Philadelphia University

Faculty of Engineering

Student Name:	
Student Number:	
Serial Number:	

First Exam, Summer Semester: 2016/2017
Dept. of Computer Engineering

Course Title:	**Neural Networks and Fuzzy Logic**	**Date:**	01/08/2017
Course No:	**630514**	**Time Allowed:**	60 Minutes
Lecturer:	Dr. Qadri Hamarsheh	**No. Of Pages:**	5

Instructions:

- **ALLOWED**: pens and drawing tools (**no red color**).
- **NOT ALLOWED**: Papers, calculators, literatures and any handouts. Otherwise, it will lead to the non-approval of your examination.
- **Shut down** Telephones, and other communication devices**.**

Please note:

- *This exam paper contains 4 questions totaling 20 marks*
- *Write your name and your matriculation number on every page of the solution sheets.*
- *All solutions together with solution methods (explanatory statement) must be inserted in the labelled position on the solution sheets.*
- *You can submit your exam after the first hour.*

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) What are the **advantages** of neural networks over conventional computers?

(i) They have the ability to learn by example.
(ii) They are more fault tolerant.
(iii) They are more suited for real time operation due to their high 'computational' rates.

a) (i) and (ii) are true **b) (i) and (iii) are true**

c) Only (i) **d) All of the mentioned**

2) A perceptron adds up all the weighted inputs it receives. If the sum exceeds a certain value, then the perceptron outputs a **1**, otherwise it just outputs a **0**, the name for the **activation function** is

a) Sigmoid function. **b) Bipolar step function.**

c) Logistic function. **d) Unipolar step function.**

3) A 4-input neuron has weights **1, 2, 3** and **4**. The transfer function is **linear**. The inputs are **4, 10, 5** and **20** respectively and the bias is equal to **0**. The output will be:

a) 238 **b) 76**

c) 119 **d) 123**

4) A **single-layer perceptron** has **3 input** units and **3 output** units. How many weights does this network have?

a) 6 **b) 9**

c) 18 **d) 25**

5) Which of the following **2 input** Boolean logic functions are **linearly separable**?

(i) AND

x_1	x_2	d
0	0	0
0	1	0
1	0	0
1	1	1

(ii) OR

x_1	x_2	d
0	0	0
0	1	1
1	0	1
1	1	1

(iii) XOR

x_1	x_2	d
0	0	0
0	1	1
1	0	1
1	1	0

(iv) NAND

x_1	x_2	d
0	0	1
0	1	1
1	0	1
1	1	0

(v) NOT XOR

x_1	x_2	d
0	0	1
0	1	0
1	0	0
1	1	1

a) **(i) and (iv)** **b)** **(iii) and (v)**

c) **. (i), (ii) and (iii)** **d)** **(i), (ii) and (iv)**

6) 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**

7) 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**

8) What does the following MATLAB function do?

net = newff (minmax (p), [10, 3], {'tansig', 'logsig'});

a)	**Initialize a multi-layer network with 10 hidden units, 3 output units and sigmoid activation functions.**
b)	**Initialize a multi-layer network with sigmoid activation functions, 10 hidden units and 3 recurrent connections back to the input layer.**
c)	**Initialize a single-layer network with 10 input units, 3 output units and linear activation functions.**
d)	**Initialize a multi-layer network with non-linear activation functions and two hidden layers – the first hidden layer has 10 units and the second one has 3 units.**

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 ***(4 marks)***

a) Explain the operation of **dendrite**, **soma**, and **axon** in the biological neuron. ***(2.5 marks)***

Solution

b) Given a two-input neuron with the following parameters: ***(1.5 marks)***

$\boldsymbol{b} = \mathbf{1.2}, \mathbf{W} = [\mathbf{3\ 2}], \boldsymbol{p} = [\mathbf{-5\ 6}]^{\boldsymbol{T}}$, calculate the neuron output for the following transfer functions:

- **A symmetrical hard limit transfer function.**
- **A saturating linear transfer function.**
- **A logistic sigmoid (logsig) transfer function.**

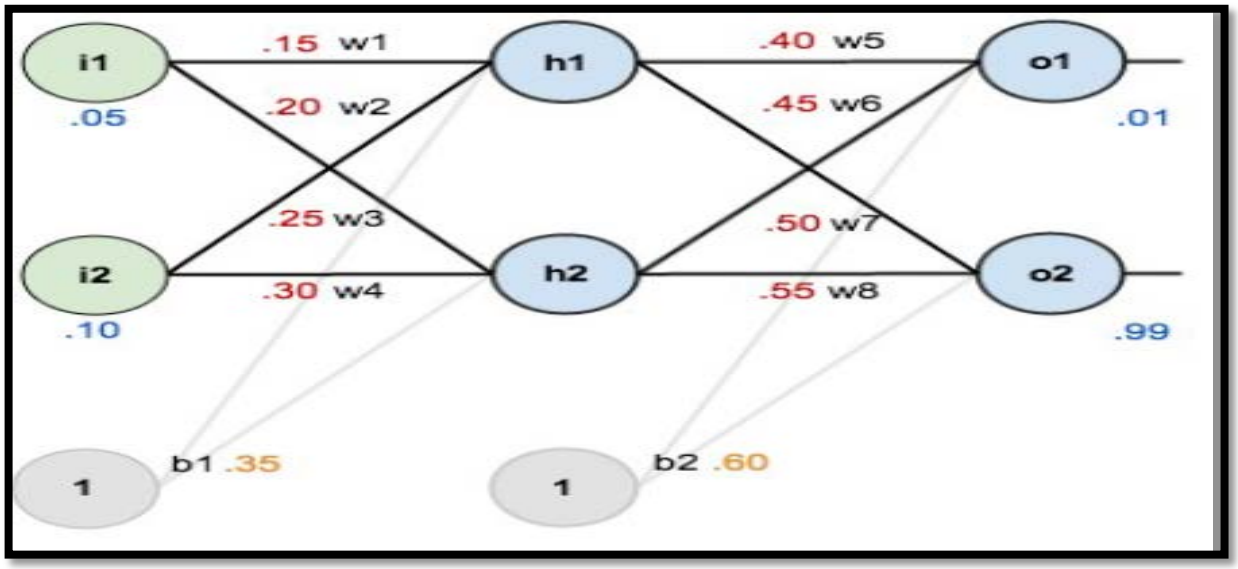
Solution

Question 3 ***(4 marks)***

Calculate the **neural network outputs** and their **errors** for the feedforward neural network with two inputs, two hidden neurons, two output neurons as shown in the diagram.

- The initial weights, the biases, and training inputs/outputs are given in the diagram.
- Single training set: given inputs **0.05** and **0.10**, the neural network targets **0.01** and **0.99**.
- The activation function for hidden and output neurons is the logistic sigmoid function:

$$\frac{1}{1+e^{-x}}$$



Solution

Question 4 *(4 marks)*

Write matlab code to

- Train a **Perceptron** network to classify two groups of data points, as illustrated below.
- Test your final network object with the following two points **P7(2,3,88,23)** and **P8(7,7,-3,-3).**

Input Vectors	Features				Class
	F1	**F2**	**F3**	**F4**	
P1	**10**	**5**	**-3**	**-2**	**0**
P2	**15**	**10**	**-7**	**0**	**0**
P3	**1**	**2**	**30**	**20**	**1**
P4	**4**	**9**	**55**	**15**	**1**
P5	**7**	**3**	**-5**	**-7**	**0**
P6	**22**	**15**	**23**	**9**	**1**

Solution

GOOD LUCK