UNIVERSITY OF RUHUNA
BACHELOR OF COMPUTER SCIENCE (SPECIAL) DEGREE (SEMESTER I)
EXAMINATION – AUGUEST 2016

COURSE UNIT: CSC4133 – Neural Networks **TIME: 2 Hours**

Answer all four Questions.

(1)

(a) Briefly describe the learning process of a biological neuron and how they are being implemented on an artificial neuron.

(5 Marks)

(b) Consider the following pseudo code implementation of a basic learning algorithm.

While epoch produces an error

Present network with next inputs from epoch

Calculate Error = T – O / T is Target, O is Output */*

If **STEP 1** *then*

STEP 2

End If

End While

Write down the missing steps, **STEP 1** and **STEP 2** in the above pseudo code.

(5 Marks)

(c) Explain why it is not possible to employ a perceptron learning algorithm when the decision boundary of a problem is non-linearly separable.

(5 Marks)

(d) Backpropagation algorithm can be implemented either in ***batch mode*** or in ***incremental mode***. However, the incremental mode is more popular than the batch mode. Give reasons as to why the incremental mode is more popular.

(5 Marks)

(e) What is meant by ***unsupervised*** learning? Discuss one practical application where we can employ supervised learning.

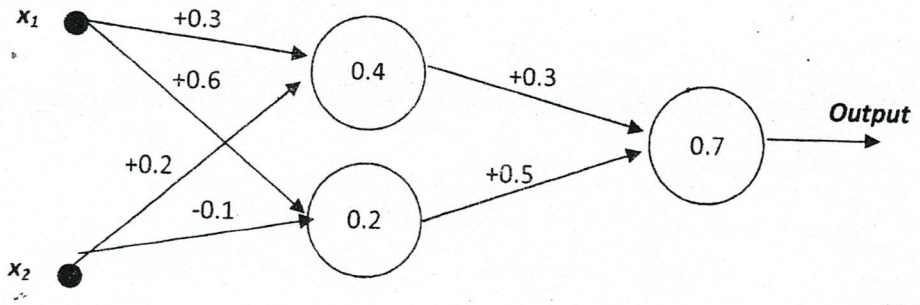
(5 Marks)

(2)

(a) What is meant by ***curse of dimensionality***?

(4 Marks)

(b) The figure below depicts an artificial neural network whose neural elements are linear threshold units. The numerical value within each unit (node) is the unit's threshold value. The numerical values alongside each arrow indicate the network's weight values. If the inputs ($\mathbf{x_1}$ and $\mathbf{x_2}$) are restricted to binary values, the network implements a Boolean function. What is this Boolean function implemented in this network? Show the calculations clearly.



(6 Marks)

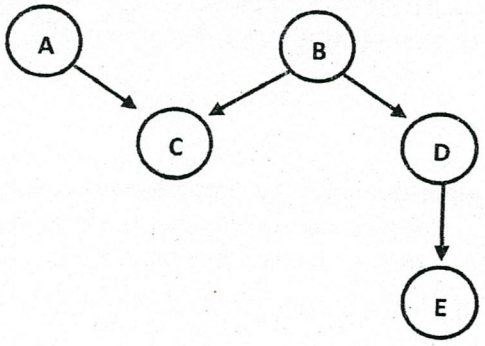
(c) In the Bayesian context, what is meant by ***Maximum Likelihood (ML)*** hypothesis?

(4 Marks)

(d) Explain how **Naïve Bayes** technique can be used for Sentiment Analysis of Twitter data.

(5 Marks)

(e) Consider the below Bayesian Belief Network (BBN).



(i) Identify and draw linear, converging and diverging type connections in the above BBN.

(ii) Write down the joint distribution **P(A, B, C, D, E)** of the above BBN.

(6 Marks)

(3)

(a) What is the difference between a validation data set and a test data set?

(4 Marks)

(b) Explain the important steps of the training procedure of the Neural Gas (NG) algorithm.

(6 Marks)

(c) Briefly explain a disadvantage of the SOM algorithm as compared to the Neural Gas algorithms.

(5 Marks)

(d) Explain two (2) advantages where a two-layer hierarchical overlapped architecture can provide over a traditional SOM or NG algorithm.

(5 Marks)

(e) Explain how a SOM algorithm can be used for pattern classification instead of clustering.

(5 Marks)

(4)

(a) Briefly explain a drawback of the ***Boosting*** algorithm as compared to the Bagging algorithm.

(5 Marks)

(b) Assume that three classifiers (C1, C2 and C3) are used to form a multiple classifier system as shown below with three classes (Class1, Class 2, and Class 3).

Classifier	**Importance of Classifier**	**Posterior Probability**		
		Class 1	**Class 2**	**Class 3**
C1	**0.65**	**0.79**	**0.28**	**0.32**
C2	**0.55**	**0.42**	**0.67**	**0.42**
C3	**0.75**	**0.27**	**0.56**	**0.68**

(i) What will be the output of the multiple classifier system if the **linear weighted average** was used to combine the outputs of the three classifiers?

(5 Marks)

(ii) What will be the output of the multiple classifier system if the **Sugeno's fuzzy integral** was used to combine the outputs of the three classifiers?

Assume that the value of the Sugeno's fuzzy measure λ is equal to **- 0.9464** in this scenario.

(5 Marks)

(c) Two data sets (Experiment 1 and Experiment 2) were applied to a classifier and the following confusion matrices were obtained.

		True Class			
		Experiment 1		**Experiment 2**	
		Positive (+)	Negative (-)	Positive (+)	Negative (-)
Predicted Class	Positive (+)	**190**	**90**	**150**	**50**
	Negative (-)	**10**	**910**	**50**	**950**

(i) Which outcome is empirically better than the other? Justify your answer using **Accuracy, Sensitivity** and **Precision** measures.

(6 Marks)

(ii) Plot the above two experimental results in a **ROC** curve and explain which experiment's result is better than the other by using a suitable distance metric.

(4 Marks)

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