23. Polynomial Regression

- When data is not following any linearity
- Polynomial regression is a regression algorithm that models the relationshi between a dependent(y)and independent variable(x) as nth degree polynomial
- **Y = b0 + b1x1 + b2x1^2 + b3x1^3 + ... + bnx1^n**

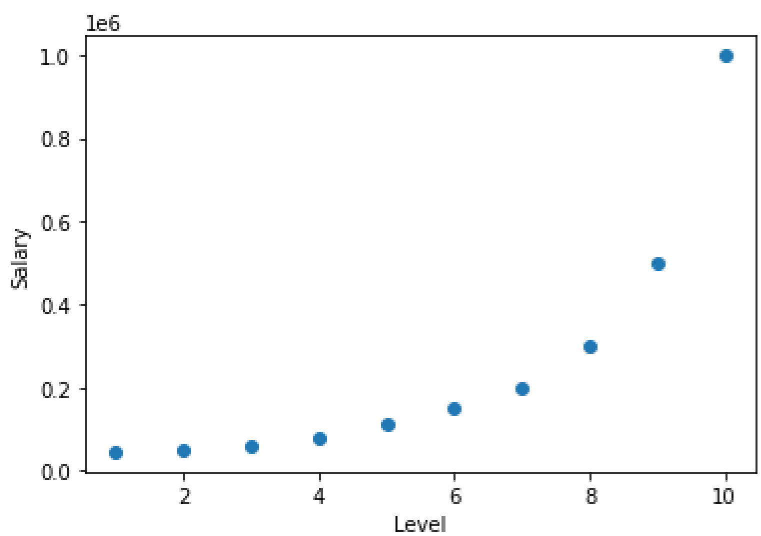
In [2]:
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

In [4]:
```
dataset = pd.read_csv(r'Data/polynomial.csv')
dataset.head(3)
```

Out[4]:

	Level	Salary
0	1	45000
1	2	50000
2	3	60000

In [8]:
```
plt.scatter(dataset["Level"], dataset["Salary"])
plt.xlabel("Level")
plt.ylabel("Salary")
plt.show()
```



- So this graph is showing that data is not linear

To check correlation

In [6]:
```
dataset.corr()
```

Out[6]:

	Level	Salary
Level	1.000000	0.817949
Salary	0.817949	1.000000

Separate data into input and output

In [9]:
```
# Remember that data should be multidimensional
x = dataset[['Level']]
y = dataset['Salary']
```

Convert data into polynomial nature

In [10]:
```
from sklearn.preprocessing import PolynomialFeatures
```

In [31]:
```
# Change the degree to 2 and so on, depend on your need, to make the model more acc
pf = PolynomialFeatures(degree=2)
pf.fit(x)
x = pf.transform(x)
x
```

Out[31]:
```
array([[1.000e+00, 1.000e+00, 1.000e+00, 1.000e+00, 1.000e+00, 1.000e+00,
        1.000e+00, 1.000e+00, 1.000e+00, 1.000e+00],
       [1.000e+00, 1.000e+00, 2.000e+00, 4.000e+00, 1.000e+00, 2.000e+00,
        4.000e+00, 4.000e+00, 8.000e+00, 1.600e+01],
       [1.000e+00, 1.000e+00, 3.000e+00, 9.000e+00, 1.000e+00, 3.000e+00,
        9.000e+00, 9.000e+00, 2.700e+01, 8.100e+01],
       [1.000e+00, 1.000e+00, 4.000e+00, 1.600e+01, 1.000e+00, 4.000e+00,
        1.600e+01, 1.600e+01, 6.400e+01, 2.560e+02],
       [1.000e+00, 1.000e+00, 5.000e+00, 2.500e+01, 1.000e+00, 5.000e+00,
        2.500e+01, 2.500e+01, 1.250e+02, 6.250e+02],
       [1.000e+00, 1.000e+00, 6.000e+00, 3.600e+01, 1.000e+00, 6.000e+00,
        3.600e+01, 3.600e+01, 2.160e+02, 1.296e+03],
       [1.000e+00, 1.000e+00, 7.000e+00, 4.900e+01, 1.000e+00, 7.000e+00,
        4.900e+01, 4.900e+01, 3.430e+02, 2.401e+03],
       [1.000e+00, 1.000e+00, 8.000e+00, 6.400e+01, 1.000e+00, 8.000e+00,
        6.400e+01, 6.400e+01, 5.120e+02, 4.096e+03],
       [1.000e+00, 1.000e+00, 9.000e+00, 8.100e+01, 1.000e+00, 9.000e+00,
        8.100e+01, 8.100e+01, 7.290e+02, 6.561e+03],
       [1.000e+00, 1.000e+00, 1.000e+01, 1.000e+02, 1.000e+00, 1.000e+01,
        1.000e+02, 1.000e+02, 1.000e+03, 1.000e+04]])
```

