Machine Learning

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Discussion Set 3 University of Southern California

Linear Regression

Problem 1

Minimize the total absolute error (L_1 norm) of linear regression when D = 0:

$$\min_{w_0} \sum_n |w_0 - y_n|$$

Problem 2

Suppose A is a square matrix. Then A is singular if and only if $\lambda = 0$ is an eigenvalue of A. Prove this statement.

Problem 3

Suppose A is a square nonsingular matrix and λ is an eigenvalue of A. Prove that $1/\lambda$ is an eigenvalue of the matrix A^{-1}.

Problem 4

Find eigenvalues and eigenvectors for

$$A = \begin{pmatrix} 2 & 3 \\ 2 & 1 \end{pmatrix}$$

Find an eigendecomposition for A.

Problem 5

The eigenvectors of a symmetric matrix A corresponding to different eigenvalues are orthogonal to each other. Prove this statement.

Problem 6

Every positive semidefinite matrix has eigenvalues ≥ 0

Problem 7

Let u, x$\in\mathbb{R}^n$ are column vectors, A is (nxn) matrix.

Task 1. Compute $\dfrac{\partial}{\partial x}u^{\mathrm{T}}x$ and $\dfrac{\partial}{\partial x}x^{\mathrm{T}}u$

Task 2. Compute $\dfrac{\partial}{\partial x}\|x\|_2^2$

Task 3. Compute $\dfrac{\partial}{\partial x}x^{\mathrm{T}}A\,x$