Part 1

1.

$$(x_1 - 4)^2 + (x_2 - 4)^2 <= (x_1 - 6)^2 + (x_2 - 2)^2$$

$$x_1 - x_2 - 2 <= 0$$

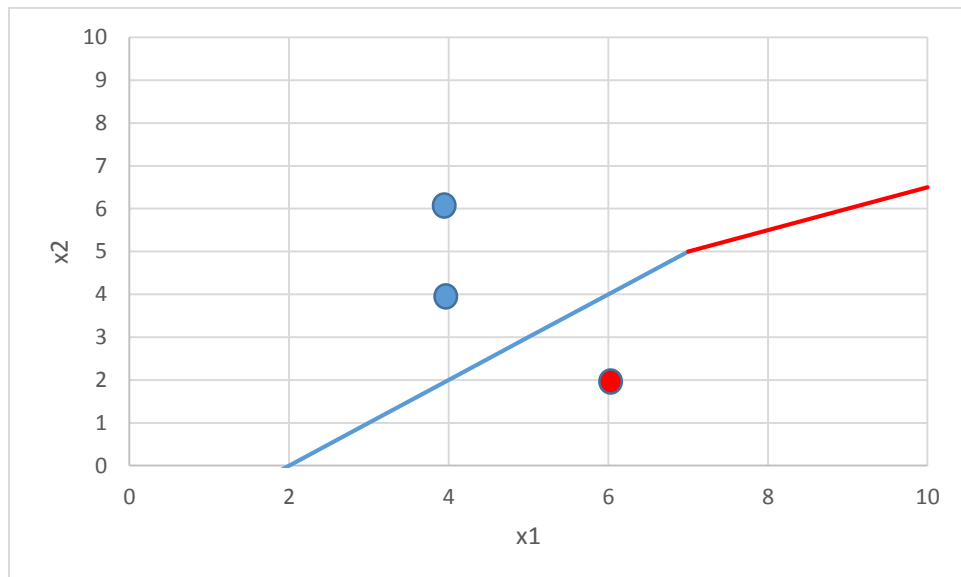Any feature satisfy this condition will be classified as pos.

$$(x_1 - 4)^2 + (x_2 - 4)^2 <= (x_1 - 6)^2 + (x_2 - 2)^2$$

$$x_1 - 2x_2 + 3 <= 0$$

Any feature satisfy this condition will also be classified as pos.

In the graph below, any point above either the blue line or the red line will be classified as pos, any point below will be neg.

$y =$
$\left\{ \begin{array}{l} \textbf{Pos} \text{ if } x_1 - x_2 - 2 <= 0 \text{ when } 0 <= x_1 <= 7 \textbf{ or } \; x_1 - 2x_2 + 3 <= 0 \text{ when } 7 <= x_1 <= 10 \\ \\ \textbf{Neg} \text{ in other condition} \end{array} \right.$

2.

The nearest neighbor for (7, 10) is node e at (5, 10)

	distance	bet distance	best node	priority queue
		∞		(f, 0)
pop f	7.07	7.07	f	(h, 0) (c, 1)
pop h	7.07	7.07	f	(i, 0) (c,1) (g, 5)
pop i	3	3	i	(c, 1) (j, 3) (g, 5)
pop c	2	2	c	(e, 0) (b, 0) (j, 3) (g, 5)
pop e	7.81	2	c	(b, 0) (d, 0) (j, 3) (g, 5)
pop b	4.47	2	c	(d, 0) (j, 3) (a, 4) (g, 5)
pop d	5.39	2	c	(j, 3) (a, 4) (g, 5)
pop j	return c			

