Simple Linear Regression

Linear Regression is one of the Machine Learning algorithms which is easy to understand and interpret. before starting with linear regression we ll try to understand what is linear Relationship

Linear Relationship

Let's take the example of men's height and weight data. Let's Consider that we want to predict the Weight of a person on the basis of Height

In [1]:
```
from IPython.display import Image
from IPython.core.display import HTML
Image(url= "https://miro.medium.com/max/158/1*M8BB72-5Q2QQDLuaURkCVg.png")
```

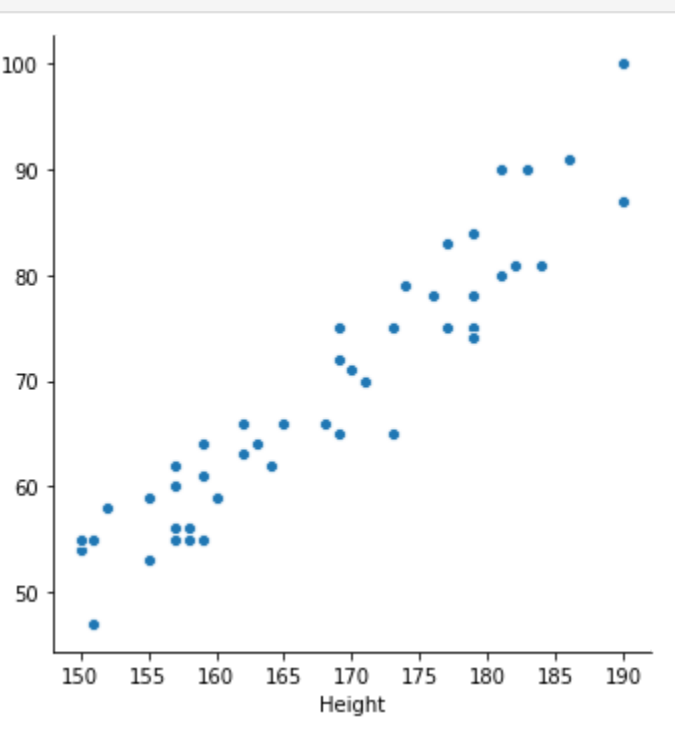
Out[1]:

	Height	Weight
0	179	84
1	177	83
2	164	62
3	181	90
4	186	91
5	162	63
6	159	55
7	155	53
8	158	56
9	151	55
10	150	54

On X-axis Height and on Y-axis Weight

In [2]:
```
Image(url= "https://miro.medium.com/max/352/1*GEPOLD46ZG8je0DMt8NQpw.png")
```

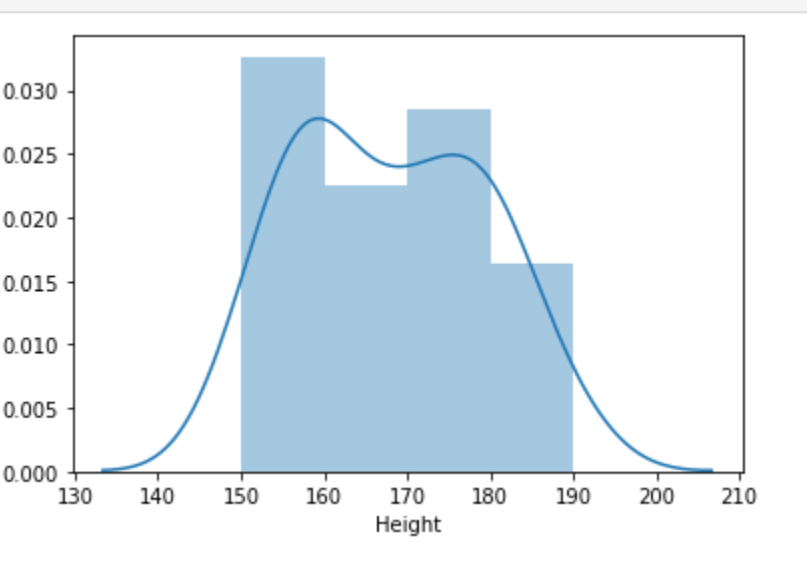
Out[2]:



