Philadelphia University
Faculty of Engineering

Marking Scheme

Exam Paper

BSc CE

Neural Networks and Fuzzy Logic (630514)

First Exam First semester Date: 19/11/2015

Section 1

Weighting 20% of the module total

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Marking Scheme

Neural Networks and Fuzzy Logic (630514)

The presented exam questions are organized to overcome course material through 4 questions.
The *all questions* are compulsory requested to be answered.

Marking Assignments

Question 1 This question is attributed with 8 marks if answered properly; the answers are as following:

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 $w_1 = 3$ and $w_2 = 1$ and a threshold value $T = 0.4$. What output does it give for the input $x_1 = 1, x_2 = 2$?

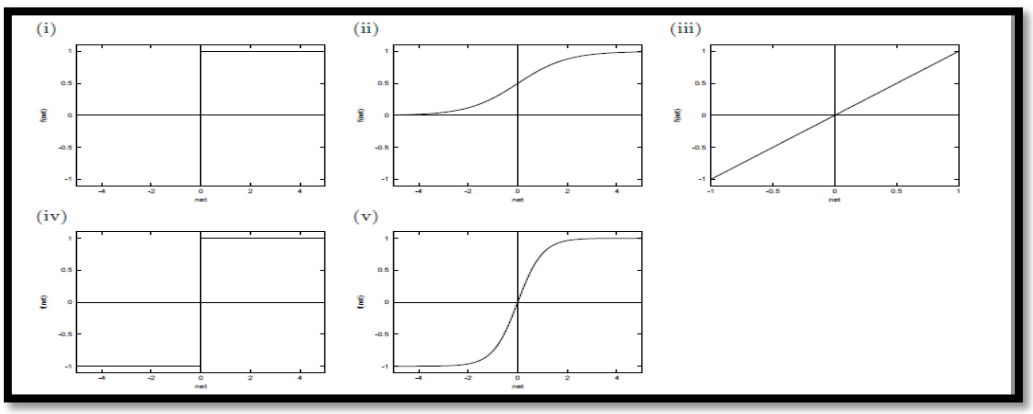
a) **3 * 1 + 1 * 2 = 5.**

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?

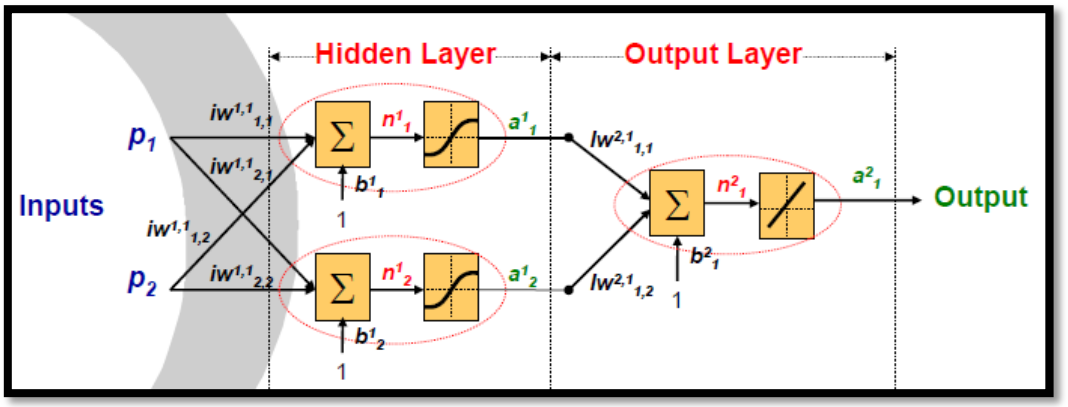
net = newff (minmax (p), [4, 2], {'tansig', 'logsig'});

