At `https://archive.ics.uci.edu/ml/datasets.php?format=&task=reg&att=&area=&numAtt=&numIns=&type=&sort=nameUp&view=table`, download the ".csv" file for the red wines in the "Wine Quality" dataset. You will now write a program/notebook which loads the data from this csv file, performs linear regression using the closed-form solution derived in class, performs the least-mean-squares (LMS) algorithm, and plots errors between the iterates of the LMS algorithm and the closed-form linear regression solution. After you have loaded the data into the data matrix X and the vector of targets $\boldsymbol{t}$, answer perform the tasks described below and answer the related questions. For this dataset, the targets are the wine quality scores and the input data consists of the other 11 features.

- Compute $\boldsymbol{w}^*$ as given in the notes. Print the first 5 entries of $\boldsymbol{w}$ and measure $\|X^\top \boldsymbol{w}^* - \boldsymbol{t}\|^2/N$. What do you think of this average error (i.e., do you think the trained regression model is good)?
- Implement the LMS algorithm for linear regression with stepsize $\eta = 1/\|\boldsymbol{\phi}(\boldsymbol{x}_n)\|^2$ as given in (1) where n is sampled from $1, 2, ..., N$ uniformly at random in each iteration. Let the initial iterate be $\boldsymbol{w}^{(0)} = \boldsymbol{0}$. Run 100000 iterations of the algorithm and create a plot of $\|\boldsymbol{w}^* - \boldsymbol{w}^{(k)}\|$ for $k = 0, 1, ..., 100000$. Measure $\|X^\top \boldsymbol{w}^{(100000)} - \boldsymbol{t}\|^2/N$.