A linear relationship describes a straight-line relationship between two variables By observing the graph we can see there is a linear relationship between height and weight. There are Mainly two assumptions associated with a Simple linear regression model: Linearity: The relationship between X and Y is linear. Normality: For any fixed value of X, Y is normally distributed

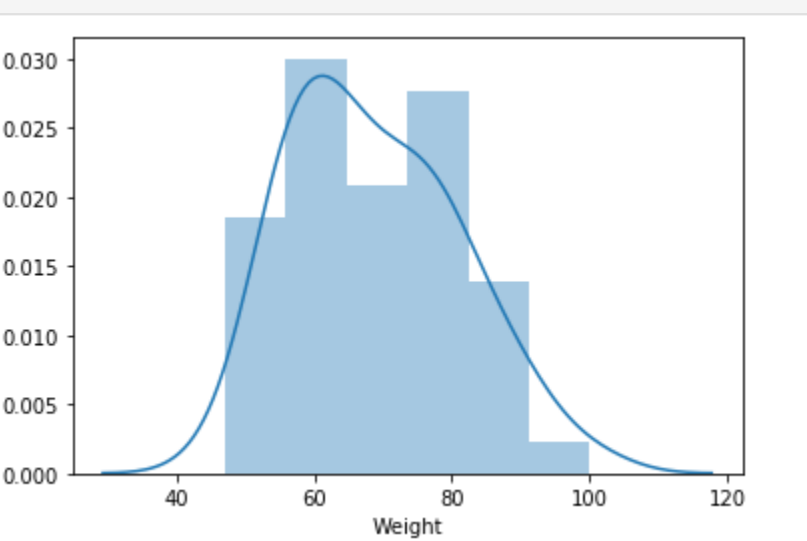
In [3]:
```
Image(url= "https://miro.medium.com/max/392/1*dWRHtUSX9RbiwNCACtddgw.png")
```

Out[3]:



In [4]:
```
Image(url="https://miro.medium.com/max/387/1*V72j9cTS5CgI3IX1r66p0w.png")
```

Out[4]:



Equation For a Simple Linear Regression

y_Predict=mx+c

m=Slope of the line

c=Y intercept

x=independent Variable (Variable that helps to predict dependent variable)

y_predict=Dependent Variable (Variable that you want to predict)

