, write a Python function to implement a simple linear regression model using scikit-learn. Explain each step of your code.

Designing Effective Machine Learning Exam Questions

Creating effective machine learning exam questions requires careful consideration of several factors:

1. Align Questions with Learning Objectives

Each question should align with the learning objectives of the course. Educators should ensure that the questions reflect the key concepts, techniques, and applications covered in the curriculum.

2. Vary Question Difficulty

To accurately assess the range of student knowledge, it is important to include questions of varying difficulty levels. This can help differentiate between students who have a strong grasp of the material and those who may need additional support.

3. Encourage Critical Thinking

Questions should be designed to promote critical thinking and problem-solving skills. This can be achieved by asking students to analyze scenarios, compare different algorithms, or evaluate the effectiveness of various approaches.

4. Use Real-World Examples

Incorporating real-world examples into exam questions can help students relate theoretical concepts to practical applications. This approach can enhance engagement and deepen understanding.

5. Provide Clear Instructions

Clear and concise instructions are essential for guiding students in answering questions. Ambiguity can lead to confusion and may not accurately reflect a student's knowledge.

Sample Machine Learning Exam Questions

To further illustrate the various types of machine learning exam questions, below are sample questions across different categories:

Multiple Choice Questions

1. Which of the following is not a type of supervised learning?

- A) Classification
- B) Regression
- C) Clustering
- D) Time Series Forecasting

Correct Answer: C

2. In which of the following scenarios would you typically use a decision tree algorithm?

- A) Predicting house prices based on various features
- B) Classifying emails as spam or not spam
- C) Segmenting customers into different groups
- D) All of the above

Correct Answer: D

True/False Questions

1. Neural networks are always the best choice for every machine learning problem.

- True
- False

Correct Answer: False

2. K-means clustering is an example of a supervised learning algorithm.

- True
- False

Correct Answer: False

Short Answer Questions

1. What is the purpose of cross-validation in model evaluation?

Expected Answer: Cross-validation is used to assess how a machine learning model will generalize to an independent dataset. It involves partitioning the data into subsets, training the model on some subsets while testing it on others to ensure that the model's performance is robust and not overly fitted to a particular training set.

2. Explain the concept of feature scaling and its importance in machine learning.

Expected Answer: Feature scaling is the process of normalizing or standardizing the range of independent variables or features in a dataset. It is important in machine learning because many algorithms, such as k-nearest neighbors and gradient descent-based algorithms, perform better when features are on a similar scale.

Essay Questions

1. Analyze the impact of hyperparameter tuning on model performance and discuss the techniques used for tuning hyperparameters.
2. Evaluate the ethical considerations in machine learning, including bias in algorithms and data privacy issues.

Practical and Coding Questions

1. Write a Python script that implements a k-nearest neighbors (KNN) classifier. Use a sample dataset and explain the choice of parameters.
2. Given a dataset, perform exploratory data analysis (EDA) and visualize the relationships between features. Discuss any insights gained from your analysis.

Conclusion

In conclusion, machine learning exam questions play a vital role in assessing students' understanding of complex concepts and their ability to apply knowledge in practical scenarios. By incorporating a variety of question types, aligning them with learning objectives, and encouraging critical thinking, educators can create effective assessments that prepare students for successful careers in machine learning. As the field continues to evolve, so too should the examination practices, ensuring they remain relevant and impactful in fostering the next generation of machine learning professionals.

Frequently Asked Questions

What is the difference between supervised and unsupervised learning in machine learning?

Supervised learning uses labeled data to train models, where the outcome is known, while unsupervised learning deals with unlabeled data to find hidden patterns or intrinsic structures.

What are overfitting and underfitting in machine learning models?

Overfitting occurs when a model learns the training data too well, capturing noise rather than the underlying pattern, leading to poor generalization. Underfitting happens when a model is too simple to capture the underlying trend of the data.

What is cross-validation and why is it important?

Cross-validation is a technique for assessing how the results of a statistical analysis will generalize to an independent dataset. It is important because it helps to ensure that the model is robust and prevents overfitting.

Explain the concept of 'feature engineering' in machine learning.

Feature engineering is the process of using domain knowledge to create features that make machine learning algorithms work better. It involves selecting, modifying, or creating new features to improve model performance.

What is a confusion matrix and how is it used in evaluating classification models?

A confusion matrix is a table that is often used to describe the performance of a classification model. It shows the true positive, true negative, false positive, and false negative counts, allowing for the calculation of various performance metrics like accuracy, precision, and recall.

What is the purpose of regularization in machine learning?

Regularization is a technique used to prevent overfitting by adding a penalty for larger coefficients in

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