Philadelphia University
Faculty of Engineering

Marking Scheme

Exam Paper

BSc CE

Neural Networks and Fuzzy Logic (630514)

First Exam Summer semester Date: 01/08/2017

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) 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			(ii) OR			(iii) XOR			(iv) NAND			(v) NOT XOR		
x_1	x_2	d	x_1	x_2	d	x_1	x_2	d	x_1	x_2	d	x_1	x_2	d
0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
0	1	0	0	1	1	0	1	1	0	1	1	0	1	0
1	0	0	1	0	1	1	0	1	1	0	1	1	0	0
1	1	1	1	1	1	1	1	0	1	1	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.**

Question 2 This question is attributed with 4 marks if answered properly; the answers are as following:

a) ***(2.5 marks)***

Solution

Components of a neuron

- The dendrites of a neuron receive the information by special connections, the synapses (Incoming signals from other neurons or cells are transferred to a neuron by synapses).
- The signals are electric impulses that are transmitted across a synaptic gap by means of a chemical process. The action of the chemical transmitter modifies the incoming signal (typically, by scaling the frequency of the signals that are received) in a manner similar to the action of the weights in an artificial neural network.
- Some synapses transfer a strongly stimulating signal, some only weakly stimulating ones.
- Dendrites branch like trees and receive electrical signals from many different sources, which are then transferred into the nucleus of the cell.
- In the soma the weighted information is accumulated.
- After the cell nucleus (soma) has received a plenty of activating (=stimulating) and inhibiting (=diminishing) signals by synapses, the soma accumulates these signals. If the accumulated signal exceeds a certain value (called threshold value), the soma of the neuron activates an electrical pulse which then is transmitted to the neurons connected to the current one.
- The axon transfers outgoing pulses.

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

Solution

First calculate the net input:

$$\boldsymbol{n} = \mathbf{Wp} + \boldsymbol{b} = [3 \;\; 2]\begin{bmatrix}-5\\6\end{bmatrix} + (1.2) = -1.8$$

Now find the outputs for each of the transfer functions.

i. a = hardlims(−1.8)= −1
ii. a = satlin(−1.8) = 0
iii. a = logsig(−1.8) = 0.1419

Question 3 This question is attributed with 4 marks if answered properly; the answers are as following:

Solution

$$net_{h1} = w_1 * i_1 + w_2 * i_2 + b_1 * 1$$

$$net_{h1} = 0.15 * 0.05 + 0.2 * 0.1 + 0.35 * 1 = 0.3775$$

$$out_{h1} = \frac{1}{1+e^{-net_{h1}}} = \frac{1}{1+e^{-0.3775}} = 0.593269992$$

$$out_{h2} = 0.596884378$$

$$net_{o1} = w_5 * out_{h1} + w_6 * out_{h2} + b_2 * 1$$

$$net_{o1} = 0.4 * 0.593269992 + 0.45 * 0.596884378 + 0.6 * 1 = 1.105905967$$

$$out_{o1} = \frac{1}{1+e^{-net_{h1}}} = \frac{1}{1+e^{-1.105905967}} = 0.75136507$$

And carrying out the same process for o_2 we get:

$$out_{o2} = 0.772928465$$

Calculating the Total Error

$$E_{total} = \sum \frac{1}{2}(target - output)^2$$

$$E_{o1} = \frac{1}{2}(target_{o1} - out_{o1})^2 = \frac{1}{2}(0.01 - 0.75136507)^2 = 0.274811083$$

$$E_{o2} = 0.023560026$$

$$E_{total} = E_{o1} + E_{o2} = 0.274811083 + 0.023560026 = 0.298371109$$

<u>Question 4</u> This question is attributed with 4 marks if answered properly; the answers are as following:

Solution

```
% Load the data points into Workspace
Points = [   10      15      1       4       7       22;
             5       10      2       9       3       15;
             -3      -7      30      55      -5      23;
             -2      0       20      15      -7      9];
Group =[0    0       1       1       0       1];                        % 1 mark
% Assign training inputs and targets
P = Points; % inputs
T = Group; % targets
% Construct a four-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
P7= [2;3;88;23];
P8 = [7;7;-3;-3];                                                      % 0.5 mark
a_P7 = sim (net, P7)                                                   % 0.5 mark
%>> a_P7 =
%1
a_P8 = sim (net, P8);                                                  % 0.5 mark
%>> a_P8 =
%0
```