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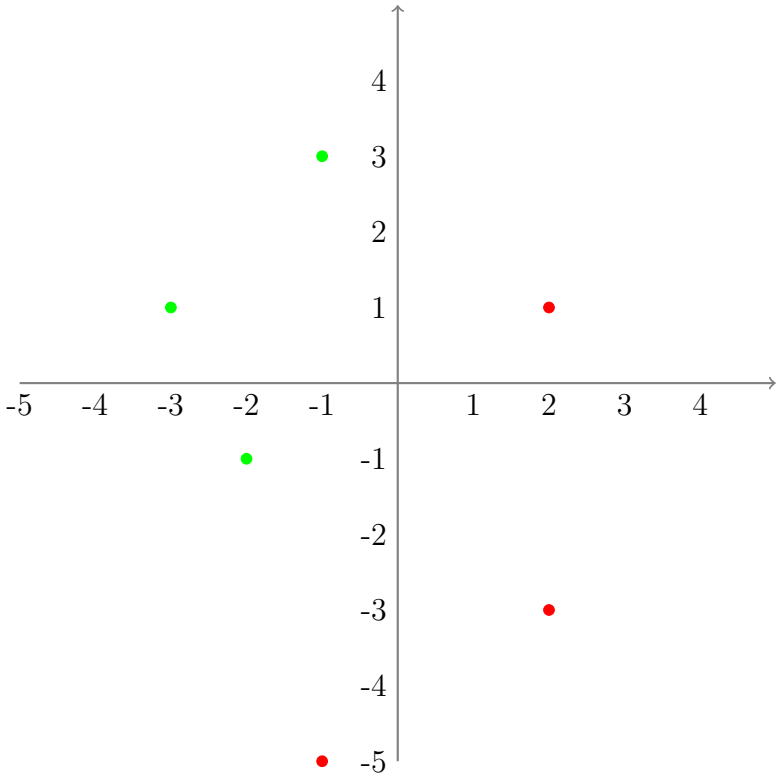
Exercise 1(a)

(i)



(ii)

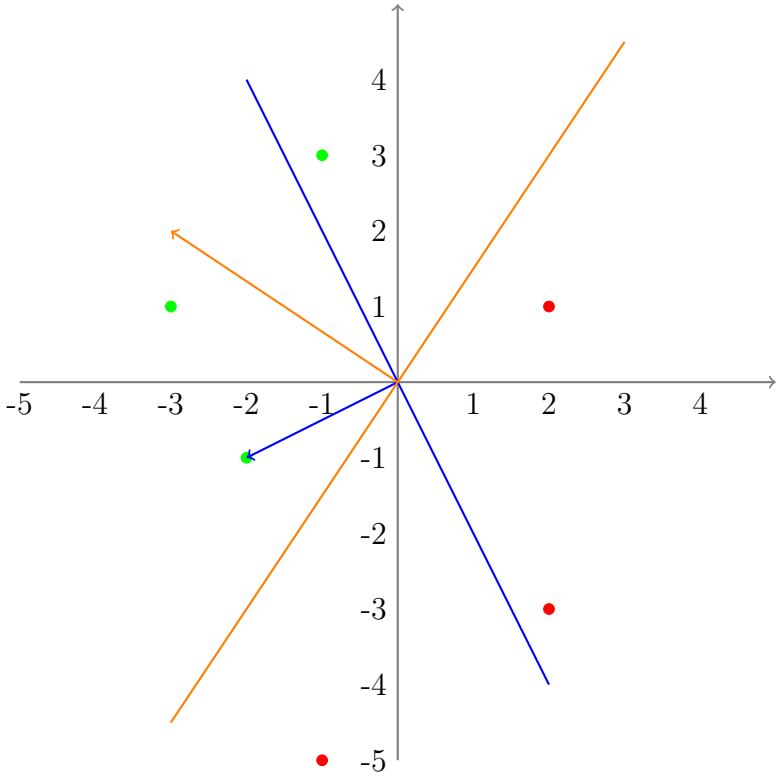
$$\text{sgn}(\langle 0, \begin{bmatrix}2\\1\end{bmatrix}\rangle) = \text{sgn}(0) = 1 \neq y_1$$

$$\Rightarrow\ w \leftarrow w + y_1 x_1 = 0 + (-1) \cdot \begin{bmatrix}2\\1\end{bmatrix} = \begin{bmatrix}-2\\-1\end{bmatrix}$$

$$\text{sgn}(\langle \begin{bmatrix}-2\\-1\end{bmatrix}, \begin{bmatrix}-1\\3\end{bmatrix}\rangle) = \text{sgn}(-1) = -1 \neq y_2$$

$$\Rightarrow\ w \leftarrow w + y_2 x_2 = \begin{bmatrix}-2\\-1\end{bmatrix} + 1 \cdot \begin{bmatrix}-1\\3\end{bmatrix} = \begin{bmatrix}-3\\-2\end{bmatrix}$$

(iii)



Blue: weight vector (with hyperplane) after first update
Orange: weight vector (with hyperplane) after second update

(iv)

$$\min_{(x,y)\in S} \frac{|\langle w,x\rangle|}{||w||} = \min_{(x,y)\in S} \frac{|\langle w,x\rangle|}{\sqrt{(-3)^2+2^2}} = \min\{\frac{|-4|}{\sqrt{13}}, \frac{|9|}{\sqrt{13}}, \frac{|11|}{\sqrt{13}}, \frac{|4|}{\sqrt{13}}, \frac{|-7|}{\sqrt{13}}, \frac{|-12|}{\sqrt{13}}\} = \frac{4}{\sqrt{13}} = 1.109$$