The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Electrical and Computer Engineering

Study Programme	: Bachelor of Technology Honours in Engineering
Name of the Examination	: Final Examination
Course Code and Title	**: EEX7241 -Neural Networks and Fuzzy Logic**
Academic Year	: 2020/21
Date	: 5th February 2022
Time	: 0930-1230hrs
Duration	: **3 hours**

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **Five (5)** questions in **Three (3)** pages.
3. Answer **all questions.**
4. Answer for each question should commence from a new page.
6. This is a Closed Book Test **(CBT).**
7. Answers should be in clear hand writing.
8. Do not use red colour pen.

Question 1

(a) Write down the major steps in Backpropagation training algorithm to train a multilayer ANN in the supervised mode. (8 marks)

(b) Briefly explain two approaches that can be used to train a set of data for supervised multilayer Artificial Neural Networks. (Must write their learning rules) (6 marks)

(c) Assume that after training an Artificial Neural Network, you find that it does not do data classification (or give output) as expected. List 3 reasons why it should happen so. (6 marks)

Question 2

(a) In each of the following cases, explain WHY Artificial Neural Networks (ANN) can be used for modeling the problem solution. Suggest the most suitable ANN to solve the problem and describe the relevance of the ANN which makes it most suitable.

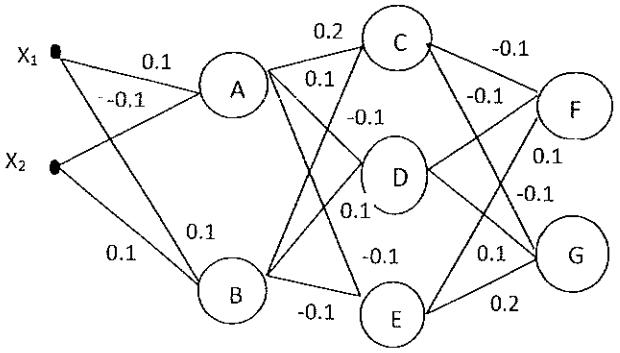
(i) Recognition of handwritten characters

(ii) Predicting Rainfall in 50 years

(iii) Pattern classification in an unknown data set

(3x3 marks)

(b) Find the updated weight on the neuron F after training with the input pair X_1 =[0.2 -0.3] X_2 = [-1 1] on the following ANN with the use of Backpropagation training algorithm. You may use the sigmoid function as the Activation function for the calculations. (9 marks)



(c) What essential feature is missing from the above diagram of a part of ANN? (2 marks)

Question 3

(a) Briefly describe what is meant by a 'fuzzy inference system'. (4 marks)

(b) List the two main types of fuzzy inference systems. (4 marks)

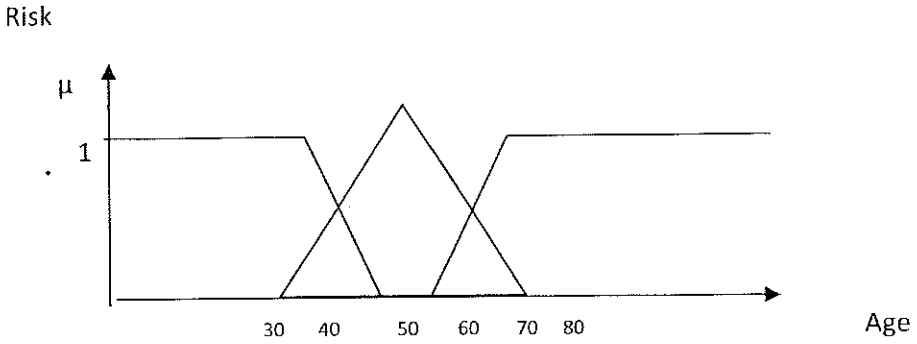
(b) Is the shape of the fuzzy membership function important in building fuzzy systems? Justify your answer. (4 marks)

(d) Give 3 example shapes used in fuzzy systems. (3 marks)

(e) Intelligent hybrid systems are designed to overcome the disadvantages of the standalone application of fuzzy, neural or expert systems. Briefly explain one way to combine 2 or 3 AI techniques to create a hybrid system. (5 marks)

Question 4

(a) A part of a Fuzzy application which shows the relationship between the Age of the customer in year and the Risk for a bank loan is given below.



Risk at ages of 30, 50, 70 are given for small (S), medium (M) and high (H) fuzzy membership functions respectively.

What are the fuzzy membership functions when the age is 40? *(give the best possible value)* (6 marks)

(b) Given the fuzzy membership functions for Age at 57.5 as follows,

$\mu S\ (57.5) = 0$
$\mu M\ (57.5) = 2/3$
$\mu H\ (57.5) = 1/3$

what is the crisp value of the Risk ? (8 marks)

(c) Given 2 fuzzy sets as,

$A = \left\{\frac{0}{1}, \frac{1}{2}, \frac{0.5}{3}, \frac{0.3}{4}, \frac{0.2}{5}\right\}$, $B = \left\{\frac{0}{1}, \frac{0.5}{2}, \frac{0.7}{3}, \frac{0.2}{4}, \frac{0.4}{5}\right\}$

What is $A \cap B$ and $\bar{A}/B$? (6 marks)

Question 5

"Water pollution has a devastating effect on agriculture. Litter pollutes irrigation water, damages soil composition and contributes to climate change which causes changes in weather patterns. Other adverse effects include damage to natural vegetation and wildlife, outbreaks of disease resulting in the loss of human lives and damage to national heritage sites."

Water Quality is measured through parameters such as PH value and Nitrate concentrate in soil. You have been given a data set with the date, rainfall amount, temperature, Nitrate concentration and PH value for a particular area in Sri Lanka for 100 years and asked to make a system to predict the water quality in 10 years' time when the rainfall and temperature values are not known.

(a) Why is it necessary to pre-process data? (2 marks)

(b) What measures can be taken to pre-process the data? (2 marks)

(c) If there are missing values for the input rainfall, what can you do to not to lose that data record? (1 mark)

(d) If the missing values are for few years which are close by, some common methods will not give a proper picture of the data set. In such a case what kind of method will you choose? (2 marks)

(e) Identify a suitable Artificial Neural Network model to solve this problem and explain why you chose it? (5 marks)

(f) What techniques were used to minimize the error of the output? (2 marks)

(g) To implement this system with Tensor Flow, what are the other supporting packages you should use? Briefly explain their functions. (2*3 marks)