(1)

(a) $$\frac{dE}{dw} = \frac{d}{dw} \sum_{i=1}^{3} \frac{1}{2}(t_i - w_i x_i - b_i)^2$$

$$\frac{dE}{dw} = -\sum_{i=1}^{3} (t_i - w_i x_i - b_i) \cdot x_i$$

$$\Rightarrow \frac{dE}{dw} = -\left[2 \cdot 1 + 3 \cdot 2 + 5 \cdot 4\right]$$

$$\therefore \frac{dE}{dw} = -28$$

Similarly, $$\frac{dE}{db} = \frac{d}{db} \sum_{i=1}^{3} \frac{1}{2}(t_i - w_i x_i - b_i)^2$$

$$\frac{dE}{db} = -\sum_{i=1}^{3} (t_i - w_i x_i - b_i)$$

$$\Rightarrow \frac{dE}{db} = -\left[2 + 3 + 5\right]$$

$$\therefore \frac{dE}{db} = -10$$

$$\therefore \frac{dE}{dw} = -28 \quad \text{and} \quad \frac{dE}{db} = -10$$

(b)

$$w \leftarrow w - \eta \frac{dE}{dw}$$

$$b \leftarrow b - \eta \frac{dE}{db}$$

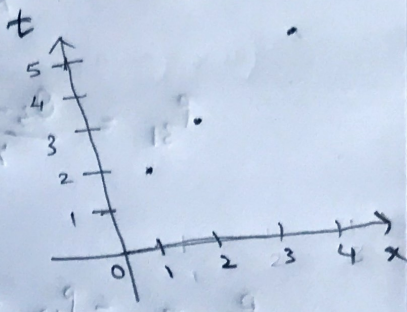
$$\Rightarrow w \leftarrow 0 - (0.1)(-28).$$

$$\Rightarrow b \leftarrow 0 - (0.1)(-10).$$

$$\therefore w = 2.8$$

$$\therefore b = 1$$

(c) Since the data points form a line, $y = mx + b$



$$\Rightarrow t_3 = mx_3 + b$$

$$\Rightarrow t_2 = mx_2 + b$$

$$\Rightarrow t_1 = mx_1 + b.$$

$$\Rightarrow t_3 - t_2 = m(x_3 - x_2).$$

$$\Rightarrow 5 - 3 = m(4 - 2).$$

$$\Rightarrow 2 = m \cdot 2$$

$$\therefore w^* = 1$$

$$\Rightarrow t_3 = mx_3 + b$$

$$\Rightarrow 5 = 1 \cdot 4 + b$$

$$\therefore b^* = 1$$

$$\therefore w^* = 1 \quad \text{and} \quad b^* = 1$$

(3)

(a) $P_{12} = \frac{\theta_1 - \theta_2}{X_{12}} = \frac{-0.3}{1} = -0.3 \text{ W}$

$P_{23} = \frac{\theta_2 - \theta_3}{X_{23}} = \frac{0.3 - 0.2}{2} = 0.05 \text{ W}$

$P_{31} = \frac{\theta_3 - \theta_1}{X_{31}} = \frac{0.2}{0.5} = 0.4 \text{ W}$

$P_2 = -P_{12} + P_{23}$

$P_2 = 0.3 + 0.05 \text{ W}$

$\therefore P_2 = 0.35 \text{ W}$

(b) $P_1 = P_{12} - P_{31} = -0.7 \text{ W}$

$P_2 = -P_{12} + P_{23} = 0.35 \text{ W}$

$P_3 = P_{31} - P_{23} = 0.35 \text{ W}$

$\Rightarrow P_1 + P_2 + P_3 = 0 \text{ W}$

$\therefore P_1 + P_2 + P_3 = 0 \text{ W}$

(c) Yes. Since the data entries are corrupted by unbiased and zero mean numbers, the data points are just displaced uniformly and linear SVM can distinguish between good and bad data.

(4)

(c): SVM with radial basis function will classify the data in higher dimensions. In higher dimensions, data can be easily seperated and SVM with radial basis works well.

(5)

Model-driven methods do not memorize the data and work well for detection. But they tend to have higher (more complex) complexity. Eg!:- Linear Regression, Linear SVM etc

Data-driven methods do memorize the data and hence do not always work well. But they are simpler models.

Eg!:- k-nearest neighbours.