UNIVERSITI SAINS MALAYSIA

Second Semester Examination
2022/2023 Academic Session

July/August 2023

EEE551 – Intelligent Systems

Duration: 2 hours

Please ensure that this examination paper consists of SIX (6) pages before you begin the examination.

Instructions: This question paper consists of **FOUR (4)** questions. Answer **ALL** questions. All questions carry the same marks.

1. a) Ali has built an expert knowledge base system that is used to identify a part of vehicle damage in his workshop. When running the system, the diagnosis of particular damage was found to be only 45% accurate. The diagnosis was a mistake. How can the error be corrected, and how is the correction easier than conventional systems?

(25 marks)

b) Administrator of the company is required to optimize the resources. The person in charge selects a knowledge-based expert system as a tool. Describe the success factors of the expert system

(25 marks)

c) Consider the following familiar set of rules:

Rule 1 IF green THEN walk
Rule 2 IF red THEN wait
Rule 3 IF green AND blinking THEN hurry
Rule 4 IF red OR green THEN the traffic light works

(i) Which of the above rules will be put into a conflict set by the system if the working memory contains two facts: green and blinking? Explain why each rule is selected or not.

(15 marks)

(ii) Which of the rules would be if we used the specificity conflict resolution strategy? Explain why.

(15 marks)

d) Describe characteristics of problems in which it is better to use rule-based-expert systems or problems where the case-based systems are more appropriate.

(20 marks)

2. a) Suppose you are designing a fuzzy logic system to control the speed of a train on a track. The inputs to the system are the distance to the next curve and the train's current speed. The system's output is the recommended speed for the train to take the curve safely.

Here are the specifications for the input and output variables:

(i) Distance: the range is from 0 to 500 meters, with the following fuzzy sets: "very close" (0-50 meters), "close" (40-150 meters), "moderate" (100-250 meters), "far" (200-400 meters), "very far" (350-500 meters).

(ii) Speed: the range is from 0 to 200 km/h, with the following fuzzy sets: "very slow" (0-30 km/h), "slow" (20-70 km/h), "moderate" (50-120 km/h), "fast" (100-170 km/h), "very fast" (150-200 km/h).

(iii) Recommended speed: the range is from 0 to 200 km/h, with the following fuzzy sets: "very slow" (0-30 km/h), "slow" (20-70 km/h), "moderate" (50-120 km/h), "fast" (100-170 km/h), "very fast" (150-200 km/h).

(60 marks)

b) A [n] _____ is a computer system that seeks to act like or simulate the functioning of a human brain

(i) artificial intelligence system
(ii) learning system
(iii) genetic algorithm
(iv) neural network

(5 marks)

c) Which of the following is a characteristic of fuzzy logic?

(i) It can handle imprecise or uncertain data
(ii) It is based on binary decision making
(iii) It requires precise numerical values for input variables
(iv) It cannot be applied to real-world problems

(5 marks)

d) Consider a fuzzy logic system for controlling the water level in a tank based on the inflow and outflow rates. The input variables are the inflow and outflow rates, and the output variable is the water level. The following fuzzy sets have been defined for each input variable:

Inflow: "low", "medium", "high"
Outflow: "low", "medium", "high"
The following fuzzy sets define the output variable (water level):

Water level: "low", "medium", "high"
The fuzzy rules for the system are:

If the inflow is low AND the outflow is low, then the water level is low.
If the inflow is medium AND outflow is medium, then the water level is medium.
If inflow is high AND outflow is low, then the water level is high.
Given the input values of inflow = 0.4 and outflow = 0.7, determine the output water level using the Mamdani method.

(i) low
(ii) medium
(iii) high
(iv) cannot be determined with the given information

(30 marks)

3. Suppose you join a project to develop an intelligent nanny robot. One of the robot's capabilities is to recognize family members' faces and warn the child under care if an approaching person is a stranger. Your responsibility is to develop an intelligent facial recognition system for the robot. For this, you are given a file containing 1500 lines of values where each line corresponds to a set of data. For each set of data, the first 240 values correspond to facial features. The last value in every line is a binary bit of either 0 or 1, representing stranger or family member, respectively.

Answer the following questions regarding the above description:

a) Based on the given data description, what could be the type of problem or application?

(5 marks)

b) How many Genotype space values are representing the inputs, and how many are representing the outputs of the intelligent recognition system? In Phenotype space, what do the values represent?

(20 marks)

c) What type of intelligent system you think is the most suitable or the simplest to be employed to develop the intelligent facial recognition system to be integrated into the nanny robot?

(5 marks)

d) Based on the type of intelligent system answered in 3(c), state one model you think is suitable to be developed into an intelligent facial recognition system. Justify your selection.

(10 marks)

e) Describe the model's structure and sizes of components.

(10 marks)

f) Explain the step-by-step procedures you would carry out to develop the mentioned intelligent system.

(50 marks)

4. Suppose you would like to develop a maximization system with a goal to obtain the largest number represented by 11 binary strings. During the developmental process, four chromosomes A, B, C and D have been generated as follows:

A	01101100110
B	11001000111
C	01110101011
D	10000111011

a) Based on the description, what type of problem or application is involved?

(5 marks)

b) Based on the various intelligent systems you have learnt, what type of intelligent system is involved in solving this problem?

(5 marks)

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c) Formulate an appropriate fitness function, *f(x)* for the problem and indicate what *x* represent.

(20 marks)

d) Determine the fitness rating of each of the chromosomes A, B, C and D.

(20 marks)

e) Show an evaluation of the probabilities that a Roulette wheel selection method would assign to each chromosome.

(20 marks)

f) Suppose spinning the wheel yields A and C as a breeding pair, and that we apply two-point crossover at bits four and eight. Analyse the applied technique. What are the two chromosomes that results?

(15 marks)

g) Given the starting population, is it possible to obtain an optimal solution using crossover alone? Explain and justify your answer.

(15 marks)

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