THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

A. M. E. C. E. A

P.O. Box 62157
00200 Nairobi - KENYA
Telephone: 891601-6
Fax: 254-20-891084
E-mail:academics@cuea.edu

MAIN EXAMINATION

AUGUST – DECEMBER 2018 TRIMESTER

FACULTY OF SCIENCE

DEPARTMENT OF COMPUTER AND LIBRARY SCIENCE

REGULAR PROGRAMME

SPECIAL EXAMINATION

CMT 442: NEURAL NETWORKS

Date: DECEMBER 2018	**Duration: 2 Hours**
INSTRUCTIONS: Answer Question ONE and any other TWO Questions	

Q1. a) With the help of a suitable diagram, explain the structure of biological neurons. Also show how information flows in the neural system. **(10marks)**

b) Provide a brief history of artificial neural networks. **(5marks)**

c) Compare brains and traditional computers in five respects. **(5marks)**

d) Outline any four areas where artificial neural networks are used. **(4marks)**

e) Below is a diagram of a single artificial neuron (unit):

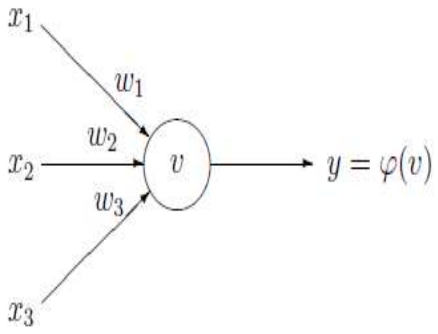


Figure 1: Single unit with three inputs.

The node has three inputs x = (x1, x2, x3) that receive only binary signals (either 0 or 1).

i) How many different input patterns this node can receive. **(1mark)**

ii) Describe the pattern for a node with four inputs. **(3marks)**

iii) Give a formula that computes the number of binary input patterns for a given number of inputs. **(2marks)**

Q2. a) Describe the following learning methods. **(12marks)**

i) Perceptron
ii) Least mean square
iii) Back propagation

b) Use a diagram to explain why an exclusive OR function is not linearly separable. **(4marks)**

c) Explain the LMS Gradient Descent method. **(4marks)**

Q3. a) With a supervised learning algorithm, we can specify target output values, but we may never get close to those targets at the end of learning. Give two reasons why this might happen. **(4marks)**

b) Distinguish between feedforward network and a recurrent network. **(4marks)**

c) Describe the competitive process of the self-organizing map algorithm. **(6marks)**

d) In a 2-D self-organizing map with input vectors of dimension m, and k neurons in the map, how many weights will these have? **(2marks)**

e) Explain how we can use a layer of Adalines to perform classification for more than two classes. **(4marks)**

Q4. a) What are the main stages in the pattern recognition process? Describe with examples, the concepts of feature vectors and discriminant functions in this context. **(10 marks)**

b) i) Write down the energy function of a discrete Hopfield net. **(4marks)**

ii) Compute the weight matrix for a 4-neuron Hopfield net with the single fundamental memory $\boldsymbol{\xi}_1 = [1,-1,-1,1]$ stored in it. **(6marks)**

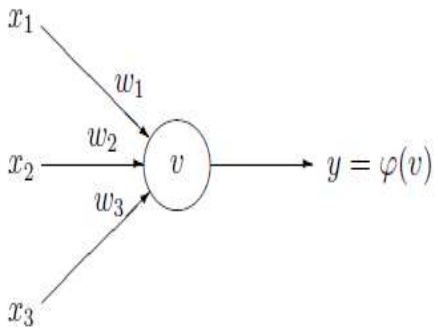
Q5. a) Explain how the hidden layer of a RBF network is different from the hidden layer in a MLP. Explain this difference in terms of:

i) What the hidden nodes compute when feeding data to the network **(4marks)**

ii) How this affects the shape of the discriminant when using the networks for classification **(4marks)**

iii) How the hidden nodes are trained in MLPs and RBF **(4marks)**

b) Consider the unit shown below.



Suppose that the weights corresponding to the three inputs have the following values:

w1 = 2
w2 = −4
w3 = 1

and the activation of the unit is given by the step-function:

$$\varphi(v) = \begin{cases} 1 \; if \; v \geq 0 \\ 0 \; otherwise \end{cases}$$

Calculate what will be the output value y of the unit for each of the following input patterns. **(8marks)**

Pattern	**P_1**	**P_2**	**P_3**	**P_4**
X_1	**1**	**0**	**1**	**1**
X_2	**0**	**1**	**0**	**1**
X_3	**0**	**1**	**1**	**1**

END