Q No 1

Ans:- We studied the general regression problem And solution of least square optimization for general polynomial regression which is

$$f_m(x_m) = \sum_{n=1}^{N} \alpha_n \phi_n(x_m)$$

where ϕ_n can be any term (degree 1, 2, 3 . . .)

Solution was

$$\hat{x} = (A^T A)^{-1} A^T y$$

Then we study the least square optimization in presence of Noise $y = Ax + e$

We studied it in presence of Gaussian Noise and eigen decomposition of least square program to study the effect of noise on our system.

i.e $\|\hat{x}_{Noisy} - \hat{x}_{clean}\|_2^2 < \frac{1}{\sigma_R^2} \|e\|_2^2$

in which worst case is $\vec{e} = \vec{u}_R$

We studied Tikhonov Regularization which is another way to stabilize least square recovery.

$$\min_{x \in \mathbb{R}^N} \|y - Ax\|_2^2 + \delta \|x\|_2^2$$

The parameter $\delta > 0$ is the term which decides the regularization. The higher its value the more is regularization (Generalizing the model on the data) and vice versa.

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