Assignment 2

1. Generate 20 real number for the variable X from the uniform distribution U [0,1]
2. Construct the training set T = { $(x_1,y_1),(x_2,y_2),\ldots\ldots,(x_{20},y_{20})$} using the relation

   $$Yi = \sin(2\pi x_i) + \epsilon_i \text{ where } \epsilon_i \sim N(0,0.25)$$

3. In the similar way construct a testing set of size 50
   I,e. Test = { $(x'_1,y'_1),(x'_2,y'_2),\ldots\ldots,(x'_{50},y'_{50})$}
4. Estimate the regularized least square polynomial regression model of order M= 1,2, 3, 9, using the training set T.

   For example for M=1 , we need to estimate

   $F(x) = \beta_1 x + \beta_0$

   For M = 2

   $F(x) = \beta_2 x^2 + \beta_1 x + \beta_0$.

5. List the value of coefficients of estimated regularized polynomial regression models for each case.
6. Obtain the prediction on testing set and compute the RMSE for regularized polynomial regression models for order M =1,2,3 and 9.
7. Plot the estimate obtained by regularized polynomial regression models for order M =1,2,3 and 9 for training set along with $y_1, y_2, \ldots, y_{20}$. Also plot our actual mean estimate $E(Y/X) = \sin(2\pi x_i)$.
8. Plot the estimate obtained by regularized polynomial regression models for order M =1,2,3 and 9 for testing set along with $y'_1, y'_2, \ldots, y'_{50}$. Also plot the $\sin(2\pi x'_i)$.
9. Study the effect of regularization parameter λ on testing RMSE and flexibility of curve and list your observations.

Bivariate Case.

(i) Construct the training set T = { $(x_1,y_1),(x_2,y_2),\ldots\ldots,(x_3,y_{20})$} using the relation

$Yi = \sin(2\pi(||x_i||) + \epsilon_i$ where $\epsilon_i \sim N(0,0.25)$ and $x_i = (x_i^1, x_i^2)$ where x_i^1, x_i^2 are from U[0,1].

In the similar way construct a testing set of size 50

I,e. Test = { $(x'_1,y'_1),(x'_2,y'_2),\ldots\ldots,(x'_{50},y'_{50})$}

(ii) Obtain the prediction on testing set and compute the RMSE for regularized polynomial regression models for order M =1,2 and 5 . Also plot the estimated function and target function for the training set and testing set.

Don't use any inbuilt functions.