BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI

Neural Networks & Fuzzy Logic (BITS F312) [1st Sem., 2022-2023]

Mid-Semester Exam – Part A (Closed Book)

Max Time- 30 min | Max Marks - 40 | Date: 01.11.2022

Q1. If crossover probability is 0.8, then what is the probability that the schema **01**10 will be destroyed after uniform crossover? Also determine the order and defining length of the schema. [3]

Q2. Encode x=4.70 as a 6-bit binary string if x varies in the range [-5, 15]. [2]

Q3. Nesterov's accelerated gradient method is an attempt to overcome the local minima problem. True/False? [1]

Q4. Which one between GA and PSO is a gradient free method? [1]

Q5. The neighborhood of the Local Best variant of the PSO algorithm should increase or decrease as the number of iteration grows? [1]

Q6. The PSO dynamics is given by $\begin{bmatrix} y(t+1) \\ v(t+1) \end{bmatrix} = \begin{bmatrix} -1.5 & -2.0 \\ 1.5 & 3.0 \end{bmatrix} \begin{bmatrix} y(t) \\ v(t) \end{bmatrix}$ where y and v represent relative position and velocity variables of a particle. Determine if the dynamics is expected to converge or diverge. [2]

Q7. Consider a two-class classification task with the following 4 actual class labels (P) and predicted class labels (Q). P=[1,0,1, 0], Q= [0.8,0.9,0.9,0.6]. Calculate Average CE loss (**Use ln**). [3]

Q8. Calculate Hinge loss when(a) score = 0.2, label = -1 (b) score = -0.7, label = -1 (iii)score = -1.1, label = -1 [3]

Q9. There are 1000 pixels in an image out of that 100 belongs to an object. If your bounding box encloses all 100 pixels. Calculate Sensitivity and Specificity [2]

Q10. Write one-hot representation for 3 bit binary pattern '100' and 000' [2]

Q11. 'X' is a measure of the ability of a classification model to identify only the relevant data points, while 'Y' is a measure of the ability of a model to find all the relevant cases within a dataset. Identify the performance measure terms' X 'and 'Y'. [2]

Q12. A neural network architecture has: 4 input nodes, single hidden layer with 5 hidden nodes, and output layer having 3 output nodes. It will require X number of weights and Y number of biases to be trained. Write values of X & Y. [2]

Q13. If a classifier misclassifies all positive samples and correctly classify all negative samples, then what is the value of TPR and FPR ? [2]

Q14. Find the change in weight using RPROP algorithm. Given: step size at (t-1)=0.01, slope at (t) and (t-1) are +1 and -1 respectively, η+=1.2, η-=0.5. [2]

Q15. Which activation function learns the parameter which controls the shape and leaky-ness of the ReLU function? [1]

Q16. Identify the network configuration described by " two neural networks contest with each other in the form of zero-sum game, where one's gain is other's loss" [1]

Q17. "Train a classifier on the small amount of labeled data, and then use the classifier to make predictions on the unlabeled data" refers to what kind of learning? [1]

Q18. Which method of regularization modifies the network but not touches the output layer, and is a sort of Ensemble learning? [1]

Q19. Which kind of loss function has capability of reducing FPs or FNs? [1]

Q20. If we increase our mini-batch size by a factor of two, by what factor we need to increase the number of epochs in order to maintain the number of times parameters of network are updated ? [1]

Q21. The problem of satisfying the requirement of the integration of new knowledge, and prevention of the forgetting of previous knowledge is described by what problem/dilemma in ANNs? [1]

Q22. "Acquisition function" is used in which kind of learning ? [1]

Q23. Name the term describing the rate at which a biometric system fails to identify a genuine (authorised) subject. [1]

Q24. Which gradient descent uses batch size of One? [1]

Q25. What is the maximum value of the derivative of sigmoid function? [1]

Q26. Which method of regularization gives the best model based on knowledge of generalization error? [1]

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BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
Neural Networks & Fuzzy Logic (BITS F312) [1st Sem, 2022-2023]
Mid-Semester Exam - Part B (Open Book)

Max Time- 60 min. Max Marks - 50 Date: 01.11.2022

Q1. (a) AND gate for bipolar inputs –output is to be realized using *iterative* procedure of Hebb learning. Find the weights and bias matrix in the form [w_1, w_2, b] after inputting (i) (-1,-1), and then inputting (ii) (-1, 1) [4]

(b) Ground truth image is made up of 90% background pixels. A proposed segmentation classifies all pixels as "background". (a)Write values of TP,TN,FP and FN(b) Calculate Accuracy & IoU [4]

Q2. A preventive maintenance schedule for bearings is to be designed by training ANN to predict the type of faults which could be none/any one /any two/all three, out of type1, type 2 , type 3 faults. Presence of fault is represented as 1, absence of fault as 0. To detect bearing faults three vibration sensors detect time domain vibration signal in x, y and z axis of the rotating machine. BPA is used for training the network. At a particular instant, the input feature vector of vibration signal, ranging between 0-40 is recorded as [10,30,40], and for this feature vector two faults are present.

Given : network has one hidden node in one hidden layer; Activation function : ReLu at hidden layer, sigmoid at output layer; all weights from input to hidden layer , from hidden to output layer , bias at hidden and output layer are o.1 ; learning rate is 0.6. Truncate all values up to four decimal places.

(a) Draw the architecture of the network
(b) Perform forward pass, find outputs at hidden layer and output layer for the normalized input feature vector in the range 0-1
(c) Find Error vector at hidden and output layer
(d) Find change in weights in (i) one of the weights from input to hidden (ii) bias at hidden layer (iii) one of weights from hidden to output layer. [2+5+4+3=14]

Q3. RBFN is trained to find belonging of a three dimensional feature vector to class 1 or class 0. There are three RBFN neurons with centers as (0,0,0), (1,1,1)and (2,0,0) of Gaussian activation function. At the output layer sigmoid function is used, all the weights and bias are unity. If output is greater than 0.5, point belongs to class 1, else to class 0 (a) Draw the labeled network (b) When feature vector (2,1,1) is presented to the network, find the output and the class to which it belongs. [12]

Q4. The following optimization problem is to be solved by Real Coded GA.

maximize $f(x_1, x_2, x_3) = x_1^2 + x_2 x_3$; $x_1,x_2,x_3 \in [1, 10]$

sub. to $x_1^2 + x_2^2 + x_3^2 \leq 200$
$x_1 + x_2 + x_3 = 20$

Assuming the initial population to be (9,10,3), (10,7,3), (3,6,10), (10,2,10), (10,5,9), (8,5,4), obtain the next generation. Consider the following:
i) Elite Count=2, P_c=1, P_m=0
ii) Static penalty with unity penalty coefficient
iii) Tournament selection with tournament size of 2 (take sequentially such as 1-2, 2-3 etc. and select the winner)
iv) Form mating pairs as first and last candidates, second and second last candidates and so on and use blend crossover with the γ values as 0.8, -0.1, 0.3. [16]

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