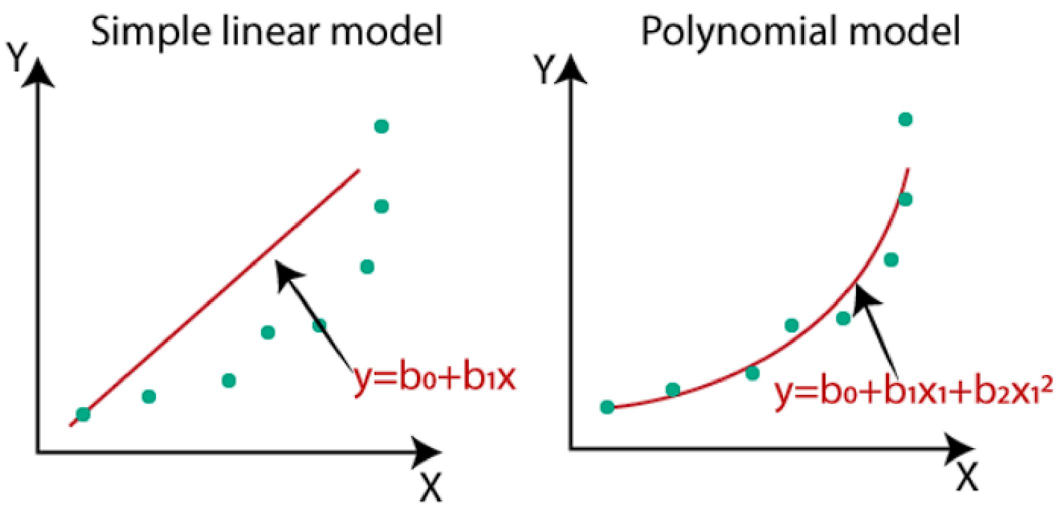
Polynomial Regression is a regression algorithm that models the relationship between a dependent(y) and independent variable(x) as nth degree polynomial.

In [ ]:
```
# y= b0+b1x1+ b2x12+ b2x13+...... bnx1n

"""It is a linear model with some modification in order to increase the accu

The dataset used in Polynomial regression for training is of non-linear natu

It makes use of a linear regression model to fit the complicated and non-lin

```

In [ ]:
```
"""In Polynomial regression, the original features are converted into Polyno
features of required degree (2,3,..,n) and then modeled using a linear model
```

In [ ]:
```
"""Need for Polynomial Regression:

If we apply a linear model on a linear dataset, then it provides us a good r
but if we apply the same model without any modification on a non-linear data
Due to which loss function will increase, the error rate will be high, and a

So for such cases, where data points are arranged in a non-linear fashion, w
We can understand it in a better way using the below comparison diagram of t
```



In [ ]:
```
"""Equation of the Polynomial Regression Model:


Simple Linear Regression equation:         y = b0+b1x         .........(a)

Multiple Linear Regression equation:         y= b0+b1x+ b2x2+ b3x3+....+ bnx

Polynomial Regression equation:         y= b0+b1x + b2x2+ b3x3+....+ bnxn
```

Implementation of Polynomial Regression using Python:

In [ ]:

```
#Problem Description:
"""There is a Human Resource company, which is going to hire a new candidate
The candidate has told his previous salary 160K per annum, and the HR have t
check whether he is telling the truth or bluff.
So to identify this, they only have a dataset of his previous company in whi
the salaries of the top 10 positions are mentioned with their levels.
By checking the dataset available, we have found that there is a non-linear
relationship between the Position levels and the salaries.
Our goal is to build a Bluffing detector regression model,
so HR can hire an honest candidate. Below are the steps to build such a mode
```

In [ ]:

```
from matplotlib import pyplot as plt
import numpy as np
import pandas as pd
import seaborn as sns
```

In [ ]:

```
df=pd.read_csv("/content/sample_data/Position_Salaries_Polynomial_DataSet.cs
```

In [ ]:

```
df.head(5)
```

Out[8]:

	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

In [ ]:

