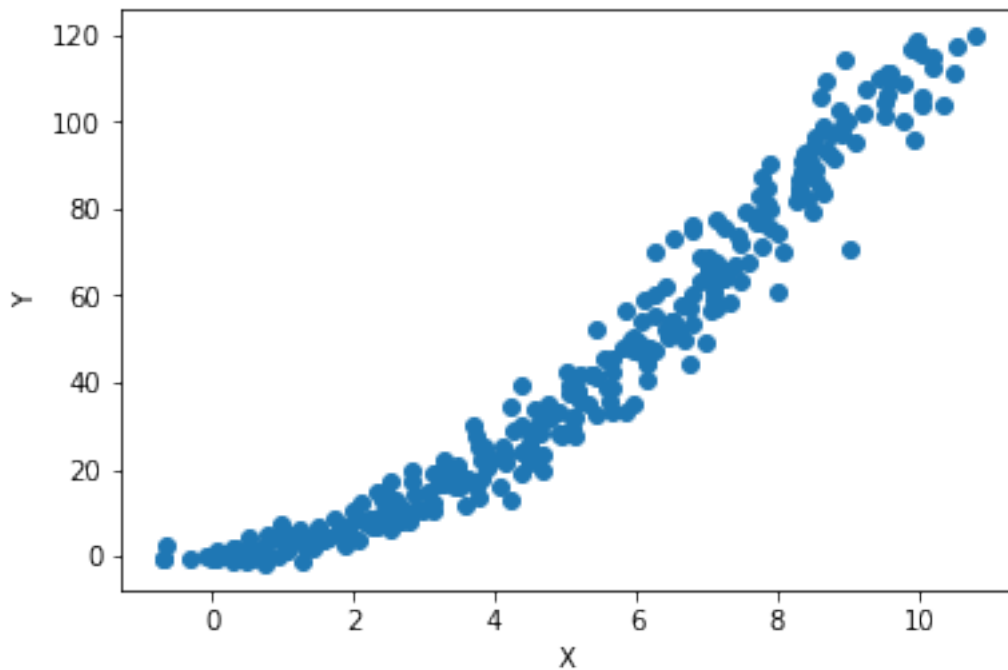


Problem1

May 14, 2018

```
In [1]: import numpy as np
import matplotlib.pyplot as plt
X_and_Y = np.load('./q1-least-square.npy')
X = X_and_Y[:, 0] # Shape: (300,)
Y = X_and_Y[:, 1] # Shape: (300,)
```

```
In [4]: plt.scatter(X, Y)
plt.xlabel('X')
plt.ylabel('Y')
plt.show()
```



```
In [6]: # Assume  $Y = w_0 + w_1 * X = (w_0, w_1) \cdot (1, X) = W \cdot X_1$ 
#  $X_1$  contains 1 and X.
X1 = np.matrix(np.hstack((np.ones((len(X), 1)), X.reshape(-1, 1))))
```

```

W = X1.T.dot(X1).I.dot(X1.T).dot(Y)
w0, w1 = np.array(W).reshape(-1)
print('Y = {:.2f} + {:.2f}*X'.format(w0, w1))

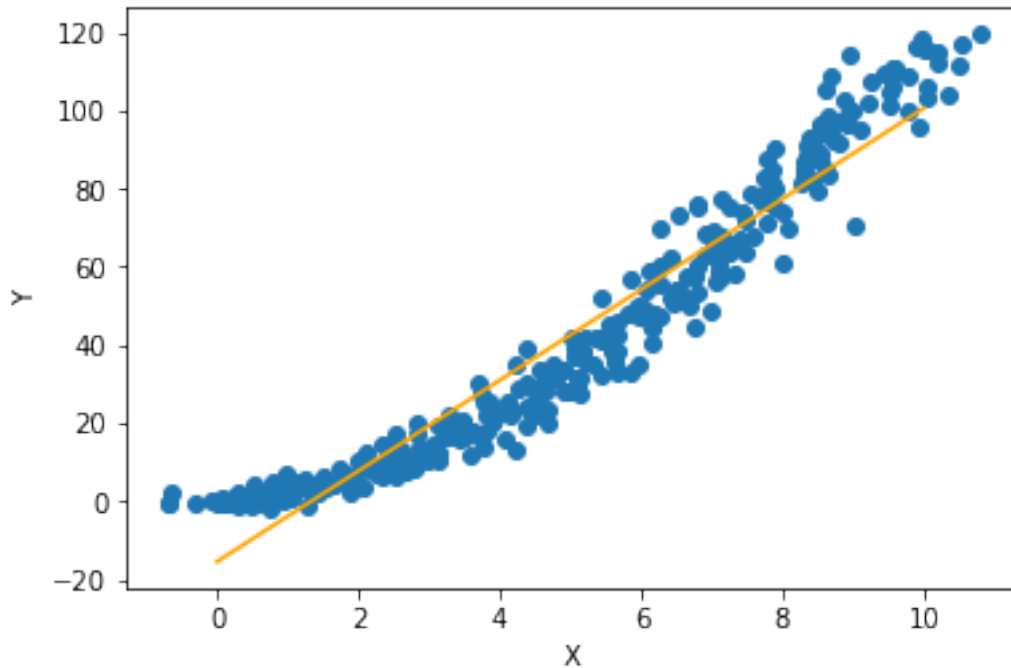
```

$Y = -15.47 + 11.61 \cdot X$

```

In [7]: X_line = np.linspace(0,10,300)
        Y_line = w0 + w1 * X_line
        plt.scatter(X, Y)
        plt.plot(X_line, Y_line, color='orange')
        plt.xlabel('X')
        plt.ylabel('Y')
        plt.show()

```



```

In [19]: # Assume  $Y = w_0 + w_1 \cdot X + w_2 \cdot X^2 = (w_0, w_1, w_2) \cdot (1, X, X^2) = W \cdot X_2$ 
        #  $X_2$  contains 1, X and  $X^2$ .
        X2 = np.matrix(np.hstack((np.ones((len(X),1)),X.reshape(-1,1),np.square(X.reshape(-1,1)))))
        W = X2.T.dot(X2).I.dot(X2.T).dot(Y) # Fill the blank here.
        w0, w1, w2 = np.array(W).reshape(-1)
        print('Y = {:.2f} + {:.2f}*X + {:.2f}*X2'.format(w0, w1, w2))

```

$Y = -1.71 + 3.02 \cdot X + 0.87 \cdot X^2$

```
In [20]: X_line = np.linspace(0,10,300)
Y_line = w0 + w1 * X_line + w2 * (X_line**2)
plt.scatter(X, Y)
plt.plot(X_line, Y_line, color='orange')
plt.xlabel('X')
plt.ylabel('Y')
plt.show()
```

