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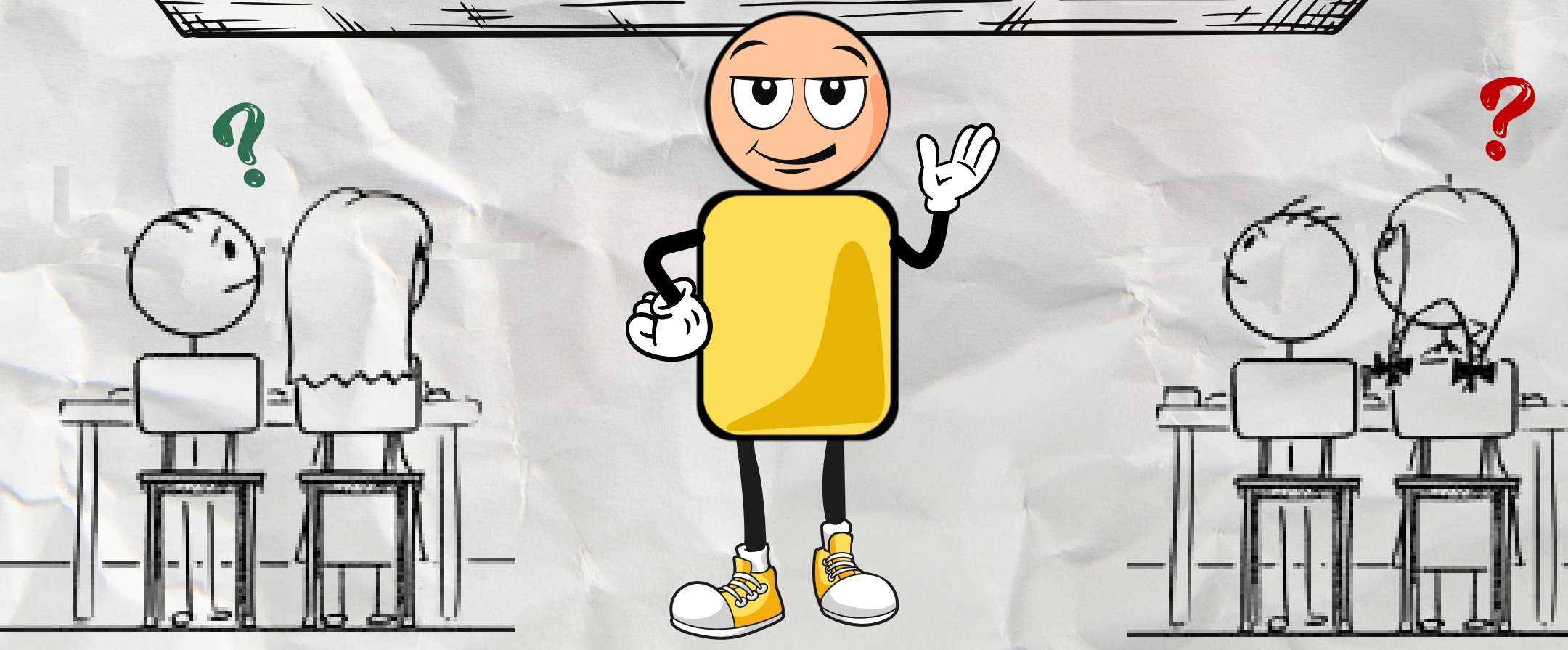
What is Gradient Descent in Machine Learning ?



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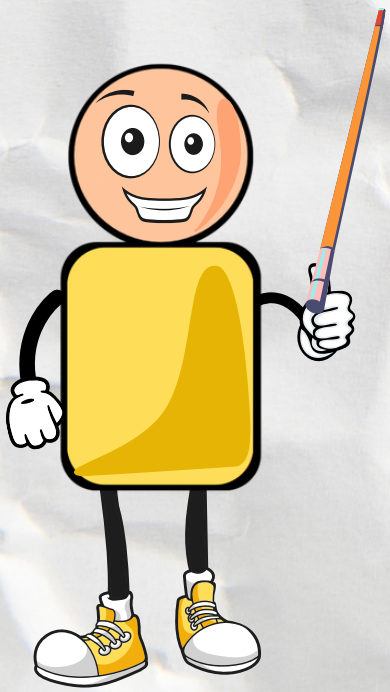
Gradient Descent is an optimization algorithm that is commonly-used to train machine learning models and neural networks. Training data helps these models learn over time, and the cost function within gradient descent specifically acts as a barometer, gauging its accuracy with each iteration of parameter updates.



