THIS PAPER IS NOT TO BE REMOVED FROM THE EXAMINATION HALLS

UNIVERSITY OF LONDON **CO3311 ZB**

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 represents the line ***y = mx + c***, in the plane. Give the input weights and bias of this perceptron and explain how you obtained these. Include a diagram in your explanation.

[5]

b) Design a network of threshold units which has 4 inputs and which outputs a one if and only if an even 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 -0.5 and -0.5 respectively. If the initial value of the bias is 1.25 calculate

i) the activation when presented with the input of (1.0, 1.0) with target 0.0
ii) The updated weights

after each round of training twice with this input.

[2x5]

2.

Compare and contrast Kohonen 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) Define the differences between:

i) ***Batch*** mode and ***online*** mode.

ii) ***Supervised*** and ***unsupervised*** learning.

iii) ***Threshold*** and ***bias***.

[6]

b) Illustrate what might go wrong if we omit the normalisation in a Kohonen network example.

[2]

c) A two unit Kohonen network has initial classes (3,4) and (2,-1). Showing your working, train the network with an example of (1,1) followed by an example of (2,-1) each with a learning rate of 0.25.

[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 and comment on your results.

[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 the number of classes be chosen in a real application?

[4]

4.

a) Explain how a Hopfield network might be used to solve an optimisation problem such as that of the 8 Queens problem of chess.

[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.

i) From this produce its state transition table and

[6]

ii) state transition diagram.

[2]

weights	**bias**	**1**	**2**	**3**
bias	0.00	0.10	0.03	-0.20
1	0.10	0.00	-2.00	0.20
2	0.03	-2.00	0.00	-0.10
3	-0.20	0.20	-0.10	0.00

Table Q4

5.

a) Using a labelled diagram as part of your answer describe the architecture of backpropagation networks.

[5]

b) Write down the algorithm for the feedforward stage of backpropagation training.

[5]

c) Explaining all of the symbols that you use, give the equations describing the backpropagation of errors in such a network.

[8]

d) A two input three-unit backpropagation network (with sigmoidal units) having all weights initially set to zero is trained with an example of (1, 1) and a target of 1 (which of course it cannot achieve). Calculate the net, activation and new set of weights.

[5]

e) In part d) it is said that the network could not achieve a target of 1. Explain why this statement is correct.

[2]

6.
a) Outline the progress made in the use of artificial neural networks in the automation of image interpretation.

[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 image interpretation, 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