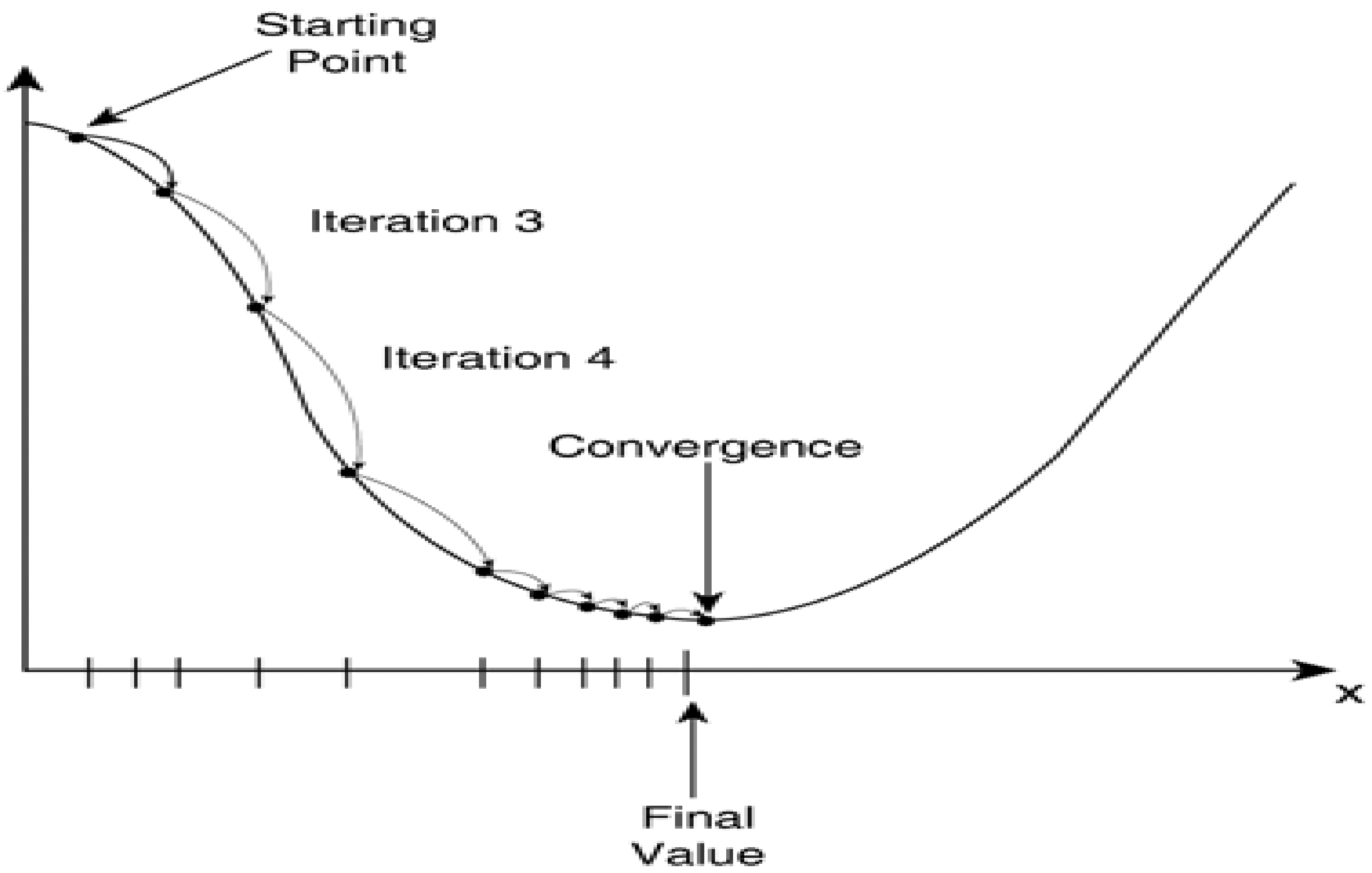
Gradient Decent



MSE Function

$$Cost\ Function(MSE) = \frac{1}{n}\sum_{i=0}^{n}(y_i - y_{i\,pred})^2$$

Replace $y_{i\,pred}$ with $mx_i + c$

$$Cost\ Function(MSE) = \frac{1}{n}\sum_{i=0}^{n}(y_i - (mx_i + c))^2$$

Step : 01

Initially,

Gradient (m) = 0
Intercept (c) = 0
Learning Rate (L) = ~0.0001

Derivatives: https://www.dummies.com/article/academics-the-arts/math/calculus/the-most-important-derivatives-and-antiderivatives-to-know-188540/