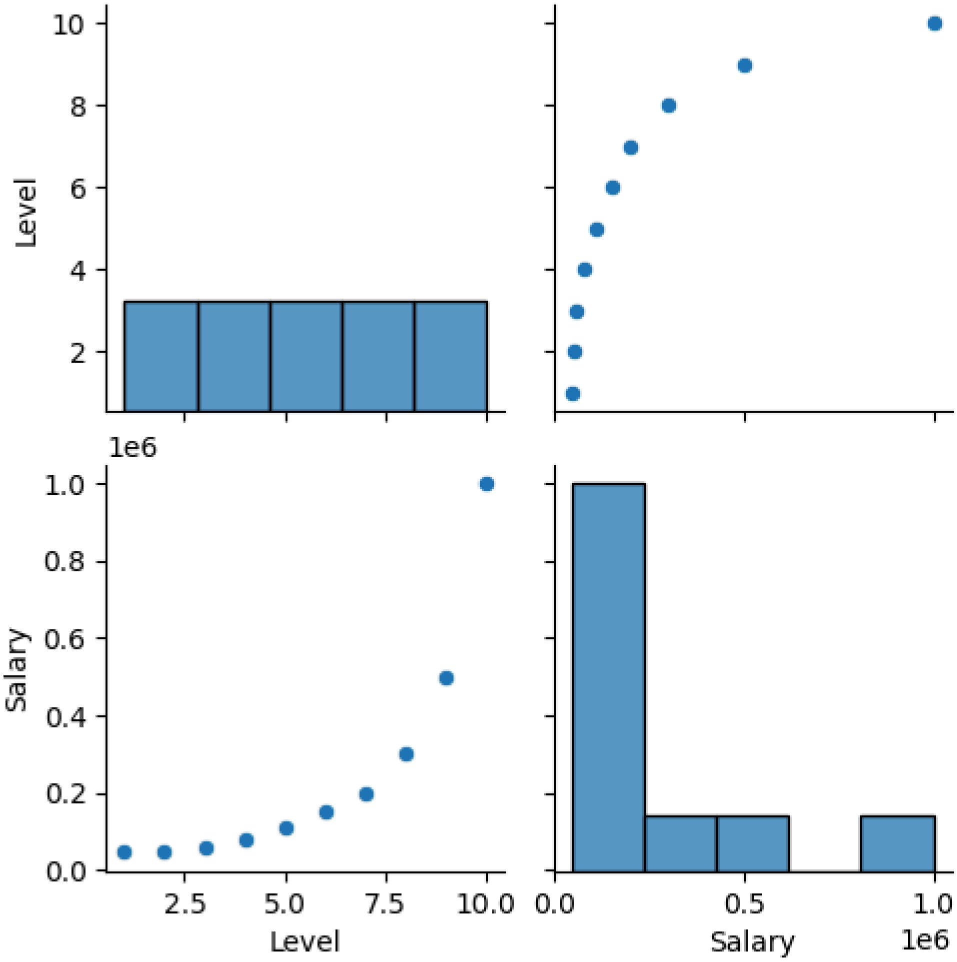
```
df
```

Out[9]:

