Model slection

January 20, 2018

1 Assignmnet 1

1.1 Model Selection (Part 1)

In [30]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
matr = []
Y = []
```

In [101]:
```
# Read the data
data = pd.read_csv("Datasets/Dataset_1_train.csv", header = -1,usecols=range(2))
cols = ["x","y"]
data.columns = cols
data.head()
```

Out[101]:

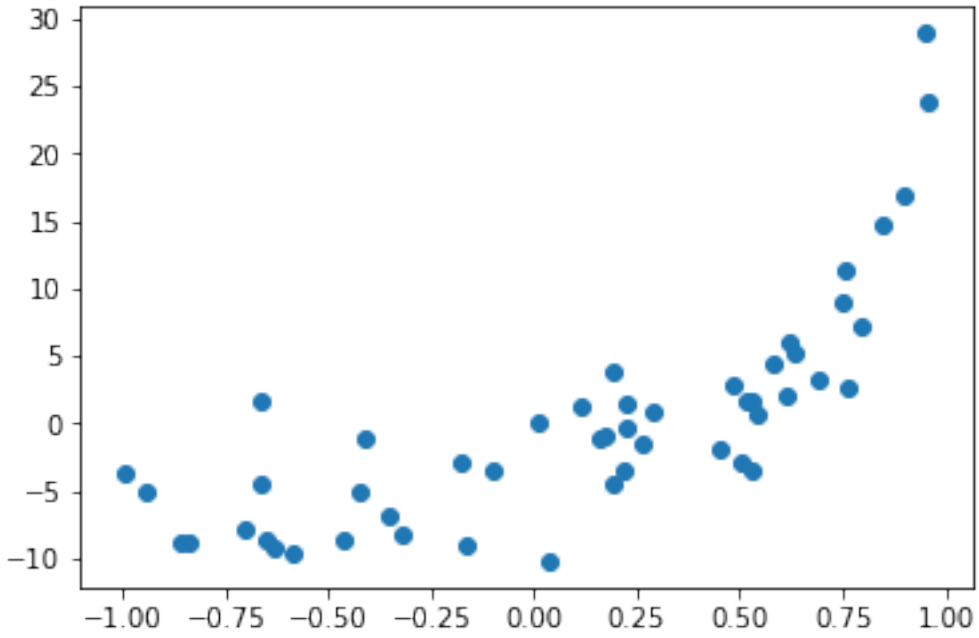
	x	y
0	0.516220	1.609671
1	0.850085	14.814006
2	-0.840629	-8.738649
3	0.227433	-0.274344
4	-0.649508	-8.683412

In [102]:
```
x = data['x']
y = data['y']
```

In [103]:
```
plt.scatter(x,y)
```

Out[103]:
```
<matplotlib.collections.PathCollection at 0x7f523ff62d68>
```

In [104]:
```
plt.show()
```




```
In [105]: matr = []
          for a in x:
              row =[]
              for p in range(20,-1,-1):
                  row = row + [a**(p)]
              matr = matr + [row]
```

```
In [106]: #Initialization for X, X^T and Y.
          Y=[]
          for i in y:
              Y = Y +[[i]]

          X = np.array(matr)
          XT = X.transpose()
```

1.1.1

$$W^* = (X^T X)^{-1} X^T Y$$

1.1.2 Using the formula we derived from class, we get the following parameters for the polynomial

```
In [107]: # Get the parameters
          A = np.dot(XT,X)
          A1 = np.matrix(A)
          A_I = A1.I
          XTX = np.dot(A_I,XT)
```

```
W = np.dot(XTX,Y)
# Get the Transpose because its easier to use as a row vector
WT = W.transpose()
# flatten the list.
p = WT.tolist()[0]
# Define the polynomial
Poly = np.poly1d(p)
```

1.1.3 Get the new Y values

Plot the curve and compare it with training data.

```
In [108]: x1 = x.tolist()
          x1.sort()
          new_y = [Poly(i) for i in x ]
          plt_y = [Poly(i) for i in x1 ]
```

1.2 Calculate The training MSE

```
In [109]: sigma = 0
          for i in range(len(new_y)):
              sigma = sigma + (new_y[i] - y[i])**2
          print("The Training mean square error is:",sigma/len(y))
```

```
The Training mean square error is: 6.474747793
```

1.2.1 Read the Validation data

