Course Name: Machine Learning and Deep learning - Fundamentals and Applications

Professor Name: Prof. M. K. Bhuyan

Department Name: Electronics and Electrical Engineering

Institute Name: Indian Institute of Technology, Guwahati

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Lecture-48

Welcome you all to the course of Machine Learning and Deep Learning. Fundamentals and Applications. I am a TA of your course. In today in this session, we will solve some questions on the basis of K-means, HSE, ANN and CNN. So, let us begin the class. For the first problem, we have to perform K-mean clustering on a data set.

This is a value given x = 31, 43, 30, 58, 62, 34, 92, 65, 33, 90 with k = 3. So, K-mean is a unsupervised algorithm where we calculate the distances to assign a point to a cluster. So, first we have to calculate the cluster center for iteration 0. So, first values are given like 0, 1, 1, 2, 2, 2, 3, 3, 3, 1.

So μ_1 is here 48.5 and μ_2 is 51.33, then μ_3 is 63.33. Then for the iteration 1, we have to find the nearest mean.

So for 31, the nearest mean is μ_1. So it will be 1. Then 43, it will be 1. Then it is like this and then this 3. So for this μ_1 is 34.

and μ_2 is 51.33 and μ_3 is 73.4. like this for 2 same process. For iteration 3.

For iteration 4, the values are like. So, you can see that from iteration 3 to iteration 4, the values are same means there is no changes. So it is already assigned to the cluster center. So the final level is, this is the final level and these are the cluster center. So here you have to find the set of final data level for initial level.

So in the iteration 3, the values are like 1 1 1 2 2 1 3 2 1 3. These are the final data level and for a second part, find the final cluster center for the table till convergence. So these are the final cluster center. That is 34.2, 61.67 and 91. So for the second question, now let us move to the second question. So here we have to perform single linkage hierarchical agglomerative clustering on the set of points. So, in the HAC starts by treating each data point as a separate cluster and then iteratively combines the closest

cluster until a stopping criteria is reached. So here it is given a single linkage.

So a single linkage means it has to find minimum distance. So first step, step 1 is initialize clusters. These are the clusters. Now in step 2, we have to calculate the pairwise distance. For that, we have to calculate the distance.

The distance can be like Manhattan or Euclidean distance. same as this K means. This is mean 0, 7, 10, 12, 4, 15, 5, 7, 0, 3, 3, 5, 3, 8, 2 10, 3, 0, 2, 6, 5, 5, 12, 5, 2, 0, 8, 3, 7 4, 3, 6, 8, 0, 11, 1 15, 8, 5, 3, 11, 0, 10, 5, 2, 5, 7, 1 This is the pairwise distances. After that the step 3 is merging This is the final step. So, we have to merge the clusters.

These are the initial clusters. From the pairwise distances, we have to merge the clusters. Then, the next step is After that then all values are merged. This is the concept of HAC hierarchical agglomerative clustering. So the dendrogram is.

This is the final dendrogram. Now let us move to the next question. Here we have some input values that is x, y and z and the intermediate value is Q and the final value is F. So first let us solve this question and we have to find the gradient of F with respect to x, y and z. So $F = (x + y) \times z$.

So $F = xz + yz$. When you differentiate with respect to x, $\frac{df}{dx} = z$. The value of z is here - 4 and when you differentiate with respect to y, $\frac{df}{dy} = z$. So it will be - 4 and the final is $\frac{df}{dz}$. So this value will be x + y.

This is equal to 3. So this is the value of gradient of F with respect to x, y and z. It will be -4, -4 and 3. So let us move to the next question. Here a artificial neural network is given. So ANN is a computational model that mimics the way nerve cells work in the human brain.

Here a network is created with multiple neurons stacked together and for these neurons the activation function is given as $f = 0$ for $x < 0$ and $f = 1$ for $x \geq 0$ when we have to find the logical function which will be defined by this neural network. So for this question let us take some values x1, x2 and the final value will be like let say O. So when we give 00 and 01, 10 and 11 so what will we find from this output. So for 00, A1 = 0.5 and when you pass this through the activation function then the output will be 1 and A2 will be - 1.5 and passing through the activation function it will give us 0 and A3 will be 1 - 0.5. So the value will be 0.5. So this is equal to 1. So 00 will give us 1 and for a second case let us take as 0 and 1 in this case A1 will be minus 0.5 which will be pass through the activation function then it will give us 0. A2 will be minus 0.5 so 0. A3 will be minus 0.5 so it will give us 0. So when we pass x1, x2 give us 0 and 1 then output

will be 0. Same goes for a third and fourth case. So for 10 we will find as 0 and for 11 we will find as 1.

You can solve this. So this belongs to which gate? This belongs to XNOR gate. The logical function will be XNOR gate. So let us move to the next question. An input image has been converted into a matrix of size 28 × 28 and a kernel or a filter of size 7 × 7 with a stride of 1. So what will be the size of the convolutional matrix? So as you already know the CNN can extract features from images and it can learn to recognize patterns.

So here the size of the matrix is given as 28 × 28. The formula is like $\frac{n-k}{s} + 1$. So here s stands for stride, n stands for dimension of input or previous layer, and k stands for kernel size. Here n is equal to 28 minus kernel size is 7, my stride equal to 1 plus 1, value should be 22. The size of the convolution matrix is 22 × 22.

Let us move to the next question. Here an input feature map of dimension 74 × 74 × 32 is passed through a 2D convolutional layer and a total of 64 filters of kernel size 3 × 3 yields a feature map of dimension 72 × 72 × 64. So we have to determine the number of parameters. For that here number of filters are 64. Kernel size is equal to (3, 3). input channel 32 number of convolutional parameters equal to number of filters into kernel size into input channel and number of bias parameter equal to number of filters.

So the total parameters equal to 64 × 3 × 3 × 32 plus the number of bias parameter is number of filters equal to 64. So the final value would be 18496. This is the final number of parameters. So in this session we have solved some problems regarding k-means, HSE, ANN and CNN. I hope you understood the problems and if you still have any doubts you can contact us in discuss forum.

So let us conclude the session. Thank you.