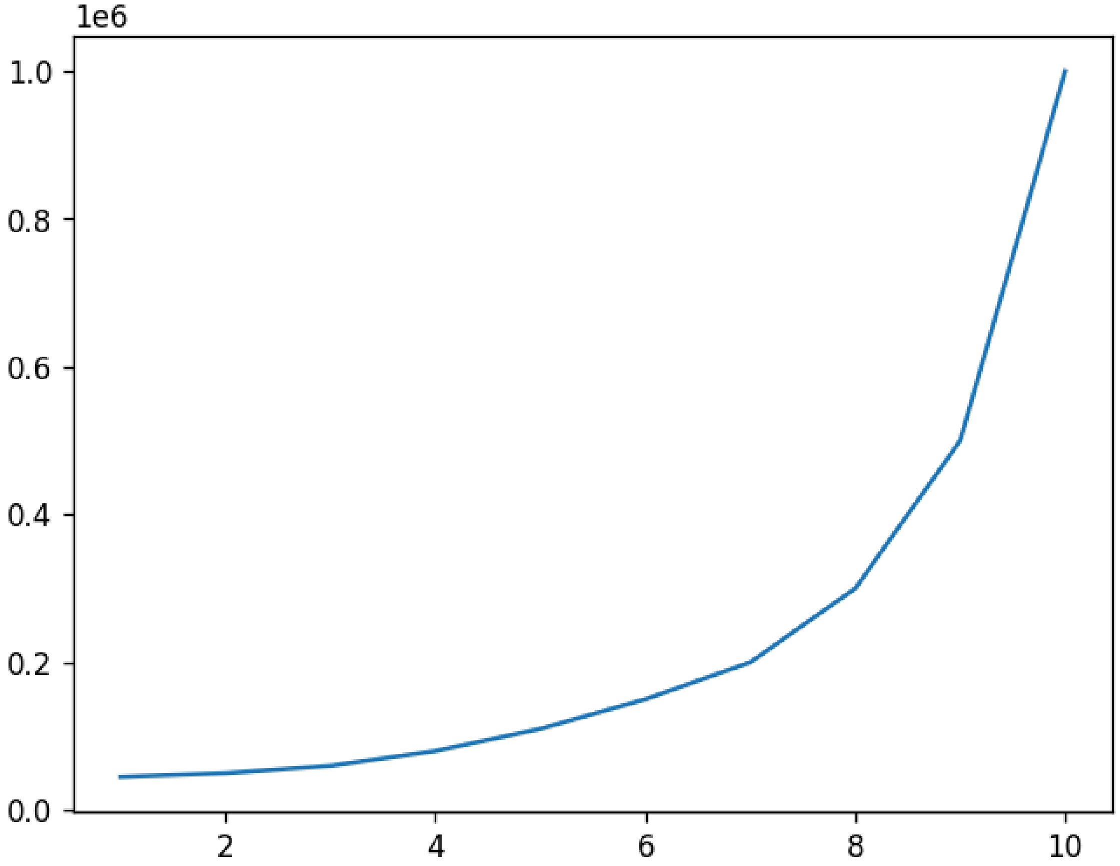
	Position	Level	Salary
0	Business Analyst	1	45000
1	Junior Consultant	2	50000
2	Senior Consultant	3	60000
3	Manager	4	80000
4	Country Manager	5	110000
5	Region Manager	6	150000
6	Partner	7	200000
7	Senior Partner	8	300000
8	C-level	9	500000
9	CEO	10	1000000

In [ ]:
```
sns.pairplot(df)
```

Out[10]:
```
<seaborn.axisgrid.PairGrid at 0x7bfeb8ea0b50>
```



```
In [ ]: plt.figure(dpi=120)
        plt.plot(df["Level"],df["Salary"])

Out[11]: [<matplotlib.lines.Line2D at 0x7bfeb6afcfa0>]
```



```
In [ ]: x=df[["Level"]].values
```

```
In [ ]: y=df[["Salary"]].values
```

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

```
In [ ]: reg=LinearRegression()
```

```
In [ ]: reg.fit(x,y)

Out[16]: LinearRegression()
```

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```
In [ ]: reg.score(x,y)

