**Written Problems**

* 1. The logical functions that can be expressed as a linear classifier of the form f(x; w) = sign(w1x1 + w2x2 + b) are AND(x1, x2) and OR(x1, x2).

The w1, w2, and bias b that mimic AND are: w1 = 1, w2 = 1 and b = -1.

The w1, w2, and bias b that mimic OR are: w1 = 1, w2 = 1 and b = 1.

XOR does not work, because for any value of w and b not all the conditions can be satisfied.

* 1. The weight vectors and biases that satisfies the XOR logical functions are:

W1 = [1 1] W2 = [1 1] Wout = [-1 3]

b1 = -1 b2 = 1 bout = -3

for x1 = 1 and x2 = -1, X = [1 -1]:

h1 = W1X + b1 = -1 so sign(h1) = -1

h2 = W2X + b2 = 1 so sign(h2) = 1

so H = [-1 1], therefore f(X;W) is:

sign(WoutH + bout) = sign(4-3) = +1

for x1 = -1 and x2 = 1, X = [-1 1]:

h1 = W1X + b1 = -1 so sign(h1) = -1

h2 = W2X + b2 = 1 so sign(h2) = 1

so H = [-1 1], therefore f(X;W) is:

sign(WoutH + bout) = sign(4-3) = +1

for x1 = -1 and x2 = -1, X = [-1 -1]:

h1 = W1X + b1 = -3 so sign(h1) = -1

h2 = W2X + b2 = -1 so sign(h2) = -1

so H = [-1 -1], therefore f(X;W) is:

sign(WoutH + bout) = sign(-2-3) = -1

for x1 = 1 and x2 = 1, X = [1 1]:

h1 = W1X + b1 = 1 so sign(h1) = 1

h2 = W2X + b2 = 3 so sign(h2) = 1

so H = [1 1], therefore f(X;W) is:

sign(WoutH + bout) = sign(2-3) = -1

so it does satisfy XOR conditions.