THIS PAPER IS NOT TO BE REMOVED FROM THE EXAMINATION HALLS

UNIVERSITY OF LONDON **CO3311 ZA**

BSc Examination

COMPUTING AND INFORMATION SYSTEMS, CREATIVE COMPUTING and COMBINED DEGREE SCHEME

Neural Networks

Date and Time: Wednesday 18 May 2016: 10.00 – 12.15

Duration: 2 hours 15 minutes

There are SIX questions on this paper. Candidates should answer **FOUR** questions. All questions carry equal marks and full marks can be obtained for complete answers to **FOUR** questions. The marks for each part of a question are indicated at the end of the part in [.] brackets.

Only your first **FOUR** answers, in the order that they appear in your answer book, will be marked.

There are 100 marks available on this paper.

A hand held calculator may be used when answering questions on this paper but it must not be pre-programmed or able to display graphics, text or algebraic equations. The make and type of machine must be stated clearly on the front cover of the answer book.

1.

a) A Perceptron unit is often described as representing ‘a line in the plane’. Explain how this description applies. Your answer must include a diagram.

[5]

b) Design a network of threshold units which has 4 inputs and which outputs a one if and only if an odd number of these inputs are one.

[5]

c) Explain how this unit could be extended to include more inputs.

[5]

d) A single threshold unit has two inputs, ?a and ?b which have initial weights of 0.25 and 0.5 respectively. If the initial value of the bias is -0.75, calculate

i) the activation when presented with the input of (0.5, 0.1) with target 1
ii) the updated weights

after each round of training twice with this input.

[2x5]

2.

Compare and contrast Backpropagation networks with Perceptron networks in terms of:

a) Types of unit normally used.
b) Training algorithm.
c) Input and output achievable.
d) Ease of use.
e) Range of applications.

Your answers should describe the effects of these differences.

[5x5]

3.

a) Describe the architecture of a Kohonen Grossberg network, giving a clearly labelled diagram showing its components and an explanation of the action of each layer.

[6]

b) Why is it important that both training set and classes are normalised?

[2]

c) A two unit Kohonen network has initial classes (1,1) and (-1,-1). Showing your working, train the network with an example of (0,1) followed by an example of (1,0) each with a learning rate of 0.5.

[8]

d) Draw a labelled diagram of the network from part c), showing the two initial units and the two examples. Mark on it the positions of the units after training with each of the examples.

[5]

e) The examples and initial units in part c) above were chosen both to make your calculations easy and also to allow you more easily to draw a diagram showing the training. How would initial classes be chosen in a real application?

[4]

4.

a) Explain how a Hopfield network might be used to solve a travelling salesman problem. Your answer should show how the problem is coded into the weights of the network.

[9]

b) Describe the algorithm which is used to produce a state transition table of a Hopfield network given its weights.

[8]

c) Table Q4 gives the weights of a Hopfield network. From this produce its state transition table and state transition diagram.

weights	**bias**	**1**	**2**	**3**
bias	0.00	0.19	0.03	0.19
1	0.19	0.00	-5.20	0.47
2	0.03	-5.20	0.00	0.52
3	0.19	0.47	0.52	0.00

Table Q4

[8]

5.
In this course we have learned about:

a) Perceptrons

b) Backpropagation networks

c) Kohonen-Grossberg networks

d) Hopfield networks and

e) Boltzmann machines

For each of these in turn:

i) Draw a labelled diagram representing a simple example.

ii) List the main limitations of such a network.

iii) State whether learning is typically supervised, unsupervised or both.

iv) Outline the learning algorithm.

[5x5]

6.

a) Outline the progress made in the use of artificial neural networks in the automation of driving motor cars.

[7]

b) List the types of neural networks that have been used in this application.

[2]

c) For each of the types given in b) above describe the specific problems to which they have been applied.

[4]

d) Linking together points from your answers to b) and c) above, explain why these particular networks are a suitable choice.

[4]

e) In applying artificial neural networks to the problems associated with self-driving cars, a number of non-technical issues have to be addressed. List the major issues.

[4]

f) Comment on how each issue given in your answer to e) above might be solved

[4]

END OF PAPER