Out[17]: 0.6690412331929895
```

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

In [ ]:
```
pred
```

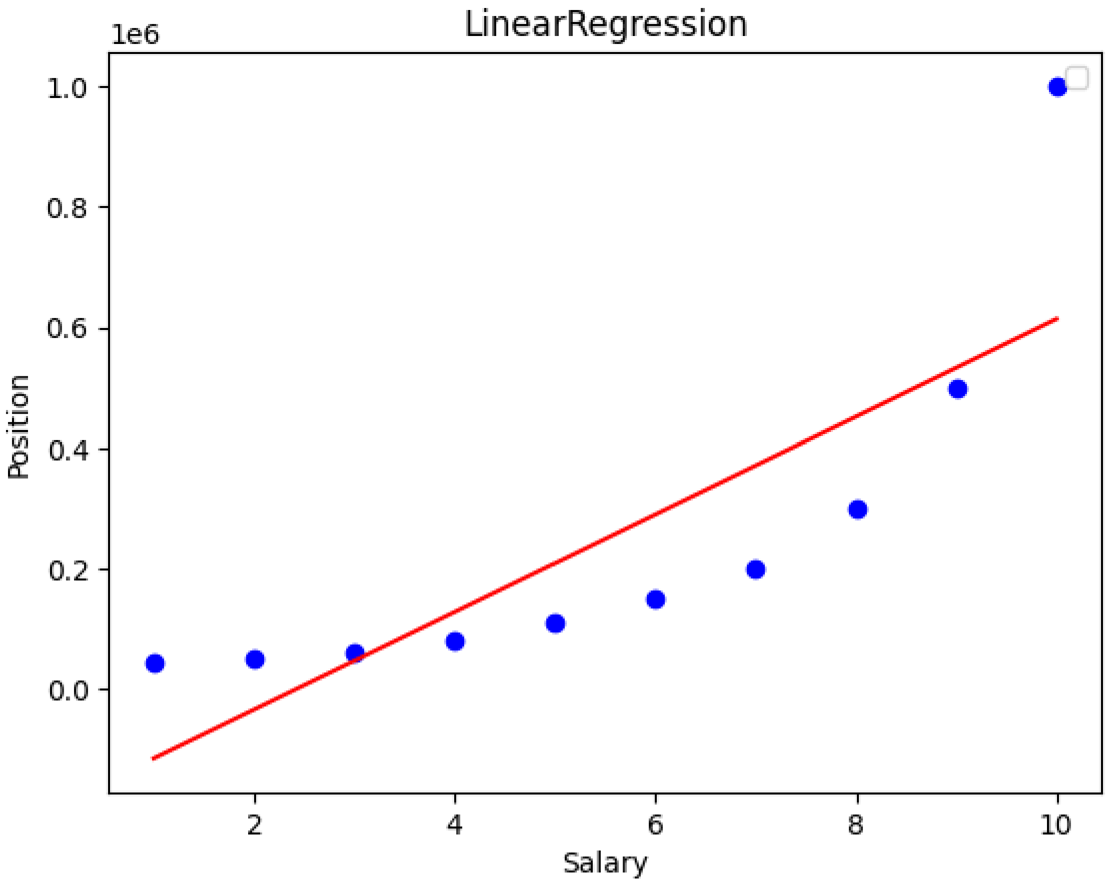
Out[19]:
```
array([[-114454.54545455],
       [ -33575.75757576],
       [  47303.03030303],
       [ 128181.81818182],
       [ 209060.60606061],
       [ 289939.39393939],
       [ 370818.18181818],
       [ 451696.96969697],
       [ 532575.75757576],
       [ 613454.54545455]])
```

In [ ]:
```
#Now find the best fit line
```

In [ ]:
```
plt.figure(dpi=100)
plt.title("LinearRegression")
plt.xlabel("Salary")
plt.ylabel("Position")
plt.plot(x,y,"ob")
plt.plot(x,pred,"red") #best fit Line
plt.legend()
```