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Kehna kya chahte ho?

Sumit Bhai, Explain It In Simple Language Please

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Let's say **Sumit** is standing on top of the hill and he is stuck there. Sadly he can't see because he has lost his eyesight after watching **"Big Boss season 121"** . There is no one around to help him. »»

What's the best way you can suggest sumit so that he can safely come down the hill?

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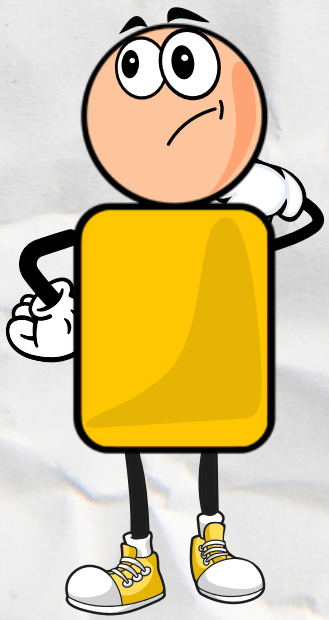
Think and mention your answers in the Chat Section



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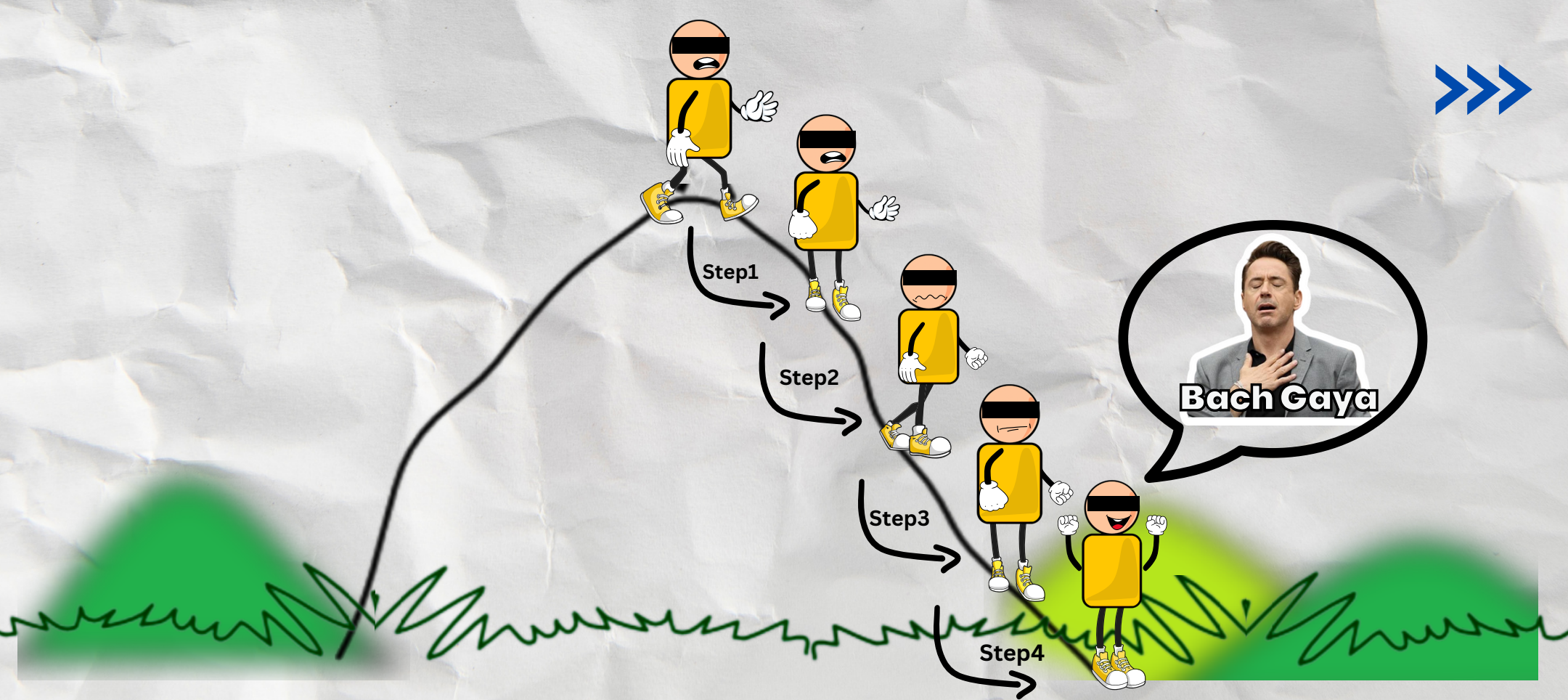
Let’s understand this.