Split data into train and test

In [13]:
```
from sklearn.model_selection import train_test_split
```

In [18]:
```
x_train, x_test, y_train, y_test = train_test_split(x,y,test_size=0.2, random_state
```

Build model using polynomial regression

In [19]:
```
from sklearn.linear_model import LinearRegression
```

In [20]:
```
lr = LinearRegression()
lr.fit(x_train, y_train)
```

Out[20]:
```
▾ LinearRegression
LinearRegression()
```

Check model accuracy

In [22]:
```
lr.score(x_test, y_test)*100
```

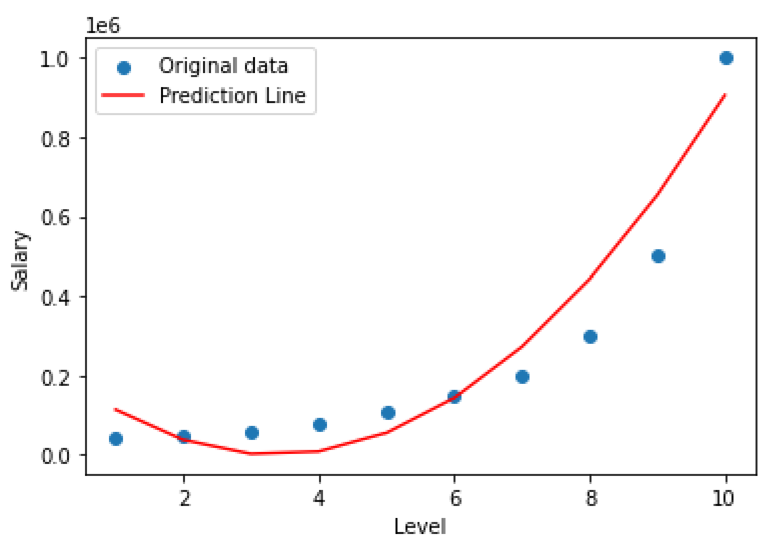
Out[22]:
```
76.66492889299911
```

Draw Prediction Line

In [23]:
```
pred = lr.predict(x)
pred
```

Out[23]:
```
array([114155.94968909,  38027.48728095,   2903.12323346,   8782.85754664,
         55666.69022046, 143554.62125495, 272446.65065008, 442342.77840588,
        653243.00452233, 905147.32899944])
```

In [26]:
```
plt.scatter(dataset["Level"], dataset["Salary"])
plt.plot(dataset['Level'], pred, c='red')
plt.xlabel("Level")
plt.ylabel("Salary")
plt.legend(["Original data", "Prediction Line"])
plt.show()
```



Remember, before testing any data, you have to convert it into polynomial feature, then use it for predcition, like below:

In [29]:
```
test = pf.transform([[9]])
test
```

```
C:\Users\rashi\AppData\Local\Programs\Python\Python39\lib\site-packages\sklearn\bas
e.py:450: UserWarning: X does not have valid feature names, but PolynomialFeatures w
as fitted with feature names
  warnings.warn(
```

Out[29]:
```
array([[ 1.,  9., 81.]])
```

In [30]:
```
lr.predict(test)
```

Out[30]:
```
array([653243.00452233])
```

Beware of overfitting / underfitting, your model should not be that much accurate, so it go to overfitting - rahter it should be best fit

In [ ]:
```

```