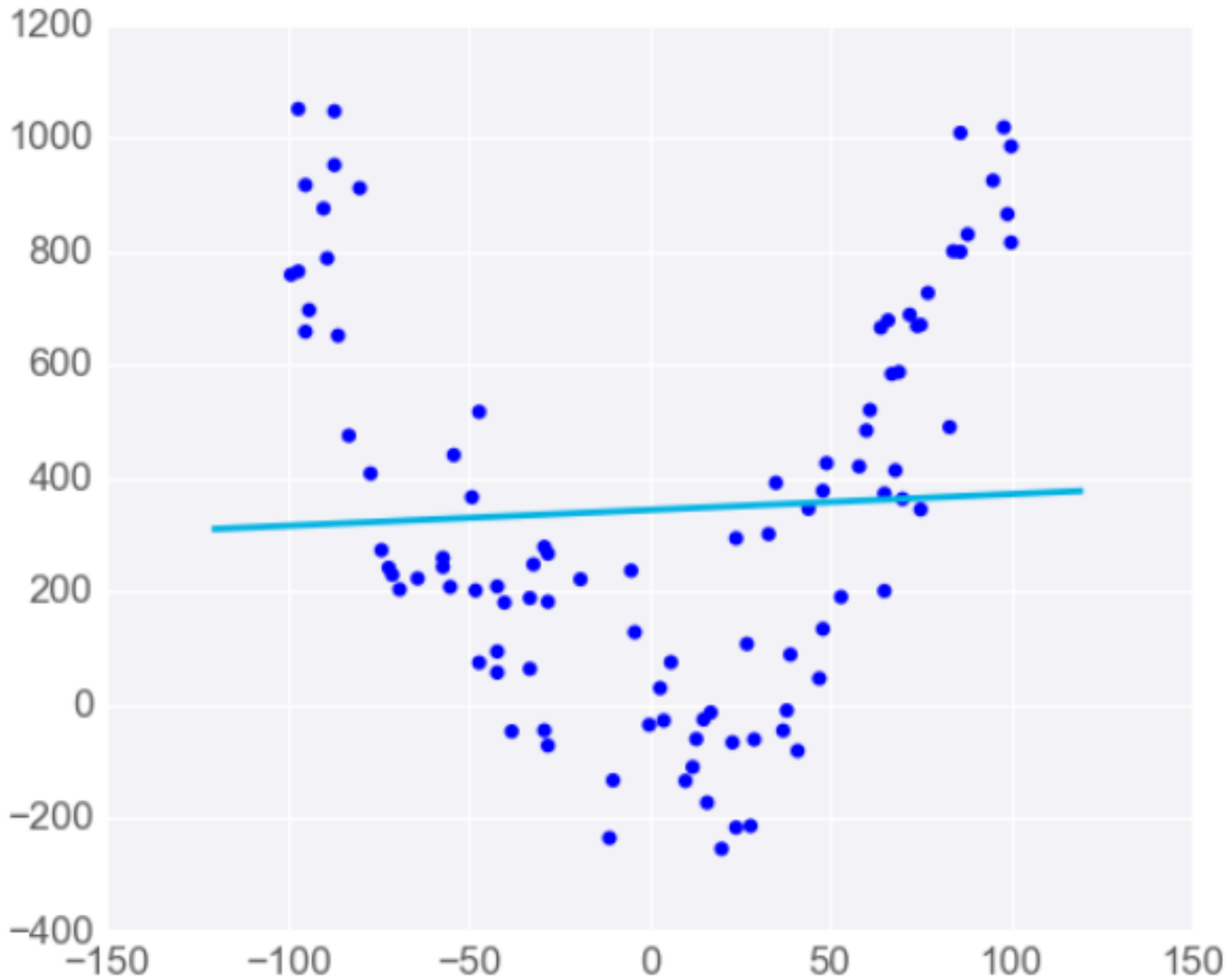