in this case, x is Height & y is the Weight

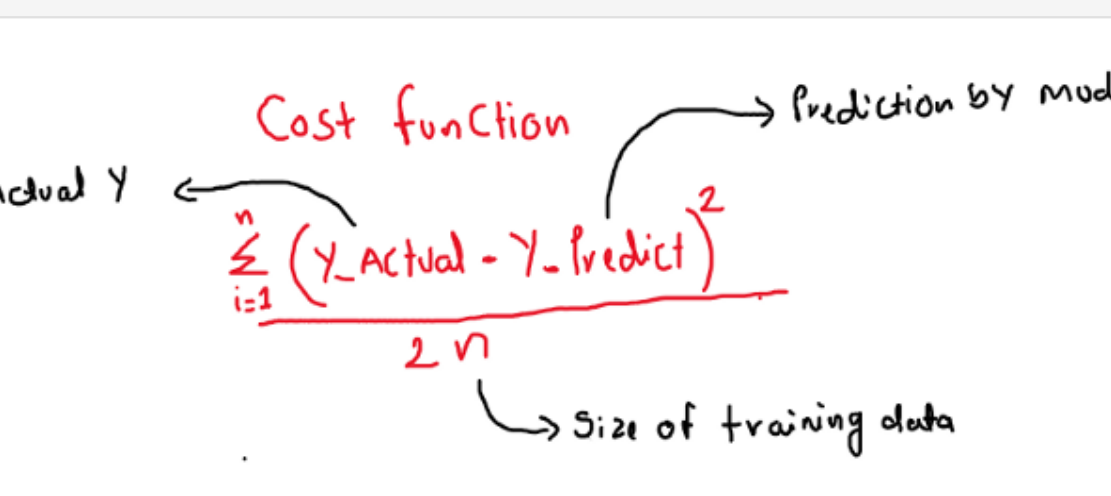
Weight=Height * m + c

Finding out m & C value

The values m and c must be chosen so that they minimize the cost function.

In [5]:
```
Image(url= "https://miro.medium.com/max/700/1*ZH-dSRYZUoMJsb_Y3pFjhw.png")
```

Out[5]:



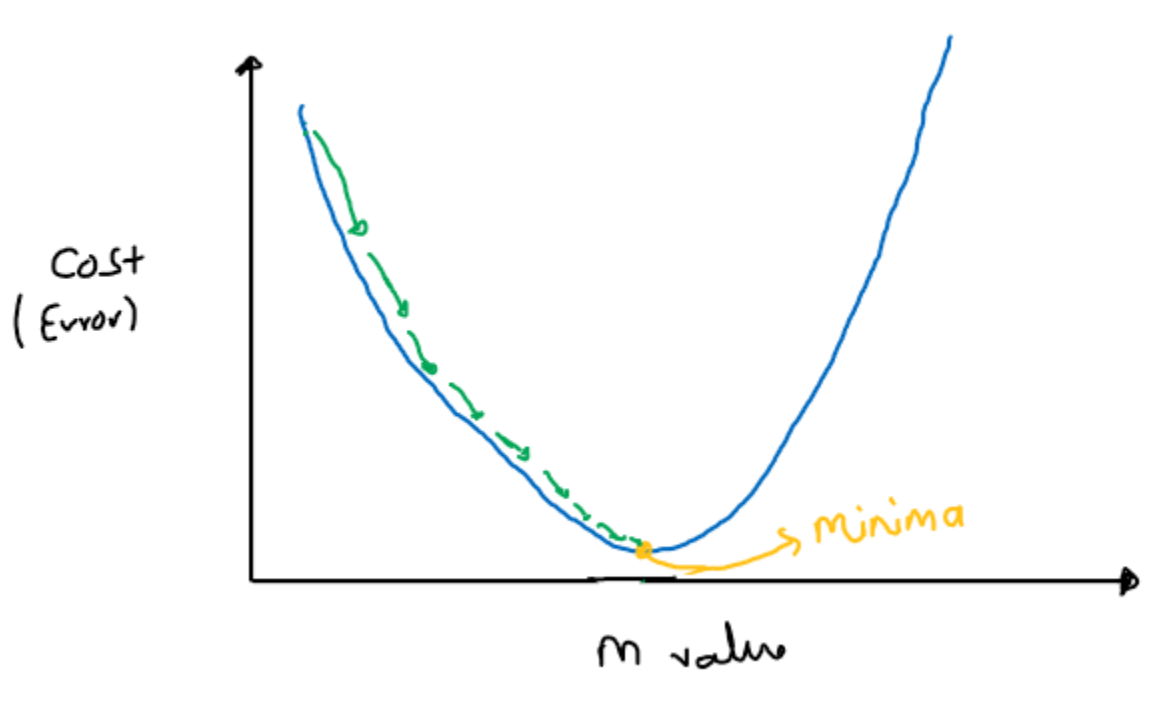
If we don't square the error then positive & negative value may get cancelled out.

Gradient Descent

Gradient Descent is used to find out the value of the M & C in such a way that Error is Minimum. It is an iterative algorithm which finds the optimal value of m & c in such a way that loss is minimum.

