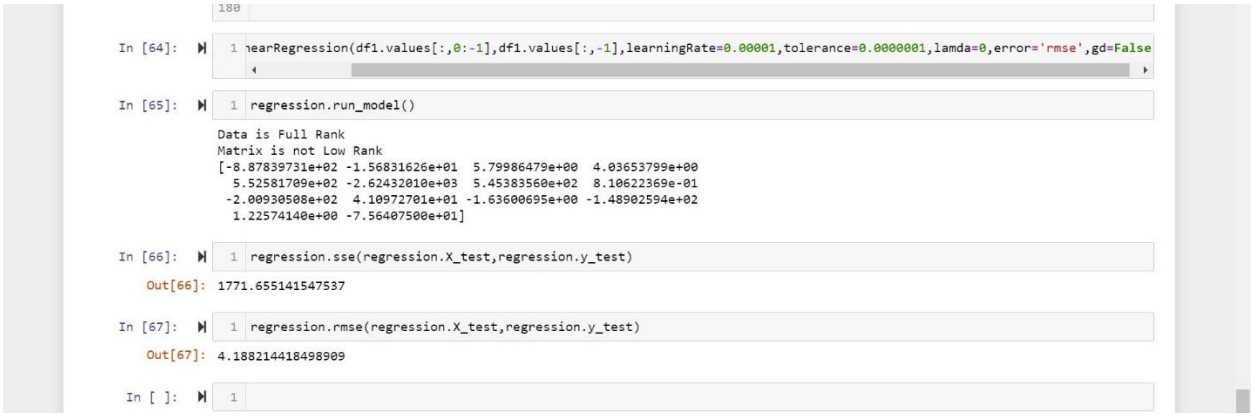
REPORT FOR LINEAR REGRESSION:

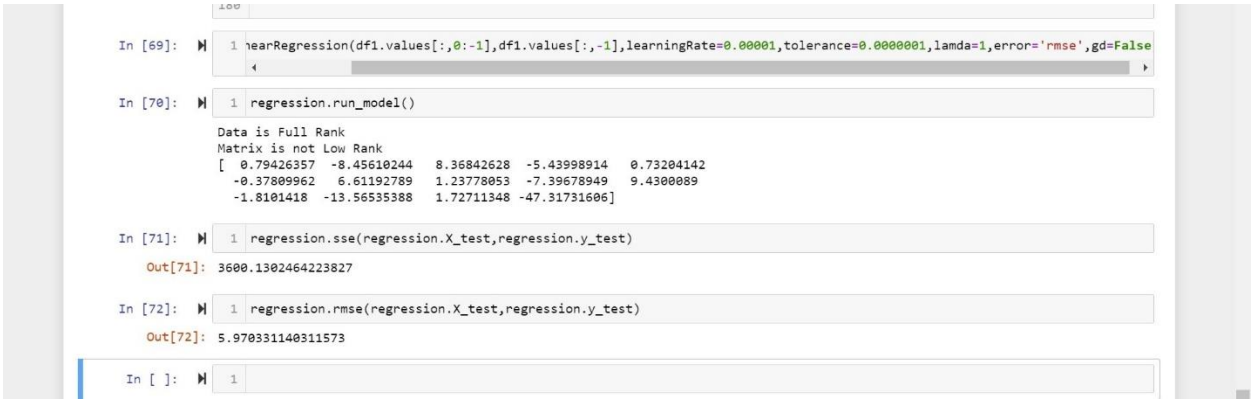
HOUSING DATASET:

Closed form solution without regularization by setting lambda to zero:



```
In [64]: 1 hearRegression(df1.values[:,0:-1],df1.values[:,-1],learningRate=0.00001,tolerance=0.0000001,lamda=0,error='rmse',gd=False

In [65]: 1 regression.run_model()

Data is Full Rank
Matrix is not Low Rank
[-8.87839731e+02 -1.56831626e+01  5.79986479e+00  4.03653799e+00
  5.52581709e+02 -2.62432010e+03  5.45383560e+02  8.10622369e-01
 -2.00930508e+02  4.10972701e+01 -1.63600695e+00 -1.48902594e+02
  1.22574140e+00 -7.56407500e+01]

In [66]: 1 regression.sse(regression.X_test,regression.y_test)

Out[66]: 1771.655141547537

In [67]: 1 regression.rmse(regression.X_test,regression.y_test)

Out[67]: 4.188214418498909

In [ ]: 1
```