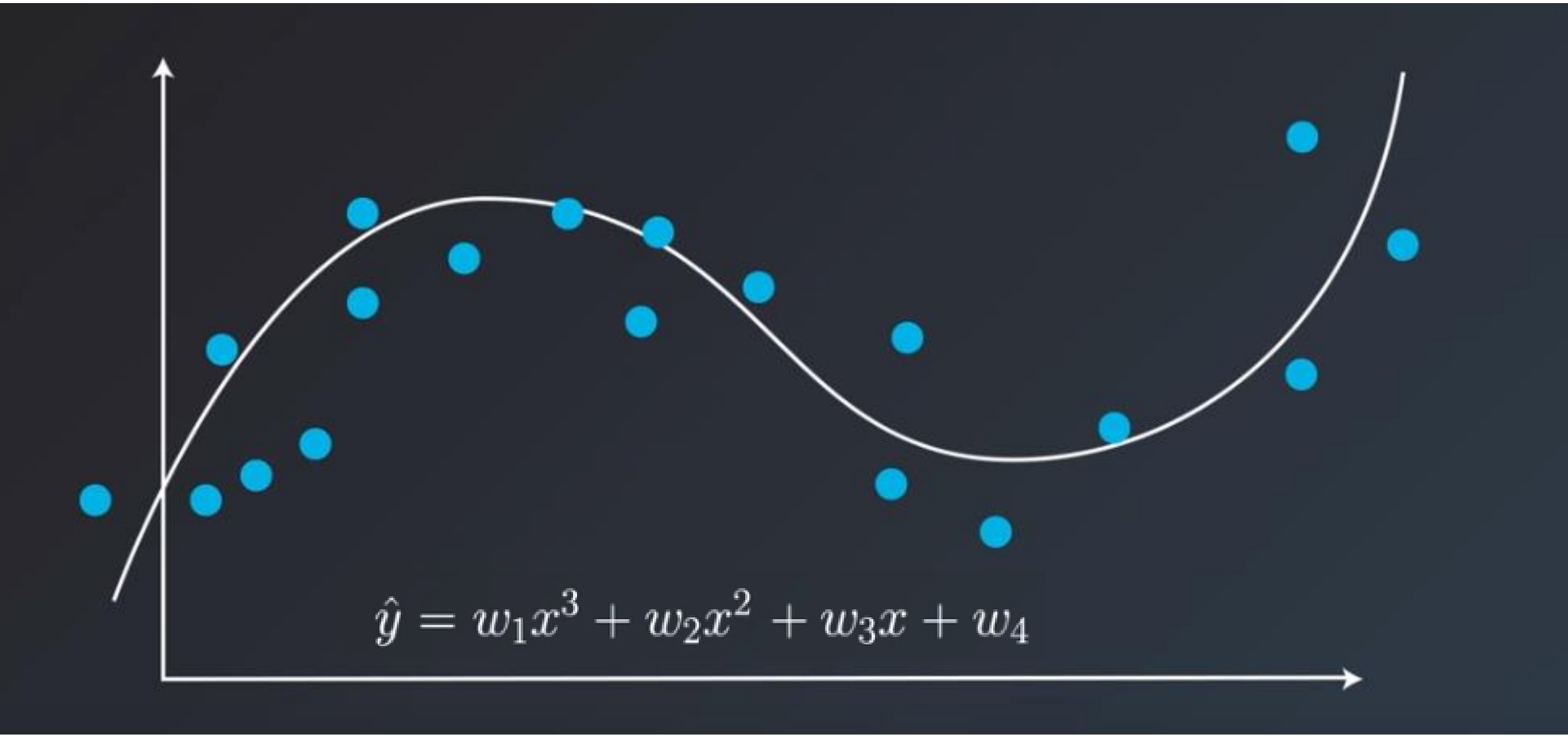
Polynomial Regression