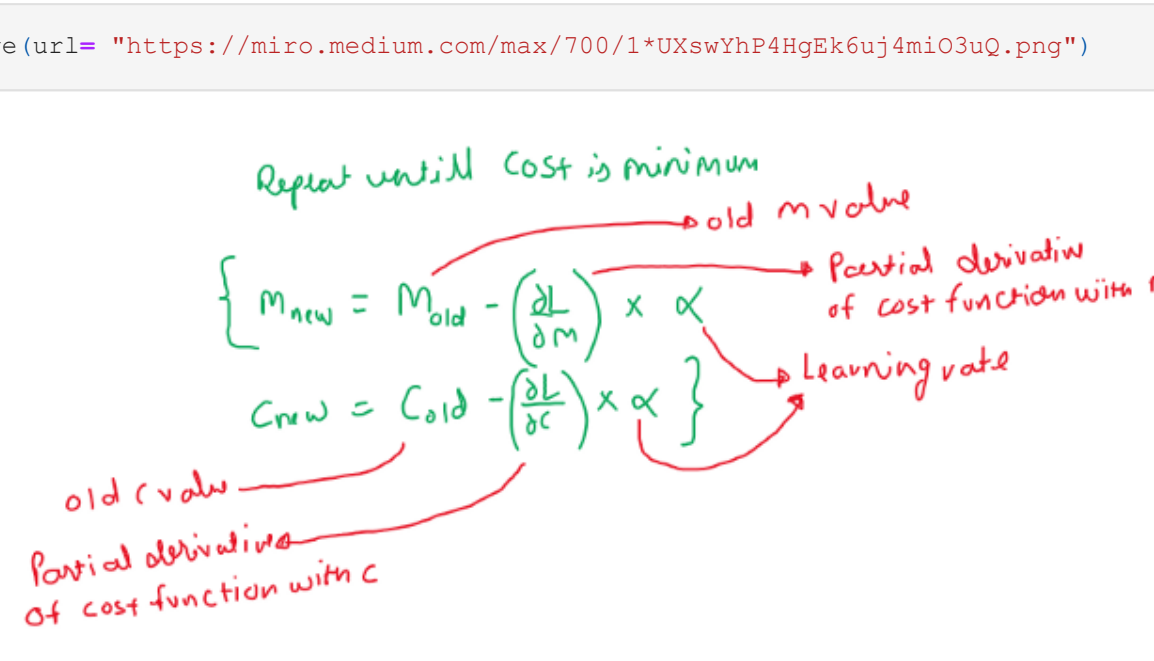
In [6]:
```
Image(url= "https://miro.medium.com/max/646/1*SlZ2UrV9NwySAl3MPEOL8g.png")
```

Out[6]:



In [7]:
```
Image(url= "https://miro.medium.com/max/700/1*UXswYhP4HgEk6uj4miO3uQ.png")
```

Out[7]:



This is an iterative process it keeps updating m & c value in such a way that loss should be minimized.

Prediction

After getting m & c value we can easily do prediction by putting the value of x in the equation

y_pred = (value of m)* (value of x)+(Value of c)

Python Implementation of Simple Linear Regression

In [8]:
```
import pandas as pd
import numpy as np
import seaborn as sns
from sklearn.model_selection import train_test_split # Creating training & Testing se
import matplotlib.pyplot as plt
from sklearn.linear_model import LinearRegression # model
%matplotlib inline
```

In [9]:
```
data=pd.read_csv(r"C:\Users\Ghost\data\Mens_height_weight.csv")
```

In [10]:
```
data.shape
```

Out[10]: (49, 2)

