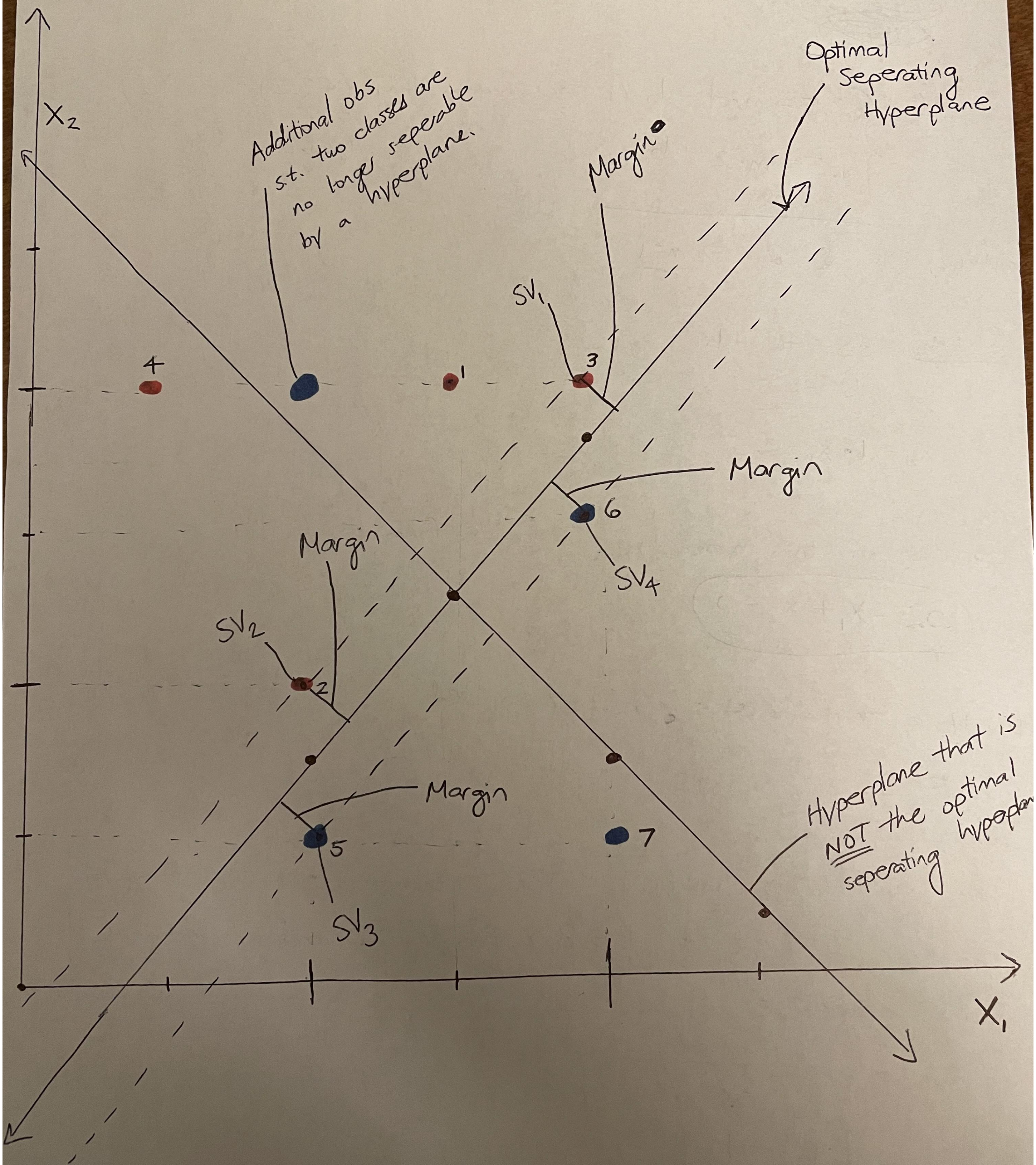
3.)

(a.) Sketch the 7 points:



(b.) Sketch: on the graph.

Eqn: $\begin{cases} 3.5 = m \cdot 4 + b & (1) \text{ since passes thru } (4, 3.5) = (X_1, X_2) \\ 1.5 = m \cdot 2 + b & (2) \quad " \quad\quad " \quad (2, 1.5) = (X_1, X_2) \end{cases}$

(1)-(2) $\quad 2 = 2m \Rightarrow \underline{m=1}$

Solve b: $\quad 3.5 = 4(1) + b$

$\underline{b = -0.5}$

$X_2 = 1 \cdot X_1 - 0.5$

Equation of this hyperplane in same form as (9.1):

$0.5 - X_1 + X_2 = 0$

(c) Note that (2,2) is classified to Red.

$0.5 - 2 + 2 = 0.5 > 0$

Thus, classification rule is:

"Classify to Red if $\beta_0 + \beta_1 X_1 + \beta_2 X_2 > 0$, and classify to Blue otherwise"

where $\boxed{\begin{aligned} \beta_0 &= 0.5 \\ \beta_1 &= -1 \\ \beta_2 &= 1 \end{aligned}}$

3.) Continued.

(d.) Margin is indicated on my sketch.

(e.) There are 4 support vectors for the Maximal Margin Classifier here:
vectors numbers: $\{2, 3, 5, 6\}$

(f.) If the 7^{th} vector moved slightly, it would not come anywhere near the margin of the above classifier. Thus, the above margin would be preserved, and the above classifier would be unaffected by this slight movement.

(g.) Hyperplane is ~~[illegible]~~ sketched on the graph.
Solve its equation: (since it passes thru $(3, 2.5)$ and $(4, 1.5)$)

$$m^* = \frac{2.5 - 1.5}{3 - 4} = -1$$

$$b^* \Rightarrow \quad 2.5 = (-1)(3) + b \Rightarrow \underline{b = 5.5}$$

<u>Eqn:</u> $X_2 = (-1)X_1 + 5.5 \Rightarrow \boxed{5.5 - X_1 - X_2 = 0}$

(h.) Additional obs is sketched on the graph. It is described below:

Obs	X_1	X_2	Y
Additional	2	4	Blue