The best way that Sumit can follow to come down the hill is:

1. Look for the slope.

2. Take small steps toward the direction of the slope.

3. Repeat 1 and 2 until you de-hill.



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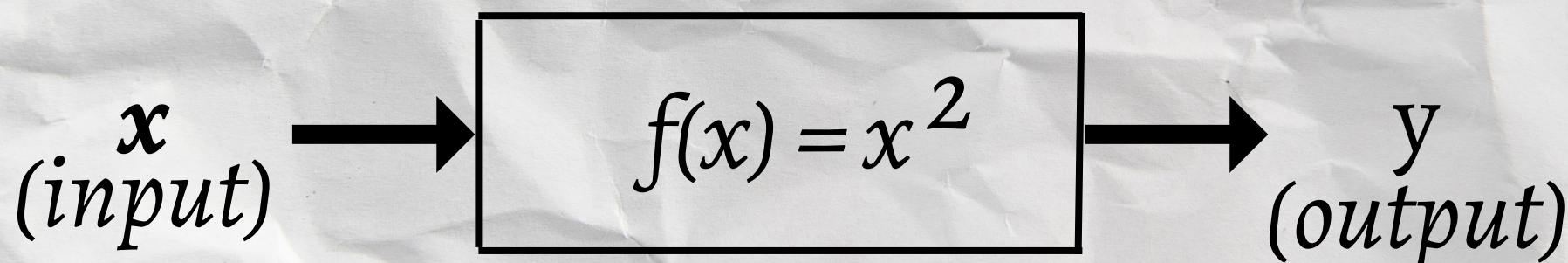
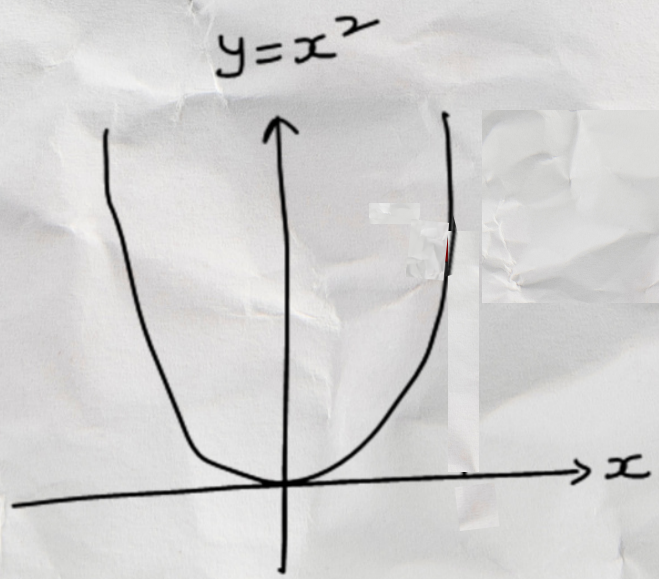
Let's take one mathematical example.

Let's say we have a function, $y = x^2$ and our objective is to find the value of x where y is minimum. In other words, we have to find the input x where the output of this equation is minimum.

