Philadelphia University **Student Name:**

Faculty of Engineering **Student Number:**

Dept. of Computer Engineering

First Exam, First Semester: 2015/2016

Course Title:	**Neural Networks and Fuzzy Logic**	**Date:**	19/11/2015
Course No:	**630514**	**Time Allowed:**	50 minutes
Lecturer:	Dr. Qadri Hamarsheh	**No. Of Pages:**	5

Information for candidates

1. *This exam paper contains 4 questions totaling 20 marks.*
2. *The marks for parts of question are shown in round brackets.*

Advices to candidates

1. *You should attempt all sub questions.*
2. *You should write your answers clearly.*

Basic notions: *The aims of the questions in this part are to evaluate the required minimal student knowledge and skills. Answers in the pass category represent the minimum understanding of basic concepts: Neuron Model and Neural Network Architectures: basic Concepts of NN's (MLP), Components of artificial neural networks; Matlab Implementation. Perceptron Learning Rule, Classification of linearly separable data with a perceptron, Backpropagation, Multi-layer feedforward networks and Matlab Implementation.*

Question 1 ***Multiple Choice*** ***(8 marks)***

Identify the choice that best completes the statement or answers the question.

1) Which of the following statements are true for typical neurons in the human brain?

a) **The neurons are connected to each other by axons, synapses and dendrites.**

b) **When the potential is bigger than a threshold, the neuron fires a pulse through the axon**

c) **Electrical potential is summed in the neuron.**

d) **All of the above answers.**

2) The network that involves **backward links** from output to the input and hidden layers is called as ____.

a) **Self-organizing maps** **b)** **Recurrent neural network**

c) **Multi layered perceptron** **d)** **Perceptrons**

3) Why is the **XOR** problem exceptionally interesting to neural network researchers?

a) **Because it can be expressed in a way that allows you to use a neural network.**

b) **Because it is binary operation that cannot be solved using neural networks.**

c) **Because it can be solved by a single layer perceptron.**

d) **Because it is the simplest linearly inseparable problem that exists.**

4) In **supervised** learning**:**

a) **The algorithms are known but not the inputs**

b) **Both the inputs and the desired outputs are known**

c) **Only input stimuli are shown to the network**

d) **None of the above**

5) A single-layer perceptron has **5** input units and **4** output units. How many weights does this network have?

a) **5** **b)** **9**

c) **20** **d)** **24**

6) A perceptron has input weights $\mathbf{w_1 = 3}$ and $\mathbf{w_2 = 1}$ and a threshold value $\mathbf{T = 0.4}$. What output does it give for the input $\mathbf{x_1 = 1, x_2 = 2?}$

