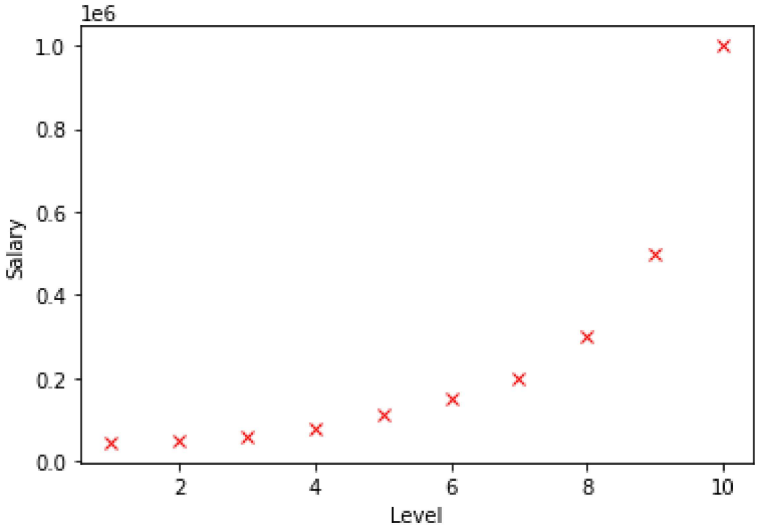
In [61]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
```

In [62]:
```
data = pd.read_csv('./Position_Salaries.csv')
data
```

Out[62]:

	Position	Level	Salary
0	Business Analyst	1	45000
1	Junior Consultant	2	50000
2	Senior Consultant	3	60000
3	Manager	4	80000
4	Country Manager	5	110000
5	Region Manager	6	150000
6	Partner	7	200000
7	Senior Partner	8	300000
8	C-level	9	500000
9	CEO	10	1000000

In [63]:
```
plt.plot(data['Level'], data['Salary'], 'rx')
plt.xlabel("Level")
plt.ylabel("Salary")
plt.show()
```



In [64]:
```
x = np.array([data['Level']]).T # this becomes vector (column vector)
y = np.array(data['Salary']) # row vector
```

In [65]:
```
#bias
x = np.hstack((np.ones((x.shape[0], 1)), x)) # [1 x]
```

In [66]:
```
# adding polynomial terms
# theta0 + theta1*x + theta2*x2 + theta3*x3
x = np.hstack((
        x,
        (x[:, 1]**2).reshape((x.shape[0], 1)),
        (x[:, 1]**3).reshape((x.shape[0], 1))
    ))
```

In [67]:
```
#normalization
# x = (x-mean)/std
x[:, 1:] = (x[:, 1:] - np.mean(x[:, 1:], axis=0))/np.std(x[:, 1:])
#using inbuilt functions/methods to find meand and std values over dataset
```

In [68]:
```
#initializing random values for theta vector
theta = np.random.rand(x.shape[1])
predictions = np.dot(x, theta)
```

In [69]:
```
#implementing the cost function
def cost_function(x, y, theta):
    prediction = np.dot(x, theta)
    cost = np.mean(np.square(prediction - y))
    return cost
```

In [70]:
```
#gradient descent and training model

def polynomial_regression(x, y, theta, alpha, iterations):
    m = x.shape[0]
    for _ in range(iterations):
        theta = theta - alpha*(1/m)*np.dot(x.T, np.dot(x, theta)-y)
        if _ % (iterations/10) == 0:
            print(f"cost: {cost_function(x, y, theta)}")
    return theta

# alpha = 0.001
# loss = []
# for _ in range(10000):
#     theta = theta - alpha*(1/m)*(np.dot(x.T, np.dot(x, theta) - y))
#     loss.append(cost_function(x, y, theta))
#     if _%(iterations/10) == 0:
#         print(f"cost: {cost_function(x, y, theta)}")
# return theta
```

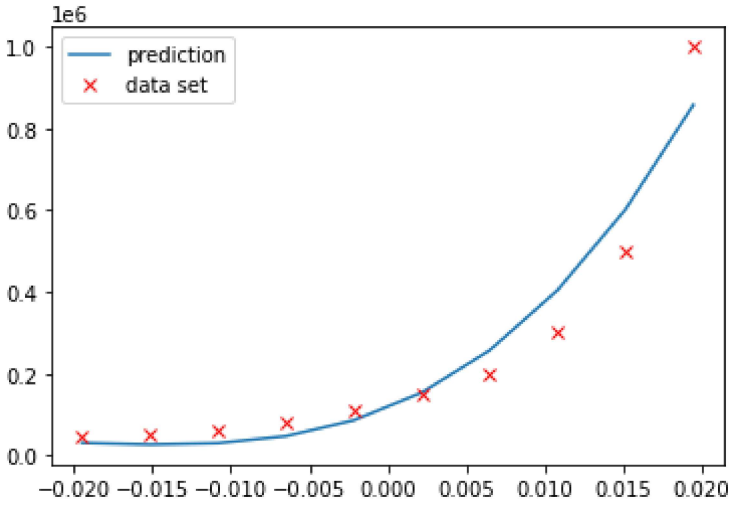
In [76]:
```
theta = polynomial_regression(x, y, theta, 0.005, 50000)
```

```
cost: 5313022913.240404
cost: 5256478182.405151
cost: 5201372929.555522
cost: 5147670466.006201
cost: 5095335038.176297
cost: 5044331803.755913
cost: 4994626808.4800205
cost: 4946186963.494384
cost: 4898980023.2984
cost: 4852974564.250033
```

In [77]:
```
prediction = np.dot(x, theta)
plt.plot(x[:, 1], prediction, label='prediction')
```

```
plt.plot(x[:, 1], y, 'rx', label='data set')
plt.legend()
```

Out[77]:
```
<matplotlib.legend.Legend at 0x2df6d629f40>
```



In [78]:
```
loss = np.sum(y-prediction)
loss
```

Out[78]:
```
1.4028046280145645e-08
```

In [ ]:
```

```