UNIVERSITY OF LONDON
IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE

EXAMINATIONS 1997

BEng Honours Degree in Computing Part III
BEng Honours Degree in Information Systems Engineering Part III
MEng Honours Degree in Information Systems Engineering Part III
BSc Honours Degree in Mathematics and Computer Science Part III
MSci Honours Degree in Mathematics and Computer Science Part III
MSc Degree in Advanced Computing
MSc Degree in Computing Science
for Internal Students of the Imperial College of Science, Technology and Medicine

This paper is also taken for the relevant examinations for the
Diploma of Membership of Imperial College
Associateship of the City and Guilds of London Institute
Associateship of the Royal College of Science

PAPER 3.89 / I3.24

NEURAL NETS

Friday, May 2nd 1997, 10.00 - 12.00

Answer THREE questions

For admin. only: paper contains 4 questions

1a Describe the architecture of a multi-layer perceptron (MLP) feed-forward network.

b Commonly, error back propagation is used to train MLP feed-forward networks. By means of formulas or a program in a high level languages such as (C, C++ or Java) show the workings of error back propagation from output layer to input layer, calculating the weight errors. Assume that we have a three layer network with *a* neurons in the input layer, *b* neurons in the hidden layer and *c* neurons in the output layer.

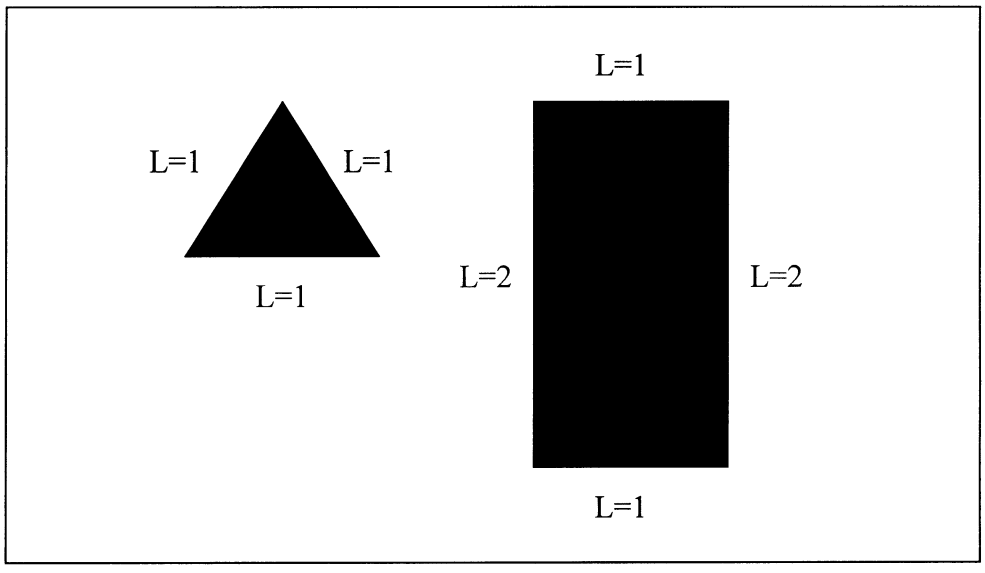
c Explain the main differences between classifying data sets using a standard multi-layer perceptron feed-forward network and using radial basis functions (RBF).

The three parts carry, respectively, 20%, 70%, 10% of the marks.

2a i) Explain the principle of Sequence Component Ratio Coding (SCRC).

ii) Explain the benefits of the SCRC method for sequence normalisation. Describe how SCRC copes with the introduction of an erroneous value within the temporal sequence, as compared to other encoding techniques.

b i) Suggest a method of encoding the edges of the graphical scene below for scale and rotation invariance of each shape in the scene. Calculate the sequence vectors for each shape in the scene. (The lengths of each shape edge are also indicated below.)



ii) How many neurons (including Component and Sequence layer) would be needed to store all shapes from the scene above in a short-term memory (STM) network? Give an explanation, including a network architecture illustration.

The two parts carry, respectively, 35%, 65% of the marks.

3a Explain the basic principles of genetic algorithms, describing the methods used to change a genetic code or sequence. Also, explain the basic method of selection in genetic algorithms.

b i) Using the travelling salesman problem, where a travelling salesman has to visit several places and our task is to find the shortest overall journey time, suggest a method of encoding the problem so that the solution can be attempted by genetic algorithms. Suggest a fitness function.

ii) Suggest a neural network paradigm that would be suitable for solving the travelling salesman problem. Explain your choice. What information is being used and how is it encoded in the input vector of the neural network for the problem?

The two parts carry, respectively, 40%, 60% of the marks.

4a Describe the basic principles behind the WISARD (Wilkie, Stonham, Aleksander recognition device) system. In your account, give an explanation of the RAM neuron and what is meant by content addressable memory in this context.

b Describe the training and running processes of the WISARD.

c RAM neurons can also have probabilistic characteristics. Explain the probabilistic tri-state logic used in the probabilistic logic node (PLN). Explain the training algorithm used to train a PLN network.

The three parts carry, respectively, 30%, 30%, 40% of the marks.

End of paper