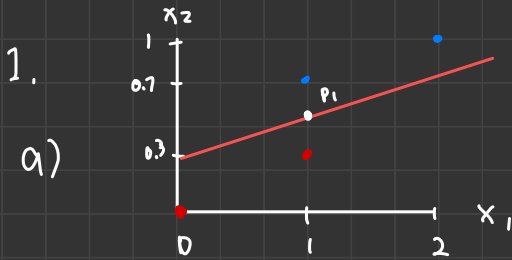


HW 8



$$m = 0.3 \quad p_1 = (1, 0.5)$$

$$0.5 = 0.3 \cdot 1 + b \quad b = 0.2$$

$$x_2 = 0.3x_1 + 0.2$$

$$x_2 - 0.3x_1 - 0.2 = 0$$

$$W = (x_1, x_2) = (-0.3, 1) \quad b = -0.2$$

$$\hat{y} = \begin{cases} 1 & \text{if } -0.2 - 0.3x_1 + x_2 > 0 \\ -1 & \text{if } -0.2 - 0.3x_1 + x_2 < 0 \end{cases}$$

b) $p = (2, 1)$

$$f(x_1, x_2) = 1 - 0.3 \times 2 - 0.2 = 0.2$$

$$\max \gamma = 0.2$$

c)

$$m = \frac{\gamma}{\|W\|} = \frac{0.2}{\sqrt{1^2 + 0.3^2}} = 0.145$$

d) All samples should be on margin

2.

$$\hat{y} = \begin{cases} 1 & z \geq 0 \\ -1 & z < 0 \end{cases}$$

$$z = x - t$$

$$J(t) = \sum \epsilon_i$$

$$\epsilon_i = \max(0, 1 - y_i z_i)$$

a)

-

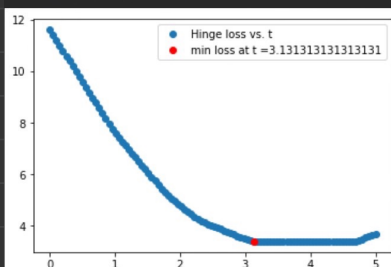
```

x = np.array([0, 1.3, 2.1, 2.8, 4.2, 5.7])
y = np.array([-1, -1, -1, 1, -1, 1])
t = np.linspace(0, 5, 100)
z = x[None,:] - t[:,None]
epsilon = np.maximum(0, 1-y[None,:]*z)
J = np.sum(epsilon, axis=1)
plt.plot(t, J, 'o')
iopt = np.argmin(J)
plt.plot(t[iopt], J[iopt], 'ro')
plt.legend(['Hinge loss vs. t', f'min loss at t = {t[iopt]}'])

```

✓ 0.2s

<matplotlib.legend.Legend at 0x17ac8e9aeb0>



b)

$$t = 3.131$$

c)

$$\epsilon_i = [0, 0, 0, 1.331, 2.069, 0]$$

d)

$$i = 3, 4$$

3.

a.

$$x = [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 0]$$

$$w = [0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0]$$

b.

$$z = [0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0]$$

c.

$$z = [0] * 16$$

d.

$$z = [0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]$$

e.

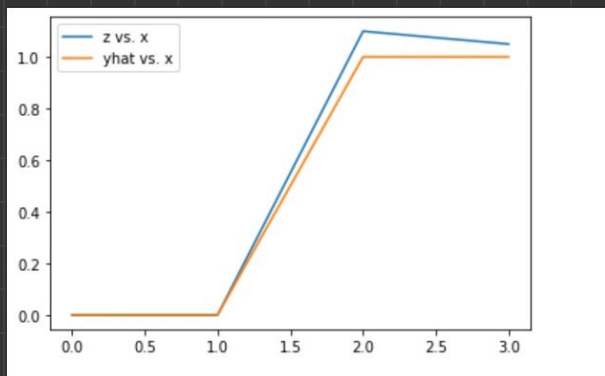
$$X_{mat} = x.reshape(4, 4).T$$

$$x = X_{mat}.T.ravel()$$

4.

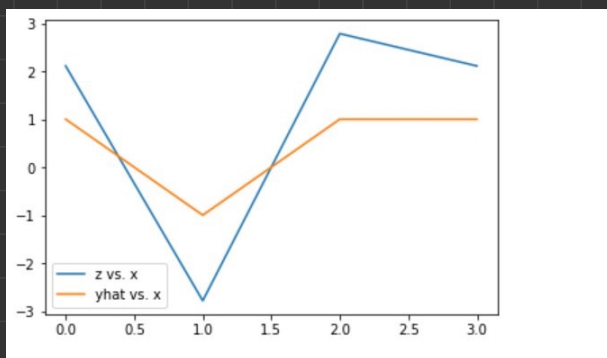
a)

$$\gamma = 3 \quad \alpha = [0, 0, 1, 1]$$



b)

$$\gamma = 0.5 \quad \alpha = [1, 1, 1, 1]$$



c).

classifier a makes more mistakes because

It only has two support vectors

$$\alpha = [0, 0, 1, 1]$$

not support vectors