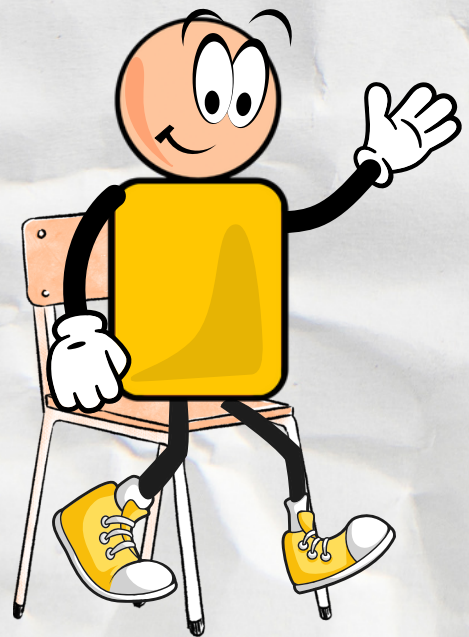




At what value of x , the output from this function would be minimum ?

In order to answer this, we need an optimization algorithm or a technique that can help us with this task.

The optimization algorithm that can solve this problem is known as Gradient Descent. In simpler words, Gradient means "Inclination" and Descent means "A Way Down". So by using this algorithm, we are trying to bring down something and here it's the "Error".



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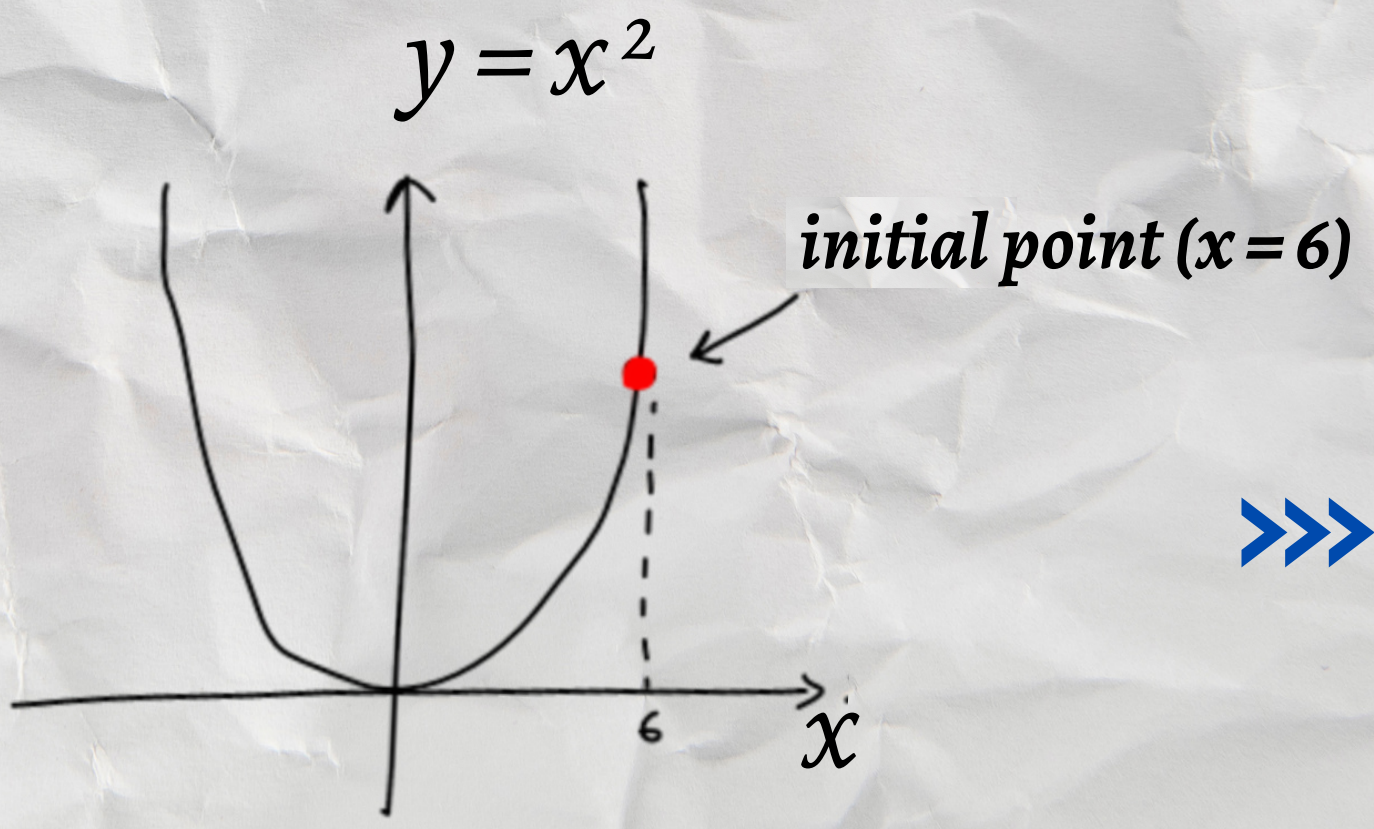
➪ Let’s understand with an example. Let’s say we have a function, $y = x^2$