```
In [110]: valid = pd.read_csv("Datasets/Dataset_1_valid.csv",header=-1,usecols=range(2))
          cols = ["x","y"]
          valid.columns = cols
          #data.head()
          u = valid['x']
          v = valid['y']
```

1.3 calculate the validation MSE

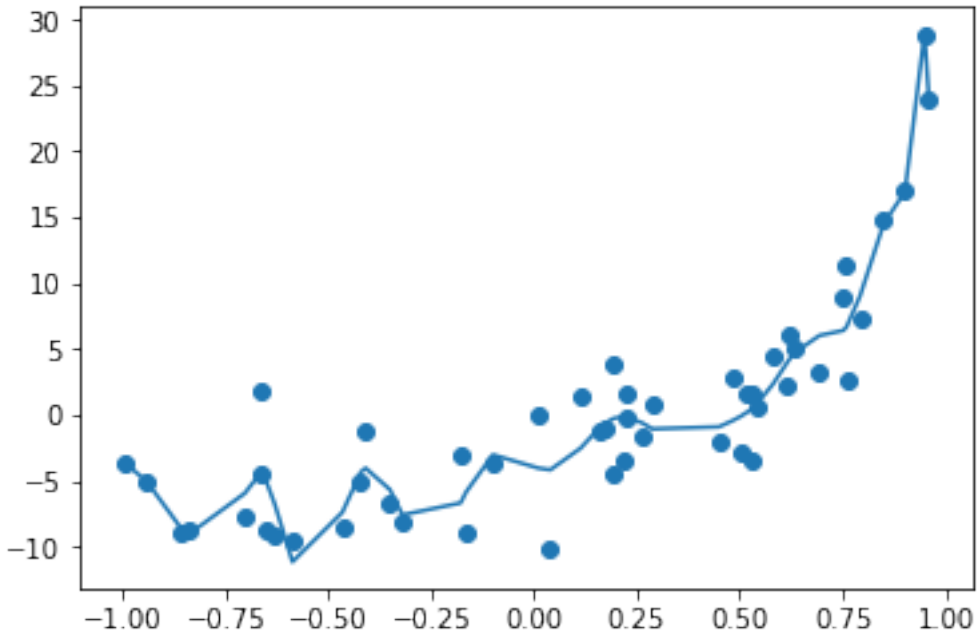
```
In [111]: new_v = [Poly(i) for i in u ]
          sigma = 0
          for i in range(len(new_v)):
              sigma = sigma + (new_v[i] - v[i])**2
          print("The validation mean square error is:",sigma/len(v))
```

```
The validation mean square error is: 1418.46219822
```

Curve Fit with Training data

```
In [112]: plt.scatter(x,y)
          plt.plot(x1,plt_y)

          plt.show()
```



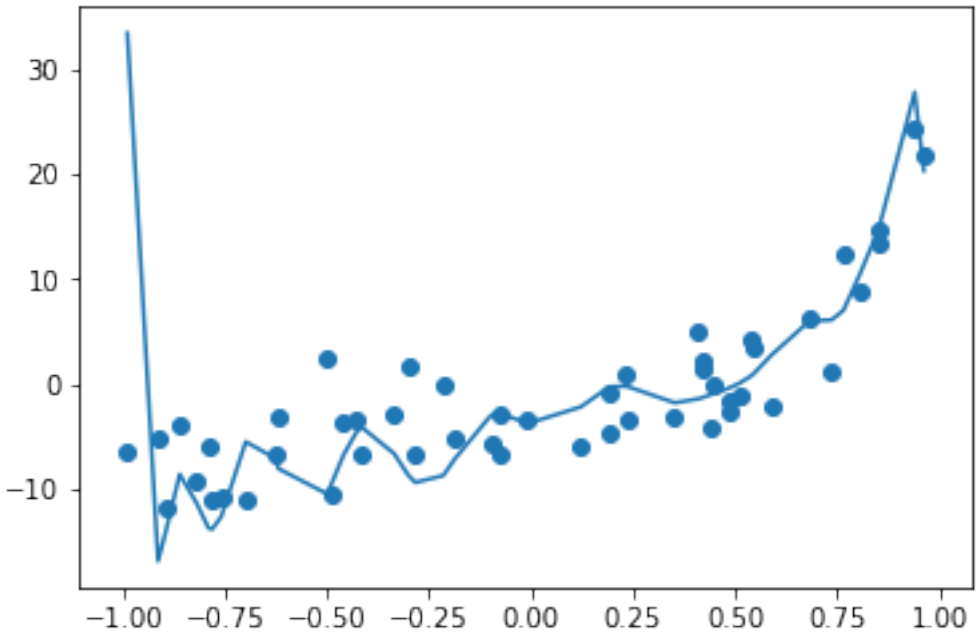
TEST CURVE FIT

```
In [116]: test = pd.read_csv("Datasets/Dataset_1_test.csv", header = -1,usecols=range(2))
          cols = ["x","y"]
          test.columns = cols
          test.head()
```

```
Out[116]:           x         y
          0 -0.335254 -2.953401
          1  0.122457 -5.836786
          2 -0.819361 -9.321124
          3 -0.860443 -3.800950
          4  0.422628  2.100318
```

```
In [117]: X = test['x'].tolist()
          X.sort()
          Y = [Poly(i) for i in X ]
```

```
In [118]: plt.plot(X,Y)
          plt.scatter(test['x'],test['y'])
          plt.show()
```


30
20
10
0
−10
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00