ML Polynomial Regression

- o Polynomial Regression is a regression algorithm that models the relationship between a dependent(y) and independent variable(x) as nth degree polynomial. The Polynomial Regression equation is given below:

$$y= b_0+b_1x_1+ b_2x_1^2+ b_2x_1^3+ \ldots\ldots b_nx_1^n$$

- o It is also called the special case of Multiple Linear Regression in ML. Because we add some polynomial terms to the Multiple Linear regression equation to convert it into Polynomial Regression.

- o It is a linear model with some modification in order to increase the accuracy.

- o The dataset used in Polynomial regression for training is of non-linear nature.

- o It makes use of a linear regression model to fit the complicated and non-linear functions and datasets.

- o **Hence, "*In Polynomial regression, the original features are converted into Polynomial features of required degree (2,...3,...n) and then modeled using a linear model.*"**

Need for Polynomial Regression:

The need of Polynomial Regression in ML can be understood in the below points:

- o If we apply a linear model on a **linear dataset**, then it provides us a good result as we have seen in Simple Linear Regression, but if we apply the same model without any modification on a **non-linear dataset**, then it will produce a drastic output. Due to which loss function will increase, the error rate will be high, and accuracy will be decreased.

- o So for such cases, **where data points are arranged in a non-linear fashion, we need the Polynomial Regression model**. We can understand it in a better way using the below comparison diagram of the linear dataset and non-linear dataset.

Simple linear model

$y = b_0 + b_1 x$

Polynomial model

$y = b_0 + b_1 x_1 + b_2 x_1^2$
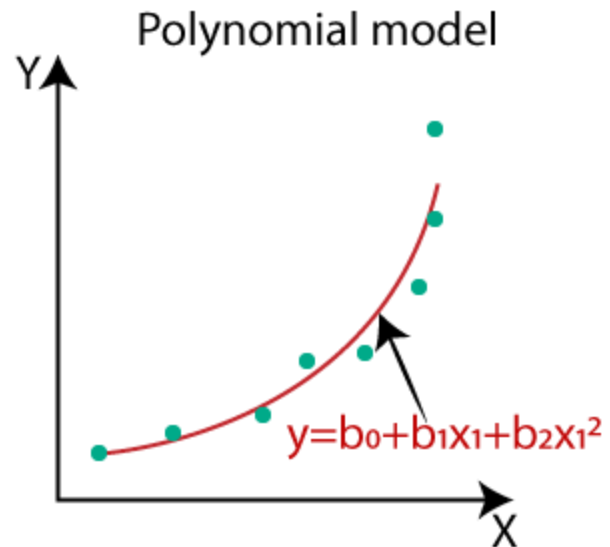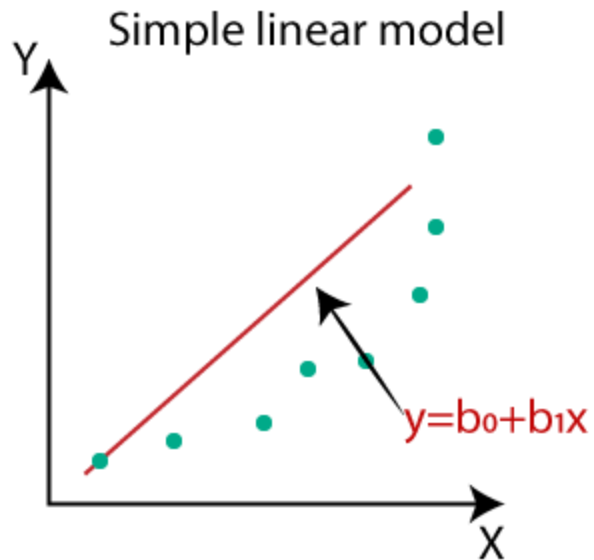
- o In the above image, we have taken a dataset which is arranged non-linearly. So if we try to cover it with a linear model, then we can clearly see that it hardly covers any data point. On the other hand, a curve is suitable to cover most of the data points, which is of the Polynomial model.

- o Hence, *if the datasets are arranged in a non-linear fashion, then we should use the Polynomial Regression model instead of Simple Linear Regression.*