Derivative	Integral (Antiderivative)
$\frac{d}{dx} n = 0$	$\int 0 \, dx = C$
$\frac{d}{dx} x = 1$	$\int 1 \, dx = x + C$
$\frac{d}{dx} x^n = nx^{n-1}$	$\int x^n \, dx = \frac{x^{n+1}}{n+1} + C$
$\frac{d}{dx} e^x = e^x$	$\int e^x \, dx = e^x + C$
$\frac{d}{dx} \ln x = \frac{1}{x}$	$\int \frac{1}{x} \, dx = \ln x + C$
$\frac{d}{dx} n^x = n^x \ln x$	$\int n^x \, dx = \frac{n^x}{\ln n} + C$
$\frac{d}{dx} \sin x = \cos x$	$\int \cos x \, dx = \sin x + C$
$\frac{d}{dx} \cos x = -\sin x$	$\int \sin x \, dx = -\cos x + C$
$\frac{d}{dx} \tan x = \sec^2 x$	$\int \sec^2 x \, dx = \tan x + C$
$\frac{d}{dx} \cot x = -\csc^2 x$	$\int \csc^2 x \, dx = -\cot x + C$
$\frac{d}{dx} \sec x = \sec x \tan x$	$\int \tan x \sec x \, dx = \sec x + C$
$\frac{d}{dx} \csc x = -\csc x \cot x$	$\int \cot x \csc x \, dx = -\csc x + C$
$\frac{d}{dx} \arcsin x = \frac{1}{\sqrt{1-x^2}}$	$\int \frac{1}{\sqrt{1-x^2}} \, dx = \arcsin x + C$
$\frac{d}{dx} \arccos x = -\frac{1}{\sqrt{1-x^2}}$	$\int -\frac{1}{\sqrt{1-x^2}} \, dx = \arccos x + C$
$\frac{d}{dx} \arctan x = \frac{1}{1+x^2}$	$\int \frac{1}{1+x^2} \, dx = \arctan x + C$
$\frac{d}{dx} \operatorname{arc\,cot} x = -\frac{1}{1+x^2}$	$\int -\frac{1}{1+x^2} \, dx = \operatorname{arc\,cot} x + C$
$\frac{d}{dx} \operatorname{arc\,sec} x = \frac{1}{x\sqrt{x^2-1}}$	$\int \frac{1}{x\sqrt{x^2-1}} \, dx = \operatorname{arc\,sec} x + C$
$\frac{d}{dx} \operatorname{arc\,csc} x = -\frac{1}{x\sqrt{x^2-1}}$	$\int -\frac{1}{x\sqrt{x^2-1}} \, dx = \operatorname{arc\,csc} x + C$

Derivatives: https://www.dummies.com/article/academics-the-arts/math/calculus/the-most-important-derivatives-and-antiderivatives-to-know-188540/

Step : 02

Calculate the partial derivative of the Cost function with respect to m. Let partial derivative of the Cost function with respect to m be Dm.

$$D_m = \frac{\partial(Cost\ Function)}{\partial m} = \frac{\partial}{\partial m}\left(\frac{1}{n}\sum_{i=0}^{n}(y_i - y_{i\,pred})^2\right)$$

$$= \frac{1}{n}\frac{\partial}{\partial m}\left(\sum_{i=0}^{n}(y_i - (mx_i + c))^2\right)$$

$$= \frac{1}{n}\frac{\partial}{\partial m}\left(\sum_{i=0}^{n}(y_i^2 + m^2x_i^2 + c^2 + 2mx_ic - 2y_imx_i - 2y_ic)\right)$$

$$= \frac{-2}{n}\sum_{i=0}^{n}x_i(y_i - (mx_i + c))$$

$$= \frac{-2}{n}\sum_{i=0}^{n}x_i(y_i - y_{i\,pred})$$

Step : 03

Similarly, let's find the partial derivative with respect to c. Let partial derivative of the Cost function with respect to c be Dc.

$$D_c = \frac{\partial(Cost\ Function)}{\partial c} = \frac{\partial}{\partial c}\left(\frac{1}{n}\sum_{i=0}^{n}\left(y_i - y_{i\,pred}\right)^2\right)$$

$$= \frac{1}{n}\frac{\partial}{\partial c}\left(\sum_{i=0}^{n}\left(y_i - (mx_i + c)\right)^2\right)$$

$$= \frac{1}{n}\frac{\partial}{\partial c}\left(\sum_{i=0}^{n}\left(y_i^2 + m^2x_i^2 + c^2 + 2mx_ic - 2y_imx_i - 2y_ic\right)\right)$$

$$= \frac{-2}{n}\sum_{i=0}^{n}\left(y_i - (mx_i + c)\right)$$

$$\frac{-2}{n}\sum_{i=0}^{n}\left(y_i - y_{i\,pred}\right)$$

Step : 04

Update the Value of m & c

$$m = m - L \times D_m$$

$$c = c - L \times D_c$$

Step : 05

Repeat Step 03 & Step 04