Homework 3

Sunday, February 19, 2017 9:13 PM

PROBLEM 1

a. $I\left(\frac{7}{10}, \frac{2}{10}, \frac{1}{10}\right) = -\frac{7}{10}\log_2\frac{7}{10} - \frac{2}{10}\log_2\frac{2}{10} - \frac{1}{10}\log_2\frac{1}{10}$

≈ 1.157

b. $I\left(\frac{1}{3}, \frac{1}{3}, \frac{1}{3}\right) = -\frac{1}{3}\log_2\frac{1}{3} - \frac{1}{3}\log_2\frac{1}{3} - \frac{1}{3}\log_2\frac{1}{3}$

≈ 1.585

so 1a. is approx. 0.428 from max entropy

c. Gain from gender:

$$1.157 - \left[0.25\, I(.80, .12, .08) + 0.75\, I(.67, .22, .11)\right]$$

$$= 1.157 - \left[0.25\left(-.80\log_2.80 - .12\log_2.12 - .08\log_2.08\right) + 0.75\left(-.67\log_2.67 - .22\log_2.22 - .11\log_2.11\right)\right]$$

$\approx 1.157 - 1.143 \approx 0.014$

Gain from student type:

$$1.157 - \left[0.5\, I(.76, .16, .08) - 0.5\, I(.64, .24, .12)\right]$$

$$= 1.157 - \left[0.5\left(-.76\log_2.76 - .16\log_2.16 - .08\log_2.08\right) + 0.5\left(-.64\log_2.64 - .24\log_2.24 - .12\log_2.12\right)\right]$$

$+ 0.5\left(-.64 \log_2 .64 - .24 \log_2 .24 - .12 \log_2 .12\right)\Big]$

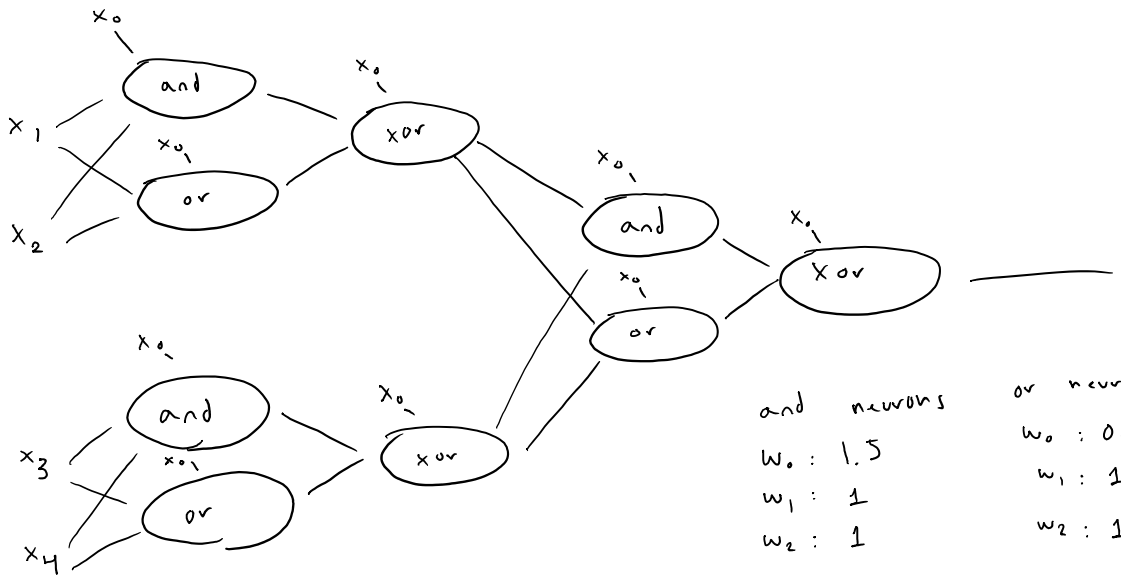
$= 1.157 - 1.144 \approx 0.013$

Based on this information, using gender as a first decision results in slightly more information gain.

