# Assignment 1

Q1 For linear regression the cost function depends upon the parameters theta.

$$h_\theta(x) = \theta_0 + \theta_1 x_1 + \theta_2 x_2 \ldots$$
$$J = (h_\theta(x) - y)^2$$
$$\frac{\partial J}{\partial \theta_j} = (h_\theta(x^i) - y^i)\, x_j^i$$

$\therefore$ It is linearly dependent on the parameters. The theta matrix is a $n \times 1$ matrix where $n$ is the no. of features.

For large values of $n$ this would become computationally more expensive thus gradient descent being slower would also perform better. Gradient decent thus is better choice if the ~~vars~~ number of features is large.

Q2 Function Approximation is concerned with finding the best fitting curve. Machine learning is ~~read~~ related to predicting a new input based on the trained data. You also need to keep overfitting & underfitting into account while performing an machine learning algorithm.

Q4 Likelihood function $\Rightarrow$

$$l(\theta) = f(x_1, x_2 \ldots x_n \mid \theta)$$

for $\theta \geq \|x\|$

$$= \left(\frac{1}{\pi\theta^2} \times \frac{1}{\pi\theta^2} \ldots\right)$$

$$= \left(\frac{1}{\pi\theta^2}\right)^n$$

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$\therefore$ To increase log likelihood we need to decrease $\theta$

$$\theta = \|x\| = \sqrt{x_1^2 + x_2^2} \quad (L_2 \text{ norm of } x)$$

$\Rightarrow$ for min. $\theta$

$$\theta = \|x\| = \sqrt{x_1^2 + x_2^2 \cdots x_n^2}$$

$$\theta = \max_{1 \le i \le n} (\|x_i\|)$$

Q3

$$R = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$$

$$R^2 = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix} \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$$

$$= \begin{bmatrix} \cos^2\theta - \sin^2\theta & -\sin\theta\cos\theta - \sin\theta\cos\theta \\ \sin\theta\cos\theta + \cos\theta\sin\theta & -\sin^2\theta + \cos^2\theta \end{bmatrix}$$

$$R^3 = \begin{bmatrix} \cos 2\theta & -\sin 2\theta \\ \sin 2\theta & +\cos 2\theta \end{bmatrix} \begin{bmatrix} \cos\theta & \sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$$

$$= \begin{bmatrix} \cos 2\theta\cos\theta - \sin 2\theta\sin\theta & -\cos 2\theta\sin\theta - \sin 2\theta\cos\theta \\ \cos\theta\sin 2\theta + \cos 2\theta\sin\theta & -\sin 2\theta\sin\theta + \cos 2\theta\cos\theta \end{bmatrix}$$

$$= \begin{bmatrix} \cos 3\theta & -\sin 3\theta \\ \sin 3\theta & \cos 3\theta \end{bmatrix}$$

We need to minimize

$$J = \sum (y_i' - y_i)^2$$

$$J = \sum \left(y_i' - \left(\frac{1}{\lambda}\right) R^3 x_i - \beta\right)$$

for minimizing:

$$\frac{\partial J}{\partial}$$

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