UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 2001/2002

September 2001

CCS501 – Neural Networks and Genetic Algorithms

CSC513 – Artificial Neural Networks

Duration : 3 hours

INSTRUCTION TO CANDIDATE:

- Please ensure that this examination paper contains **FIVE** questions in **FOUR** printed pages before you start the examination.
- Answer **ALL** questions.
- You can choose to answer either in Bahasa Malaysia or English.

ENGLISH VERSION OF THE QUESTION PAPER

1. Briefly explain the following questions:

   (a) Prior to learning, why is it recommended to initialise a neural network with random weight values?

   (b) What do you understand by the concept of *Momentum* in a back propagation network?

   (c) For learning purposes, what are the two modes of pattern presentation to a back propagation network? Which one is better and why?

   (d) What is the key difference between the delta rule and generalised delta rule?

   (e) The self organising feature map algorithm exhibits three important statistical characteristics of the input. Briefly describe these properties?

   (f) What do you understand by the concept of neural network generalisation? Also, describe 'premature generalisation' and 'incorrect generalisation' and how to recover from these situations.

   (g) Discuss at least four heuristics to achieve accelerated convergence of back-propagation learning.

   (20 marks)

2. State whether the given statements are TRUE or FALSE.
   Note: Negative marking applies, i.e. –0.5 for each incorrect answer. Answer **at least** 8 questions.

   (a) The Perceptron learning algorithm uses the calculated error value to update the connection weights.

   (b) The total error calculated for a set of training patterns is a function of the square of the weight vectors within the neural network.

   (c) Input units in a neural network do not process information.

   (d) In a neural network, knowledge of the world is defined by the network's parameters.

   (e) Back propagation networks are basically multilayer perceptrons.

   (f) Input units in a back propagation network are capable of deriving abstractions from the input patterns.

   (g) In a back propagation network, the error produced at any layer is a consequence of the error produced at the previous layer.

(h) During Kohonen map learning, the weights of the winning unit is moved in the direction of the input pattern.

(i) In a Kohonen map, patterns with a high probability of occurrence are mapped onto larger regions in the output layer.

(j) When a back propagation network uses momentum, learning will proceed in a rapid manner as long as the training data is relatively similar.

(10 marks)

3. In the university examination scheduling problem, initially we need to decide when the examinations will be held.

The main criteria in this assignment is that bigger examinations (i.e. number of candidates) are held earlier.

The availability of space (i.e. seating) is another aspect which must be met. Individual room assignment is not an issue here. Only the total seating available at any one time is considered at this juncture.

We should also minimise the number of candidates having several examinations in a row (i.e. one after the other).

Assume there are mechanisms to count the number of clashes (i.e. multiple examinations involving same students at the same time) and the number of candidates with several examinations in a row.

(a) Discuss the suitability of using Genetic Algorithm to solve the above-mentioned problem.

(b) Discuss the suitability of using Memetic Algorithm to solve the above-mentioned problem.

(c) Provide a proper representation assuming you are going to solve the problem using Evolutionary Algorithm (i.e. with Genetic Algorithm or Memetic Algorithm).

(d) Provide a fitness function for solving the problem.

(e) Discuss the suitability of the following local searches, if we are using Memetic Algorithm to solve the problem:

(i) 2-opt heuristics

(ii) Tabu search

(f) Discuss the role played by crossover and mutation in Genetic Algorithm.

(30 marks)

4. Assume there exists a system which can generate a feasible examination schedule based on the problem described in question 3.

   (a) If we want to further improve the solution generated by the above-mentioned system, which approach would you choose: tabu search, simulated annealing or ant colony optimisation? Justify your choice and why you did not choose the others.

   (b) Describe the usage of simulated annealing to further improve the solution.

   (c) Discuss whether constraint satisfaction approaches can be used in improving a given feasible solution for the above-mentioned problem.

   (20 marks)

5. (a) Describe the criterion you would use in deciding whether to use tabu search or hill climbing in solving a problem.

   (b) Determine how you would use the tabu search to solve the following equation: $a + 2b + 3c + 4d = 0$.

   (c) How does simulated annealing differ from Tabu Search?

   (20 marks)

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