NPTEL Online Certification Courses Indian Institute of Technology Kharagpur

Introduction to Machine Learning

Assignment- Week 0

TYPE OF QUESTION: MCQ

Number of questions: **10** **Total mark: 10 X 2 = 20**

MCQ Question

QUESTION 1:

Find the maxima and minima of the function $f(x) = x + \frac{1}{x}$.

A. -1,1
B. 1,-1
C. -2,2
D. 2,-2

Correct Answer: A.
Detailed Solution:

$f'(x) = 1 - \frac{1}{x^2}$, so at $x = 1\ and\ -1, f'(x) = 0$.

$f''(x) = \frac{2}{x^3}$.

For $x = 1, f''(x) = \frac{2}{1} > 0$, so $x = 1$ is a point of minima for the function.

For $x = -1, f''(x) = -\frac{2}{1} < 0$, so $x = -1$ is a point of maxima for the function.

QUESTION 2:

Precision is defined as the fraction of relevant instances among the retrieved instances and Recall is defined as the fraction of relevant instances that have been retrieved over the total amount of relevant instances. A typical Information Retrieval system retrieves a total of 20 documents for a particular query out of which only 5 are relevant. Find the Precision and Recall of the system. Total set of relevant documents = 10.

A. 0.5,0.25
B. 0.25, 0.5
C. 0.5,0.5
D. 0.25,0.25

Correct Answer: B.

Detailed Solution: Precision = (relevant instances among retrieved instances / total no of all retrieved instances) = 5/20 = 0.25

Recall = (relevant instances among retrieved instances / total no of relevant instances) = 5/10 = 0.5

QUESTION 3:

Entropy associated with each possible data value is the negative logarithm of the probability mass function for the value. Example Formula is:

$$H(S) = -\sum_i p_i log_2(p_i)$$

Here, $H(S)$ denotes entropy, i represents a class, and p_i denotes the probability of that class.

Given a list of 20 examples including 10 positive, 5 negative and 5 neutral examples. The entropy of the dataset with respect to this classification is:

A. 3/2

B. 2

C. 5/2

D. 3

Correct Answer: A

H(S) = -((½ log (½))+(¼ log (¼))+(¼ log (¼))) = 3/2

QUESTION 4:

Find the limit $lim_{x->2} \frac{\sqrt{7+x}-3}{x-2}$

(Hint: Use L-Hospital's rule)

A. 1/3
B. 1/6
C. 2/3
D. 5/6

Correct Answer: B
Detailed Solution: Use L-Hospital's rule.

QUESTION 5:

5 runners run a race. How many different ways can the top 3 finishers be selected, if we do not care about the specific order of these top 3?

A. 5
B. 10
C. 20
D. 30

Correct Answer: B.

Detailed Solution: Top 3 without order can be selected in 5C3 = 10 ways.

QUESTION 6:

A busy student must complete 3 problem sets before doing laundry. Each problem set requires 1 day with probability 2/3 and 2 days with probability 1/3. Let B be the number of days a busy student delays laundry. What is E[B]?

[Here, E[B] denotes the expectation of the event B]

Example: If the first problem set requires 1 day and the second and third problem sets each requires 2 days, then the student delays for B = 5 days.

A. 2
B. 3
C. 4
D. 5

Correct Answer: C

Detailed Solution:

E[B] = 3*(2/3)*(2/3)*(2/3) + 4*3*(2/3)*(2/3)*(1/3) + 5*3*(2/3)*(1/3)*(1/3) + 6*(1/3)*(1/3)*(1/3) = 4

QUESTION 7 :

In a class, there are 15 students who like chocolate. 13 students like vanilla. 10 students like neither. If there are 35 students in the class, how many students like chocolate and vanilla?

A. 2
B. 12
C. 3
D. 20

Correct Answer: C.

Detailed Solution:
X: set of students who like chocolate
Y: set of students who like vanilla

$|X \cup Y| = |X| + |Y| - |X \cap Y|$

From the given data, $|X|$ = 15, $|Y| = 13$, $|X \cup Y| = 35 - 10 = 25$.

$|X \cap Y| = 15 + 13 - 25 = 3.$

QUESTION 8:

Suppose there is a sentence "let's play or not play". The bag-of-words representation vector of the sentence is the count of each word in the sentence, which corresponds to:

let's play or not
[1 2 1 1].

The point in the space is s = (1,2,1,1).

Now suppose we have some query vectors related to 'play' q1 = (0,1,0,0) and a query vector related to 'let's' q2 = (1,0,0,0). Find the nearest query of the sentence vector (s).
Hint : (Use Cosine similarity distance of two points to perform the same).

A. q1
B. q2

Correct Answer: A
Detailed Solution: Compute cosine similarity of q1 and s. Then compute the cosine similarity of q2 and s. The query with the higher cosine similarity with s is the nearest query to the sentence.

QUESTION 9:

Let u be a $n \times 1$ vector, such that $u^T u = 1$. Let I be the $n \times n$ identity matrix. The $n \times n$ matrix A is given by $(I - kuu^T)$, where k is a real constant. u itself is an eigenvector of A, with eigenvalue −1. What is the value of k?

A. -2
B. -1
C. 2
D. 0

Correct Answer: C

Detailed Solution:

$(I - kuu^T)u = -1.u$

$u - kuu^T u = -u$

$2u = ku$ (note: $u^T u = 1$)

$k = 2$

QUESTION 10:

Let $A^{m \times n}$ be a matrix of real numbers. The matrix AA^T has an eigenvector x with eigenvalue b. Then the eigenvector y of $A^T A$ which has eigenvalue b is equal to

A. $x^T A$
B. $A^T x$
C. x
D. Cannot be described in terms of x

Correct Answer: B

Detailed Solution: $AA^T x = bx$

multiplying A^T to both sides,

$A^T A A^T x = bA^T x$

$(A^TA)(A^Tx) = b(A^Tx)$

From the equation above ,we observe that A^Tx is an eigenvector of the matrix A^TA with the eigenvalue b. As y is also an eigenvalue of the same matrix with the same eigenvalue, $y = A^Tx$.

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