Second Semester Examination
2021/2022 Academic Session

July/August 2022

EPE401 – Artificial Intelligent in Manufacturing
(Kecerdikan Rekaan Dalam Pembuatan)

Duration : 2 hours
(Masa : 2 jam)

Please check that this examination paper consists of FIVE [5] pages of printed material before you begin the examination.

[Sila pastikan bahawa kertas peperiksaan ini mengandungi LIMA (5) muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]

INSTRUCTIONS : Answer **ALL FOUR [4]** questions.

[**Arahan** : Jawab **EMPAT (4)** soalan.].

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1. [a] Determine TWO(2) similarities and TWO(2) differences between outliers and extreme values.

(30 marks)

[b] Explain how outliers are determined in the data.

(30 marks)

[c] Figure 1[c] shows two clusters. Reason whether the two clusters are well separated.

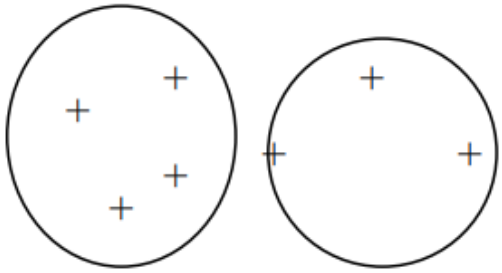

Figure 1[c]

(40 marks)

2. [a] Based on the dataset in Table 2[a], construct a decision tree which predicts the number of students who passes Artificial Intelligence course (True(T) or False(F)) based on their previous GPA (High(H), Medium(M), or Low(L)) and whether they have studied the course (True(T) or False(F)).

Table 2[a]

GPA	Studied	Passed
L	F	F
L	T	T
M	F	F
M	T	T
H	F	T
H	T	T

(40 marks)

[b] Figure 2[b] shows the output of WEKA classifier visualize function.