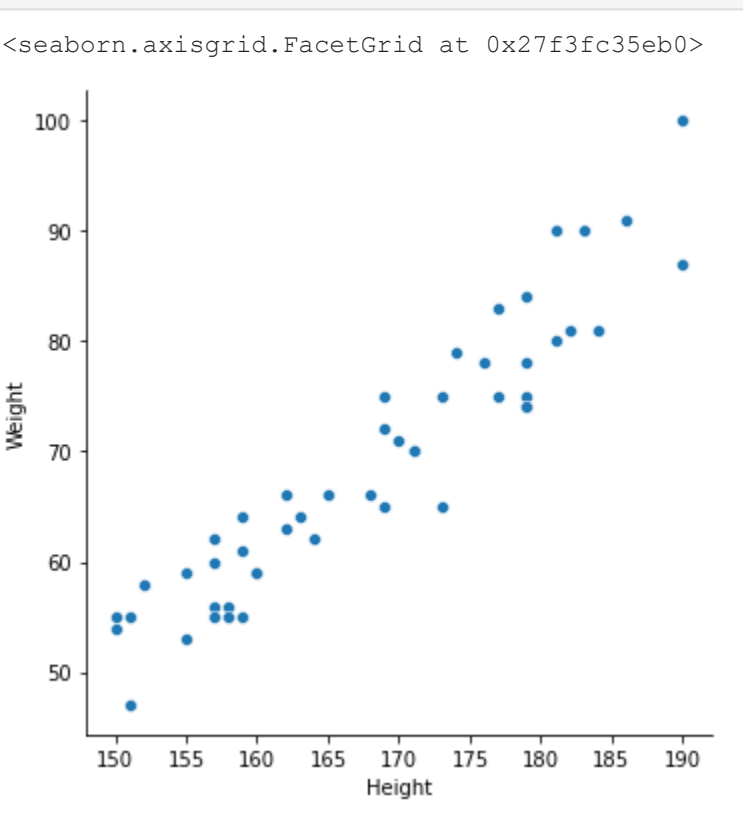
In [11]:
```
data
```

Out[11]:

	Height	Weight
0	179	84
1	177	83
2	164	62
3	181	90
4	186	91
5	162	63
6	159	55
7	155	53
8	158	56
9	151	55
10	150	54
11	157	60
12	176	78
13	163	64
14	190	87
15	169	72
16	160	59
17	171	70
18	165	66
19	182	81
20	179	78
21	157	56
22	159	64
23	151	47
24	168	66
25	184	81
26	173	75
27	159	61
28	181	80
29	190	100
30	157	55
31	169	65
32	177	75
33	171	70
34	160	59
35	173	65
36	183	90
37	169	75
38	179	74
39	150	55
40	170	71
41	179	75
42	158	55
43	155	59
44	152	58
45	157	62
46	174	79
47	162	66
48	179	74

In [12]:
```
sns.relplot(x="Height",y="Weight",data=data)
```

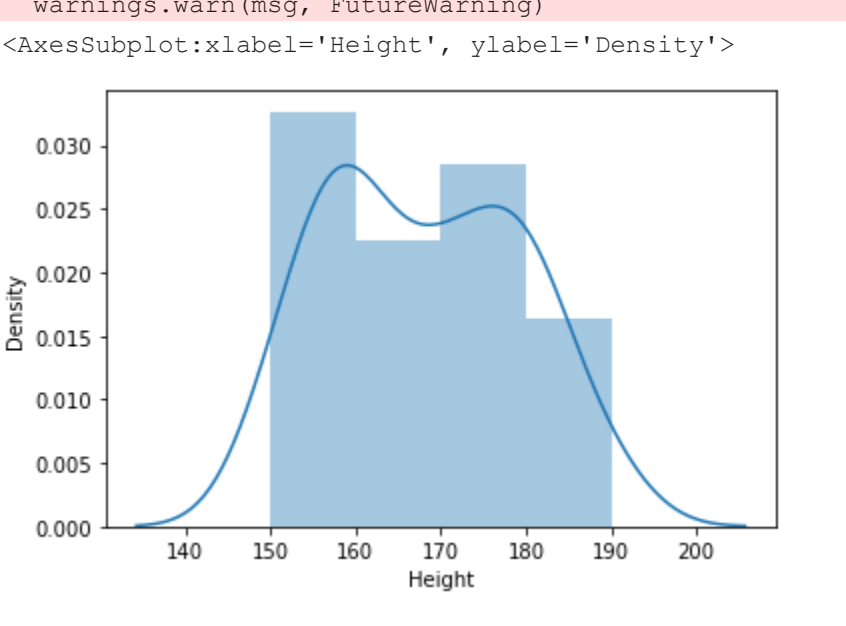
Out[12]: <seaborn.axisgrid.FacetGrid at 0x27f3fc35eb0>



