

Statistical Machine Learning

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Exercise 1: Ridge Regression

(2 points) In the following you have to implement least squares and ridge regression (both L2-loss)

1. $\mathbf{w} = \text{LeastSquares}(\text{Designmatrix}, \mathbf{Y})$:

- (a) input: design matrix $\mathbb{R}^{n \times d}$ and the outputs $\mathbf{Y} \in \mathbb{R}^n$ (column vector)
- (b) output: weight vector \mathbf{w} of least squares regression as column vector

2. $\mathbf{w} = \text{RidgeRegression}(\text{Designmatrix}, \mathbf{Y}, \text{Lambda})$:

- (a) input: the design matrix $\mathbb{R}^{n \times d}$, the outputs $\mathbf{Y} \in \mathbb{R}^n$ (column vector), and the regularization parameter $\lambda \in \mathbb{R}^+ := \{x \in \mathbb{R} \mid x \geq 0\}$.
- (b) output: weight vector \mathbf{w} of ridge regression as column vector.
Use the non-normalized version $\mathbf{w} = (\phi^T \phi + \lambda \mathbb{1}_d)^{-1} \phi^T \mathbf{Y}$

Note that the regression with L1-loss is already provided in **L1LossRegression(Designmatrix, Y, Lambda)**

Answer:

(1 Point) Let us assume that $d = 1$. Write a function $\text{Basis}(X, k)$