3.
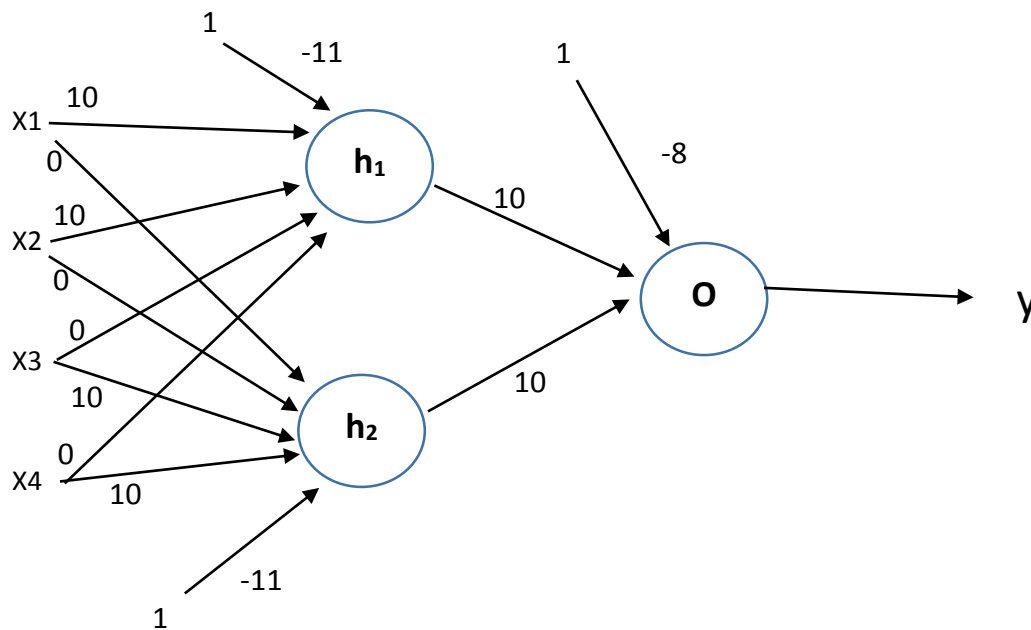
4.

Let $f(a) = 1/(1 + e^{-a})$

Output of node C = f (0 * 1 + 1 * (-0.5) + 1 * (-0.5)) = f(-1) = 0.2689

Output of node D = f (0 + 1 − 1) = 0.5

Output of node E = f (0.2689 * (-2) + 0 + 0.5 * 1) = f (-0.0378) = 0.49

Output of node F = f (0.5 * (-2) + 0.2689 * (-2) – 0.5) = f(-2.0378) = 0.1153

Error of output units

Δ_E = (Y_E – O_E) O_E (1 – O_E) = (1 – 0.49) * 0.49 * (1 – 0.49) = 0.1274

Δ_F = (Y_F – O_F) O_F (1 – O_F) = (0 – 0.1153) * 0.1153 * (1 – 0.1153) = -0.01176

Error for hidden units

Δ_c = (Δ_E * (-2) + (-2)* Δ_F) * O_c (1 – O_c) =

(0.1274 * (-2) – 0.01176 * (-2)) * 0.2689 * (1-0.2689) = -0.04547

Δ_D = (Δ_E * 1 + (-2)* Δ_F) * O_D (1 – O_D) = (0.1274 + 2 * 0.01176) * 0.5 * (1 - 0.5) = 0.03773
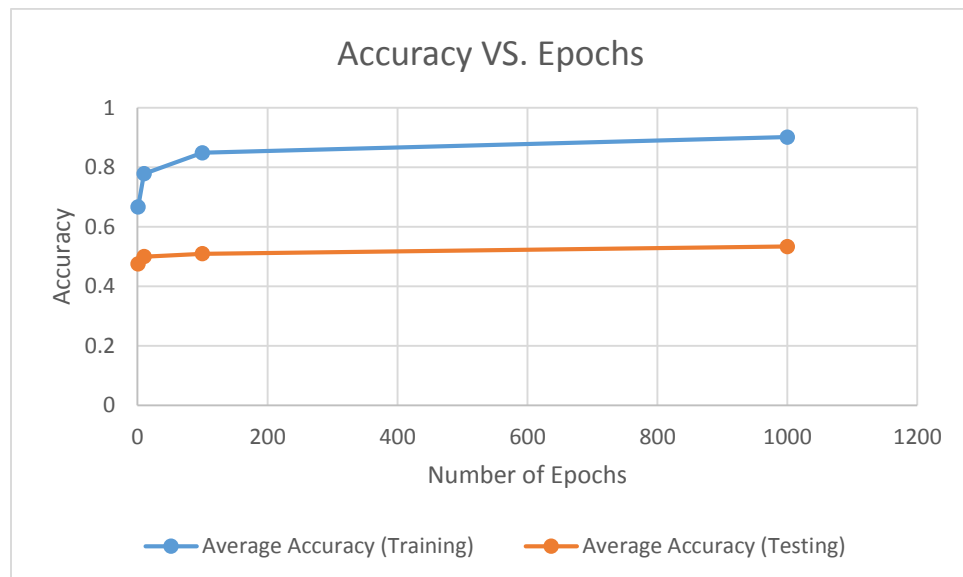
Determine updated weight for DF:

W_{FD} = -2 + 0.1 * 0.5 * Δ_F = -2 + 0.1 * 0.5 * (-0.01176) = -2.00059

Determine updated weight for AD:

W_{DA} = -0.5 + 0.1 * 0 * Δ_D = -0.5

Part 2

5.

6.

ROC Curve with 100 Epochs