1. a) Given, $y = x_1 a_1 + x_2 a_2 - b$

$$y = [x_1 \quad x_2 \quad +1] \begin{bmatrix} a_1 \\ a_2 \\ -b \end{bmatrix}$$

$$y = x^T w$$

where $x^T = [x_1 \quad x_2 \quad -1]$ $w = \begin{bmatrix} a_1 \\ a_2 \\ b \end{bmatrix}$

b) $0 = x^T w$

$$0 = [x_1 \quad x_2 \quad -1] \begin{bmatrix} a_1 \\ a_2 \\ b \end{bmatrix}$$

$$0 = x_1 a_1 + x_2 a_2 - b$$

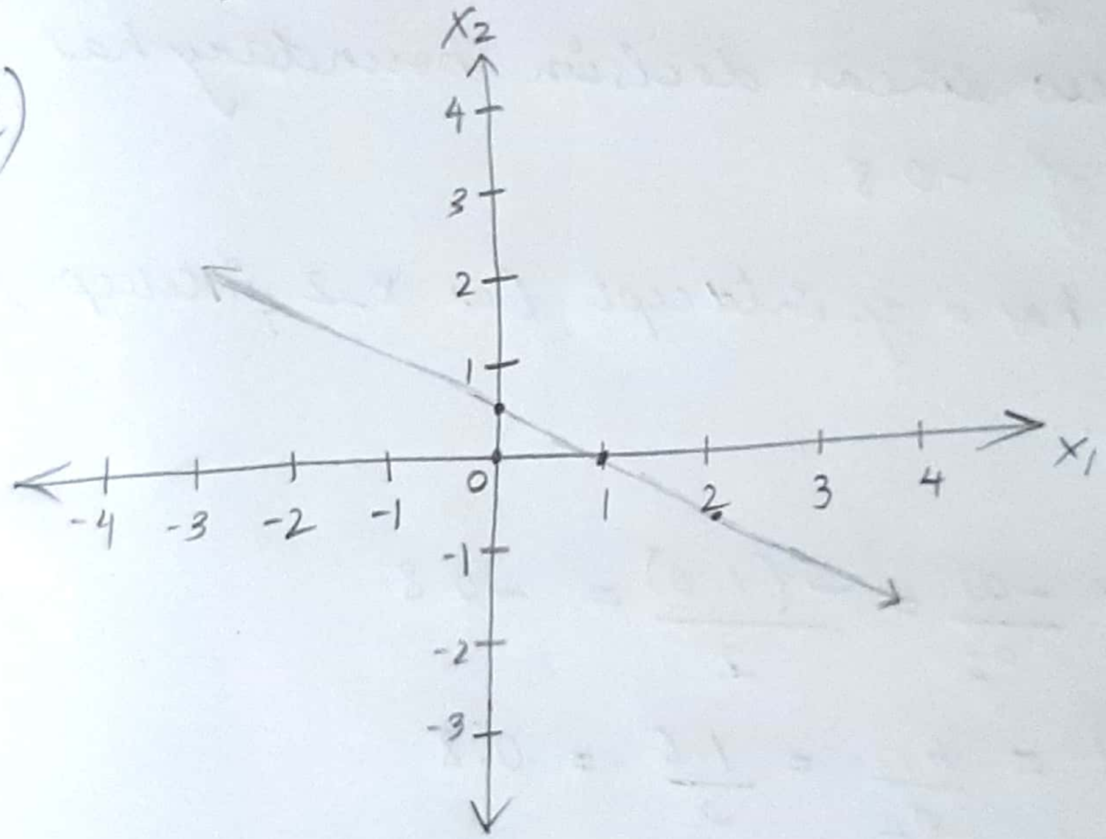
$$b - x_1 a_1 = x_2 a_2$$

$$x_2 = -\frac{a_1}{a_2} x_1 + \frac{b}{a_2}$$

Slope $= \frac{-a_1}{a_2}$ Intercept $= \frac{b}{a_2}$

c) $X = \begin{bmatrix} 0 & 0.4 \\ 0.2 & 0.1 \\ 0.5 & 0.6 \\ 0.9 & 0.8 \end{bmatrix}$

d)



$$x_2 = -\frac{a_1}{a_2} x_1 + \frac{b}{a_2}, \quad a_1 = 1, \ a_2 = 2, \ b = 1$$

$$x_2 = -\frac{1}{2} x_1 + \frac{1}{2}$$

x_1	x_2
1	0
0	1/2
2	-1/2

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e) The decision boundary is a straight line with a positive slope of +0.5.

It has a y-intercept (or x_2 intercept) of 0.2. [Slope $= \frac{-a_1}{a_2} = \frac{-(-1)}{2} = 0.5$ y-intercept: $= \frac{b}{a_2} = \frac{0.4}{2} = 0.2$]

f) The new linear decision boundary has a slope of -0.8.

It also has a y-intercept (or x_2 intercept) of 0.8.

$$\text{Slope} = \frac{-a_1}{a_2} = \frac{-(1.6)}{2} = -0.8$$

$$\text{y-intercept} = \frac{b}{a_2} = \frac{1.6}{2} = 0.8$$