Uva Wellassa University, Sri Lanka
End Semester Examination – December 2009
CST416-2 Neural Network

Time: Two (02) hours

Total 04 Questions.
Answer **ALL** questions.

Question 1.

(a) Considering the processing function to be step processing function with a threshold, show the functioning mechanism of a neuron in a simple feed forward artificial neural network. (05 marks)

(b) Explain the influencing factors of functioning of a biological neuron for the scientists to design artificial neuron functioning as in *part (a)*, including similarities of those factors. (05 marks)

(c) Explain the difference of the functioning mechanisms of artificial neuron mentioned in *part (a)*, compared with the biological neuron. (05 marks)

(d) Comment on the following statements:

(i) Sigmoid function is introduced to ANN processing functions as it is similar to Step processing function.

(ii) Use of Bias in Artificial Neural Network.

(iii) Momentum can be used to avoid paralyzed training in ANN.

(iv) Human use associate memory space as well as rule base in computing mathematical operation.

(10 marks)

Question 2.

(a) In the application of the *backpropagation algorithm*, there are two passes of computation: the *forward pass* and the *backward pass*. How will you distinguish between these two passes? Illustrate your answer by using a diagram showing the activations involved in each pass of a backpropagation network. (02 marks)

(b) Explain why the weights in a neural network which are to be trained by the backpropagation algorithm are given random initial starting values rather than identical starting values? (03 marks)

(c) The network shown in Figure Q2 when properly trained should respond with $[1, 0.6]^T$ to the input pattern $[1, 2, -2]^T$ and with $[0.6, 1]^T$ to the input pattern $[0.5, -2, 0.9]^T$. Perform a single cycle of the network using the backpropagation algorithm for a learning rate of 0.9. For the activation function, select an appropriate Sigmoid function. (10 marks)

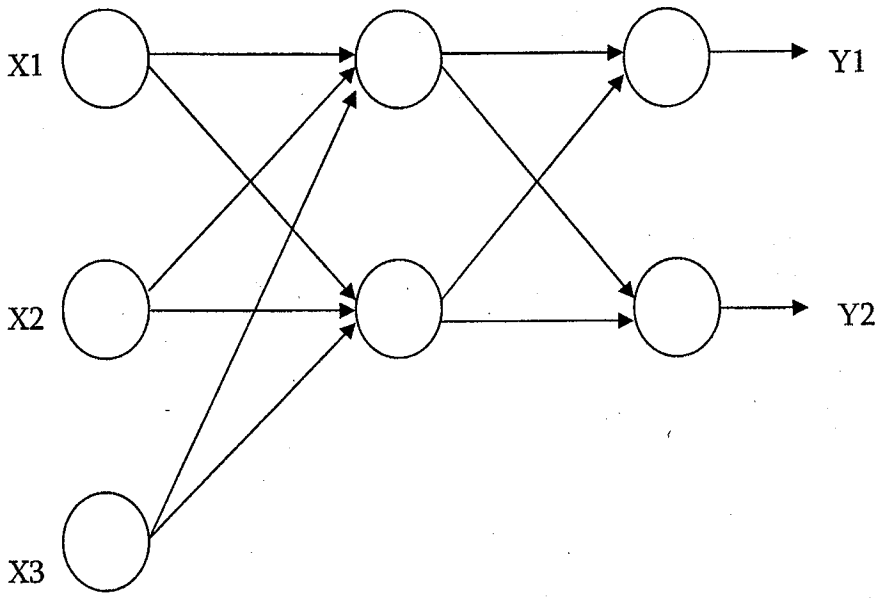

Fig Q2

(d) The following are deficiencies of the backpropagation algorithm. Explain the deficiency and suggest remedies to minimize their influence on the learning/training/usage of the neural network.

(i) Deficiencies associated with the gradient descent method when applied to the weight update. (05 marks)

(ii) Deficiencies associated with network paralysis as a result of using the sigmoid activation function. (05 marks)

Question 3.

(a) The Hebb rule is sometimes used by converting the binary training patterns (inputs and targets) to bipolar form to find the weight matrix. Apply this procedure to find the weight to store the following classifications:

$s(1) = (1, 0, 1), t(1) = 1$

$s(2) = (1, 1, 0), t(2) = 0$

(10 marks)

(b) Using binary step function (with threshold 0) as the input unit's activation function, test the response of your network on each of the binary training patterns. (05 marks)

(c) Using bipolar step function (with threshold 0) as the output unit's activation function, convert the training pattern to bipolar form and test the network response again. (05 marks)

(d) Test the response of your network on each of the following noisy versions of the bipolar form of the training patterns: (0, -1, 1), (0, 1, -1), (0, 0, 1), (0, 0, -1), (0, 1, 0), (1, 0, -1), (1, -1, 0), (1, 0, 0), (1, 1, 0), and (1, 1, 1). Which of the response are correct, which are incorrect and which are indefinite (undetermined)? (05 marks)

Question 4.

(a) Explain the essential differences between programming a computer and training a neural network. What kind of information is needed for each task? What are the advantages and disadvantages of the conventional rule-based and neural network approaches? Give examples of the kinds of problems you think would be best suited to each approach. (Note:-please use a table to answer each of the questions pose here.) (05 marks)

(b) One feature that distinguishes humans from other animals is their learning and memorizing capacity. Human memory system can be broadly classified into three categories (a) Sensory memory, (b) Short-term memory, and (c) Long-term memory. Explain how these are related to an artificial neural network. (05 marks)

(c) Propose five projects for Advance Level students where they can use ANN technology. Justify your proposals. (05 marks)

(d) A big harvest of Mango, Orange, Woodapple and Pineapple is collected at an orchard daily. Such fruits are collected at a common place. Those fruits travel on the belt and get separated in to four heaps. The fruits reaching the end of the belt get focused to a video camera and the data fed to a system. There by separate the fruits in to four such heaps. Describe how the ANN technology can be applied to design the above stated computer program. (05 marks)

(e) After collecting considerable data of decisions taken by several experienced pilots on operating air craft's; an ANN has trained in order to make precise decisions under various circumstances. It is said that such an ANN is most suitable than an experienced pilot in making decisions at an emergent situation. Comment in support of the above statement. (05 marks)

2