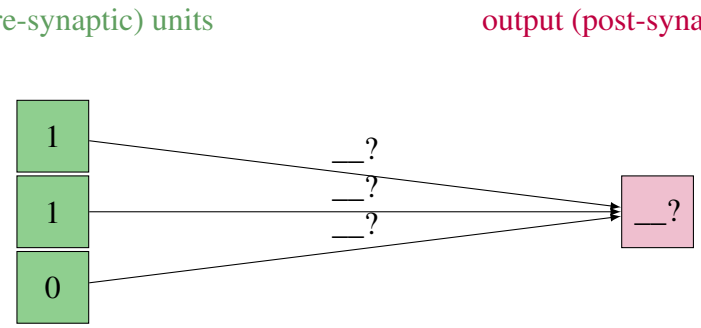
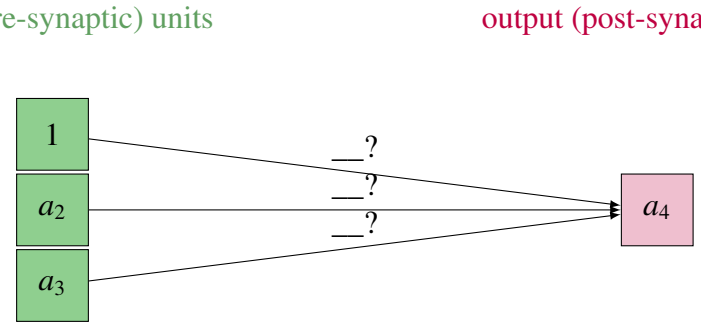
LING3804: Problem Set 1

Due via Carmen dropbox at 11:59 PM 1/26.

1. [10 pts.] Fill in weights and post-synaptic value for the 'or' neuron as defined in Section 1.3 of Lecture Notes 1, with antecedents a_2=1, a_3=0:



2. (a) [4 pts.] Using the same activation function for the 'or' neuron above, fill in weights for a neuron that outputs a_4=0 for input a_2=1, a_3=0 and a_4=1 for any other combination of 0's and 1's for a_2 and a_3 (assume the first input is always a_1=1 as in the examples in Section 1.3 of Lecture Notes 1):

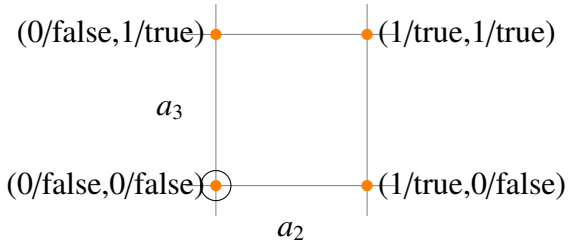


(b) [2 pts.] Show calculations for a_4 in the above figure if a_2=0, a_3=0:

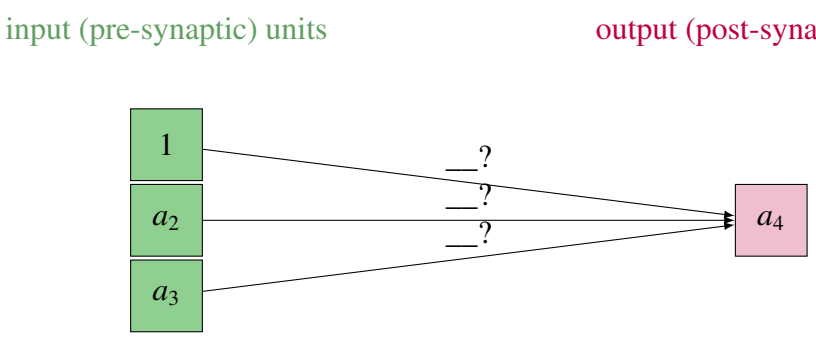
(c) [2 pts.] Show calculations for a_4 in the above figure if a_2=0, a_3=1:

(d) [2 pts.] Show calculations for a_4 in the above figure if a_2=1, a_3=1:

(e) [2 pts.] Shade the region on the below graph for which this figure outputs 1:



3. (a) [4 pts.] Using the same activation function for the 'or' neuron above, fill in weights for a neuron that outputs a_4=0 for input a_2=0, a_3=1 and a_4=1 for any other combination of 0's and 1's for a_2 and a_3 (assume the first input is always a_1=1 as in the examples in Section 1.3 of Lecture Notes 1):

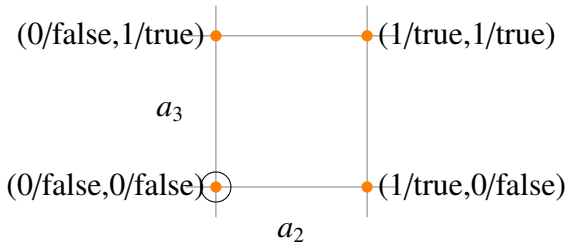


(b) [2 pts.] Show calculations for a_4 in the above figure if a_2=0, a_3=0:

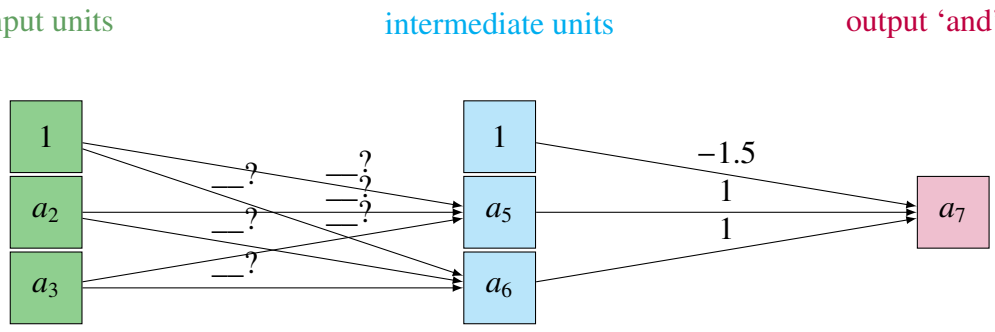
(c) [2 pts.] Show calculations for a_4 in the above figure if a_2=1, a_3=0:

(d) [2 pts.] Show calculations for a_4 in the above figure if a_2=1, a_3=1:

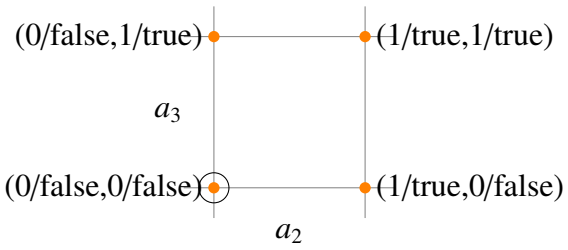
(e) [2 pts.] Shade the region on the below graph for which this figure outputs 1:



4. (a) [4 pts.] Using the two neurons from your solutions for Questions 2 and 3 above, fill in weights for a two-layer network to calculate whether two inputs are equal to each other (that is, both ones or both zeros), based on the two-layer network in Section 1.5 of Lecture Notes 1 (keep the activations for the first input and intermediate units the same as in the lecture notes, and keep the last layer weights the same, as shown in the figure):



(b) [2 pts.] Shade the region on the below graph for which this network outputs 1:



5. [10 pts.] The finite-state automaton below, taken from Section 2.1 of Lecture Notes 2, does something weird if we enter both numbers at the same time as input at time steps 1s and 2s, as shown in the figure below. Fill in the activation values in the figure to show what will happen.