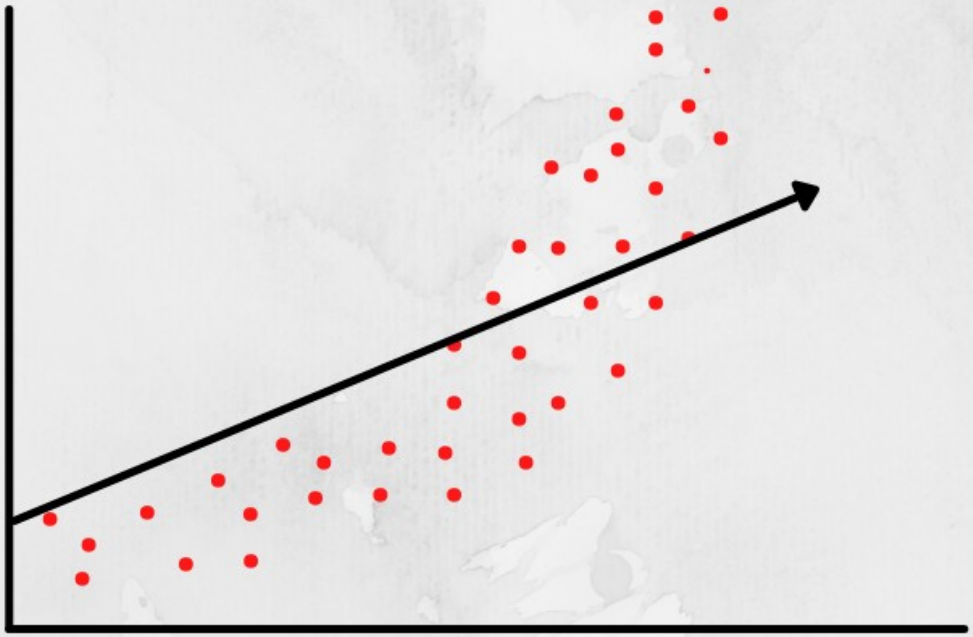
Polynomial Regression

Tushar B. Kute,
http://tusharkute.com

Polynomial Regression

- In simple linear regression algorithm only works when the relationship between the data is linear But suppose if we have non-linear data then Linear regression will not capable to draw a best-fit line and It fails in such conditions.
- Consider the below diagram which has a non-linear relationship and you can see the Linear regression results on it, which does not perform well means which do not comes close to reality.
- Hence, we introduce polynomial regression to overcome this problem, which helps identify the curvilinear relationship between independent and dependent variables.

