PMSCS Program
Department of Computer Science and Engineering
Jahangirnagar University, Savar, Dhaka
M. Sc. in Computer Science, Final Examination, Summer 2016
PMSCS 677: Artificial Neural Networks

Full Marks: 60 **Duration: 3 hours**

[There are eight questions. Answer any six questions.]

1. (a) Give an analogy between biological neuron and artificial neuron. 3

   (b) Show a simple schematic diagram of a perceptron. 3

   (c) Explain the sigmoid activation function used in neural networks. Why this activation function is widely used in multi-layer neural network? 4

2. (a) Explain supervised, unsupervised and competitive learning. 3

   (b) Critically comment on the learning rate for training a neural network. 3

   (c) Describe the MSE learning algorithm for a single-layer perceptron. 4

3. (a) Explain a neural network that can be used to classify data which follow OR type decision process. 3

   (b) What is the basic difference between Perceptron and ADALINE? Also mention the applications of ADALINE. 3

   (c) Describe back propagation neural network training algorithm. 4

4. (a) *Explain with an example the technique of overcoming the main limitation of single-layer Perceptron.* 3

   (b) Discuss Hebbian learning principle. 3

   (c) Draw and describe the schematic diagrams of ADALINE and MADALINE. 4

5. Consider the following set of training vectors (patterns) X_1 and X_2 are used in training a Rosenblatt's single-layer Perceptron. The desired outputs, initial weights and learning rate are given below. Calculate the updated weight matrix after the two run forward. 10

$$X_1 = \begin{bmatrix} -1 \\ -1 \end{bmatrix}; \quad X_2 = \begin{bmatrix} -1 \\ 1 \end{bmatrix} \quad d = \begin{bmatrix} 1 \\ -1 \end{bmatrix}; \quad \textit{initial weight}, W^0 = \begin{bmatrix} 1 \\ 1 \end{bmatrix};$$

$$\textit{learning rate}, \quad \eta = 0.1$$

6. A SOM (self organizing map) network has 5-2 architecture. It is trained using the following training samples to cluster the samples into two clusters (1 and 2): 10

   i1: (1, 1, 0, 0, 0)
   i2: (0, 0, 0, 1, 1)
   i3: (0, 1, 0, 0, 1)

   The network is trained for two iterations. After that the samples are classified into clusters. Assume learning rate η=0.6. If a new sequence (1, 0, 0, 1, 0) is applied then which cluster it belongs to?

7. The following three pattern pairs are stored in a Kosko's energy BAM:. 10

   $X_1 = (1, -1, -1, -1, -1, 1)$ $Y_1 = (1, 1, -1, -1, -1)$
   $X_2 = (-1, 1, 1, -1, -1, -1)$ $Y_2 = (1, -1, 1, -1, -1)$
   $X_3 = (-1, -1, 1, -1, 1, 1)$ $Y_3 = (-1, 1, 1, 1, -1)$

   Show that if X_3 is given to the network as a testing pattern then Y_3 will be retrieved.

8. (a) Write short notes on associative memory. 4

   (b) Consider the following patterns are stored in an auto-associative Hopfield memory. 6

   A_1=[-1, 1, -1, 1], A_2=[1, 1, 1, -1], A_3=[-1, -1, -1, 1].

   (i) If a testing pattern A_2 is given to the network, then show which pattern will be retrieved?

   (ii) If a new pattern A=[1,1,1,1] is given to the network, then show which pattern will be retrieved?

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PMSCS 677: Artificial Neural Networks

Full Marks: 60 **Duration: 3 hours**

[There are eight questions. Answer any six questions.]

1. (a) Show a simple schematic diagram of a neural model. 3.5
   (b) Describe three commonly used activation functions for neural networks. 4.5
   (c) Give an analogy between biological neuron and artificial neuron. 2
2. (a) Explain supervised and unsupervised learning. 3
   (b) Describe the MSE leanring mechanism for a simple perceptron. 4
   (c) Explain AND type decision making process using perceptron. 3
3. (a) Draw and describe the schematic diagrams of ADALINE and MADALINE. 6
   (b) What is the basic difference between Perceptron and ADALINE? 2
   (c) Mention practical applications of ADALINE and MADALINE. 2
4. (a) What is the main limitation of single-layer Perceptron? Describe it using an example. Discuss a mechanism to overcome it. 6
   (b) Discuss Hebbian learning principle. 4
5. Consider the following set of training vectors (patterns) X_1 and X_2 are used in training a Rosenblatt's single-layer Perceptron. The desired outputs, initial weights and learning rate are given below. Calculate the updated weight just after the one run forward. 10

$$X_1 = \begin{bmatrix} -1 \\ -1 \end{bmatrix}; \quad X_2 = \begin{bmatrix} -1 \\ 1 \end{bmatrix} \quad d = \begin{bmatrix} 1 \\ -1 \end{bmatrix}; \quad W^0 = \begin{bmatrix} 1 \\ 1 \end{bmatrix}; \quad \textit{learning rate}, \quad \eta = 0.1$$

6. (a) Describe back propagation neural network training algorithm. Also explain why this algorithm is called 'back propagation'? 7
   (b) Write short notes on "Exponential BAM (eBAM)". 3
7. Consider a Kosko's BAM: the following three pattern pairs are stored. 10

$X_1 = (1, -1, -1, -1, -1, 1)$ $\quad Y_1 = (1, 1, -1, -1, -1)$
$X_2 = (-1, 1, 1, -1, -1, -1)$ $\quad Y_2 = (1, -1, 1, -1, -1)$
$X_3 = (-1, -1, 1, -1, 1, 1)$ $\quad Y_3 = (-1, 1, 1, 1, -1)$

Show that if X3 is given to the network as a testing pattern then Y3 will be retrieved.

