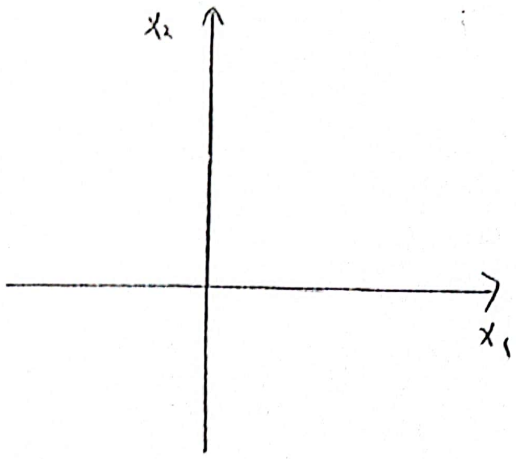
Assignment 1 Yizhen Lu lu773@wisc.edu

1. a)

$$y = x^T w = \begin{bmatrix} x_1 & x_2 & -1 \end{bmatrix} \begin{bmatrix} a_1 \\ a_2 \\ -b \end{bmatrix}$$

b)



$y = a_1x_1 + a_2x_2 - b = 0$ decision boundary

$y: a_2x_2 = -a_1x_1 + b$

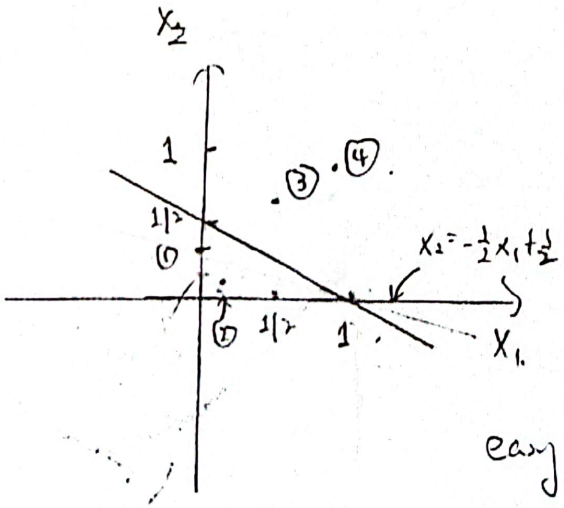
$y: x_2 = -\frac{a_1}{a_2}x_1 + \frac{b}{a_2}$

slope: $-\frac{a_1}{a_2}$, intercept: $\frac{b}{a_2}$.

c)

$$X = \begin{bmatrix} 0 & 0.4 & 1 \\ 0.2 & 0.1 & 1 \\ 0.5 & 0.6 & 1 \\ 0.9 & 0.8 & 1 \end{bmatrix}$$

d)



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

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

easy to see ①, ② belongs to label -1

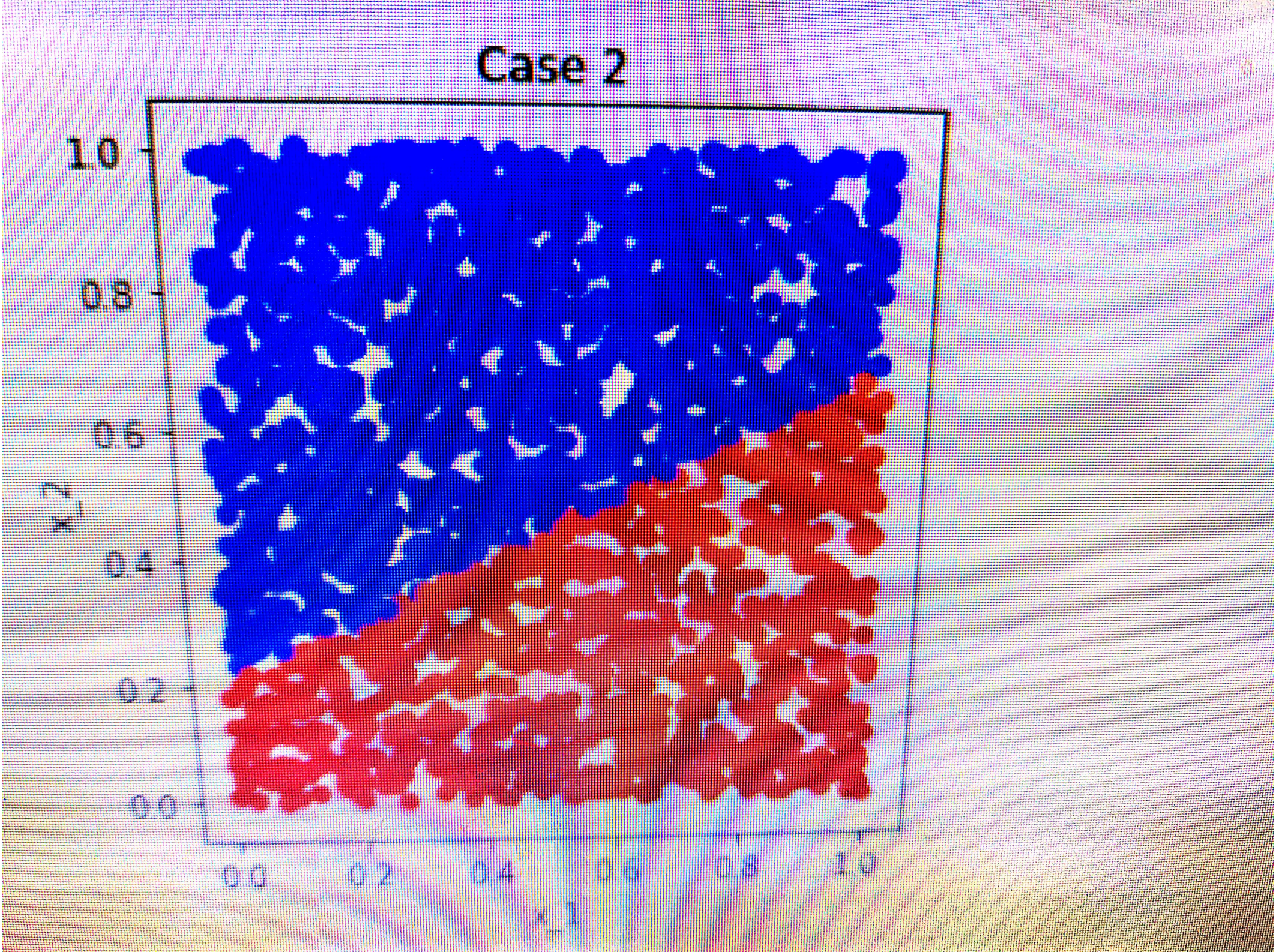
③, ④ belongs to label 1.