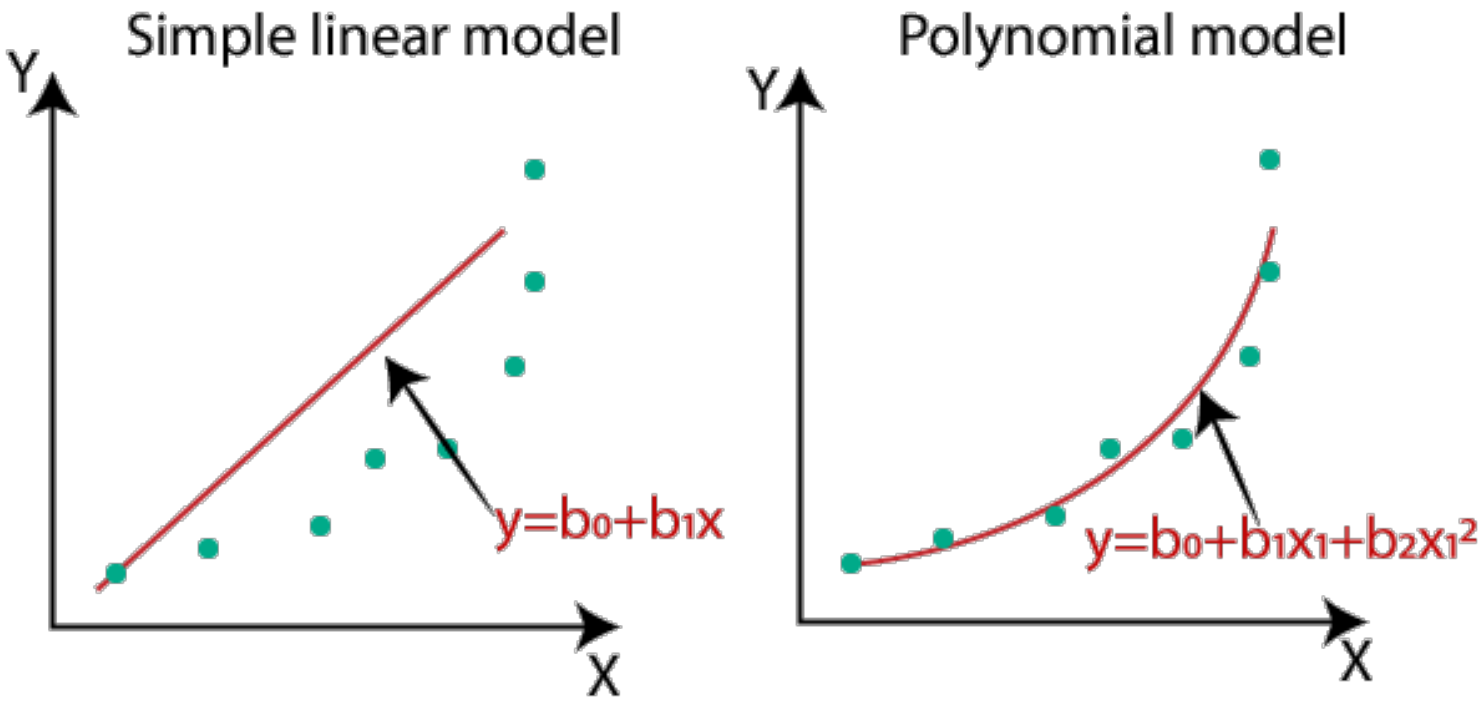
Linear Regression



Linear Regression

$$Y = \theta_0 + \theta_1 x$$

Linear vs. Polynomial Regression



Polynomial Regression

- Polynomial regression is a form of Linear regression where only due to the Non-linear relationship between dependent and independent variables we add some polynomial terms to linear regression to convert it into Polynomial regression.
- Suppose we have X as Independent data and Y as dependent data.
- Before feeding data to a mode in preprocessing stage we convert the input variables into polynomial terms using some degree.

Polynomial Regression

- Consider an example my input value is 35 and the degree of a polynomial is 2 so I will find 35 power 0, 35 power 1, and 35 power 2 And this helps to interpret the non-linear relationship in data.
- The equation of polynomial becomes something like this.

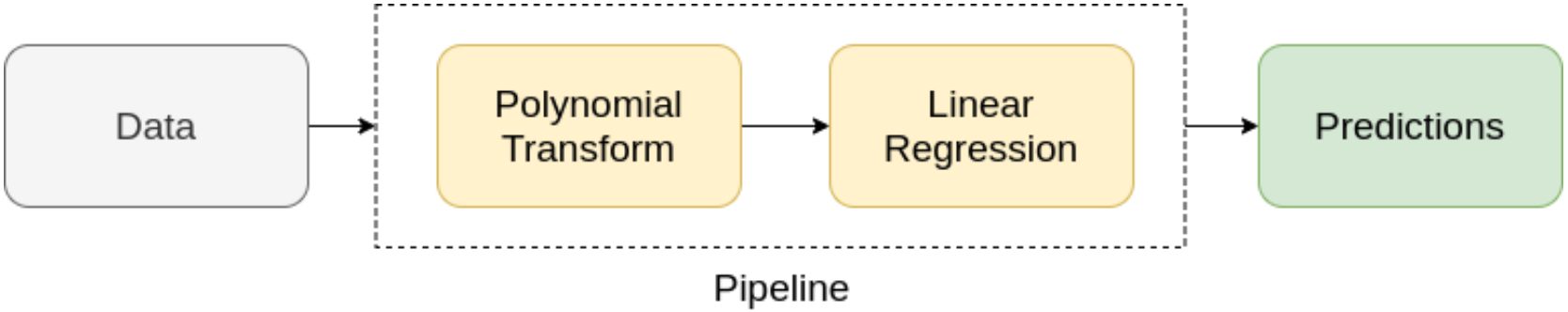
$$y = a_0 + a_1x^1 + a_2x^2 + \ldots + a_nx^n$$

- The degree of order which to use is a Hyperparameter, and we need to choose it wisely.
- But using a high degree of polynomial tries to overfit the data and for smaller values of degree, the model tries to underfit so we need to find the optimum value of a degree.

Polynomial Linear Regression

- If you see the equation of polynomial regression carefully, then we can see that we are trying to estimate the relationship between coefficients and y.
- And the values of x and y are already given to us, only we need to determine coefficients and the degree of coefficient here is 1 only, and degree one represents simple linear regression Hence, Polynomial regression is also known as polynomial Linear regression.

Steps


Data
Polynomial Transform
Linear Regression
Predictions
Pipeline

Polynomial Transform

```
>>> import numpy as np
>>> from sklearn.preprocessing import PolynomialFeatures
>>> X = np.arange(6).reshape(3, 2)
>>> X
array([[0, 1],
       [2, 3],
       [4, 5]])
>>> poly = PolynomialFeatures(2)
>>> poly.fit_transform(X)
array([[ 1.,  0.,  1.,  0.,  0.,  1.],
       [ 1.,  2.,  3.,  4.,  6.,  9.],
       [ 1.,  4.,  5., 16., 20., 25.]])
```

Useful web resources

- www.mitu.co.in
- www.scikit-learn.org
- www.towardsdatascience.com
- www.medium.com
- www.analyticsvidhya.com
- www.kaggle.com
- www.stephacking.com
- www.github.com

Thank you

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Web Resources
https://mitu.co.in
http://tusharkute.com

contact@mitu.co.in

tushar@tusharkute.com