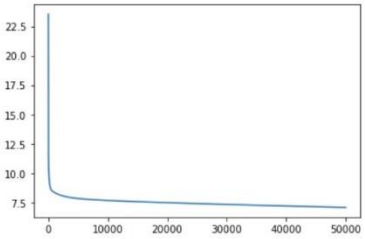
Closed form solution with regularization by setting lambda to one:



```
In [69]: 1 hearRegression(df1.values[:,0:-1],df1.values[:,-1],learningRate=0.00001,tolerance=0.0000001,lamda=1,error='rmse',gd=False

In [70]: 1 regression.run_model()

Data is Full Rank
Matrix is not Low Rank
[  0.79426357  -8.45610244   8.36842628  -5.43998914   0.73204142
  -0.37809962   6.61192789   1.23778053  -7.39678949   9.4300089
  -1.8101418  -13.56535388   1.72711348 -47.31731606]

In [71]: 1 regression.sse(regression.X_test,regression.y_test)

Out[71]: 3600.1302464223827

In [72]: 1 regression.rmse(regression.X_test,regression.y_test)

Out[72]: 5.970331140311573

In [ ]: 1
```

Gradient descent without regularization by setting lambda to zero:

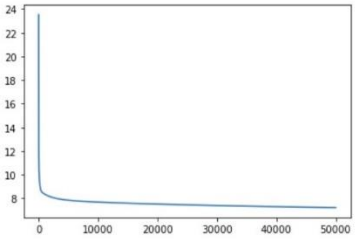
```
 20%|██        | 10147/50000 [00:00<00:00, 50842.25it/s]

Data is Full Rank
Matrix is not Low Rank

100%|██████████| 50000/50000 [00:01<00:00, 46346.00it/s]

[  3.85267419  -7.92298865   9.86545372  -6.19994561  -1.23979828
  -1.85499398   2.4905758    0.10104455  -5.22903213   4.15652314
  -1.77758094  -8.95509298   1.65486639 -33.50472901]
```




```
In [75]:  1 regression.sse(regression.X_test,regression.y_test)

Out[75]: 3921.849503829587

In [76]:  1 regression.rmse(regression.X_test,regression.y_test)

Out[76]: 6.231387735266009
```

Gradient descent with regularization by setting lambda to one:

```
 10%|█         | 4826/50000 [00:00<00:00, 47852.97it/s]

Data is Full Rank
Matrix is not Low Rank

100%|██████████| 50000/50000 [00:01<00:00, 48545.80it/s]

[  4.65722821  -7.15692845   8.69501969  -5.84915757  -1.75952123
  -2.24255484   1.28276381  -0.8776595   -4.77419881   2.43805007
  -1.74562075  -7.71045448   1.89251372 -27.45544291]
```




```
In [79]:  1 regression.sse(regression.X_test,regression.y_test)

Out[79]: 4103.441288215353

In [80]:  1 regression.rmse(regression.X_test,regression.y_test)

Out[80]: 6.374020047543673
```

CONCRETE DATASET:

Closed form solution without regularization by setting lambda to zero:

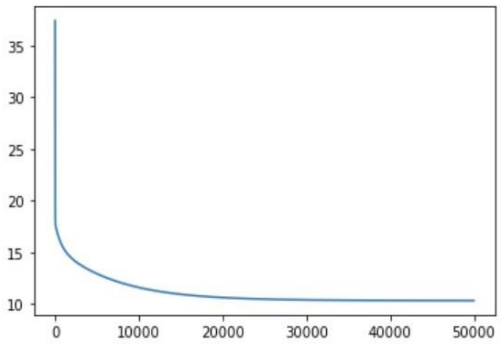
```
In [93]:
1 earRegression(df2.values[:,0:-1],df2.values[:,-1],learningRate=0.00001,tolerance=0.0000001,lamda=0,error='rmse',gd=False)

In [94]:
1 regression.run_model()

Data is Full Rank
Matrix is not Low Rank
[180.77629685  43.35643796  38.06887182  32.96880546 -44.09269706
 125.95410191   7.84180827   8.24620907  44.18309374]

In [95]:
1 regression.sse(regression.X_test,regression.y_test)

Out[95]: 25148.075220628154

In [96]:
1 regression.rmse(regression.X_test,regression.y_test)

Out[96]: 11.048892933303
```

Closed form solution with regularization by setting lambda to one:

```
In [97]:
1 nearRegression(df2.values[:,0:-1],df2.values[:,-1],learningRate=0.00001,tolerance=0.0000001,lamda=1,error='rmse',gd=False

In [98]:
1 regression.run_model()

Data is Full Rank
Matrix is not Low Rank
[ 52.44500223  45.43789833  39.62186709  36.05581307 -47.82069195
 -19.4473459    8.48001233  12.05988588  39.77389248]

In [99]:
1 regression.sse(regression.X_test,regression.y_test)

Out[99]: 24327.651892244372

In [100]:
1 regression.rmse(regression.X_test,regression.y_test)

Out[100]: 10.867170631547424
```

Gradient descent without regularization by setting lambda to zero:

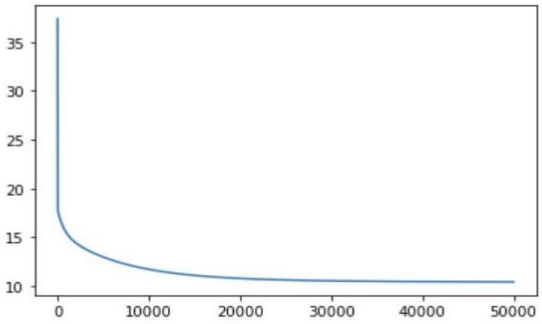
```
Data is Full Rank
Matrix is not Low Rank
100%|██████████| 50000/50000 [00:01<00:00, 41117.52it/s]
[ 53.24330618  49.49776075  44.99788816  43.60982192 -48.24606938
 -25.66801858   9.65915532  14.44286155  43.49127396]
```




```
In [105]: 1 regression.sse(regression.X_test,regression.y_test)
Out[105]: 25030.206219499276

In [106]: 1 regression.rmse(regression.X_test,regression.y_test)
Out[106]: 11.022969447225304
```

Gradient descent with regularization by setting lambda to one:

```
In [108]: 1 regression.run_model()
 17%|██          | 8662/50000 [00:00<00:00, 42860.30it/s]
Data is Full Rank
Matrix is not Low Rank
100%|██████████| 50000/50000 [00:01<00:00, 41039.04it/s]
[ 47.30977418  46.44852072  40.73076803  37.22624987 -42.68710239
 -23.54892608   9.78459877  13.68964143  39.3580547 ]
```




```
In [109]: 1 regression.sse(regression.X_test,regression.y_test)
Out[109]: 24367.36313482544

In [110]: 1 regression.rmse(regression.X_test,regression.y_test)
Out[110]: 10.876036527954705
```

YACHT DATASET:

Closed form solution without regularization by setting lambda to zero:

```
In [115]:
1 earRegression(df3.values[:,0:-1],df3.values[:,-1],learningRate=0.00001,tolerance=0.0000001,lamda=0,error='rmse',gd=False)

In [116]:
1 regression.run_model()

Data is Full Rank
Matrix is not Low Rank
[181.39015046   0.99972068 -12.25958288  12.00213118  -4.50659082
 -15.38878247 316.62149451]

In [117]:
1 regression.sse(regression.X_test,regression.y_test)

Out[117]: 5221.291183715714

In [118]:
1 regression.rmse(regression.X_test,regression.y_test)

Out[118]: 9.176838994495796
```