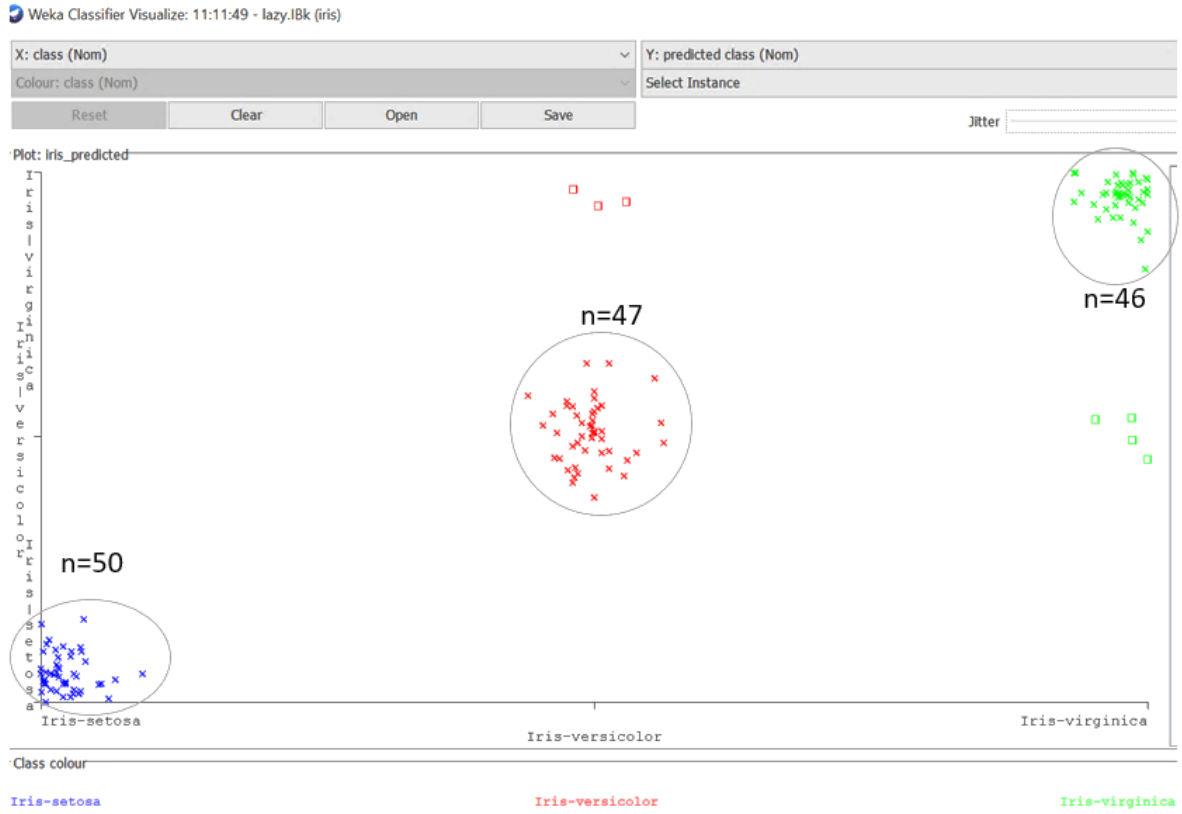

Figure 2[b]

(i) Calculate the percentage of incorrectly classified instances.

(ii) Summarize the results displayed in the form of confusion matrix.

(60 marks)

3. A feedforward backpropagation neural network comprises of an input layer (2 input neurons), a hidden layer (2 hidden neurons), and an output layer (one output neuron) to provide results that approximate the OR logical operator. The following standard values are used: threshold = 0.5, learning rate = 0.3, neuron weight = 0.5, activation function = sigmoid.

[a] Sketch the neural network.

(20 marks)

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[b] Perform ONE(1) training iteration cycle with TWO(2) training data sets. The formulas are provided in Appendix.

(80 marks)

4. Consider the Travelling Salesman Problem (TSP) of determining the quickest route across 20 cities so that each city is only visited once and the journey ends in the beginning city. Assume the practice is to use a genetic algorithm (GA) to tackle this problem, with genes representing linkages between cities. A relationship between Kuala Lumpur and Penang, for example, is represented by a single gene called 'KP.' Assume that the direction in which the salesman moves is irrelevant, and that KP = PK, please answer the following questions using the information provided above.

[a] Calculate the number of possible genes in a solution.

(20 marks)

[b] Identify TWO(2) requirements that the TSP must meet in order for a GA to solve it.

(40 marks)

[c] One common issue in optimization will be the violation of constraints. Based on the TSP, determine ONE(1) constraint and propose an adaptive penalty method to be used in the GA.

(40 marks)

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Appendix

Formulas given for feedforward multilayer perceptron neural networks

Activation functions

$$X = \sum_{i=1}^{n} x_i w_i - \emptyset$$

$$Y^{step} = \begin{cases} 1, if\ X \geq 0 \\ 0, if X < 0 \end{cases}$$

$$Y^{sign} = \begin{cases} +1, if\ X \geq 0 \\ -1, if X < 0 \end{cases}$$

$$Y^{sigmoid} = \frac{1}{1 + e^{-X}}$$

$$Y^{linear} = X$$

Error back propagation functions

$$e(p) = Y_d(p) - Y(p)$$
$$w_i(p+1) = w_i(p) + \alpha \times x_i(p) \times e(p)$$
$$\Delta w_{jk}(p) = \alpha \times \gamma_j(p) \times \delta_k(p)$$

Error gradient for neurons in the output layer

$$\delta_k(p) = y_{k(p)} \times [1 - y_k(p)] \times e_k(p)$$
$$e_k(p) = y_{d,k}(p) - y_k(p)$$
$$\Delta w_{jk}(p) = \alpha \times \gamma_j(p) \times \delta_k(p)$$
$$w_{jk}(p+1) = w_{jk}(p) + \Delta w_{jk}(p)$$

Error gradient for neurons in the hidden layer

$$\delta_j(p) = y_{j(p)} \times [1 - y_j(p)] \times \sum_{k=1}^{l} \delta_k(p) \times w_{jk}(p)$$

$$\Delta w_{ij}(p) = \alpha \times x_i(p) \times \delta_j(p)$$

$$w_{ij}(p+1) = w_{ij}(p) + \Delta w_{ij}(p)$$