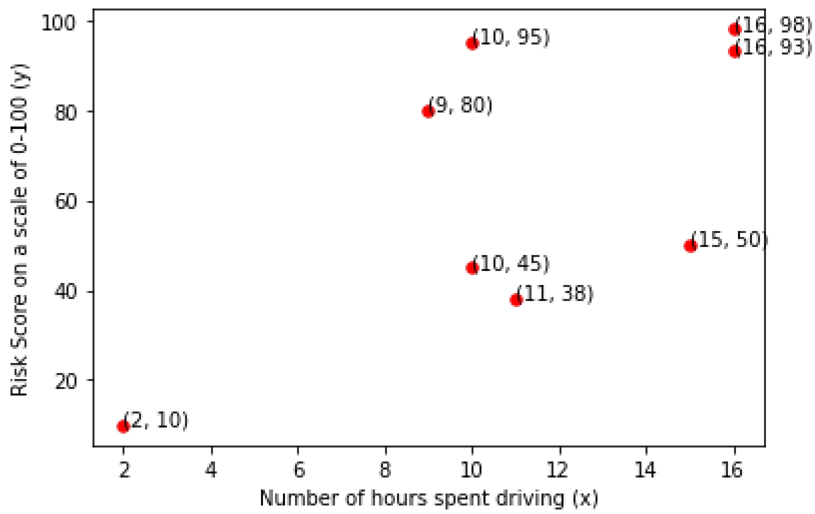
```
# Correlation Analysis
# Denote Association between two quantitative Variables
# Positive Correlation

import matplotlib.pyplot as plt
X = [10,9,2,15,10,16,11,16]
Y = [95,80,10,50,45,98,38,93]
assert len(X) == len(Y)
m = len(X)
plt.scatter(X,Y,color="red", s=30)
for x,y in zip(X,Y):
  plt.annotate((x,y), (x, y))
plt.xlabel("Number of hours spent driving (x)")
plt.ylabel("Risk Score on a scale of 0-100 (y)")
plt.show()
```



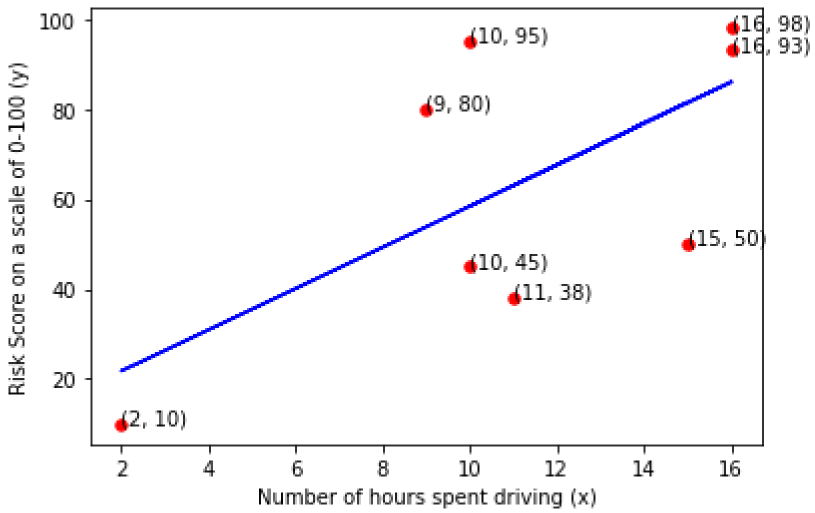

```
from math import sqrt

class Assignment1:

  # Constructor
  def __init__(self, datapoints):

    print('ML Assignment 1 class created\n')

    X,Y = self.get_feature_vector(datapoints)
    pearson = self.get_pearson(X,Y)
    b0,b1 = self.training(X,Y,pearson)
    r2 = self.get_r2_score(X,Y,b0,b1)
    sklearn_r2 = self.get_sklearn_r2_score(X,Y)
    self.plot_graph(X,Y,b0,b1)


  # Accept Supervised datapoints as input
  def get_feature_vector(self, datapoints):

    print('\nGet Feature Vector\n==========')
    print('Datapoints = ',datapoints)
```

```
    X = []
    Y = []

    for x,y in datapoints:

      #upper and lower bound for x
      assert x>=0
      assert x<=16
      assert type(x)==int

      #upper and lower bound for y
      assert y>=0
      assert y<=100
      assert type(y)==int

      X.append(x)
      Y.append(y)

    print('X = ',X)
    print('Y = ',Y)

    return X,Y


  # Determining if Linear Regression is the right
  def get_pearson(self, X, Y):

    print('\nCompute Karl Pearson\'s Coefficient\n===========')

    sum_x = sum(X)
    sum_y = sum(Y)
    m = len(X)
    sum_xy = 0
    sum_x2 = 0
    sum_y2 = 0
    for x,y in zip(X,Y):
      sum_xy += (x*y)
      sum_x2 += (x*x)
      sum_y2 += (y*y)
    numerator = m*sum_xy - sum_x*sum_y
    denominator = sqrt(m*sum_x2-(sum_x*sum_x))*sqrt(m*sum_y2-(sum_y*sum_y))
    pearson = numerator/denominator

    assert pearson>=-1
    assert pearson<=1

    print('Karl Pearson\'s Coefficient Correlation = {pearson}'.format(pearson=pea
    if pearson < -0.5:
      print('Strong Negative Correlation')
    elif pearson < 0:
      print('Weak Negative Correlation')
    elif pearson == 0:
      print('No Correlation')
    elif pearson < 0.5:
```

```
        print('Weak Positive Correlation')
      else:
        print('Strong Positive Correlation')
      return pearson


    # Fitting the regression line
    def training(self, X, Y, pearson):

      print('\nTraining\n===========')

      assert pearson>=0.5 or pearson<=-0.5
      print('Strong Correlation, Dataset is fit for Linear Regression')

      # Compute b1
