Chapter 1 :Complete Linear Regression with Math.
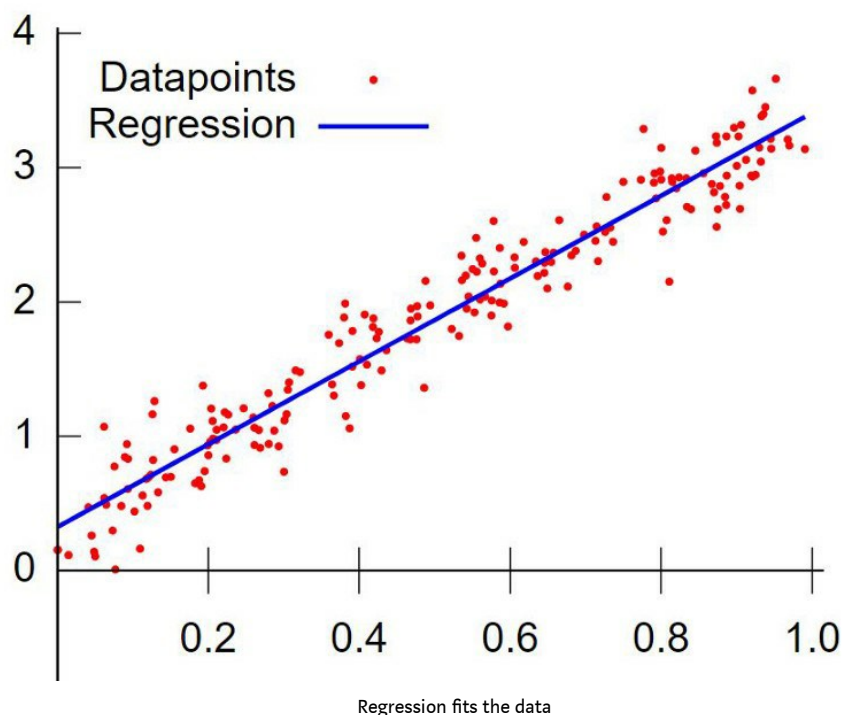
Madhu Sanjeevi (Mady) [Follow]
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Prerequisite : **Different types of machine learning.**

Linear Regression: it is a linear model that establishes the relationship between a dependent variable *y(Target)* and one or more independent variables denoted *X(Inputs)*.


Regression fits the data

Goal is to find that blue straight line (which is best fit) to the data.

Our Training Data consists of X and y values so we can plot them on the graph, that's damn easy. now *what's next?* how to find that blue line????

First lets talk about how to draw a linear line in the graph,

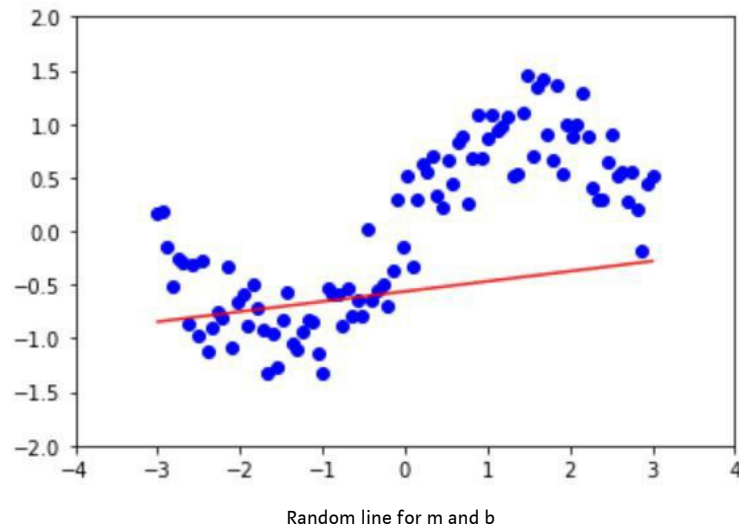In math we have an equation which is called linear equation

```
y = mX+b { m->slope , b->Y-intercept }
```
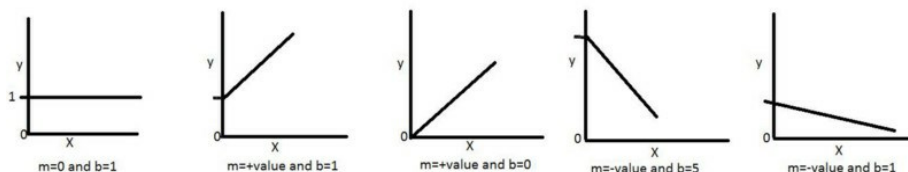
so we can draw the line if we take any values for m and b

> *How do we get the m and b values ??? and how do we know exact m and b values for the best fit line??*

Lets take a simple data set (sine wave form -3 to 3) and First time we take random values of m and b values and we draw a line something like this.