Linear Regression Works Best When the Data is Linear

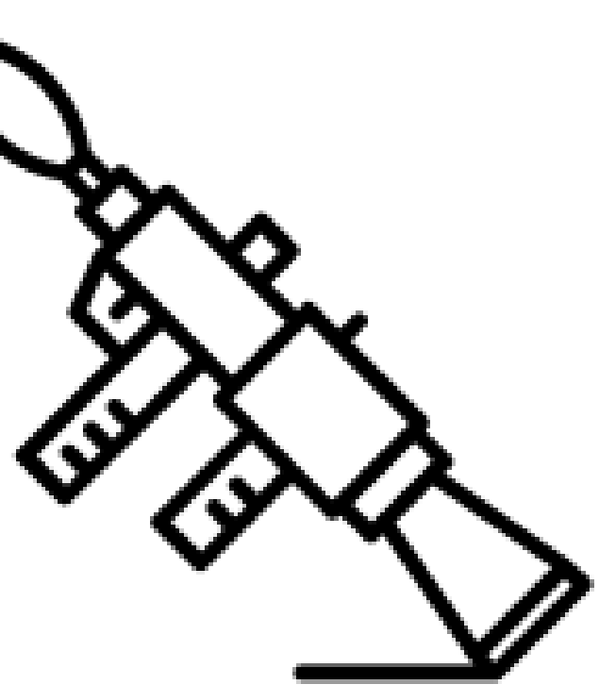


DICE ANALYTICS

Polynomial Regression