8. (a) What is an associative memory? 4
   (b) Consider the following patterns are stored in an auto-associative Hopfield memory. 6

A_1=[-1, 1, -1, 1], A_2=[1, 1, 1, -1], A_3=[-1, -1, -1, 1].

   (i) If a testing pattern A_2 is given to the network, then show which pattern will be retrieved?
   (ii) If a new pattern A=[1,1,1,1] is given to the network, then show which pattern will be retrieved?

Neural Network

EMCS Program
Department of Computer Science and Engineering
Jahangirnagar University, Savar, Dhaka
M. Sc. in Computer Science Final Examination, Spring 2015
EMCS 677: Artificial Neural Networks

Full Marks: 60 **Duration: 3:00 hours**

[There are eight questions. Answer any six questions.]

1. (a) Discuss the differences between ANN and biological neural network and also draw some analogy. 4
   (b) What is a Perceptron? Describe the MSE algorithm for training perceptron. 6

2. (a) What is the main limitation of single-layer Perceptron? Describe it using an example. Discuss a mechanism to overcome it? 7
   (b) Describe different types of activation functions used in neural networks. 3

3. (a) What is the basic difference between Perceptron and ADALINE? 2
   (b) Describe along with diagrams the ADALINE and MEDALINE. Also mention their one important practical application. 8

4. (a) Explain supervised and unsupervised learning? 3
   (b) Consider the following set of training vectors (patterns) X_1 and X_2 are used in training a Rosenblatt's single-layer Perceptron. The desired outputs, initial weights and learning rate are given below. Calculate the updated weight just after the one run forward. 7

$$X_1 = \begin{bmatrix} 0.5 \\ -1 \\ 0 \\ 1 \end{bmatrix}; \quad X_2 = \begin{bmatrix} -1 \\ 1 \\ 0.5 \\ -1 \end{bmatrix}; \quad d = \begin{bmatrix} 1 \\ -1 \end{bmatrix}; \quad W^0 = \begin{bmatrix} 1 \\ -1 \\ 0 \\ 0.5 \end{bmatrix}; \quad \alpha = 0.15$$

5. (a) Write down the back propagation neural network training algorithm. Also explain why this algorithm is called 'back propagation'? 8
   (b) Mention some applications of back propagation algorithm. 2

6. (a) Discuss Hebbian learning rule. 2
   (b) Describe the working principle along with recognition algorithm of auto-associative Hopfield memory. 6
   (c) Write a short note on Hamming distance. 2

7. Consider Kosko's BAM has stored the following pattern pairs. 10

X_1=[-1, 1, 1, -1, -1] Y_1=[1, -1, 1, -1],
X_2=[1, 1, 1, -1, -1] Y_2=[1, 1, 1, -1].

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Full Marks: 10 **Duration: 20 mins.**

Answer any two of the following questions

1. Write down the analogy of important components between biological neural network and artificial neural network. 5
2. Explain supervised learning and unsupervised learning. 5
3. Explain three common activation functions used in neural networks. 5

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Full Marks: 60 **Duration: 3 hours**

[There are eight questions. Answer any six questions.]

1. (a) Describe the concept of artificial neural network and biological neural network and also draw analogy between these two. 5

   (b) Explain different types of activation functions used in neural networks. 3

   (c) Draw a basic neural network model. 2

2. (a) What do you mean supervised and unsupervised learning? 3

   (b) Describe a basic perceptron's learning MSE algorithm. 4

   (c) Explain AND type decision making process using perceptron. 3

3. (a) Draw the schematic diagrams of ADALINE and MADALINE. 6

   (b) What is the basic difference between Perceptron and ADALINE? 2

   (c) Mention practical applications of ADALINE and MADALINE. 2

4. (a) What is the main limitation of single-layer Perceptron? Describe it using an example. Discuss a mechanism to overcome it. 6

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5. Consider the following set of training vectors (patterns) X_1 and X_2 are used in training a Rosenblatt's single-layer Perceptron. The desired outputs, initial weights and learning rate are given below. Calculate the updated weight just after the one run forward. 10

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6. (a) Describe back propagation neural network training algorithm. Also explain why this algorithm is called 'back propagation'? 7

   (b) Write short notes on Exponential BAM. 3

7. (a) Explain competitive learning in the perspective of SOM. 3

   (b) Describe SOM algorithm with the help of an example. 7

8. (a) Explain associative memory. 4

   (b) Consider the following patterns are stored in an auto-associative Hopfield memory. 6

   A_1=[1, -1, -1, 1, 1], A_2=[-1, 1, -1, 1, 1], A_3=[1, 1, 1, -1, 1].

   If a testing pattern A=[-1, -1, -1, 1, 1] is given to the network, then what pattern will be retrieved?

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6. A SOM (self organizing map) network has 5-2 architecture. It is trained using the following training samples to cluster the samples into two clusters (1 and 2): 10

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$X_2 = (-1, 1, 1, -1, -1, -1)$ $\quad Y_2 = (1, -1, 1, -1, -1)$
$X_3 = (-1, -1, 1, -1, 1, 1)$ $\quad Y_3 = (-1, 1, 1, 1, -1)$

Show that if X_3 is given to the network as a testing pattern then Y_3 will be retrieved.

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   (b) Consider the following patterns are stored in an auto-associative Hopfield memory. 6

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