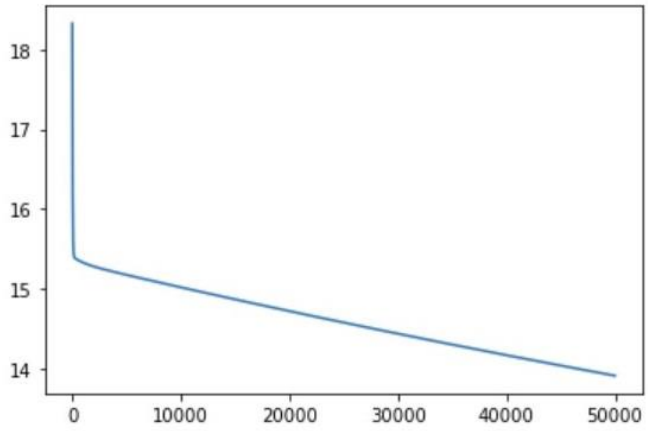
Closed form solution with regularization by setting lambda to one:

```
In [119]:
1 earRegression(df3.values[:,0:-1],df3.values[:,-1],learningRate=0.00001,tolerance=0.0000001,lamda=1,error='rmse',gd=False)

In [120]:
1 regression.run_model()

Data is Full Rank
Matrix is not Low Rank
[ 3.27325932e+01  5.82345884e-02 -1.51979356e+01  9.84967166e+00
  8.85940655e-01 -9.99588756e-01  7.38781043e+01]

In [121]:
1 regression.sse(regression.X_test,regression.y_test)

Out[121]: 9933.912529476347

In [122]:
1 regression.rmse(regression.X_test,regression.y_test)

Out[122]: 12.65797754922623
```

Gradient descent without regularization by setting lambda to zero:

```
In [124]:  1 regression.run_model()
```

```
 16%|██          | 8199/50000 [00:00<00:00, 75837.95it/s]
Data is Full Rank
Matrix is not Low Rank
100%|██████████| 50000/50000 [00:00<00:00, 86238.49it/s]
[ 1.87129589e+01  5.88725517e-03 -8.82796510e+00  8.70887209e+00
  1.73782708e+00  1.59659352e+00  4.53149288e+01]
```

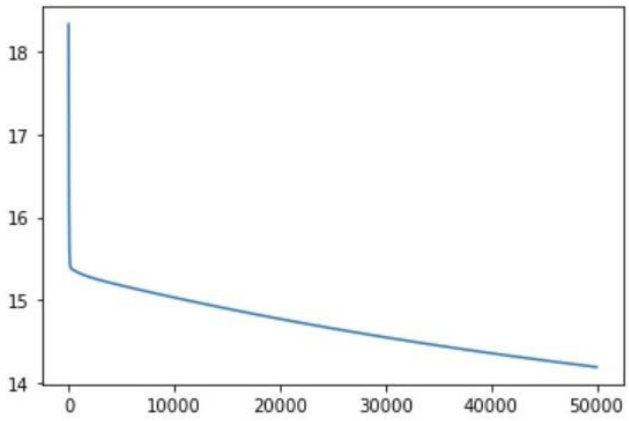



```
In [125]:  1 regression.sse(regression.X_test,regression.y_test)
Out[125]: 11175.655633545544

In [126]:  1 regression.rmse(regression.X_test,regression.y_test)
Out[126]: 13.425815067193371
```

Gradient descent with regularization by setting lambda to one:

```
In [128]:  1 regression.run_model()
```

```
 14%|██          | 7088/50000 [00:00<00:00, 66450.81it/s]
Data is Full Rank
Matrix is not Low Rank
100%|██████████| 50000/50000 [00:00<00:00, 70640.62it/s]
[15.17267759 -0.04388453 -7.15191093  7.60743021  1.85800034  1.68202108
 35.69852805]
```




```
In [129]:  1 regression.sse(regression.X_test,regression.y_test)
Out[129]: 11622.573857290012

In [130]:  1 regression.rmse(regression.X_test,regression.y_test)
Out[130]: 13.691634988779388
```