Model Selection



Simple Problem

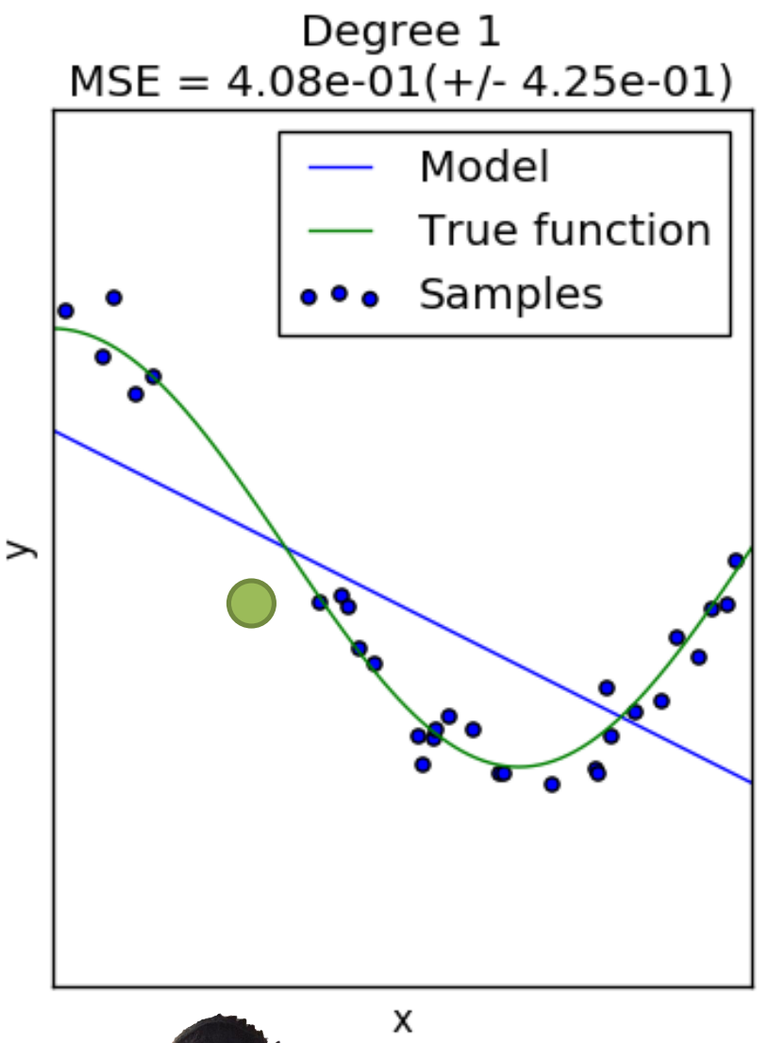
Complex Solution

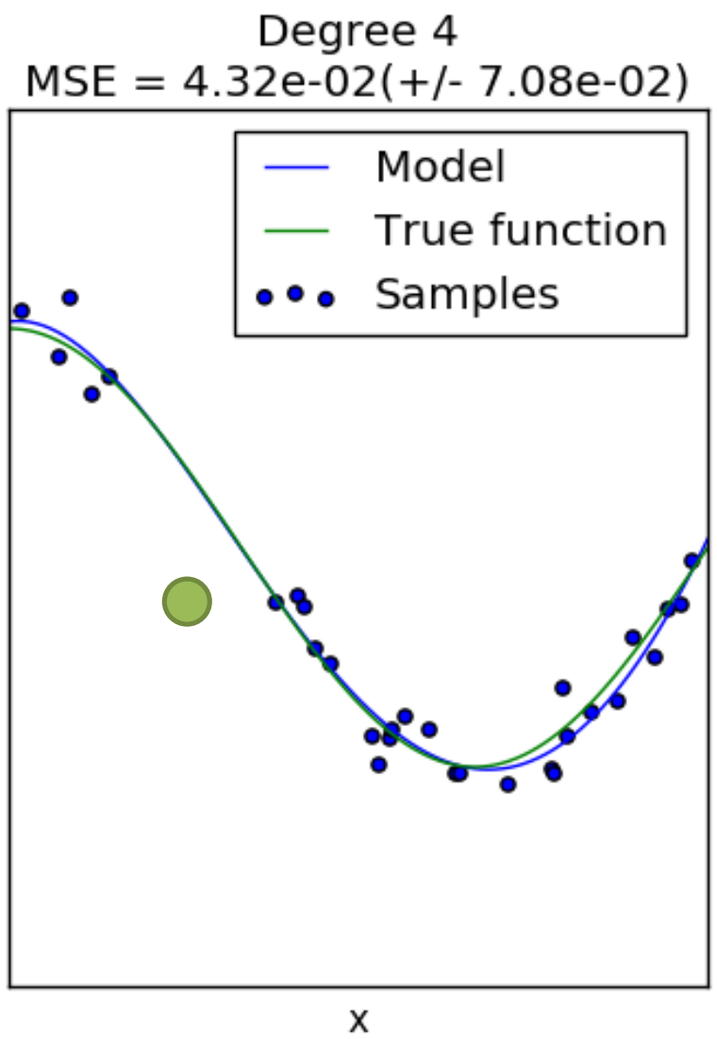
Model Selection

