Deep Learning

Assignment- Week 3

TYPE OF QUESTION: MCQ/MSQ

Number of questions: 10 **Total mark: 10 X 1 = 10**

QUESTION 1:

Find the distance of the 3D point, $P = (-3, 1, 3)$ from the plane defined by $2x + 2y + 5z + 9 = 0$?

a. 3.1
b. 4.6
c. 0
d. ∞ (infinity)

Correct Answer: b

Detailed Solution:

$$\text{Distance} = \frac{-3*2 + 1*2 + 3*5 + 9}{\sqrt{-3*-3 + 1*1 + 3*3}} = 4.6$$

QUESTION 2:

What is the shape of the loss landscape during optimization of SVM?

a. Linear
b. Paraboloid
c. Ellipsoidal
d. Non-convex with multiple possible local minimum

Correct Answer: b

Detailed Solution:

In SVM the objective to find the maximum margin based hyperplane (W) such that

$W^Tx + b = 1$ for class = +1 else $W^Tx + b = -1$

For the max-margin condition to be satisfied we solve to minimize ||W||.

The above optimization is a quadratic optimization with a paraboloid landscape for the loss function.

QUESTION 3:

How many local minimum can be encountered while solving the optimization for maximizing margin for SVM?

a. 1
b. 2
c. ∞ (infinite)
d. 0

Correct Answer: a

Detailed Solution:

In SVM the objective to find the maximum margin-based hyperplane (W) such that

$W^T x + b = 1$ for class = +1 else $W^T x + b = -1$

For the max-margin condition to be satisfied we solve to minimize $||W||$.

The above optimization is a quadratic optimization with a paraboloid landscape for the loss function. Since the shape is paraboloid, there can be only 1 global minimum.

QUESTION 4:

Which of the following classifiers can be replaced by a linear SVM?

a. Logistic Regression
b. Neural Networks
c. Decision Trees
d. None of the above

Correct Answer: a

Detailed Solution:

Logistic regression framework belongs to the genre of linear classifier which means the decision boundary can segregate classes only if they are linearly separable. SVM is also

capable of doing so and thus can be used instead of logistic regression classifiers. Neural networks and decision trees are capable of modeling non-linear decision boundaries which linear SVM cannot model directly.

QUESTION 5:

Find the scalar projection of vector b = <-2, 3> onto vector a = <1, 2>?

a. 0
b. $\frac{4}{\sqrt{5}}$
c. $\frac{2}{\sqrt{17}}$
d. $\frac{-2}{17}$

Correct Answer: b

Detailed Solution:

Scalar projection of b onto vector a is given by the scalar value $\frac{\boldsymbol{b} \cdot \boldsymbol{a}}{|\boldsymbol{a}|}$

QUESTION 6:

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

Correct Answer: c

Detailed Solution:

To determine the separating hyper-plane, we need at least 1 example (which becomes a support vector) from each of the classes.

QUESTION 7:

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

Correct Answer: a

Detailed Solution:

Hinge loss is meant to yield a value of 0 if the predicted output (p) has the same sign as that of the class label and satisfies the margin condition, |p| > 1. If the signs differ, the loss is meant to increase linearly as a function of p. Option (a) satisfies the above criteria.

QUESTION 8:

Suppose we have one feature $x \in R$ and binary class y. The dataset consists of 3 points: p1: (x1, y1) = (−1, −1), p2: (x2, y2) = (1, 1), p3: (x3, y3) = (3, 1). Which of the following true with respect to SVM?

a. Maximum margin will increase if we remove the point p2 from the training set.
b. Maximum margin will increase if we remove the point p3 from the training set.
c. Maximum margin will remain same if we remove the point p2 from the training set.
d. None of the above.

Correct Answer: a

Detailed Solution:

Here the point p2 is a support vector, if we remove the point p2 then maximum margin will increase.

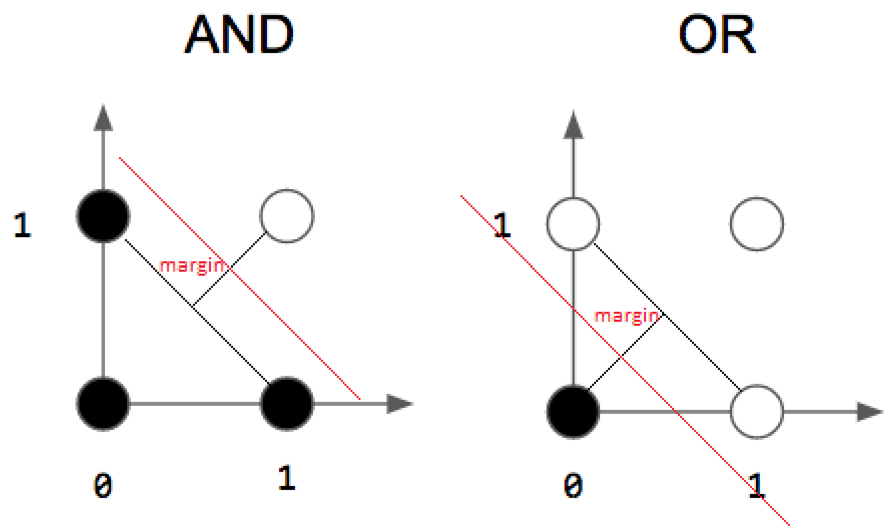
Question 9:

If we employ SVM to realize two input logic gates, then which of the following will be true?

a. The weight vector for AND gate and OR gate will be same.
b. The margin for AND gate and OR gate will be same.
c. Both the margin and weight vector will be same for AND gate and OR gate.
d. None of the weight vector and margin will be same for AND gate and OR gate.

Correct Answer: b

Detailed Solution:



As we can see although the weight vectors are not same but the margin is same.

QUESTION 10:

What will happen to the margin length of a max-margin linear SVM if one of non-support vector training example is removed??

a. Margin will be scaled down by the magnitude of that vector
b. Margin will be scaled up by the magnitude of that vector
c. Margin will be unaltered
d. Cannot be determined from the information provided

Correct Answer: c

Detailed Solution:

In max-margin linear SVM, the separating hyper-planes are determined only by the training examples which are support vectors. The non-support vector training examples do not influence the geometry of the separating planes. Thus, the margin, in our case, will be unaltered.

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