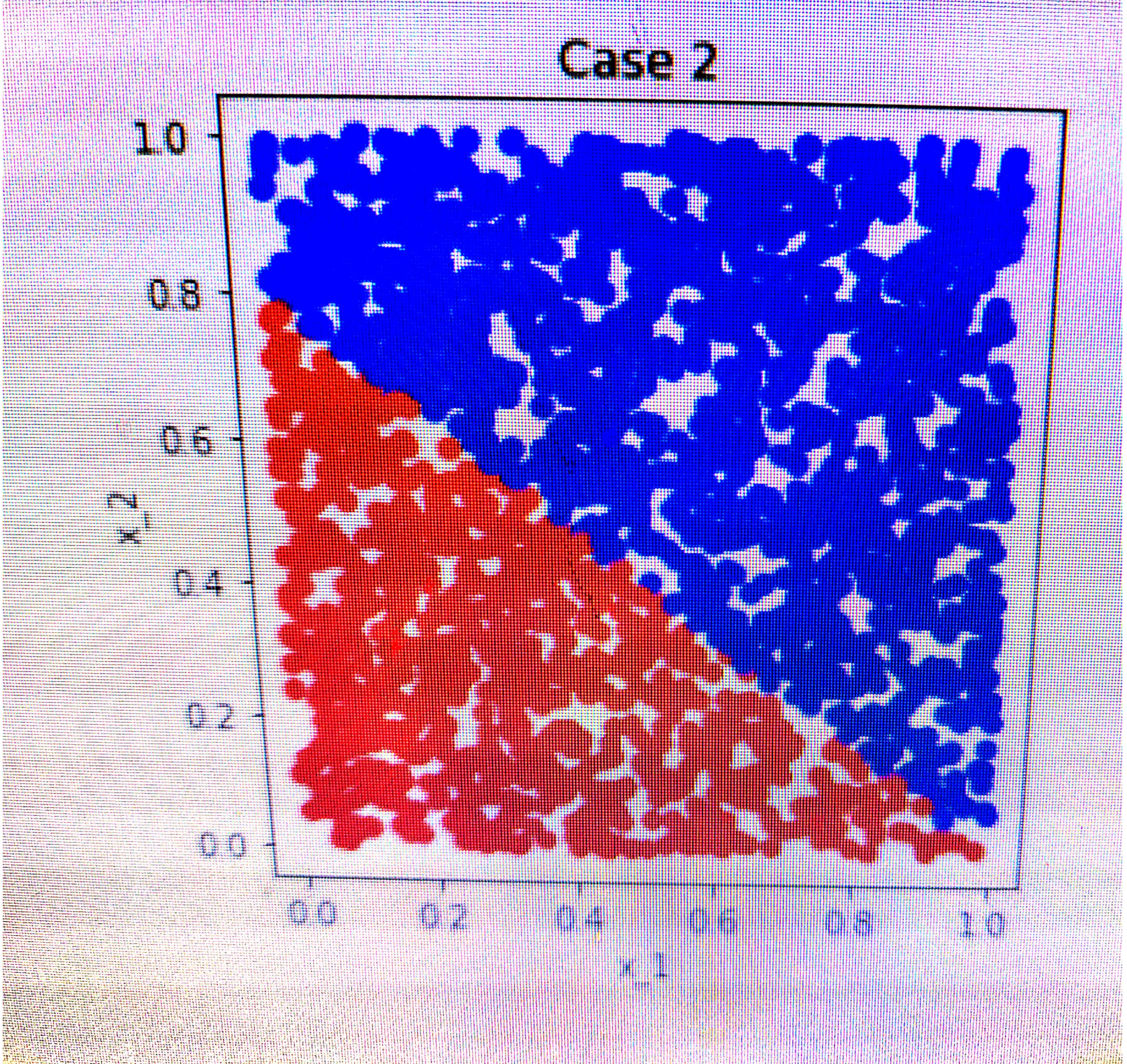
e) The decision boundary shown in the program is roughly

$y: x_2 = 0.4x_1 + 0.2$.

f) When the weight changes to $[1.6, 2, -1.6]^T$, the decision boundary becomes roughly $y: x_2 = -0.8x_1 + 0.8$.

Compared with e), whose weight is $[-1, 2, -0.4]^T$, we see that the new slope decreases while the intercept also decreases.


Case 2
1.0
0.8
0.6
0.4
0.2
0.0
x_1
0.0
0.2
0.4
0.6
0.8
1.0
x_2


Case 2
1.0
0.8
0.6
0.4
0.2
0.0
x_2
0.0
0.2
0.4
0.6
0.8
1.0
x_1