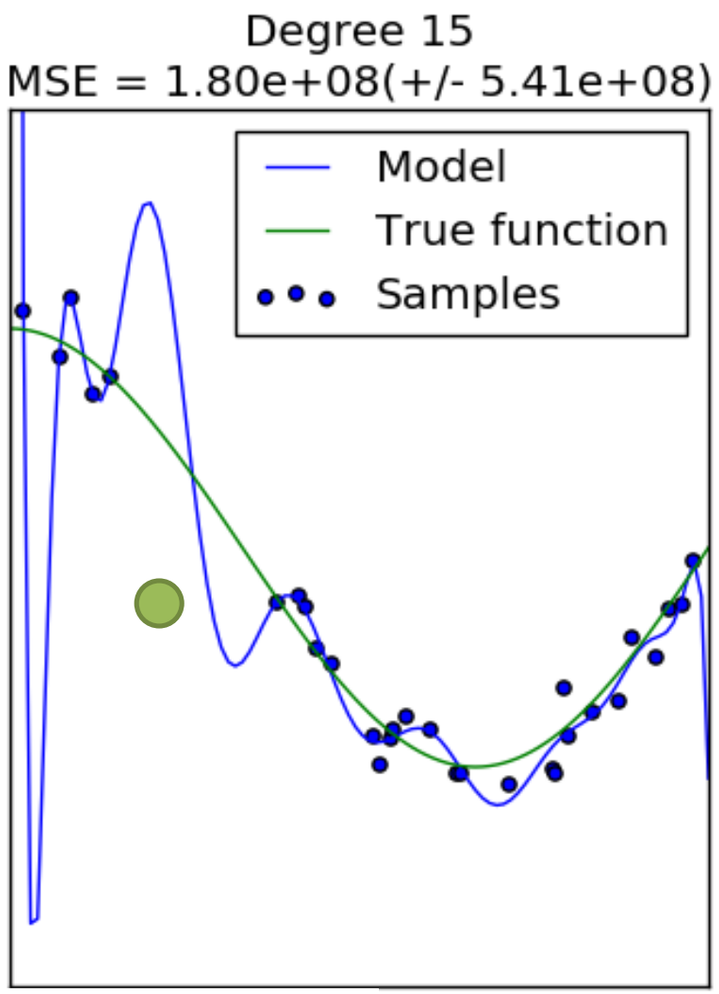
Complex Problem

Simple Solution

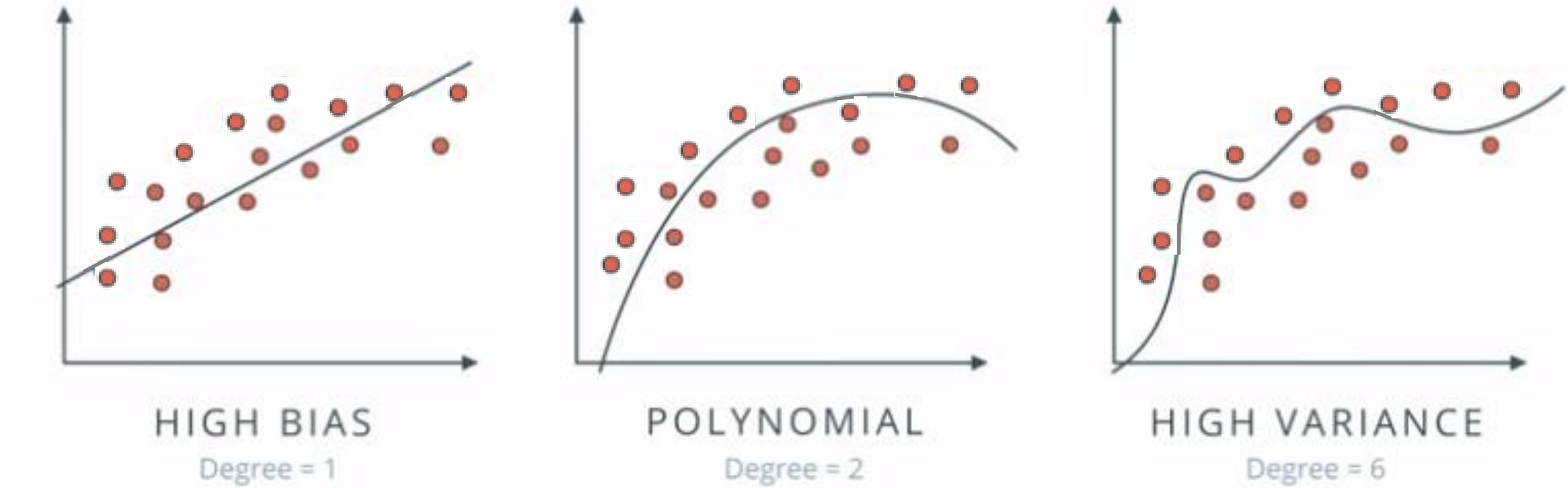
Under-fitting & Over-fitting



