School of Computing and Electrical Engineering
Indian Institute of Technology Mandi

CS671 : Deep Learning and Applications

Mid-semester Examination

Date: April 7, 2021 Total Marks: 20

Time: 04:15 PM - 06:00 PM

1. Consider a multilayer feedforward neural network (MLFFNN) with one hidden layer. The number of nodes and the activation functions for the nodes in each of the layers is given below. The loss function include L_2-regularization with regularization parameter λ also. Error backpropagation method using vanilla gradient descent (GD) technique with a learning rate parameter η is considered for training the network that minimizes the loss. Give the loss function that need to be minimized. Derive the expressions for the local gradients (δ_k^o and δ_j^h) and the change of weights in different layers of the network.

   [5 Marks]

Layer	Number of nodes	Node index	Activation function
Input Layer	d	i	Linear
Hidden Layer	J	j	*tan* hyperbolic
Output Layer	K	k	Linear

2. Draw a neural network that is used to fit a polynomial curve of degree 2. Indicate the inputs, output, weights for each connection and activation functions clearly. Consider the following set of training samples with input (x) and desired output (y). Assume the initial values of the weights as 1. Consider the value of learning rate parameter η as 0.5. The network is trained using stochastic gradient descent (SGD) algorithm. Give the updated weight values after the first iteration. [1.5 + 3.5 = 5 Marks]

x	y
2	4
0	−0.5
1	2
3	6

3. Explain the bias-variance tradeoff in designing a DNN model for function approximation.

   [5 Marks]

4. Give the weight update rule for error backpropagation learning in deep neural network that uses both momentum factor and adaptive learning rate. [3 Marks]

5. Oscillations are observed in SGD and momentum-based GD algorithm. Give the reasons for these oscillations in both the algorithms. [2 Marks]