1 CPS 803 Fall 2021 Assignment-1

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Q1: Linear Regression

Problem: 1

Solution: Same As in Example discussed in class.

1- $h_\theta(\hat{x}^{(i)}) = \theta_3 \hat{x}_3 + \theta_2 \hat{x}_2 + \theta_1 \hat{x}_1 + \theta_0 \hat{x}_0$

$$J(\theta) = \frac{1}{2} \sum_{i=1}^{n} \left(h_\theta(\hat{x}^{(i)}) - y^{(i)} \right)^2 \rightarrow 1$$

objective function $J(\theta)$ of the linear regression problem on the new dataset $\{(\hat{x}^{(i)}, y^{(i)})\}_{i=1}^{n}$

2 Gradient descent

we start with some θ and keep changing θ to reduce $J(\theta)$.

we use the gradient $\theta_j := \theta_j - \alpha \frac{\partial}{\partial \theta_j} J(\theta) \rightarrow 2$

putting the value eq 1 in eq 2

we get

$$\theta_j := \theta_j - \alpha \sum_{i=1}^{n} \left[\left(h_\theta(\hat{x}^{(i)}) - y^{(i)} \right) \hat{x}_j^{(i)} \right]$$ ✓

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Q2: Calculations

given

$$\forall x, p(y^{(i)} = 1 | t^{(i)} = 1, x^{(i)} = x) = \alpha$$

$$\forall x, p(y^{(i)} = 0 | t^{(i)} = 1, x^{(i)} = x) = 1 - \alpha$$

$$\forall x, p(y^{(i)} = 1 | t^{(i)} = 0, x^{(i)} = x) = 0$$

$$\forall x, p(y^{(i)} = 0 | t^{(i)} = 0, x^{(i)} = x) = 1$$

$$p(t^{(i)} = 1 | y^{(i)} = 1, x^{(i)}) = 1$$

$$P(A|B) = \frac{P(B|A)p(A)}{P(B)}$$

$$P(t^{(i)} = 1 | y^{(i)} = 1, x^{(i)}) = \frac{P(y^{(i)} = 1, x^{(i)} | t^{(i)} = 1) p(t^{(i)} = 1)}{P(y^{(i)} = 1, x^{(i)})}$$

$$P(t^{(i)} = 1 | y^{(i)} = 1, x^{(i)}) = \frac{P(y^{(i)} = 1, x^{(i)} | t^{(i)} = 1) P(t^{(i)} = 1)}{P(y^{(i)} = 1, x^{(i)} | t^{(i)} = 0) P(t^{(i)} = 0) + P(y^{(i)} = 1, x^{(i)} | t^{(i)} = 1) p(t^{(i)} = 1)}$$

$$P(t^{(i)} = 1 | y^{(i)} = 1, x^{(i)}) = \frac{P(y^{(i)} = 1, x^{(i)} | t^{(i)} = 1)(t^{(i)} = 1)}{(y^{(i)} = 1, x^{(i)} | t^{(i)} = 0)(t^{(i)} = 1) + P(y^{(i)} = 1, x^{(i)} | t^{(i)} = 1)(t^{(i)} = 1)}$$

Since, $\forall x, p(y^{(i)} = 1 | t^{(i)} = 0, x^{(i)} = 0) = 0 \longleftarrow$ use this in equation

$$P(t^{(i)} = 1 | y^{(i)} = 1, x^{(i)}) = \frac{P(y^{(i)} = 1, x^{(i)} | t^{(i)} = 1)(t^{(i)} = 1)}{(0)(0.5) + p(y^{(i)} = 1, x^{(i)} | t^{(i)} = 1)(t^{(i)} = 1)}$$

$$P(t^{(i)} = 1 | y^{(i)} = 1, x^{(i)}) = \frac{P(y^{(i)} = 1, x^{(i)} | t^{(i)} = 1)(t^{(i)} = 1)}{P(y^{(i)} = 1, x^{(i)} | t^{(i)} = 1)(t^{(i)} = 1)} = \underline{\underline{1}} \checkmark$$