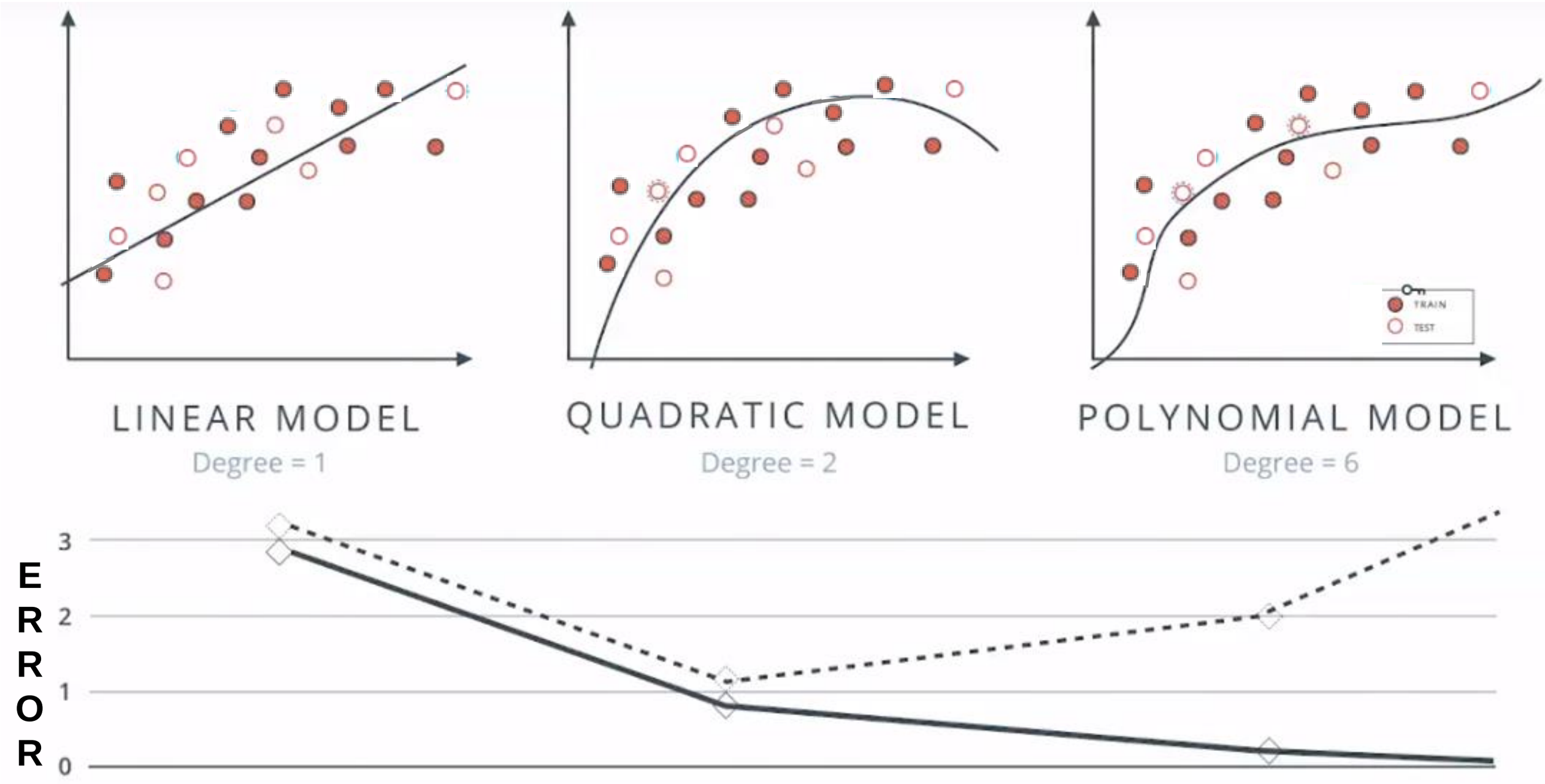




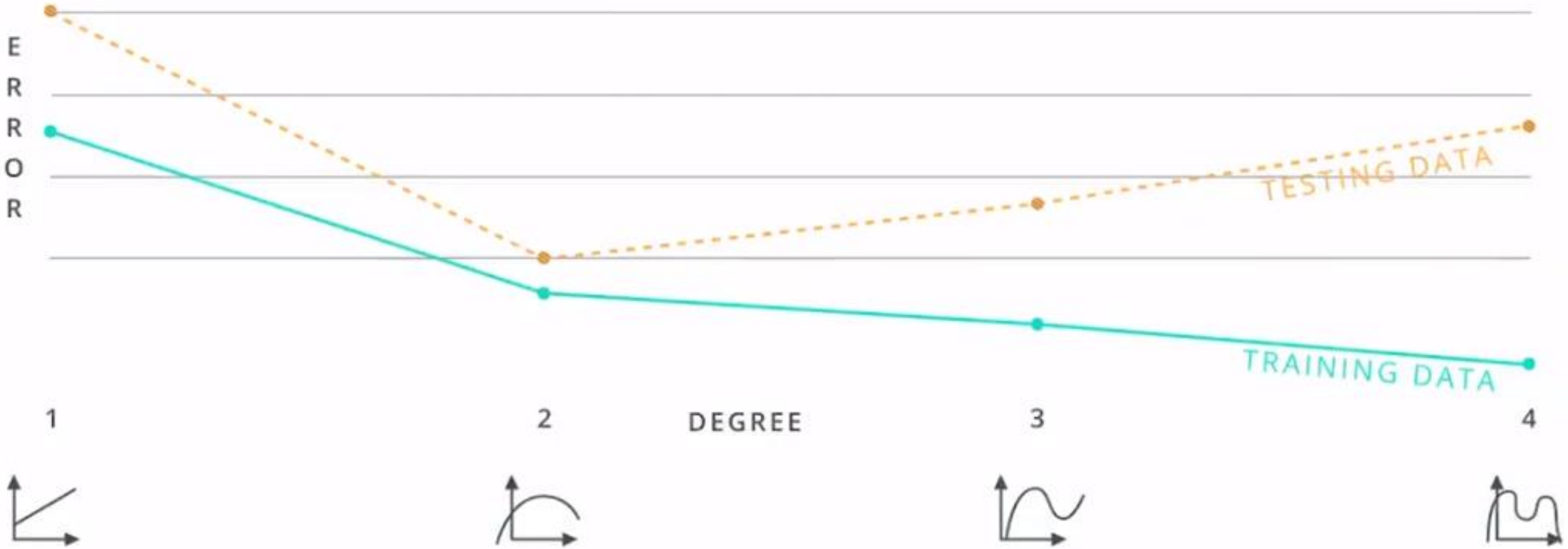
Model Complexity



Model Complexity

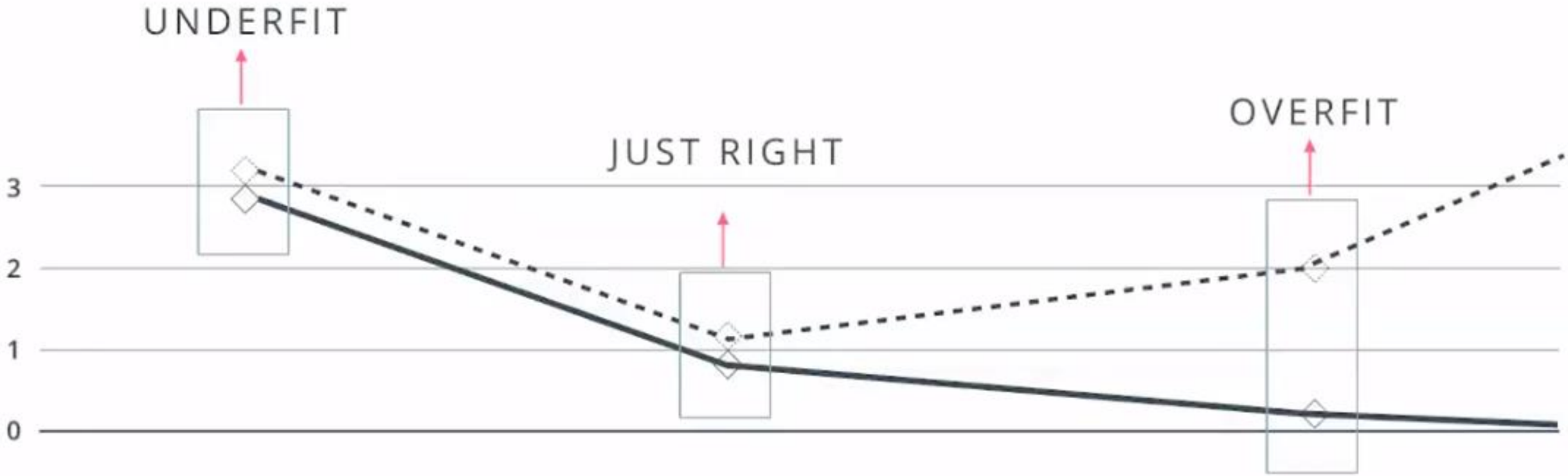


Model Complexity



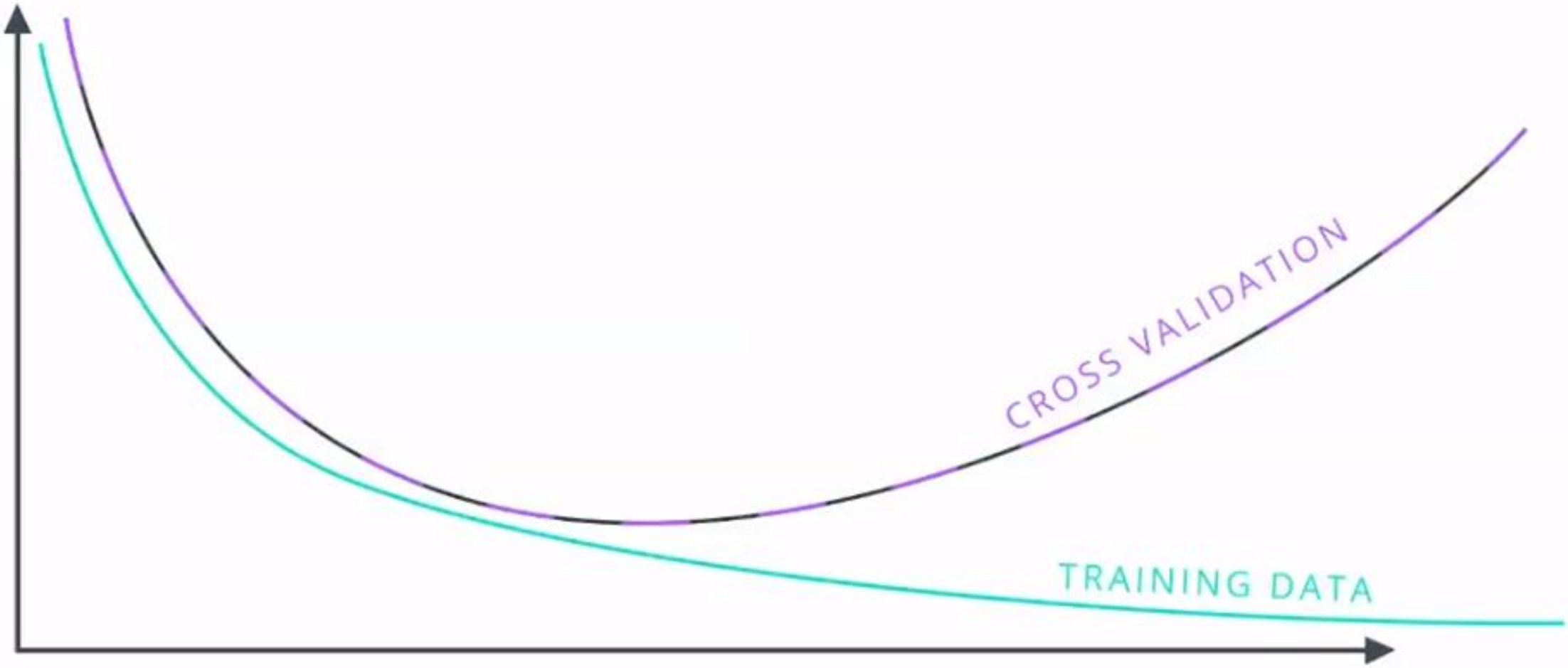
DICE ANALYTICS

Model Complexity

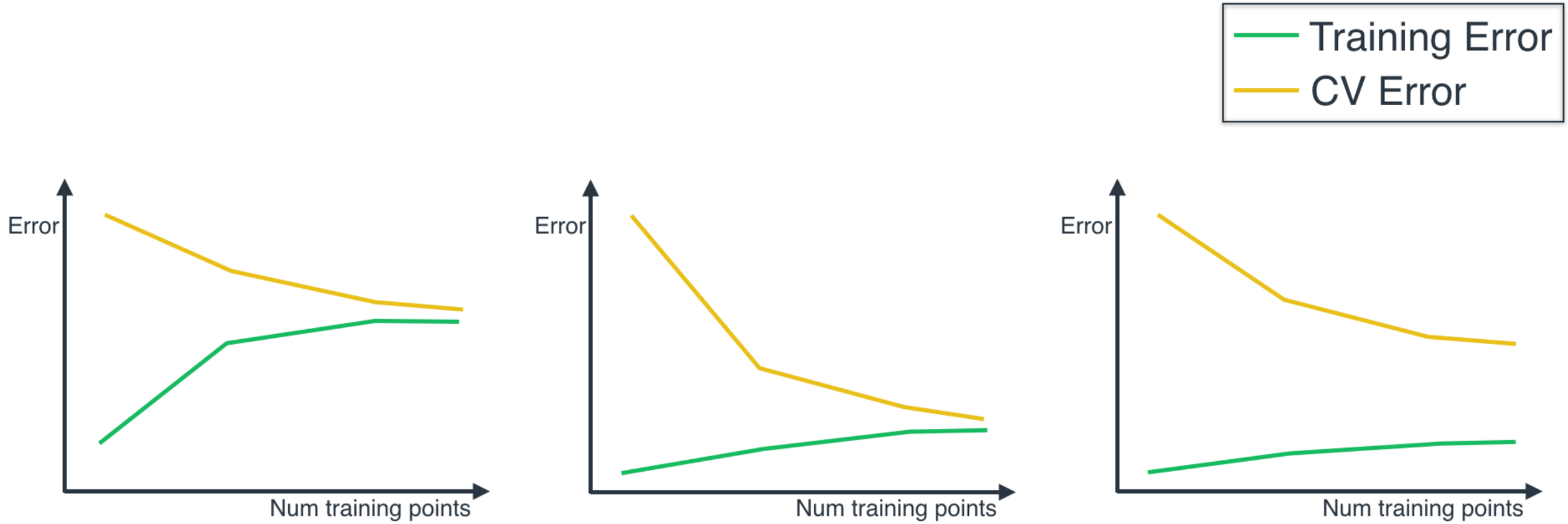