      b1_numerator = 0
      b1_denominator = 0
      x_mean = sum(X)/len(X)
      y_mean = sum(Y)/len(Y)
      for x,y in zip(X,Y):
        b1_numerator = b1_numerator + (x-x_mean)*(y-y_mean)
        b1_denominator = b1_denominator + (x-x_mean)*(x-x_mean)
      b1 = b1_numerator/b1_denominator

      # Compute b0
      b0 = y_mean-b1*x_mean

      # Weight Quantization
      b0, b1 = round(b0,6), round(b1,6)

      print("Regression Line Equation : y = {b0} + {b1}*x".format(b0=b0,b1=b1))

      # Return Coefficients
      return b0, b1


    # Compute R2 Score
    def get_r2_score(self, X, Y, b0, b1):

      print('\nR2 Score\n===========')

      sse = 0 # Residual Sum of Squares
      sst = 0 # Total Sum of Squares
      y_mean = sum(Y)/len(Y)
      for x,y in zip(X,Y):
        y_pred = b0+b1*x
        sse += ( (y-y_pred)*(y-y_pred) )
        sst += ( (y-y_mean)*(y-y_mean) )
      r2 = 1 - (sse/sst)
      print('R2 Score  = ',r2)

      return r2



    # Sklearn R2 Score
```

```
  def get_sklearn_r2_score(self,X,Y):

    import numpy as np
    from sklearn.linear_model import LinearRegression

    print('\nSklearn R2 Score\n===========')

    X = np.array(X).reshape(-1,1)
    Y = np.array(Y).reshape(-1,1)

    reg = LinearRegression().fit(X, Y)
    r2 = reg.score(X,Y)
    print('Sklearn R2 Score  = ',r2)

    return r2

  def plot_graph(self,X,Y,b0,b1):

    import matplotlib.pyplot as plt

    print('\nPlot Graph\n===========')

    plt.scatter(X,Y,color="red", s=30)
    Y_pred = []
    for x,y in zip(X,Y):
      Y_pred.append(b0+b1*x)
      plt.annotate((x,y), (x, y))
    plt.plot(X,Y_pred, color="#0000ff")
    plt.xlabel("Number of hours spent driving (x)")
    plt.ylabel("Risk Score on a scale of 0-100 (y)")
    plt.show()



# Datapoints for supervisory learning
datapoints = [[10,95],[9,80],[2,10],[15,50],[10,45],[16,98],[11,38],[16,93]]

assignment1 = Assignment1(datapoints)
```

```
ML Assignment 1 class created


Get Feature Vector
===========
Datapoints =  [[10, 95], [9, 80], [2, 10], [15, 50], [10, 45], [16, 98], [11,
X =  [10, 9, 2, 15, 10, 16, 11, 16]
Y =  [95, 80, 10, 50, 45, 98, 38, 93]

Compute Karl Pearson's Coefficient
===========
Karl Pearson's Coefficient Correlation = 0.6611314653759117
Strong Positive Correlation

Training
===========
Strong Correlation, Dataset is fit for Linear Regression
Regression Line Equation : y = 12.584628 + 4.587899*x

R2 Score
===========
R2 Score  =  0.43709481451007637

Sklearn R2 Score
===========
Sklearn R2 Score  =  0.43709481451010035

Plot Graph
===========
```



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