Asal Shavandi

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a.

$$\phi(\omega) = (X\omega - y)^T(X\omega - y) = \omega^T X^T X\omega - 2\omega^T X^T y + y^T y$$

$$\frac{\partial \phi(\omega)}{\partial(\omega)} = 2X^T X\omega - 2X^T y = 0 \rightarrow X^T X\omega = X^T y \rightarrow \omega = (X^T X)^{-1} . X^T y$$

$$\phi(\omega + \delta) - \phi(\omega) \geq 0 \quad 2\delta^T X^T X\omega - 2\delta^T X^T y + \delta^T X^T X\delta \geq 0$$

$$\xrightarrow[\omega]{\text{replace}} 2\delta^T X^T \underbrace{X(X^T X)^{-1}}_{I} X^T y - 2\delta^T X^T y + \delta^T X^T X\delta \geq 0$$

$$\rightarrow 2\delta^T X^T y - 2\delta^T X^T y + \delta^T X^T X\delta \geq 0 \rightarrow (X\delta)^T X\delta \geq 0 \text{ always true!}$$

b.

$$\phi(\omega) = (X\omega - y)^T(X\omega - y) + \lambda\omega^T\omega = \omega^T X^T X\omega - 2\omega^T X^T y + y^T y + \lambda\omega^T\omega$$

$$\frac{\partial(\phi\omega)}{\partial\omega} = 2X^T X\omega - 2X^T y + 2\lambda\omega = 0 \rightarrow X^T X\omega - X^T y + \lambda\omega = 0$$

$$X^T y = (X^T X + \lambda I)\omega \rightarrow \omega = (X^T X + \lambda I)^{-1} . X^T y$$

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a. No that is not a proper way. Each person's probability of having the disease is 0.1 so for a space with 10 people, the probability of one person having the disease would be $(0.1)^{10}$

b.

$P(X=1|D=1) = 0.7$

$P(X=0|D=0) = 0.8$

$$P(D=1|X=1) = ? = \frac{P(X=1|D=1)P(D=1)}{P(X=1)}$$

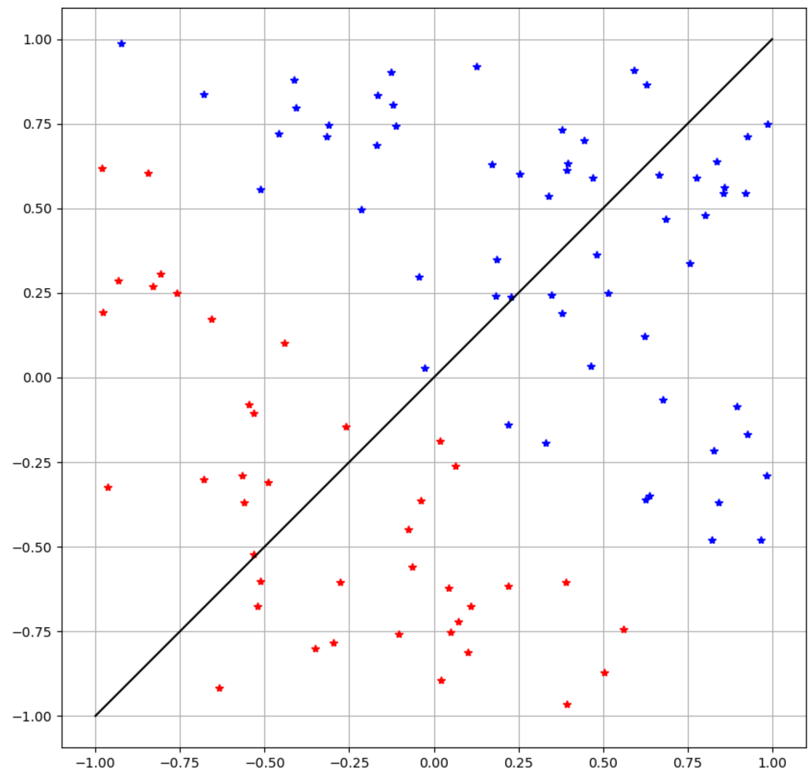
$$P(X=1) = P(X=1|D=0)P(D=0) + P(X=1|D=1)P(D=1)$$

$$P(X=1|D=0) + \underbrace{P(X=0|D=0)}_{0.8} = 1 \rightarrow P(X=1|D=0) = 0.2$$

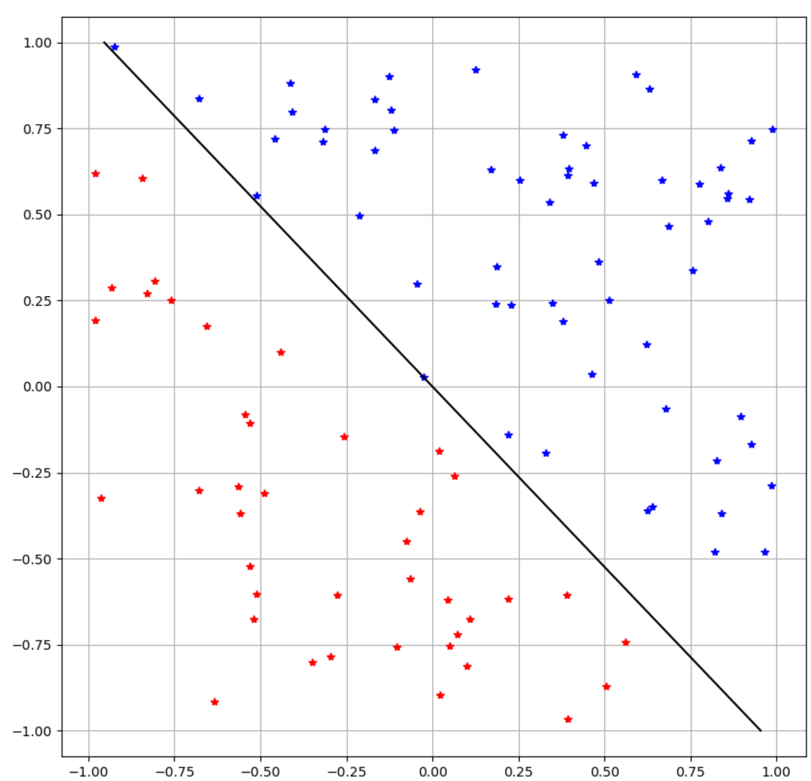
$$\rightarrow P(X=1) = (0.2)(0.9) + (0.7)(0.1) = 0.25$$

$$P(D=1|X=1) = \frac{(0.7)(0.1)}{(0.25)} = 0.28$$

Initial.png



Perceptron.png
Number of Iterations: 9
Error Rate of Perceptron: 0.00



Least_Square.png
Error Rate of Least Squares: 0.00