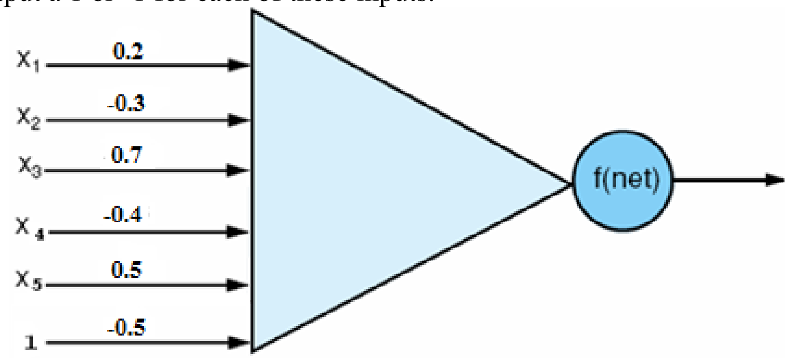
CSC 425/525 Homework #8 (Chapter 11)
Due Date: Wednesday, April 5

Word process all answers. Figures may be hand drawn. Undergraduates answer question 1 and four of the remaining questions. Graduate students answer all seven questions.

1. Given the following perceptron with the linear threshold activation function, determine whether it will output a 1 or -1 for each of these inputs.



   a. x1 = 1, x2 = 1, x3 = 0, x4 = 0, x5 = 1
   b. x1 = 0, x2 = 1, x3 = 1, x4 = 1, x5 = 1
   c. x1 = 1, x2 = 1, x3 = 1, x4 = 0, x5 = 0
   d. Repeat a using the sigmoid activation function.
   e. Repeat b using the sigmoid activation function.
   f. Repeat c using the sigmoid activation function.

2. Can a perceptron learn the difference between a truck and a van with the following data? Explain.

Mass	Length	Type
10	6	Truck
20	5	Truck
5	4	Van
2	5	Van
2	8	Van
3	6	Truck
10	7	Truck
15	8	Truck
5	9	Truck

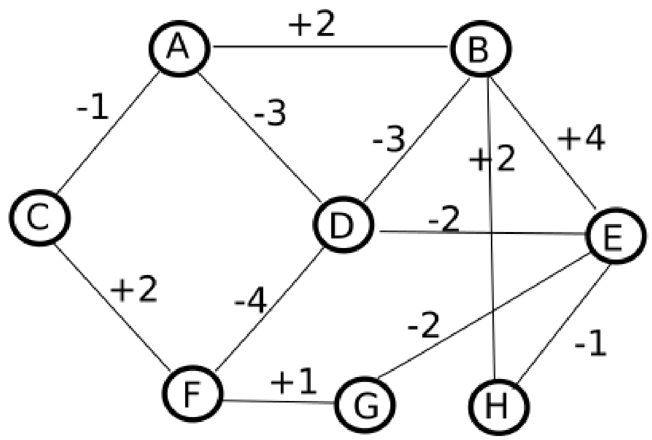
3. We have the following six associations. Use them to derive the weights for an 8 input-4 output linear associator similar to figure 11.22. You can just list the weights as a final vector, or you can draw the network.

   [-1, -1, -1, 1, 1, -1, 1, 1] → [-1, -1, 1, 1]
   [-1, 1, 1, 1, -1, -1, -1, -1] → [-1, 1, -1, -1]
   [1, 1, 1, -1, -1, -1, 1, -1] → [1, 1, 1, -1]
   [-1, -1, 1, -1, 1, -1, 1, 1] → [1, -1, -1, 1]
   [1, 1, 1, 1, 1, 1, 1, -1] → [-1, -1, -1, -1]
   [1, 1, -1, -1, -1, 1, -1, 1] → [1, -1, 1, -1]

4. In your own words, explain why it is difficult to compute the adjustments to weights leading from the hidden layer to the input layer for a feedforward backpropagation network that contains one hidden layer.

5. Research one of these SVM "kernel tricks": Fisher kernel, Gaussian kernel, Graph kernel, Polynomial kernel, RBF kernel, Sigmoid kernel, Spectrum kernel for strings (also known as the String kernel). Briefly explain how it works and list some problems it might be most suitable for being applied to.

6. Use the following Hopfield Network to answer the questions below.



a. What is the stable state reached when starting with G = 1 and H = 1 and all of the other nodes at 0?
b. What is the stable state reached when starting all nodes start at 1?
c. What is the stable state reached when starting with A = 1, C = 1 and D = 1 (all other nodes start at 0)?
d. For bonus credit, write a program which will find all of the stable states of this network and identify every stable state. With 8 nodes, there are 256 different combinations of inputs. There are 11 stable states. List them all (you do not need to submit your program, just the 11 stable states).