Assignment

Que:1 Suppose we have a dataset of 6 points with two features (x and y) and a binary target variable (0 or 1), as follows:

Point 1: (1, 3) -> Target: 0

Point 2: (2, 2) -> Target: 0

Point 3: (3, 1) -> Target: 0

Point 4: (6, 3) -> Target: 1

Point 5: (7, 2) -> Target: 1

Point 6: (8, 1) -> Target: 1

Solution: We want to use KNN with K=3 to classify a new point with coordinates (4, 2). To do this, we need to calculate the distances between the new point and the 6 points in the dataset.

Calculate Distance:

Distance from (4, 2) to Point 1: sqrt((4-1)^2 + (2-3)^2) = 3.16

Distance from (4, 2) to Point 2: sqrt((4-2)^2 + (2-2)^2) = 2

Distance from (4, 2) to Point 3: sqrt((4-3)^2 + (2-1)^2) = 1.41

Distance from (4, 2) to Point 4: sqrt((4-6)^2 + (2-3)^2) = 2.24

Distance from (4, 2) to Point 5: sqrt((4-7)^2 + (2-2)^2) = 3

Distance from (4, 2) to Point 6: sqrt((4-8)^2 + (2-1)^2) = 4.12

The three closest points to (4, 2) are Point 3, Point 2, and Point 4. All three of these points have a target value of 0. Therefore, we classify the new point as 0.

So, using KNN with K=3, the predicted target value for the new point with coordinates (4, 2) is 0.

Algorithm of K-Means:

Step-1: Select the number K to decide the number of clusters.

Step-2: Select random K points or centroids. (It can be other from the input dataset).

Step-3: Assign each data point to their closest centroid, which will form the predefined K clusters.

Step-4: Calculate the variance and place a new centroid of each cluster.

Step-5: Repeat the third steps, which means reassign each datapoint to the new closest centroid of each cluster.

Step-6: If any reassignment occurs, then go to step-4 else go to FINISH.

Step-7: The model is ready.

Que: 2) Suppose we have a dataset with 8 points in two-dimensional space:

(2, 3), (3, 2), (3, 3), (4, 3), (5, 3), (5, 4), (6, 4), (6, 5)

We want to apply K-Means algorithm to make cluster.

Solution:

Step 1: We want to cluster these points into two clusters using K-Means. We start by randomly selecting two initial cluster centroids:

C1 = (2, 3)

C2 = (4, 3)

Step 2: Using these initial centroids, we can assign each point to its nearest cluster:

Cluster 1: (2, 3), (3, 2), (3, 3)

Cluster 2: (4, 3), (5, 3), (5, 4), (6, 4), (6, 5)

Step 3: We can then calculate the mean of each cluster and use these as the new centroids:

C1 = mean((2, 3), (3, 2), (3, 3)) = (2.67, 2.67)

C2 = mean((4, 3), (5, 3), (5, 4), (6, 4), (6, 5)) = (5.2, 3.8)

Step 4: We can now reassign each point to its nearest cluster based on the new centroids:

Cluster 1: (2, 3), (3, 2), (3, 3)

Cluster 2: (4, 3), (5, 3), (5, 4), (6, 4), (6, 5)

Step 5: We can see that the clusters have not changed. We can stop the algorithm here and conclude that the final clusters are:

Cluster 1: (2, 3), (3, 2), (3, 3)

Cluster 2: (4, 3), (5, 3), (5, 4), (6, 4), (6, 5)

So, the two clusters obtained using K-Means are (2, 3), (3, 2), (3, 3) and (4, 3), (5, 3), (5, 4), (6, 4), (6, 5).

Que 3: Given an input image with dimensions 32x32x3, and a convolutional layer with 16 filters of size 3x3, followed by a max pooling layer with a pool size of 2x2, what will be the output dimensions of the pooling layer?

Solution: The output dimensions of a convolutional layer can be calculated using the formula:

Output dimension = floor((Input dimension - Filter size + 2 x Padding)/Stride + 1)

where Input dimension is the dimension of the input data, Filter size is the size of the convolutional filters, Padding is the amount of zero-padding applied to the input data, Stride is the stride used in the convolution operation.

Applying this formula to the given problem, we get:

Output dimension of the convolutional layer = (32 - 3 + 2 x 0)/1 + 1 = 30x30x16

Next, the max pooling layer with a pool size of 2x2 will reduce the spatial dimensions of the output by a factor of 2 in both the horizontal and vertical directions, while retaining the number of channels (i.e., 16). Therefore, the output dimensions of the pooling layer will be:

Output dimension of the pooling layer = 15x15x16

So the output of the max pooling layer will have dimensions 15x15x16.