NPTEL Week 3 Live Sessions

on Deep Learning (noc24_ee04)

Powered by:

A course offered by: Prof. Prabir Kumar Biswas, IIT Kharagpur

- Python coding: SVM, KNN
- Week 1, Week 2 solution
- Week 3 practice questions

By

Arka Roy
NPTEL PMRF TA

Prime Minister's Research Fellow
Department of Electrical Engineering, IIT Patna
Web: https://sites.google.com/view/arka-roy/home

Content of the live session

1. **Solution of week 1 & week 2 quiz**

2. **Solving numerical problems from week 3**

Which of the following is (are) region descriptor(s) ? Choose the correct option.

I) Fourier descriptor II) co-occurrence matrix III) Intensity histogram IV) Signature

a. Both I and IV
b. Only I
c. Both II and III
d. None of the above

Which of the following is not a Co-occurrence matrix-based descriptor?

a. Entropy
b. Uniformity
c. Intensity histogram.
d. All of the above.

Consider a two class Bayes' Minimum Risk Classifier. Probability of class ω_1 is $P(\omega_1) = 0.4$. $P(x|\omega_1) = 0.65$, $P(x|\omega_2) = 0.5$ and the loss matrix values are

$$\begin{bmatrix} \lambda_{11} & \lambda_{12} \\ \lambda_{21} & \lambda_{22} \end{bmatrix} = \begin{bmatrix} 0.1 & 0.9 \\ 0.85 & 0.15 \end{bmatrix}$$

Find the Risk $R(\alpha_1|x)$.

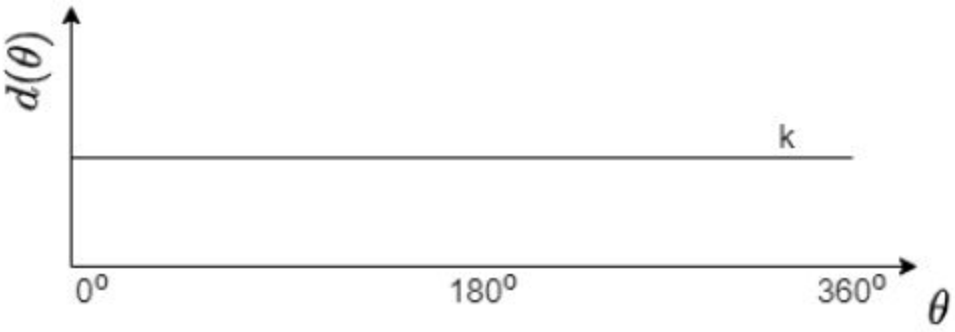
a. 0.51

b. 0.61

c. 0.53

d. 0.39

Signature descriptor of an unknown shape is given in the figure. If the value of k is 7 cm., what is the area of the unknown shape



a. 145 sq. cm.

b. 49 sq cm.

c. 98 sq cm.

d. 154 sq cm.

Suppose Fourier descriptor of a shape has K coefficient, and we remove last few coefficients and use only first m (m<K) number of coefficients to reconstruct the shape. What will be effect of using truncated Fourier descriptor on the reconstructed shape?

a. We will get a smoothed boundary version of the shape.

b. We will get only the fine details of the boundary of the shape.

c. Full shape will be reconstructed without any loss of information.

d. Low frequency component of the boundary will be removed from contour of the shape.

Given an image I (fig 1), The gray co-occurrence matrix C (fig 2) can be constructed by specifying the displacement vector d = (dx, dy). Let the position operator be specified as (1, 1), which has the interpretation: one pixel to the right and one pixel below. (Both the image and the partial gray co-occurrence is given in the figure 1, and 2 respectively. Blank values and 'X','Y' values in gray co-occurrence matrix are unknown.)

2	0	2	0	1
0	1	1	2	2
2	1	2	2	1
1	2	2	0	1
1	0	1	2	0

Fig1: I

Two random variables $X1$ and $X2$ follows Gaussian distribution with following mean and variance.

$$X1 \sim N\ (0,3)\ and\ X2 \sim N\ (0,2)$$

Which of the following options is true?

a. Distribution of $X1$ will be flatter than the distribution of $X2$
b. Distribution of $X2$ will be flatter than the distribution of $X1$
c. Peak of the both distributions will be at same height
d. None of the above

In which scenario the discriminant function will be linear when a two class Bayesian classifier is used to classify two class of points distributed normally? Choose the correct option.

I. $\Sigma_1 = \Sigma_2$ but Σ is not an identity matrix
II. $\Sigma_1 = \Sigma_2$ but Σ is an identity matrix   III. $\Sigma_1 \neq \Sigma_2$

a. Only II
b. Both I and II
c. Only III
d. None of the above

Choose the correct option regarding discriminant functions $g_i(x)$ for multiclass classification (x is the feature vector to be classified).

