UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 8 Examination in Engineering: November 2017

Module Number: EE8208   Module Name: Intelligent Systems Design

[Three Hours]

[Answer **all questions**, each question carries **10 marks**]

Q1 a) Average height of a Sri Lankan is 151 cm. Draw Membership Functions for a probable Fuzzy Sets "Short", "Average" and "Tall" in the Universe of Discourse "Height of Sri Lankans".

[2.0 Marks]

b) Draw a typical "Triangular" type Membership Function for a Fuzzy Set. Mathematically define the Membership Function $\mu(x)$ by assuming appropriate parameters.

[2.0 Marks]

c) Define operations i) Intersection (AND), ii) Union (OR), and iii) Complement by using the Membership Functions of the Fuzzy Sets A and B. Also interpret these operations in diagrams of Universe of Discourse vs Fuzzy Membership.

[3.0 Marks]

d) Consider the Fuzzy Sets A = {1/a, 0.3/b, 0.2/c, 0.8/d, 0/e} and B = {0.6/a, 0.9/b, 0.1/c, 0.3/d, 0.2/e} in the Universe of Discourse X={a, b, c, d, e}. Calculate the Intersection, Union and Complements of A and B.

[3.0 Marks]

Q2 A Fuzzy Logic controller is to be designed for a classical feedback control system.

a) Draw the classical feedback control diagram with Process, Fuzzy Controller and the feedback path. Define the Control Error e(k) and Rate of Error r(k) with respect to the SV (Set Value) and PV (Process Value).

[2.0 Marks]

b) Define four typical Fuzzy Rules for controlling based on the Universes of Discourse; Error e(k), Rate of Error r(k) and Control Output du(k), with appropriate linguistic variables.

[2.0 Marks]

c) Define the membership functions for the linguistic variables denied in the Universes of Discourse e(k), r(k) and du(k), and show them in appropriate diagrams.

[3.0 Marks]

d) Show how to calculate the Control Output du(k) for a given values of e(k) and r(k) by using a numerical example. Use the method "Center of Gravity" to calculate the final du(k).

[3.0 Marks]

Q3 a) With a supervised learning algorithm, we can specify target output values, but we may never get close to those targets at the end of learning. Give two reasons why this might happen.

[2.5 Marks]

b) What is a training set and how is it used to train neural networks?

[2.0 Marks]

c) Write a pseudo code for the supervised training algorithm.

[2.5 Marks]

d) Draw the neural network to implement the XOR Boolean function.

[3.0 Marks]

Q4 a) Distinguish difference between a feedforward neural network and a Recurrent Neural Network (RNN).

[2.0 Marks]

b) Sketch the basic architecture of a RNN.

[2.0 Marks]

c) Explain the vanishing gradient problem in RNN and how it affects the operation of the RNN.

[3.0 Marks]

d) Describe how the Long-Short Term Memory (LSTM) Module overcomes the vanishing gradient problem in RNN.

[3.0 Marks]

Q5 a) Define the following terms.
   i)   Agent   iii) Rationality
   ii) Agent function   iv)   Autonomy

[2.0 Marks]

b) Write pseudocode agent programs for the goal-based and reflex with state agents.

[3.0 Marks]

d) What is the difference between a performance measure and a utility function?

[2.0 Marks]

e) Suppose that the performance measure is concerned with just the first T time steps of the environment and ignores everything thereafter. Show that a rational agent's action may depend not just on the state of the environment but also on the time step it has reached.

[3.0 Marks]