```
WARNING:matplotlib.legend:No artists with labels found to put in legend.
Note that artists whose label start with an underscore are ignored when le
gend() is called with no argument.
```

Out[21]:
```
<matplotlib.legend.Legend at 0x7bfeb23eccd0>
```



In [ ]:
```
#introducing the variable with degree =2 (PLR - Polynomial Linear Regressio
#we will build the Polynomial Regression model, but it will be a little dif
```

In [ ]:
```
from sklearn.preprocessing import PolynomialFeatures
poly=PolynomialFeatures(degree=2)
x_poly=poly.fit_transform(x)
poly
```

Out[22]:
```
PolynomialFeatures()
```

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In [ ]:
```
x_poly
```

Out[23]:
```
array([[  1.,   1.,   1.],
       [  1.,   2.,   4.],
       [  1.,   3.,   9.],
       [  1.,   4.,  16.],
       [  1.,   5.,  25.],
       [  1.,   6.,  36.],
       [  1.,   7.,  49.],
       [  1.,   8.,  64.],
       [  1.,   9.,  81.],
       [  1.,  10., 100.]])
```

In [ ]:
```
poly_reg2=LinearRegression()
poly_reg2.fit(x_poly,y)
```

Out[24]:
```
LinearRegression()
```

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In [ ]:
```
poly_reg2.score(x_poly,y)
```

Out[25]:
```
0.9162082221443942
```

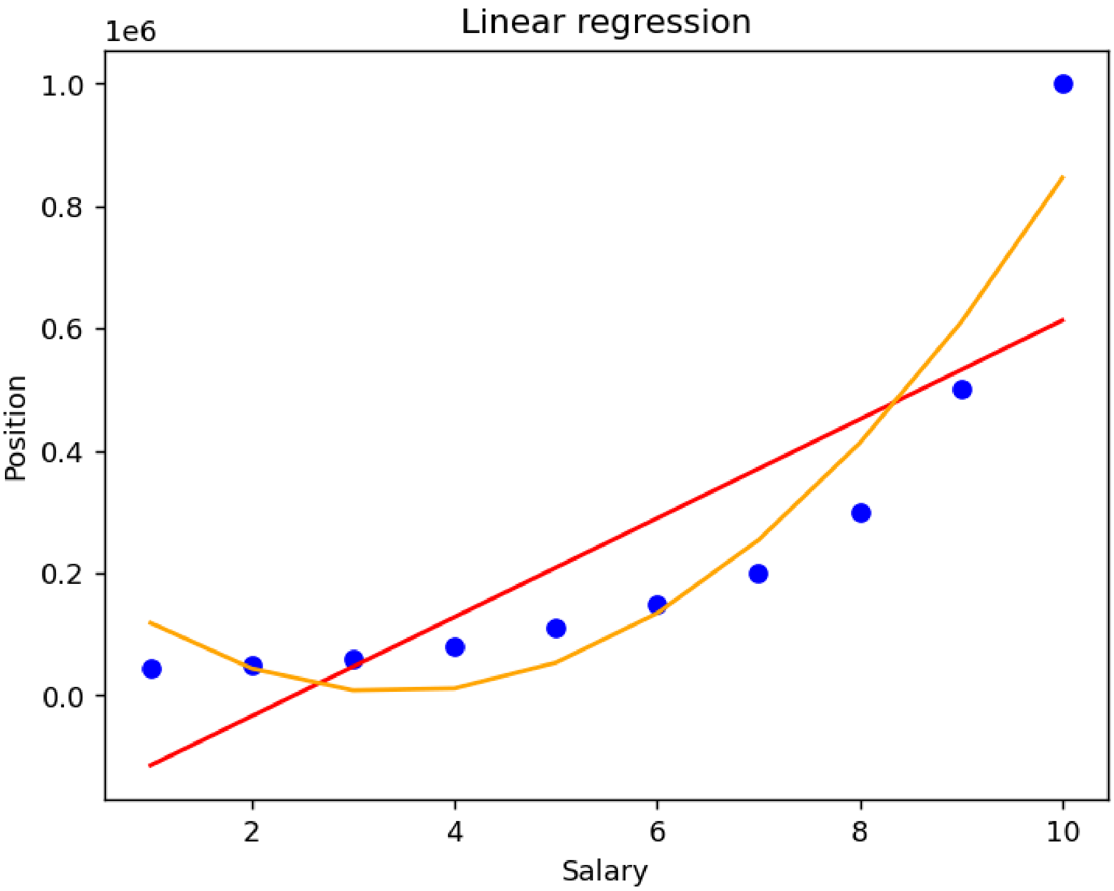
In [ ]:
```
pred2=poly_reg2.predict(x_poly)
```

In [ ]:
```
pred2
```

Out[27]:
```
array([[118727.27272727],
       [ 44151.51515151],
       [  8439.39393939],
       [ 11590.90909091],
       [ 53606.06060606],
       [134484.84848485],
       [254227.27272727],
       [412833.33333333],
       [610303.03030303],
       [846636.36363636]])
```

```
In [ ]: plt.figure(dpi=130)
        plt.title('Linear regression')
        plt.xlabel('Salary')
        plt.ylabel('Position')
        plt.plot(x,y,'ob');
        plt.plot(x,pred,'red');
        plt.plot(x,pred2,'orange')
```

```
Out[28]: [<matplotlib.lines.Line2D at 0x7bfeb1e18880>]
```



```
In [ ]: #Use PolynomialFeatures class of preprocessing.
```

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

```
In [ ]: poly=PolynomialFeatures(degree=3)
        x_poly=poly.fit_transform(x)
        poly
```