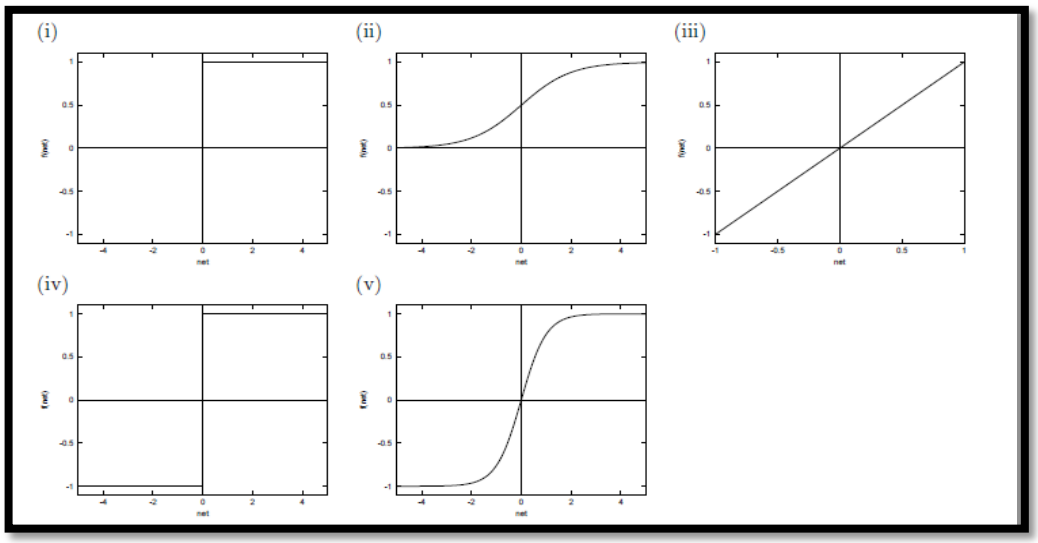
a) **3 * 1 + 1 * 2 = 5.**

b) **3 * 1 + 1 * 2 = 5.This is more than the threshold, so output +1.**

c) **3 * 1 + 1 * 2 = 5. Now subtract the threshold: 5 – 0.4 = 4.6.**

d) **3 * 1 + 1 * 2 = 5.This is more than the threshold, so output 0.**

7) Identify each of the following activation functions.



a)	**(i) Unipolar step [hardlim], (ii) Unipolar sigmoid [logsig], (iii) Linear [purelin], (iv) Bipolar step [hardlims], (v) Bipolar sigmoid [tansig].**
b)	**(i) Bipolar step [hardlims], (ii) Unipolar sigmoid [logsig], (iii) Linear [purelin], (iv) Unipolar step [hardlim], (v) Bipolar sigmoid [tansig].**
c)	**(i) Bipolar step [hardlims], (ii) Bipolar sigmoid [tansig], (iii) Linear [purelin], (iv) Unipolar step [hardlim], (v) Unipolar sigmoid [logsig].**
d)	**(i) Unipolar step [hardlim], (ii) Bipolar sigmoid [tansig], (iii) Linear [purelin], (iv) Bipolar step [hardlims], (v) Unipolar sigmoid [logsig].**

8) What does the following MATLAB function do?

```
net = newff (minmax (p), [4, 2], {'tansig', 'logsig'});
```

a)	**Initialize a multi-layer network with non-linear activation functions and two hidden layers – the first hidden layer has 4 units and the second one has 2 units.**
b)	**Initialize a multi-layer network with sigmoid activation functions, 4 hidden units and 2 recurrent connections back to the input layer.**
c)	**Initialize a single-layer network with 4 input units, 2 output units and linear activation functions.**
d)	**Initialize a multi-layer network with 4 hidden units, 2 output units and sigmoid activation functions.**

Familiar and Unfamiliar Problems Solving: *The aim of the questions in this part is to evaluate that the student has some basic knowledge of the key aspects of the lecture material and can attempt to solve familiar and unfamiliar problems Neuron Model and Neural Network Architectures: basic Concepts of NN's (MLP), Components of artificial neural networks; Matlab Implementation. Perceptron Learning Rule, Classification of linearly separable data with a perceptron, Backpropagation, Multi-layer feedforward networks and Matlab Implementation.*

Question 2 ***(3 marks)***

Draw the **diagram** of the neural network given by the following parameters using **standard** notation and **MATLAB abbreviated** notation.

- The input vector contains two features.
- Neural network with **2** layers:
  - 1st layer (hidden layer) consists of **2** neurons with tangent-sigmoid transfer functions.
  - 2nd layer (output layer) consists of **1** neuron with linear transfer function

Solution

Question 3 *(3 marks)*

a) What are the **advantages** of neural networks over conventional computers?
(List 3 advantages) *(1.5 marks)*

Solution

b) The **input** to a single-input neuron is **2.0**, its **weight** is **2.3** and its **bias** is **-3**. What is the output of the neuron if it has the following **transfer functions**? *(1.5 marks)*

[1]. Hard limit.

[2]. Linear.

[3]. Log-sigmoid.

Solution

Question 4 *(6 marks)*

a) Write matlab code to *(4 marks)*

- Train a **Perceptron** network to classify two groups of data points, as illustrated below.
- Test your final network object with the following two points $\mathbf{p_9(-2,-3)}$ and $\mathbf{p_{10}(0.5,4)}$.

b) Draw the **decision boundary** for these points. *(2 marks)*

Data	x_1	x_2	Group
p_1	-3	-0.5	0
p_2	-2	-1.2	0
p_3	-1.5	0.7	1
p_4	-1	3	1
p_5	-1	-3.5	0
p_6	0	2	1
p_7	0	-2.5	0
p_8	1	0.7	1

Solution

GOOD LUCK