In [13]:
```
sns.distplot(data["Height"])
```

```
D:\anaconda\envs\dtale\lib\site-packages\seaborn\distributions.py:2557: FutureWarning:
`distplot` is a deprecated function and will be removed in a future version. Please ad
apt your code to use either `displot` (a figure-level function with similar flexibilit
y) or `histplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
```

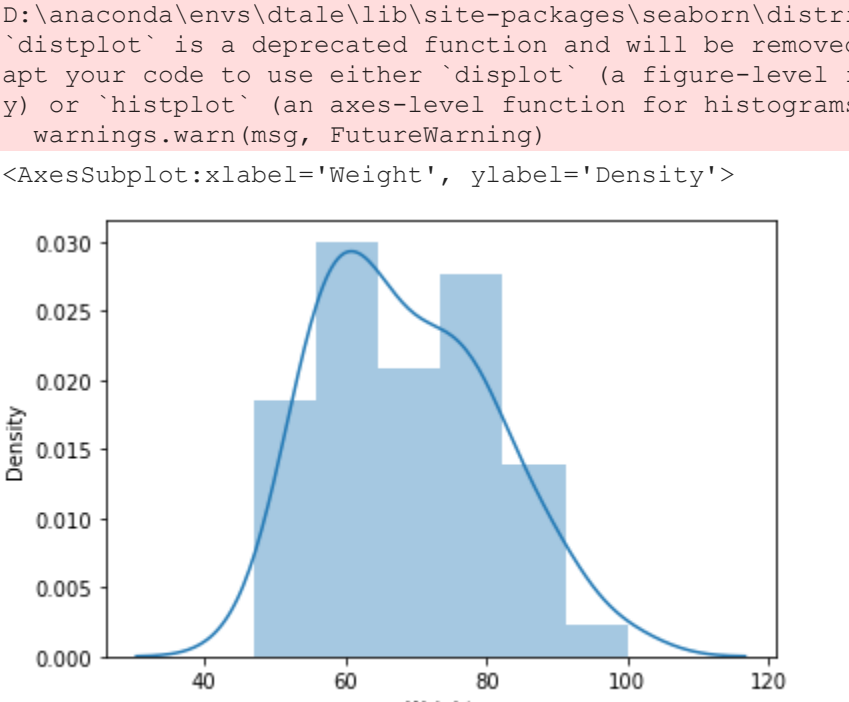
Out[13]: <AxesSubplot:xlabel='Height', ylabel='Density'>



In [14]:
```
sns.distplot(data["Weight"])
```

```
D:\anaconda\envs\dtale\lib\site-packages\seaborn\distributions.py:2557: FutureWarning:
`distplot` is a deprecated function and will be removed in a future version. Please ad
apt your code to use either `displot` (a figure-level function with similar flexibilit
y) or `histplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
```

Out[14]: <AxesSubplot:xlabel='Weight', ylabel='Density'>



In [15]:
```
data.corr()
```

Out[15]:

	Height	Weight
Height	1.000000	0.942603
Weight	0.942603	1.000000

In [16]:
```
x=data["Height"] #independent
y=data["Weight"] #Dependent (Variable that i want to predict)
```

In [17]:
```
x.shape #1 D array
```

Out[17]: (49,)

In [18]:
```
x_matrix=x.values.reshape(-1,1) #converting to 2D array as sklearn needs 2d array
```

