CS490/584 – Data Mining
HW8 Neural Network

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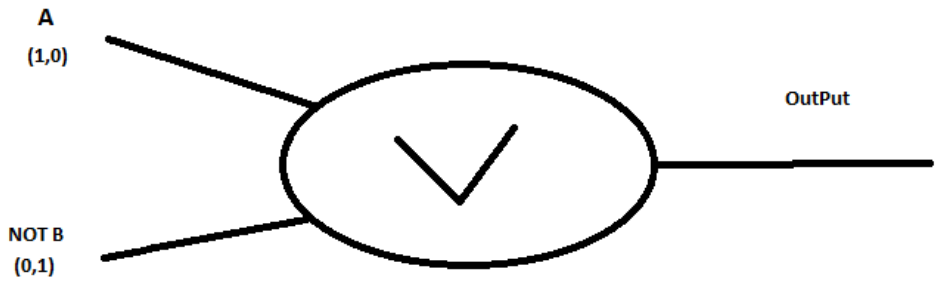
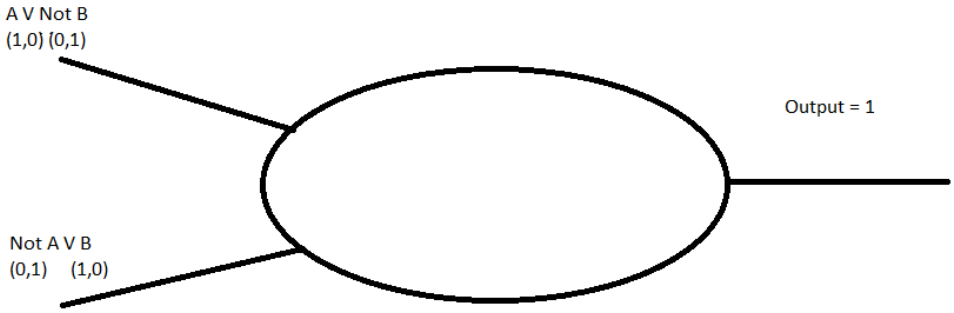
1. Define a neural network with two input units and one output unit that computes each of the following Boolean functions. Note that for each function, if it is possible to construct a Perceptron (i.e., single processing unit) that implements this function, define a set of weights that will work. If it is not possible to implement this function using a Perceptron, proof it by determining function value using a truth table and plotting the data on a 2d grid (see examples on pages 37-39 of textbook). (30 points)

   i. A ∨ ¬B



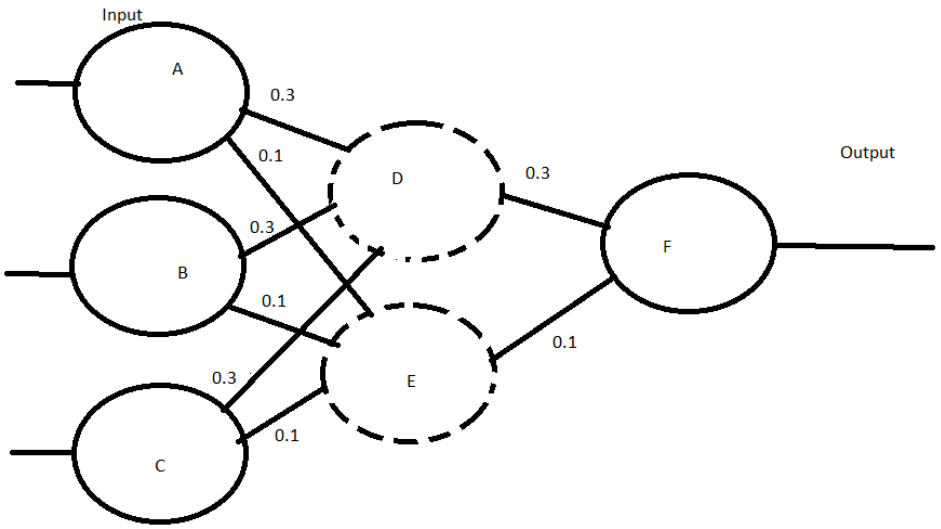
   ii. (A ∨ ¬B) ∧ (¬A ∨ B)

A	B	Not A	Not B	AV Not B	Not A V B	
1	1	0	0	1	1	
0	0	1	1	1	1	



2. Consider a learning task where there are three real-valued input units, A, B and C, and one output unit, F. You are to create a 2-layer neural network with two hidden units, D and E, defining the hidden layer. The activation function used at nodes D, E and F is the sigmoid function defined on page 45 of the textbook. Each input unit is connected to every hidden unit, and each hidden unit is connected to the output unit. The initial weights are given as: Wad = 0.3, Wae = 0.1, Wbd = 0.3, Wbe = 0.1, Wcd = 0.3, Wce = 0.1, Wdf = 0.3, Wef = 0.1.

   a. Draw the neural network as defined above. (15 points)



b. What is the output of nodes D, E and F given a training example with values A = 0.4, B = 0.5, and C = 0.2? Assume that D, E, and F all output real values as computed by their associated sigmoid function. (15 points)

D = A(0.3) + B(0.3) = 1/1+e^(-x) x = 0.27 = 0.567
D = A(0.3) + C(0.3) = 1/1+e^(-x) x = 0.18 = 0.545
D = B(0.3)+ C(0.3) = x = 0.21 = 0.552

E =A(0.1)+B(0.1) = 0.09 = 0.522
E = A(0.1)+C(0.1) = 0.06 = 0.515
E = B(0.1)+C(0.1) = 0.07 = 0.517

F = 0.567(0.3) + 0.522(0.1) = 0.1701 + 0.0522 = 0.2223 = 1/1+e^(-x) = 0.5553
F = 0.1701 + 0.0515 = 0.2216 = 1/1+e^(-x) = 0.5552
F = 0.1701 +0.0517 = 0.2218 = 1/1+e^(-x) = 0.5552
F = 0.1635 + 0.0522 = 0.2157 = 0.5537
F = 0.1635 + 0.0515 = 0.2150 = 0.5535
F = 0.1635 + 0.0517 = 0.2152 = 0.5536
F = 0.1656 + 0.0522 = 0.2178 = 0.5542
F = 0.1656 + 0.0515 = 0.2171 = 0.5541
F = 0.1656 + 0.0517 = 0.2173 = 0.5541

3. Briefly answer each of the following questions. (40 points)
   a. How do Neural Network (NN) encode knowledge and how do they learn?
   They use perceptrons to encode functions and link percptrons together with the output of one perceptron into another perceptron creating a multi-layered perceptrons to learn how to calculate functions.
   b. How do NN determine the error from output and internal nodes?
   We backpropogate by taking the error we get and refining the weights between each perceptron.
   c. What value range(s) are typically used for NN I/O and why?
   0 to 1 because the sigmond doesn't produce outside that range for output and it can be used as a percentage.

This assignment is based on the textbook "A Gentle Introduction to Neural Networks". **It is due at 5 PM on Friday April 12, 2019, and is worth 100 points. Late submission will be accepted until 8AM Friday (4/20).**