**Nptel Online Certification Course**
**Indian Institute of Technology Kharagpur**
**Computer Vision**
**Assignment - Week 10**

**Number of questions: 10** **Total marks: 10x2=20**

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**QUESTION 1:** **Type: MSQ**

Which are the following statements are true for Bayesian learning?

a) There exists conditional independence between every pair of features given the value of the class variable in Naive Bayes.

b) No prior knowledge of hypothesis used.

c) Multiple solutions occur.

d) It may not require to compute marginal probability of data for classification.

**Correct Answer:** a, d
**Detailed Solution:**
Naive Bayes assumes that all the features are conditionally independent. It uses the knowledge of priors to compute posterior probability. It may not require to compute marginal probability of data for classification. Only single solution exists.

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**QUESTION 2:** **Type: MSQ**

Which of the following can act as possible termination conditions in K-Means?

a) For a fixed number of iterations.

b) The assignment of observations to clusters does not change between iterations, except for cases with a bad local minimum.

c) Centroids do not change between successive iterations.

d) For a fixed number of clusters.

**Correct Answer:** a), b), c)

**Detailed Solution:**

The possible termination conditions in K-Means clustering:
1) This condition limits the runtime of the clustering algorithm, but in some cases, the quality of the clustering will be poor because of an insufficient number of iterations. 2) Except for cases with a bad local minimum, this produces a good clustering, but runtimes may be unacceptably long. 3) This also ensures that the algorithm has converged at the minima.

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**QUESTION 3:** **Type: MCQ**

Assume, you have 5 types of objects with 3 attributes each as shown in the table. Consider object A and object C as the initial centroids.

Table 1:

| Object | Attribute 1 | Attribute 2 | Attribute 3 |
|---|---|---|---|
| A | 1 | 1 | 1 |
| B | 2 | 1 | 2 |
| C | 5 | 3 | 2 |
| D | 4 | 4 | 0 |
| E | 3 | 1 | 3 |

What will be the elements in each clusters after the first iteration?

a) Cluster 1: A, B, E Cluster 2: C, D

b) Cluster 1: A, B Cluster 2: C, D, E

c) Cluster 1: A, E Cluster 2: B, C, D

d) Cluster 1: A, C Cluster 2: B, D, E

**Correct Answer:** a

**Detailed Solution:**

Calculate the distance between each object with the cluster centroids.
Distance between Cluster 1 centroid (A) and B = 1.41
Distance between Cluster 1 centroid (A) and C = 4.58
Distance between Cluster 1 centroid (A) and D = 4.35
Distance between Cluster 1 centroid (A) and E = 2.82
Distance between Cluster 2 centroid (C) and A = 4.58
Distance between Cluster 2 centroid (C) and B = 3.60
Distance between Cluster 2 centroid (C) and D = 2.44
Distance between Cluster 2 centroid (C) and E = 3
Thus, the two clusters will be (A, B, E) and (C, D).

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**QUESTION 4:** **Type: Numeric**

The output of a neural network is $[1, 2, 7, 4, 5]$. Find the softmax probability for 7.

**Correct Answer:** 0.8373

**Detailed Solution:**

Softmax probability of 7 in the output $[1, 2, 7, 4, 5]$ will be $\frac{e^7}{e^1+e^2+e^7+e^4+e^5} = 0.8373$

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**QUESTION 5:** **Type: MCQ**

Assume you want to cluster 7 observations into 3 clusters using the K-Means clustering algorithm. After first iteration, clusters C1, C2, C3 have following observations:
C1: (1,1), (2,2), (3,3) C2: (2,4), (4,2) C3: (7,7), (9,9)
What will be the Manhattan distance for observation (7, 7) from cluster centroid C1 in the second iteration?

a) 1.414

b) 7.07

c) 10

d) 5

**Correct Answer:** c
**Detailed Solution:**
Finding centroid for data points in cluster C1 = ((1+2+3)/3, (2+4+6)/3) = (2, 2)
Finding centroid for data points in cluster C2 = ((2+4)/2, (4+2)/2) = (3, 3)
Finding centroid for data points in cluster C3 = ((7+9)/2, (7+9)/2) = (8, 8)
Hence, C1: (2,2), C2: (3,3), C3: (8,8)
Manhattan distance between centroid C1, i.e., (2, 2) and (7, 7) = (7-2) + (7-2) = 10

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**FOR QUESTIONS 6 AND 7:**

Consider the following neural network. Ix : Inputs; Ox : Outputs. W1 = 0.15, w2 = 0.20, w3 = 0.25, w4 = 0.3, w5 = 0.40, w6 = 0.45, w7 = 0.50, w8 = 0.55.