In [19]:
```
X_train,X_test,Y_train,Y_test=train_test_split(x_matrix,y,test_size=0.30,random_state=
```

In [20]:
```
reg=LinearRegression() #model
```

In [21]:
```
reg.fit(X_train,Y_train) # training the model intercept (constant) & slope
```

Out[21]: LinearRegression()

In [22]:
```
reg.coef_
```

Out[22]: array([1.01169941])

In [23]:
```
reg.intercept_
```

Out[23]: -101.73399165720735

In [24]:
```
predictY=reg.predict(X_test)
```

In [25]:
```
from sklearn.metrics import mean_squared_error


mse = mean_squared_error(Y_test, predictY) #Returns mean square error
print(mse)
```

22.461826003852135

In [26]:
```
from math import sqrt
rmse=sqrt(mse)
print(rmse)
```

4.739390889539724

In [27]:
```
reg.score(X_train,Y_train)
```

Out[27]: 0.9020237693810655

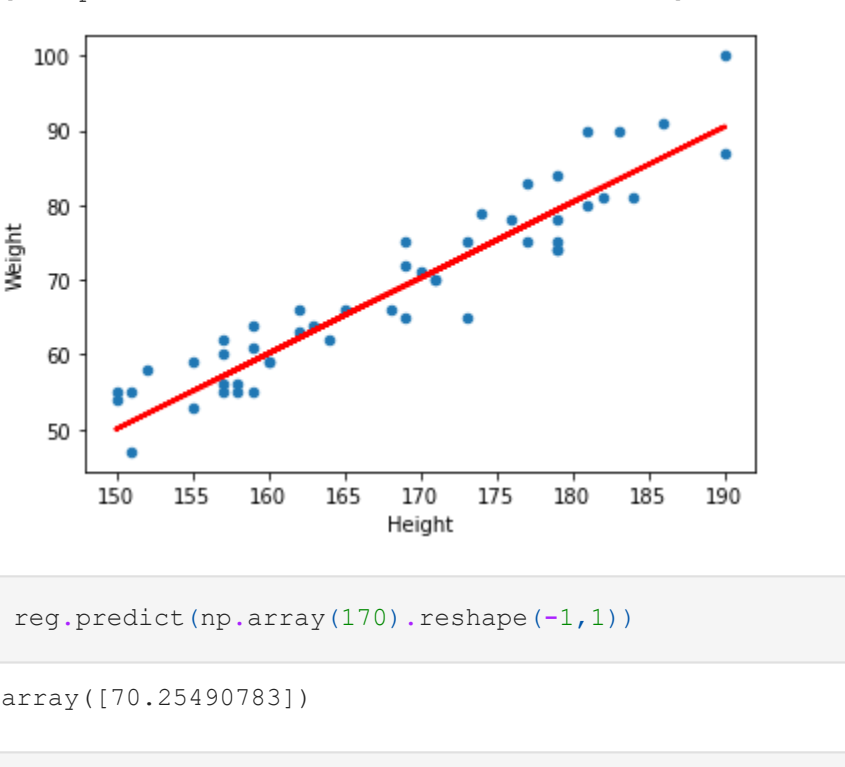
In [28]:
```
reg.score(X_test,Y_test)
```

Out[28]: 0.849702288382004

In [29]:
```
# first, plot the observed data
allpred=reg.predict(x_matrix)
data.plot(kind='scatter', x='Height', y='Weight')

# then, plot the least squares line
plt.plot(x, allpred, c='red', linewidth=2)
```

Out[29]: [<matplotlib.lines.Line2D at 0x27f4b3b0d30>]



In [30]:
```
reg.predict(np.array(170).reshape(-1,1))
```

Out[30]: array([70.25490783])

In [31]:
```
import pickle as pk
```

In [33]:
```
filename = 'lr_model.pickle'
pk.dump(reg, open(filename, 'wb'))
```

In [ ]: