Polynomial Regression

What if there is non-linearity in the data, can simple Linear Regression work?

Ans: No

What modifications can be done to Linear Regression for the model to be complex enough to fit non-linear data?

Ans: By using **Polynomial Regression** → transforms linear equation of linear Regression to Polynomial equations

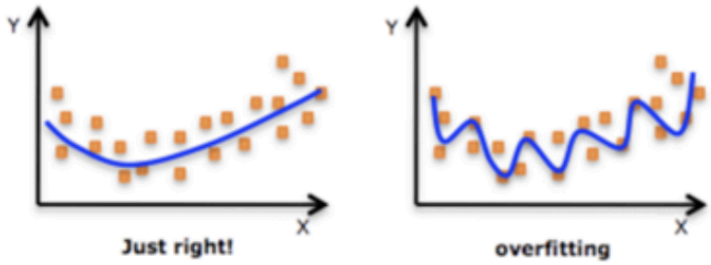
How does Polynomial Regression work?

Ans: if Linear Regression has $\hat{y} = w_1 f_1 + w_2 f_2 + \ldots\ldots w_d f_d + w_0$;

polynomial introduces features like $f_{1'} = f_1^2$, $f_{2'} = f_2^3$, $f_{3'} = f_3^2$

making the Model complex for handling non-linearity.

Bias-Variance



If model A (right): covers all data points with high-degree features

i.e. predicting hyperplane passes through all the data points

Model B (left): misses out only a handful of data points using lower degree features,

I.e. predicting hyperplane misses a handful of data points

Then which model is better?

Ans: Model B generalizes on the data → model captures the pattern of the data and does not get influenced by Outliers (hence those points are missed)

Model B, a simpler model than Model A → **Occam's Razor**

What can we say about model A?
Ans: Model overfits the data → fitting to outliers/noises in the data

When to say a model is underfitting the data?
Ans: When the model is not able to predict most of the data points in the data → model has poor performance.

How are training and test data related to the underfit and overfit model?

Ans: an under-fitted model → has a high training and test loss
- An Overfitted model → very low training loss but a high testing loss.

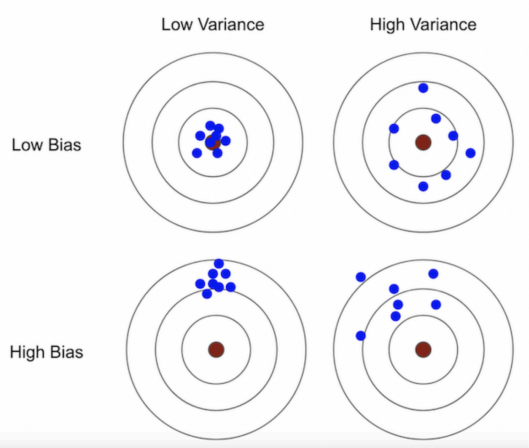
What is a suitable model?

Ans: a tradeoff between both such the model has a low training and testing loss → perfectly fit model

We can understand Underfit and overfit using Bias and Variance.

What do we mean by Bias and Variance?

Ans: Understanding bias- variance with a target shooting example



Observe

- High Bias → have a wrong aim
- High Variance → an unsteady aim.

How is underfit related to Bias and Variance?

Ans: Now in Underfitting → predictions are consistent but are wrong→ for different training sets → **High Bias and low Variance**

How is overfit related to Bias and Variance?

Ans: Now in Overfitting → predictions vary too much and are wrong → for different training sets → **Low Bias and High Variance.**