Random line for m and b

> *How we drew the above line?*

we take the first X value(x1) from our data set and calculate y value(y1)

```
y1=m*x1+b {m,b->random values lets say 0.5,1
           x1->lets say -3 (first value from our data-set)

y1=(0.5 * -3) + 1
y1=-0.5
by applying all x values for m and b values we get our first line.

Above picture has its own random variables ( I hope you understand
the concept)
```

That line is *not* fitting well to the data so we need to change m and b values to get the best fit line.

> *How do we change m and b values for the best fit line??*

Either we can use an awesome algorithm called **Gradient Descent** (Which I will cover in next story with also the math used in there.)

Update: Here is the ***Gradient Descent*** Story

Or we can borrow direct formulas from statistics(they call this **Least Square Method**) I will also cover if possible in next story.

$$m = \frac{\sum_{i=1}^{n}(x_i - \overline{X})(y_i - \overline{Y})}{\sum_{i=1}^{n}(x_i - \overline{X})^2} \qquad b = \overline{Y} - m\overline{X}$$

Right now lets black box, we assume that we are getting the m and b values, Every time when the m and b values change we may get a different line and finally we get the best fit line
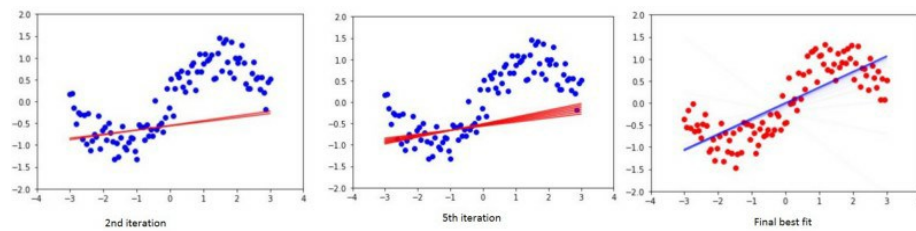
Pretty cool right?

So *What's next??? Predicting new data, remember?? so* we give new X values we get the predicted y values how does it work ??

same as above **y= m X +b** , we now know the final m and b values.

This is called **simple linear regression** as we have only one independent X value. Lets say we wanna predict housing price based the size of house

X= Size (in sqft's) y= Price (in dollar's)

```
X           y
1000       40
2000       70
500        25
. . . . . . . . . . . .
```

What if we have more independent values of X????

Lets say we wanna predict housing price not only by the size of house but also by no of bedrooms

x1= Size (in sqft's), x2=N_rooms and y= Price (in dollar's)

```
x1    x2    y
1000   2     50
2000   4     90
500    1     35
. . . . . . . . . . .
```

The process same as above but the equation changes a bit

Note: Lets alias b and m as $\theta 0$ and $\theta 1$ (theta 0 and theta 1) respectively.

$y = \theta 0 + \theta 1 {}^*X \rightarrow b+mX \rightarrow Simple\ LR \rightarrow Single\ variable\ LR$

$y = \theta 0 + \theta 1 {}^*x1 + \theta 2 {}^*x2 + .. \theta n {}^*xn \rightarrow Multiple\ LR \rightarrow Multi\ variable\ LR$

Now we can predict as many things as we wish.

That's it for this story , Hoping it helps at least 1 person.

In the next story I will talk about **<u>Gradient Descent Algorithm.</u>**

until then See ya!

Machine Learning   Linear Regression   Gradient Descent   Supervised Learning

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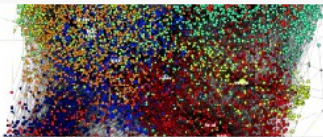
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