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.**

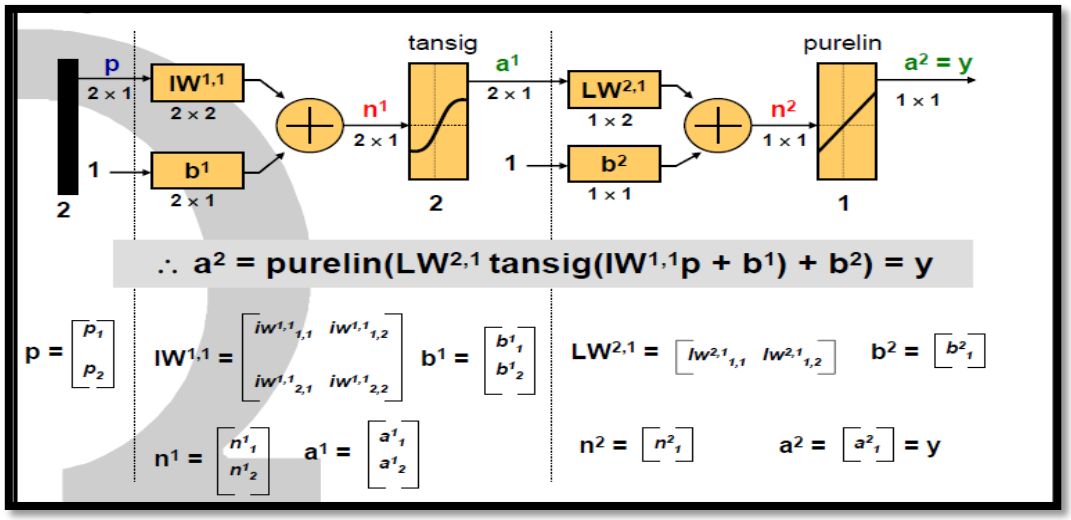
Question 2 This question is attributed with 3 marks if answered properly; the answers are as following:

Solution

standard notation



MATLAB abbreviated notation



Question 3 This question is attributed with 3 marks if answered properly; the answers are as following:

a) ***(1.5 marks)***

Solution

(i) They have the ability to learn by example

(ii) They are more faults tolerant because they are always able to respond and small changes in input do not normally cause a change in output.

(iii) Because of their parallel architecture, they are more suited for real time operation due to their high 'computational' rates.

b) ***(1.5 marks)***

Solution

[1]. For the hard limit **transfer function:**

$$a = hardlim(1.6) = 1.0$$

[2]. For the linear transfer **function:**

$$a = purelin(1.6) = 1.6$$

[3]. For the log-sigmoid **transfer function:**

$$a = logsig\,(1.6) = \frac{1}{1+e^{-1.6}} = 0.8320$$

Question 4 This question is attributed with 6 marks if answered properly; the answers are as following:

Solution

```
% Load the data points into Workspace
Points = [ -3   -2   -1.5  -1   -1    0    0      1; ...
           -0.5  -1.2  0.7   3   -3.5   2   -2.5   0.7];
Group = [  0    0     1     1    0     1    0      1];          % 1 mark
% Assign training inputs and targets
P = Points; % inputs
T = Group; % targets
% Construct a two-input, single-output perceptron
net = newp (minmax (P), 1);                                    % 0.5 mark
% Train the perceptron network with training inputs (p) and targets (t)
net = train (net, P, T);                                       % 0.5 mark
% Simulate the perceptron network with same inputs again
a = sim (net, P);                                              % 0.5 mark
%>> a =
%0 0 1 1 0 1 0 1 % correct classification
%>> T =
%0 0 1 1 0 1 0 1
% Querying the perceptron with inputs it never seen before
P9 = [-2; -3];
P10 = [0.5; 4];                                                % 0.5 mark
a_P9 = sim (net, P9)                                           % 0.5 mark
%>> a_P9 =
%0
a_P10 = sim (net, P10);                                        % 0.5 mark
%>> a_P10 =
%1; ∴ the perceptron classifies P9 and P10 correctly.
```