

CSE 404: Introduction to Machine Learning (Fall 2019)

Homework #5

Due 10/18/2019 11:59PM

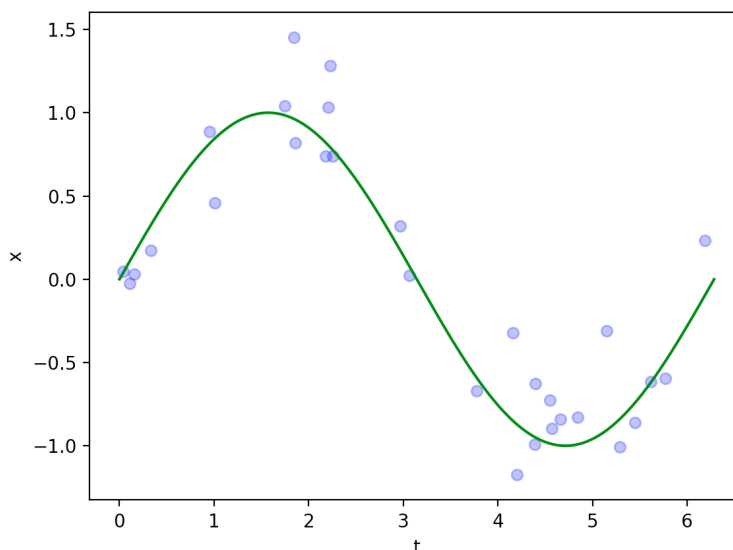
1. (70 points) Complete the linear regression functions (least squares and ridge regression) in the class. Use the code to conduct the following experiments:

- (a) (10 points) Randomly generate 30 data points from the sine function, where each data point (\mathbf{x}, y) has the form:

$$\mathbf{x} = [x^0, x^1, x^2, \dots, x^{10}], x \in [0, 2\pi]$$

$$y = \sin(x) + \varepsilon, \varepsilon \in \mathcal{N}(0, 0.3)$$

- (b) (10 points) Plot the data points along with the sine function. You should be able to see a figure similar to the following:



- (c) (20 points) Randomly split the dataset (you can use the function provided in the Regression code) and use 30% of the data points for training and the rest for testing. Apply ridge regression using different $\lambda \in \Lambda = [1e-10, 1e-5, 1e-2, 1e-1, 1, 10, 100, 1000]$. Plot the training and testing performance.
 - (d) (30 points) Implement s -fold cross validation. Use $k = 4$ to choose the optimal λ from the set Λ above.
2. (30 points) Complete the gradient descent optimizers (gradient descent and stochastic gradient descent). Use the code to conduct the following experiments:
 - (a) (10 points) Implement ridge regression using the gradient descent optimizer. Apply gradient descent based ridge regression using a random data set with $N = 1000$ and $d = 50$, and plot the objective changes at each iteration.
 - (b) (20 points) Apply stochastic gradient descent using a batch size $n = 5, 10, 100, 500$ and for each batch size, plot the objective changes at each iteration.