```
Out[31]: PolynomialFeatures(degree=3)
```

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In [ ]:
```
x_poly
```

Out[32]:
```
array([[   1.,    1.,    1.,    1.],
       [   1.,    2.,    4.,    8.],
       [   1.,    3.,    9.,   27.],
       [   1.,    4.,   16.,   64.],
       [   1.,    5.,   25.,  125.],
       [   1.,    6.,   36.,  216.],
       [   1.,    7.,   49.,  343.],
       [   1.,    8.,   64.,  512.],
       [   1.,    9.,   81.,  729.],
       [   1.,   10.,  100., 1000.]])
```

In [ ]:
```
poly_reg3=LinearRegression()
poly_reg3.fit(x_poly,y)
```

Out[33]:
```
LinearRegression()
```

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In [ ]:
```
poly_reg3
```

Out[34]:
```
LinearRegression()
```

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In [ ]:
```
poly_reg3.score(x_poly,y)
```

Out[35]:
```
0.9812097727913366
```

In [ ]:
```
pred3=poly_reg3.predict(x_poly)
```

In [ ]:
```
pred3
```

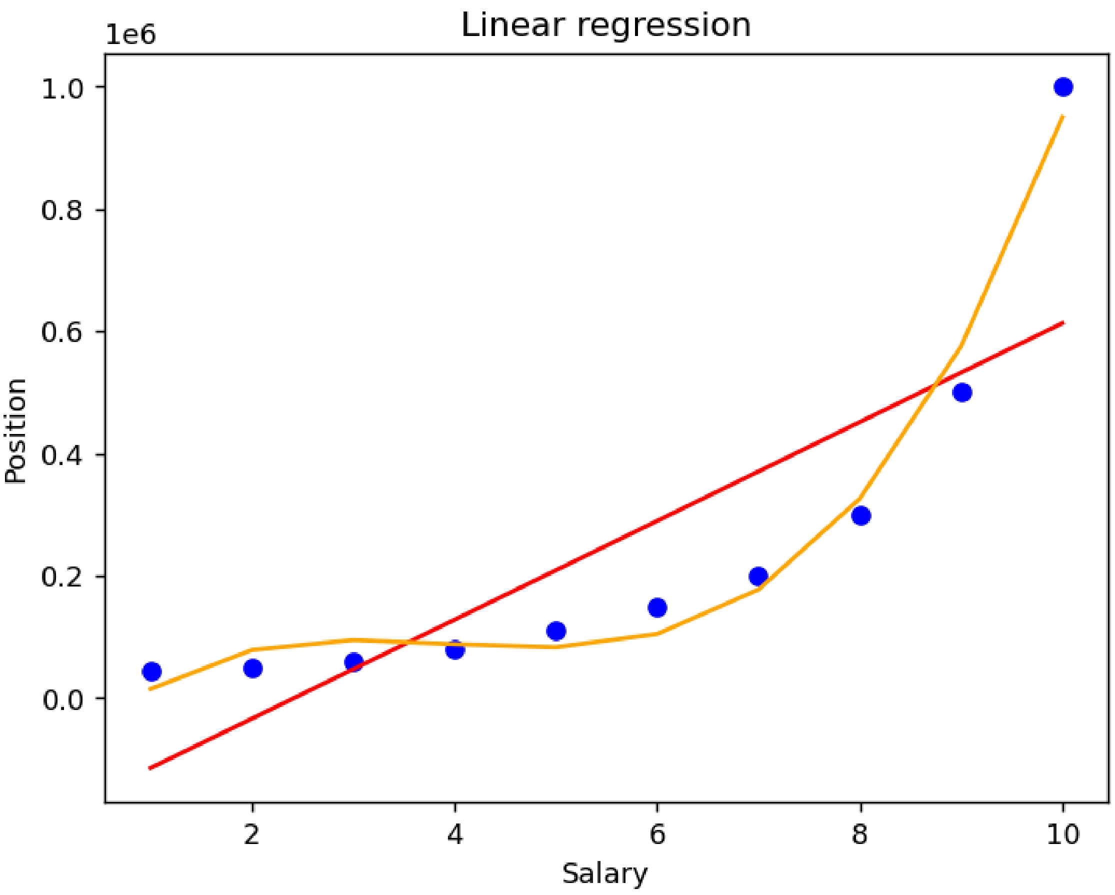
Out[37]:
```
array([[ 14902.09790211],
       [ 78759.90675991],
       [ 94960.37296037],
       [ 88223.77622378],
       [ 83270.3962704 ],
       [104820.51282052],
       [177594.40559441],
       [326312.35431236],
       [575694.63869463],
       [950461.53846152]])
```

In [ ]:

```
plt.figure(dpi=130)
plt.title('Linear regression')
plt.xlabel('Salary')
plt.ylabel('Position')
plt.plot(x,y,'ob');
plt.plot(x,pred,'red');
plt.plot(x,pred3,'orange')
```

Out[38]:

```
[<matplotlib.lines.Line2D at 0x7bfeb1ebdc90>]
```



In [ ]:

```
from sklearn.preprocessing import PolynomialFeatures
poly=PolynomialFeatures(degree=9)
x_poly=poly.fit_transform(x)
poly
```

Out[39]:

```
PolynomialFeatures(degree=9)
```

In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
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In [ ]:

```
poly_reg9=LinearRegression()
poly_reg9.fit(x_poly,y)
```

Out[40]:

```
LinearRegression()
```

In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
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```
In [ ]: poly_reg9.score(x_poly,y)
```

```
Out[41]: 0.9999999999999828
```

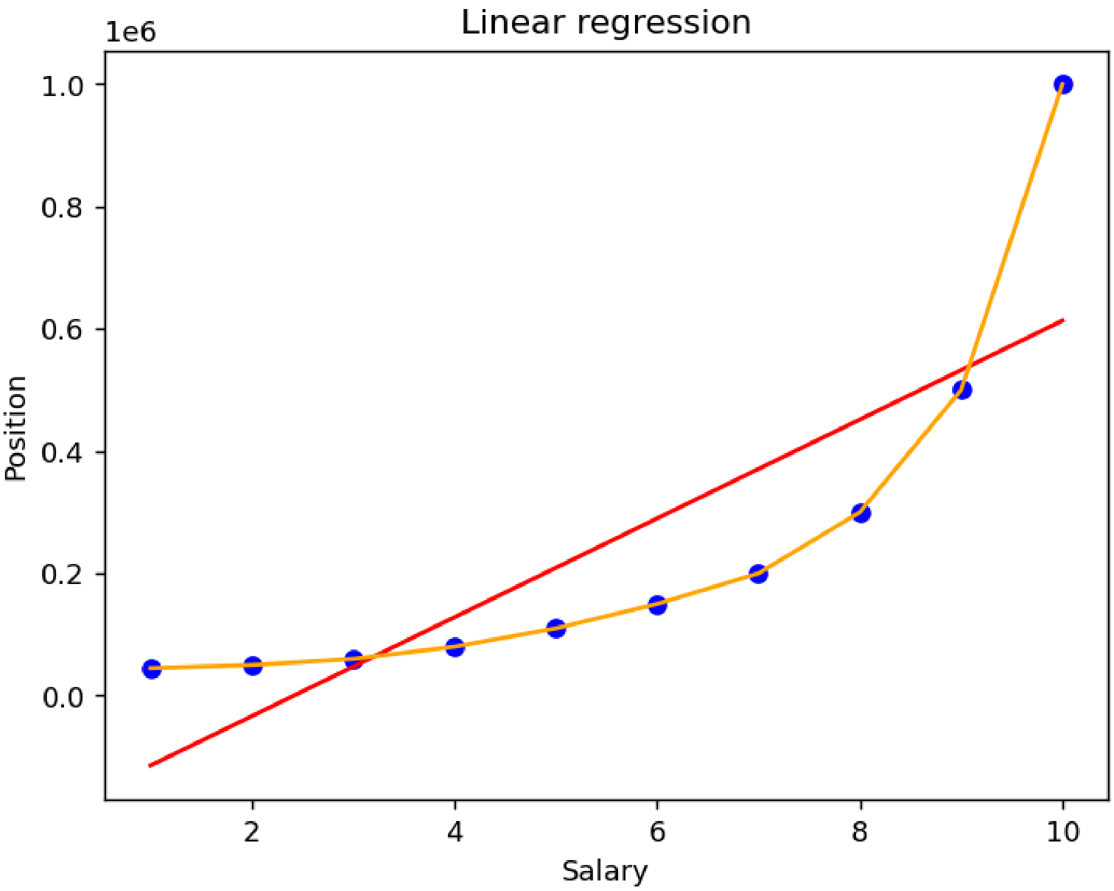
```
In [ ]: pred9=poly_reg9.predict(x_poly)
```

```
In [ ]: pred9
```

```
Out[43]: array([[  44999.95524136],
                [  50000.00570684],
                [  60000.01207874],
                [  79999.99142668],
                [ 110000.02227248],
                [ 149999.99920151],
                [ 200000.01396641],
                [ 300000.00429198],
                [ 499999.92400357],
                [1000000.07181498]])
```

```
In [ ]: plt.figure(dpi=130)
        plt.title('Linear regression')
        plt.xlabel('Salary')
        plt.ylabel('Position')
        plt.plot(x,y,'ob');
        plt.plot(x,pred,'red');
        plt.plot(x,pred9,'orange')
```

```
Out[44]: [<matplotlib.lines.Line2D at 0x7bfeafd02fb0>]
```



```
In [ ]:
```