

# AI-Assignment - 6 :-

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## Polynomial Regression Model :-

x	y
7.6	157
7.1	174

step 1 : Read dataset,  $\eta = 0.1$ , epochs = 1,  $m_1 = 1$ ,  $m_2 = 1$ ,  $c = -1$

step 2 : iter = 1

step 3 : Sample  $i = 1$

step 4 :  $y_p^i = m_2 (x_i)^2 + m_1 x_i + c$

$$y_p^i = (1)(7.6)^2 + (1)(7.6) - 1 = 64.36$$

step 5 :  $E = \frac{1}{2} (y_i - y_p^i)^2$

$$= \frac{1}{2} (157 - 64.36)^2$$

$$E = 4291.08$$

step 6 :  $\frac{\partial E}{\partial m_1} = -[y_i - m_2 x_i^2 - m_1 x_i - c] x_i$

$$= [157 - (1)(7.6)^2 - (1)(7.6) + 1] (7.6)$$

$$\frac{\partial E}{\partial m_1} = -704.06$$

$\frac{\partial E}{\partial m_2} = -[y_i - m_2 x_i^2 - m_1 x_i - c] x_i^2$

$$= [157 - (1)(7.6)^2 - (1)(7.6) + 1] (7.6)^2$$

$$\frac{\partial E}{\partial m_2} = -5350.88$$

$$\frac{\partial \epsilon}{\partial c} = -[y_i - m_2 x_i^2 - m_1 x_i - c]$$

$$= -[174 - (1)(7.6)^2 - (1)(7.6) + 1]$$

$$\frac{\partial \epsilon}{\partial c} = -92.64$$

Step 7 :-  $\Delta m_1 = -\eta \frac{\partial \epsilon}{\partial m_1} = -(0.1)(-704.06) = 70.4$

$$\Delta m_2 = -\eta \frac{\partial \epsilon}{\partial m_2} = -(0.1)(-5350.88) = 535.08$$

$$\Delta c = -\eta \frac{\partial \epsilon}{\partial c} = -(0.1)(-92.64) = 9.26$$

Step 8 :-

$$m_1 = m_1 + \Delta m_1 = 1 + 70.4 = 71.4$$

$$m_2 = m_2 + \Delta m_2 = 1 + 535.08 = 536.08$$

$$c = c + \Delta c = -1 + 9.26 = 8.26$$

Step 9! Sample  $\Rightarrow i = i + 1 = 1 + 1 = 2$  &  $i \leq n$   $\Rightarrow$  step (10)

Step 4:  $y_p^i = m_2 (x_i)^2 + m_1 x_i + c$

$$= (536.08)(7.1)^2 + (71.4)(7.1) + 8.26$$

$$= 27023.79 + 506.94 + 8.26$$

$$y_p^i = 27538.99$$

Step 5:  $E = \frac{1}{2}(y_i - y_p^i)^2 = \frac{1}{2}(174 - 27538.99)^2$

$$E = 374421338.9$$

Step 6:  $\frac{\partial \epsilon}{\partial m_1} = -[y_i - m_2 x_i^2 - m_1 x_i - c]x_i$

$$= -[174 - (536.08)(7.1)^2 - (71.4)(7.1) - 8.26](7.1)$$

$$= -(174 - 27023.79 - 506.94 - 8.26)(7.1)$$

$$= -(-27364.99)(7.1)$$

$$\frac{\partial \epsilon}{\partial m_1} = 194291.429$$

$$\begin{aligned}\frac{\partial \epsilon}{\partial m_2} &= -[y_i - m_2 x_i^2 - m_1 x_i - c] x_i^2 \\ &= -(-27364.99)(7.1)^2\end{aligned}$$

$$\frac{\partial \epsilon}{\partial m_2} = 1379469.14$$

$$\begin{aligned}\frac{\partial \epsilon}{\partial c} &= -[y_i - m_2 x_i^2 - m_1 x_i - c] \\ &= -(-27364.99)\end{aligned}$$

$$\frac{\partial \epsilon}{\partial c} = 27364.99$$

$$\text{Step 7: } \Delta m_1 = -\eta \frac{\partial \epsilon}{\partial m_1} = -(0.1)(194291.429) = -19429.14$$

$$\Delta m_2 = -\eta \frac{\partial \epsilon}{\partial m_2} = -(0.1)(1379469.14) = -137946.91$$

$$\Delta c = -\eta \frac{\partial \epsilon}{\partial c} = -(0.1)(27364.99) = -2736.49$$

$$\text{Step 8: } m_1 = m_1 + \Delta m_1 = 71.4 - 19429.14 = -19357.74$$

$$m_2 = m_2 + \Delta m_2 = 536.08 - 137946.91 = -137410.83$$

$$c = c + \Delta c = 8.26 - 2736.49 = -2728.23$$

$$\text{Step 9: Sample } i = i + 1 = 2 + 1 = 3 \quad \begin{matrix} 4 & i \leq n_s \\ 3 & 2 \end{matrix} \quad \begin{matrix} f \rightarrow \text{next step} \\ \rightarrow \text{next step} \end{matrix}$$

$$\text{Step 10: } \text{iter} = \text{iter} + 1 = 1 + 1 = 2, \quad \text{iter} > \text{epochs} \quad \rightarrow \text{next step}$$

$$\text{Step 11: end/stop}$$