Statement i : Risk value $R(\alpha_i|x)$ in Bayes minimum risk classifier can be used as a discriminant function.
Statement ii : Negative of Risk value $R(\alpha_i|x)$ in Bayes minimum risk classifier can be used as a discriminant function.
Statement iii : Negative of Aposteriori probability $P(\omega_i|x)$ in Bayes minimum error classifier can be used as a discriminant function.
Statement iv : Aposteriori probability $P(\omega_i|x)$ in Bayes minimum error classifier can be used as a discriminant function.

a. Only Statement i is true
b. Both Statements ii and iii are true
c. Both Statements i and iv are true
d. Both Statements ii and iv are true

For a two-class problem, the linear discriminant function is given by $g(x) = a^t y$. What is updation rule for finding the weight vector a? Here y is augmented feature vector.

a. $a(k+1) = a(k) + \eta \sum y$
b. $a(k+1) = a(k) - \eta \sum y$
c. $a(k+1) = a(k-1) - \eta a(k)$
d. $a(k+1) = a(k-1) + \eta a(k)$

If we choose the discriminant function $g_i(x)$ as a function of posterior probability. i.e. $g_i(x) = f(p(w_i/x))$. Then, which of following cannot be the function $f(\,)$?

a. $\mathrm{f(x) = a^x}, where\ a > 1$
b. $\mathrm{f(x) = a^{-x}}, where\ a > 1$
c. $\mathrm{f(x) = 2x + 3}$
d. $f(x) = \exp(x)$

You are given some data points for two different class.

Class 1 points: $\{(11,11),(13,11),(8,10),(9,9),(7,7),(7,5),(15,3)\}$

Class 2 points: $\{(7,11),(15,9),(15,7),(13,5),(14,4),(9,3),(11,3)\}$

Assume that the points are samples from normal distribution and a two class Bayesian classifier is used to classify them. Also assume the prior probability of the classes are equal i.e.,

$$p(\omega_1) = p(\omega_2)$$

Which of the following is true about the corresponding decision boundary used in the classifier? (Choose correct option regarding the given statements)

Statement i: Decision boundary passes through the midpoint of the line segment joining the means of two classes

Statement ii: Decision boundary will be orthogonal bisector of the line joining the means of two classes.

a. Only Statement i is true

b. Only Statement ii is true

c. Both Statement i and ii are true

d. None of the statements are true

You are given some data points for two different class.

Class 1 points: $\{(11,11), (13,11), (8,10), (9,9), (7,7), (7,5), (15,3)\}$

Class 2 points: $\{(7,11), (15,9), (15,7), (13,5), (14,4), (9,3), (11,3)\}$

Classify the following two new samples $(A = (6,11), B = (14,3))$ using K-nearest neig

Where K=3. Use Manhattan distance as a distance function.

Given two points (x_1, y_1) and (x_2, y_2), the Manhattan Distance d between them is

d = |x_1 - x_2| + |y_1 - y_2|

a. A belongs to class 1 and B belongs to class 1.
b. A belongs to class 2 and B belongs to class 2.
c. A belongs to class 1 and B belongs to class 2.
d. A belongs to class 2 and B belongs to class 1.

Suppose if you are solving a four-class problem, how many discriminants function you will need for solving?

a. 1
b. 2
c. 3
d. 4

Find the scalar projection of vector b = <-4, 1> onto vector a = <1,2>?

a. 0
b. $\frac{-2}{\sqrt{5}}$
c. $\frac{2}{\sqrt{7}}$
d. $\frac{-2}{5}$

The distance of a feature vector [2, 3, -2] from the separating plane $x_1 + 2x_2 + 2x_3 + 5 = 0$ is given by.

a. 5

b. 5/3

c. 3

d. 13

For a 2-class problem what is the minimum possible number of support vectors. Assume there are more than 4 examples from each class

a. 4
b. 1
c. 2
d. 8

Which one of the following is a valid representation of hinge loss (of margin = 1) for a two-class problem?

y = class label (+1 or -1).

p = predicted (not normalized to denote any probability) value for a class.?

a. $L(y, p) = \max(0, 1- yp)$
b. $L(y, p) = \min(0, 1- yp)$
c. $L(y, p) = \max(0, 1 + yp)$
d. None of the above

Suppose we have the below set of points with their respective classes as shown in the table.
Answer the following question based on the table.

X	Y	Class Label
1	0	+1
-1	0	-1
2	1	+1
-1	-1	-1
2	0	+1

What can be a possible decision boundary of the SVM for the given points?

a. $y = 0$
b. $x = 0$
c. $x = y$
d. $x + y = 1$

Find the decision boundary of the SVM trained on these points and choose which of the following statements are true based on the decision boundary.

i) The point (-1,-2) is classified as -1

ii) The point (1,-2) is classified as -1

iii) The point (-1,-2) is classified as +1

iv) The point (1,-2) is classified as +1

a. Only statement ii is true
b. Both statements i and iii are true
c. Both statements i and iv are true
d. Both statements ii and iii are true

X	Y	Class Label
1	0	+1
-1	0	-1
2	1	+1
-1	-1	-1
2	0	+1