PROBLEM 3

a. Single perceptron, $w_0 = 4$, $w_1 - w_7 = 1$

b. Multilayer perceptron, using logic of 3 XOR gates



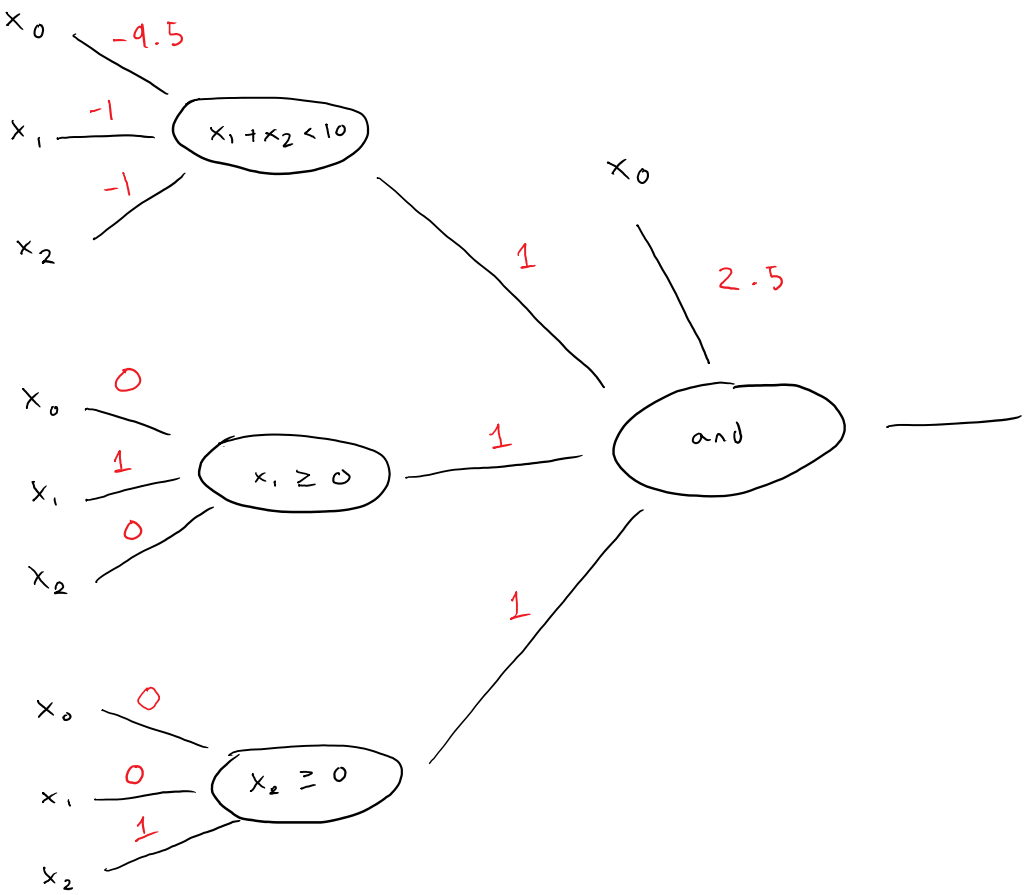
and neurons
w_0 : 1.5
w_1 : 1
w_2 : 1

or neurons
w_0 : 0.5
w_1 : 1
w_2 : 1

xor neurons
w_0 : 0.5
w_1 : -1
w_2 : 1

c. Single perceptron, $w_0 = 0$, $w_1 = -3$, $w_2 = 1$

d. multilayer perceptron



PROBLEM 4

Because the prediction isn't based on any attributes, and there are an equal number of both positive and negative samples, when you take one out, the opposite class gains the majority so the classifier will always be trained to classify to the opposite class of the testing sample.

Example:

100	positive
100	negative

negative sample selected as test

train	100	positive	test	1	negative
	99	negative			

Classifier picks positive but test sample is negative.