



Second Semester Examination
2020/2021 Academic Session

July/August 2021

EPE 401 – ARTIFICIAL INTELLIGENCE IN MANUFACTURING

Duration : 2 hours

Please check that this examination paper consists of FIVE (5) pages including appendixes before you begin the examination.

Instructions : Answer ALL **FOUR (4)** questions.

Answer to each question must begin from a new page.

1. Ten Potamotrygon stingrays (20 cm disc diameter) are kept in a clear aquarium tank. A deep learning system is proposed to detect skin infection (multiple pink-colored lumps of 1 cm²) on the fish body based on the full top view of the aquarium tank captured with a camera.
 - [a] Suggest the types of layers that should be included in the proposed deep learning system.

(2 marks)
 - [b] Structure these layers from [a] in a flow diagram and provide justification.

(8 marks)

2. [a] Products A and B are produced using CNC machines X and Y. Each unit of product A requires 15 minutes processing on machine X, and 25 minutes processing on machine Y. Each unit of product B requires 7 minutes processing on machine X and 45 minutes processing on machine Y. Machine X and Y have an operation hours of 20 hours and 40 hours per week, respectively. Each unit of product A sold gives a profit of RM100 and each unit of product B sold contributes to profit of RM200. A week before, customer will release weekly minimum demand for both products, D_A and D_B . Each unit of unsatisfied demand for product A costs RM120, each unit of unsatisfied demand for product B costs RM230. The manufacturer would be using a genetic algorithm (GA) program to decide the right quantities of product A and B, Q_A and Q_B to produce. In the GA, Q_A and Q_B are represented by integer. The GA program will run over 5000 generations to obtain the best feasible solution. Develop a GA fitness function embedded with a dynamic penalty mechanism in text-based instruction, pseudocode or Matlab code (programming syntax can be ignored). Variable returned by the fitness function is given as "Output".

(7 marks)
- [b] Estimate the impact of following changes to the genetic algorithm parameter by sketching graphs of the best and average values of the fitness function across generations, before and after the changes.
 - (i) Increase the mutation rate from 0.001 to 0.01.
 - (ii) Reduce the crossover rate from 0.75 to 0.30.
 - (iii) Increase the population from 10 to 100.

(3 marks)

3. [a] Describe TWO (2) challenges of Data Mining

(4 marks)

- [b] In Figure 3[b], the instances are classified using k-NN classifier which assigns a test instance to the majority class associated with its k nearest training instances.

Distance between instances is measured using Euclidean distance. Assume “unweighted” k-NN (every nearest neighbour contributes equally to the final vote).

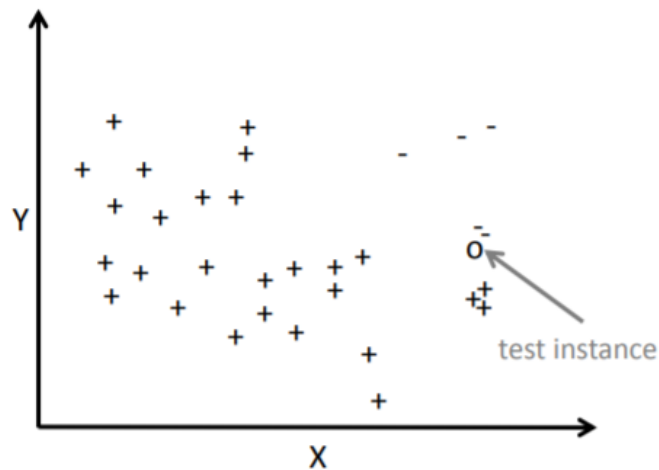


Figure 3[b]. Positive(+) and negative (-) instances projected onto a vector space of two real-valued features (X and Y).

- (i) What would be the class assigned to this test instance for $k=1$?
- (ii) What would be the class assigned to this test instance for $k=5$?
- (iii) Based on this particular training set, would you recommend setting $k = 11$? Justify the reason.

(6 marks)

4. [a] Figure 4[a] shows a decision tree constructed from a dataset using WEKA tool. Construct the list of If-then decision rules.

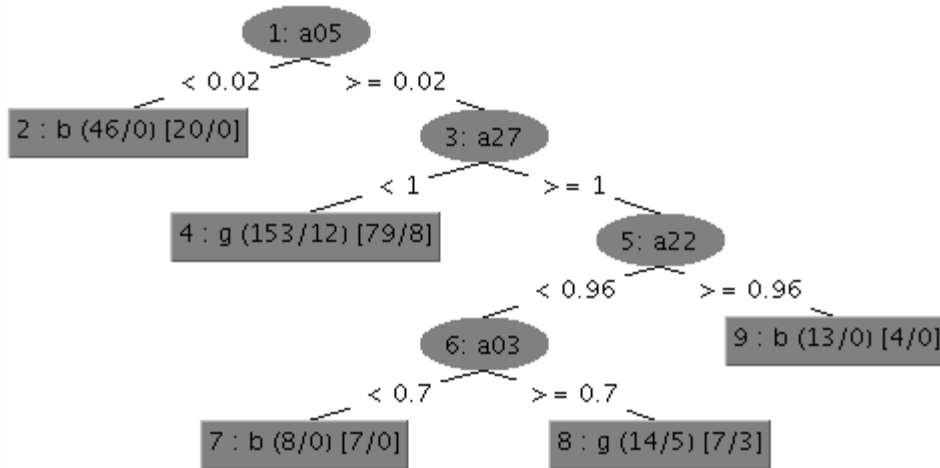


Figure 4[a]. Decision tree

(4 marks)

- [b] Figure 4[b] shows the confusion matrix output on J-48 algorithm using WEKA.

Classifier output

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=== Stratified cross-validation ===
=== Summary ===
Correctly Classified Instances      167           93.8202 %
Incorrectly Classified Instances    11            6.1798 %
Kappa statistic                    0.9058
Mean absolute error                 0.0486
Root mean squared error             0.2019
Relative absolute error             11.0723 %
Root relative squared error         43.0865 %
Total Number of Instances          178

=== Detailed Accuracy By Class ===
TP Rate  FP Rate  Precision  Recall  F-Measure  Class
0.983    0.034    0.935     0.983   0.959      a
0.944    0.056    0.918     0.944   0.931      b
0.875    0.008    0.977     0.875   0.923      c

=== Confusion Matrix ===
 a  b  c  <-- classified as
58  1  0  |  a = a
 3  67 1  |  b = b
 1  5 42 |  c = c
    
```

Figure 4[b]. Weka J-48 classifier output.

- (i) Calculate the number of instances in this problem.
- (ii) Calculate the percentage of incorrectly classified instances.
- (iii) Explain whether the results reflect a supervised or unsupervised learning problem?

(6 marks)

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