➪ Also let’s assume that we are right now standing at point (x=6)(initial point)

➪ Now our objective is to get that value of x for which the output of this function is minimum.

➪ From the figure, we can simply say that at x = 0, y is also 0, which is basically the minimum value of the output(y)

But how to do this using Gradient Descent?



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Now, we will apply the same logic and approach we used earlier to save sumit.

- ⇨ Look for slope.
- ⇨ Take small steps toward the direction of the slope.

What is the slope of the function $y = x^2$?

The slope of any function is the derivative of the function

$$y = x^2$$

Lets take derivative of y with respect to x

$$\frac{d}{dx}(y) = \frac{d}{dx}(x^2)$$

$$\frac{dy}{dx} = 2x$$

← *Slope of the function $y=x^2$*

Rule

$$\frac{d}{dx}(x^n) = (nx^{n-1})$$

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We have the slope of the function

$$y = x^2 \text{ which is } 2x$$

Now let's go to the second step.

We will now, reduce the value of x towards the direction of the slope from the current value which is x = 6

current value $x = 6$

Next value = current value − $\alpha(2x)$

current value: initial value of x

α: step size

$2x$: slope of the function

We have used the minus sign because we are trying to reduce the current value or go down from the current value in the direction of slope by taking small steps

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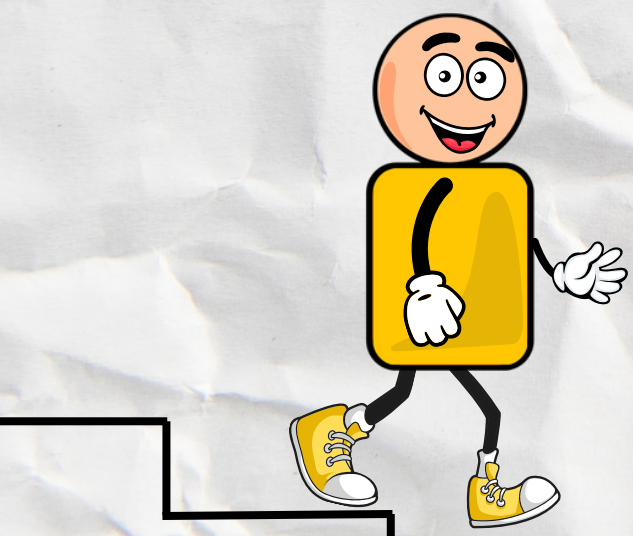
What is the step size ?

Steps size will control the speed at which we want to descend. Here I don't want to be very fast or very slow, so the tried and tested value is 0.01 but you may always play with this value and tune it. This is also known as a HyperParameter.



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After applying the formula , we will get

