Assignment #3

Course: *Machine learning*
Date: *October 31st, 2025*

Assignment

In this assignment, you will learn about regularization methods, gradient descent, and stochastic gradient descent. Again, be careful not to use the same data for training (any stage of training) and testing your model. Your tasks are:

1. "Communities and Crime" dataset. Use the "Communities and Crime" dataset from the previous assignment with the same preprocessing.

The last column of the dataset (ViolentCrimesPerPop) is your target variable. Remove the attributes state, county, community, community name, and fold (columns 1 to 5). `https://archive.ics.uci.edu/dataset/183/communities+and+crime`

1. Fit the models using Ridge and Lasso regression from Scikit-learn,
2. Try different values of the regularization parameter and evaluate its effect (use Scikit-learn). You can also use functions that help you search the parameter space.
3. Choose the optimal regularization parameter and describe the process.
4. Compare the attributes you selected with forward attribute selection (the results from the previous assignment) with the attributes selected by the lasso method.
5. Comment on the results.

2. "Wine quality" dataset. Download the "Wine quality" dataset. Choose only the white wine data. Preprocess the data as you did in the previous assignments. The data is available at `https://archive.ics.uci.edu/dataset/186/wine+quality`. You will be doing a regression. Wine quality grades (last column) are your target.

1. **Implement batch gradient descent and stochastic gradient descent to find the solution for *ridge regression* from scratch.**
2. Test it on "Wine quality" data.
3. Test different learning rates and try to find a good one. Comment on the results.
4. Compare the times to convergence and the results of the two gradient descents that you implemented.