If all the Activation Functions are ReLU, then answer the following question 6 and 7:.

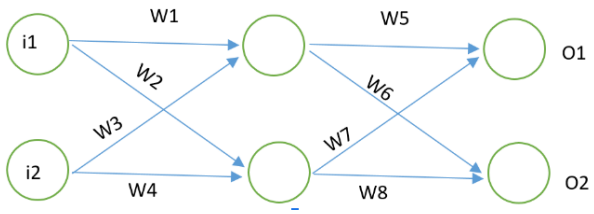


Figure 1: Feedforward neural network.

**QUESTION 6:** **Type: Comprehensive**

What will be the output for Input [1, 1]?

a) O1 : 0.21, O2 : 0.68

b) O1 : 0, O2 : 0

c) O1 : 0.37, O2 : 0.53

d) O1 : 0.42, O2 : 0.46

**Correct Answer:** d

**Detailed Solution:**

I1 = 1, I2 = 1

H1 = ReLU(1*0.15 + 1*0.25) = ReLU(0.4) = 0.4

H2 = ReLU(1*0.20 + 1*0.31) = ReLU(0) = 0.51

O1 = ReLU(0.40*0.40 + 0.51*0.50) = ReLU(0.415) = 0.42

O2 = ReLU(0.40*0.45 + 0.51*0.55) = ReLU(0.46) = 0.46

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**QUESTION 7:** **Type: Comprehensive**

What is the total error if o1 and o2 are 0 and 1, respectively? The error is given by $E = \frac{1}{2}(target - output)^2$.

a) 0.234

b) 0.468

c) 0.274

d) 0.548

**Correct Answer:** b

**Detailed Solution:**

Error will be calculated as:

$E = \frac{1}{2}(0 - 0.42)^2 + \frac{1}{2}(1 - 0.46)^2 = 0.468.$

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**QUESTION 8:** **Type: Numeric**

Consider a multilayer feed forward network which takes a 6-D feature vector as input and produces a 3-D output vector. The network has one hidden layer with number of neurons 10. Please note that the input vector is the input to the first hidden layer. What is the dimension of the parametric space over which the optimization process would be carried out to train the network?

**Correct Answer:** 103

**Detailed Solution:**

The input to the hidden layer has $6 + 1 = 7$ parameters for weights and bias. Each of them are connected to all the 10 nodes in the hidden layer. Thus, parameters here would be $7 \times 10 = 70$. Next input to the output layer is $10 + 1 = 11$. Dimension of parameteric space = $70 + 11 \times 3 = 103$.

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**QUESTION 9:** **Type: MSQ**

We want to classify whether a student will be promoted or not based on the marks he has scored in English and Maths out of 10. Consider the following table consisting of five samples.

Table 2:

| English | Maths | Label |
|---|---|---|
| 9 | 10 | promoted |
| 6 | 7 | promoted |
| 5 | 4 | not promoted |
| 1 | 4 | not promoted |
| 5 | 8 | promoted |

We introduce a new student whose marks are 7 and 5 in English and Maths, respectively. Which of the following statements are true after computing KNN (K=3)?

a) The student does not get promoted.

b) The nearest sample to (7, 5) is at a distance of 2.23.

c) The student gets promoted.

d) The nearest sample to (7, 5) is at a distance of 3.61.

**Correct Answer:** b), c)

**Detailed Solution:**

Calculate the distance between each sample and the new sample (7, 5).
Distance between (9, 10) and (7, 5) = 5.38
Distance between (6, 7) and (7, 5) = 2.23
Distance between (5, 4) and (7, 5) = 2.23
Distance between (1, 4) and (7, 5) = 6.08
Distance between (5, 8) and (7, 5) = 3.61
It is closest to (5, 8), (5, 4) and (6, 7). Thus, the minimum distance is 2.23 and the student gets promoted.

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**QUESTION 10:** **Type:MCQ**

A box of cartridges contains 30 cartridges, of which 6 are defective. If 3 of the cartridges are removed from the box in succession without replacement, what is the probability that all the 3 cartridges are defective?

a) $\frac{120}{27000}$

b) $\frac{90}{24360}$

c) $\frac{120}{24360}$

d) $\frac{216}{27000}$

**Correct Answer:** c

**Detailed Solution:**

Let A be the event that the first cartridge is defective.
Let B be the event that the second cartridge is defective.
Let C be the event that the third cartridge is defective.
Then probability that all 3 cartridges are defective is $P(A \cap B \cap C)$
Hence, $P(A \cap B \cap C) = P(A) \times P(B|A) \times P(C|A \cap B)$
= (6/30) * (5/29) * (4/28)
= (6 * 5 * 4)/(30 * 29 * 28).

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