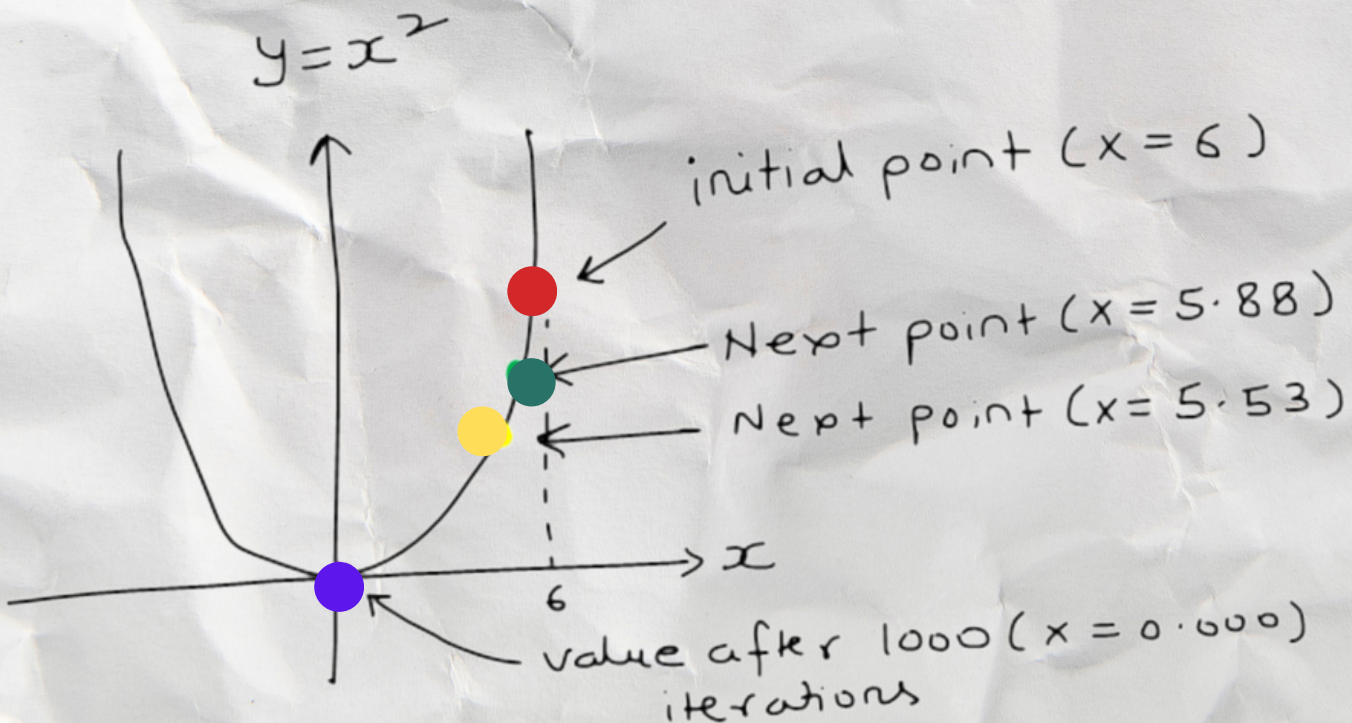
$$\text{next value} = 6 - [(0.01) \times (2 \times 6)]$$
$$= 5.88$$

$$\text{next value} = 5.88 - [(0.01) \times (2 \times 5.88)]$$
$$= 5.53$$

We will keep on repeating this task/step for 1000 times

value after 1000 times applying the same formula

$$x = 0.000000023$$



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This is what Gradient Descent is all about.

The best usage of Gradient Descent can be seen in any Machine Learning Algorithm which is having a Cost Function to optimize.

1. Linear Regression

2. Logistic Regression

3. ANN

I hope now you are clear with

"What is Gradient Descent"

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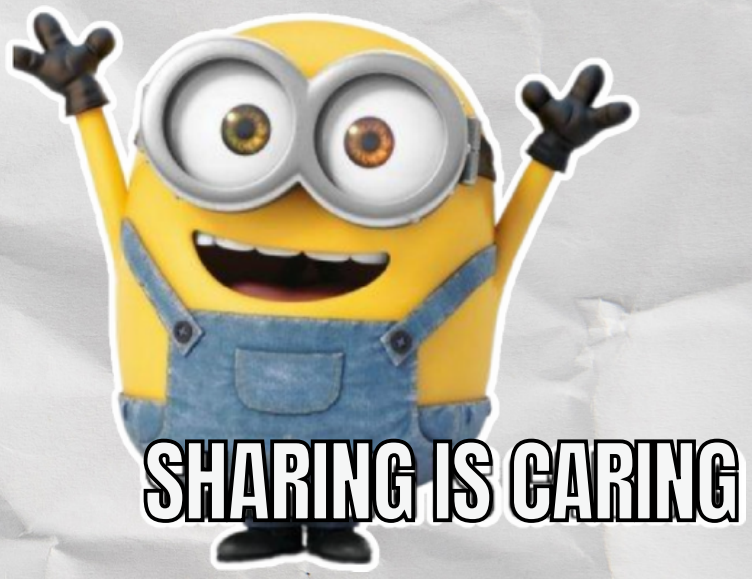

And do comment with your questions if you have any.

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