Uva Wellassa University, Sri Lanka
Faculty of Science & Technology
Computer Science & Technology Degree Program
1st Semester Examination – March 2011
CST 416-2 Neural Network

Time: **Two (02)** hours | Total **04** Questions | Answer **ALL** questions

Question 1. **(25 marks)**

(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.

(b) *McCulloch-Pitts* neurons are the simplest form of model neurons. Describe the operation of a *McCulloch-Pitts* model neuron and its relationship to a real neuron.

(c) Describe how a single McCulloch-Pitts neuron (with either a bias input or a threshold) may be used to implement a 2-input *NOR gate*.

(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.

Question 2. **(25 marks)**

(a) Mention three types of *supervised learning.*

(b) With a *supervised learning* algorithm, we can specify target output values, but we may never get close to those targets at the end of learning. Give two reasons why this might happen.

(c) Why can't the *XOR problem* be solved by a one-layer perceptron?

(d) Describe the competitive process of the *Self-Organizing Map* algorithm.

(e) Describe the relationship between the *Self-Organizing Map* algorithm, and the *Learning Vector Quantization* algorithm.

Question 3. **(25 marks)**

(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.

(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?

(c) The network shown in Figure-1 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 $\eta = 0.9$ and $\lambda = 1$. For calculation assume $f(net) = \frac{2}{1+e^{-\lambda net}} - 1$, $f'(net) = \frac{1}{2}(1 - f(net)^2)$ and $E_{max} > error$.

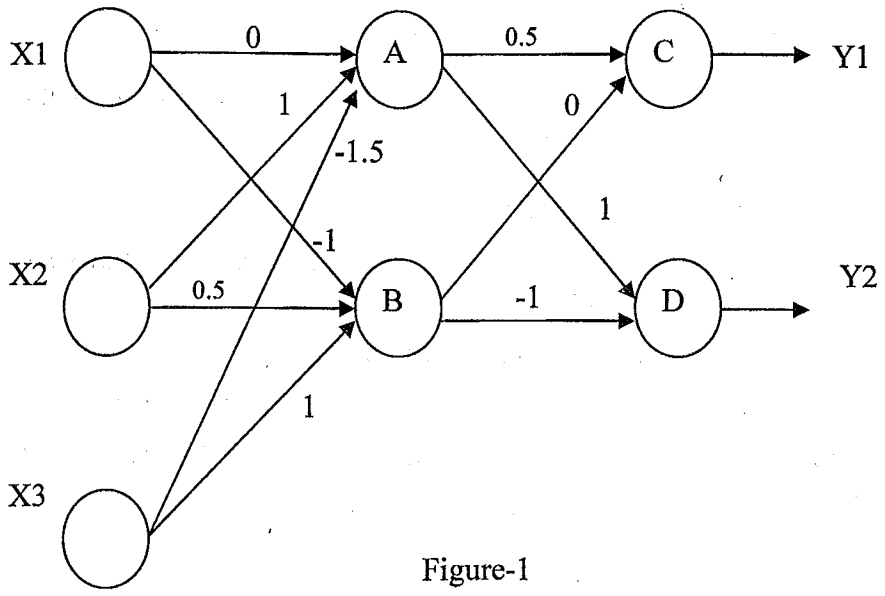

Figure-1

(d) Apply the *Hebb rule* to the training patterns define the *XOR* function.

(e) Using the *Hebb rule*, find the weight required to perform the following classifications: Vectors (1, 1, 1, 1) and (-1, 1, -1, -1) are members of the class (and therefore have target value 1); vectors (1, 1, 1, -1) and (1, -1, -1, 1) are not members of the class (and have target value -1).

Question 4. **(25 marks)**

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

(b) 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.

(c) A surveillance camera is used to observe the main hall of an office building. From the position of visitors in the camera frame, want to compute their position on the building map. Describe a neural network that could be used to achieve this task. How can the system be calibrated?

(d) Describe a neural network that could be used to identify the colour of human skin in a computer vision application. How can it be trained?

(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 emergency situation. Comment in support of the above statement.