Model Complexity

Model Complexity



Impact of training points

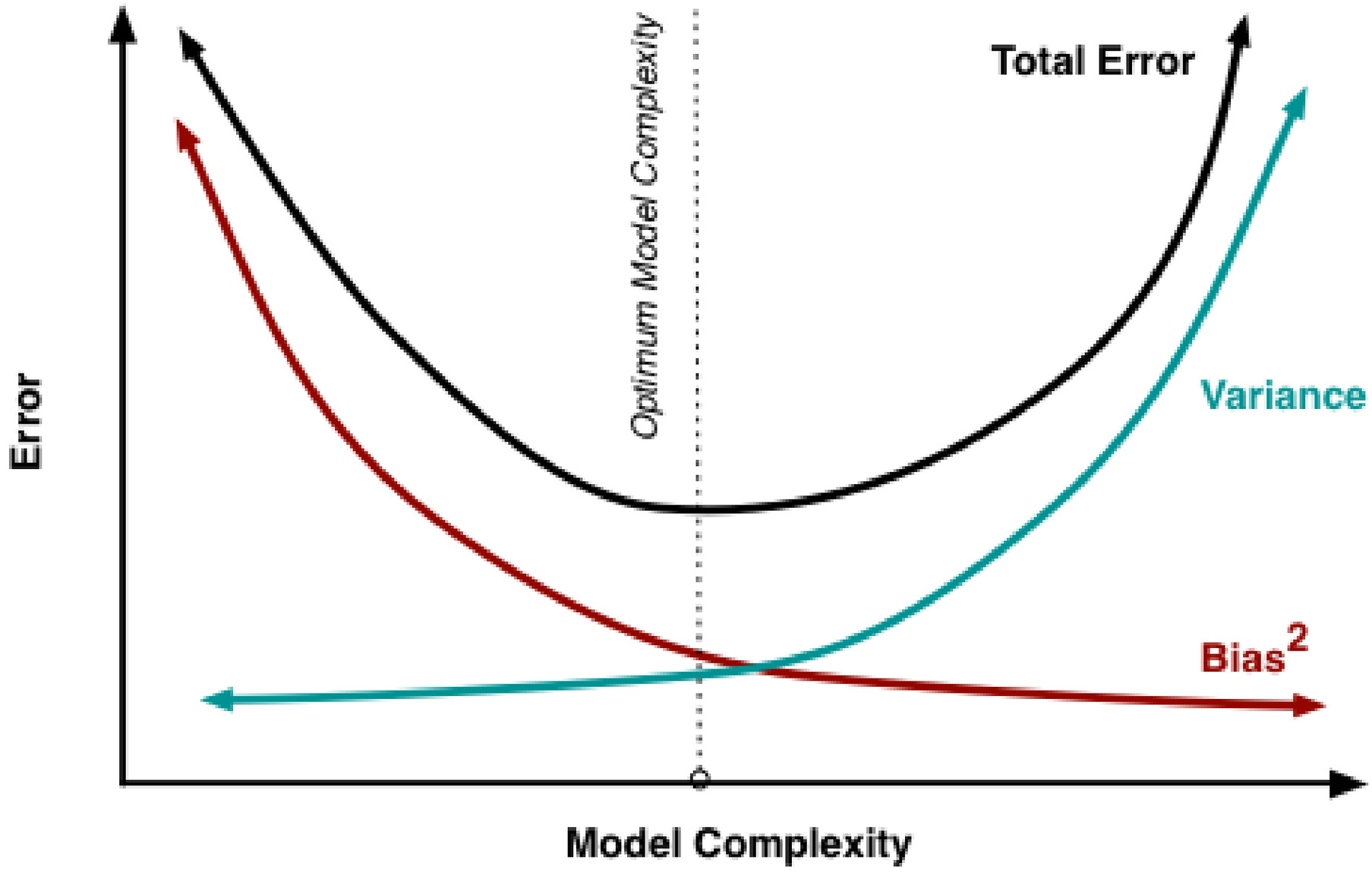


High Bias
(Underfitting)

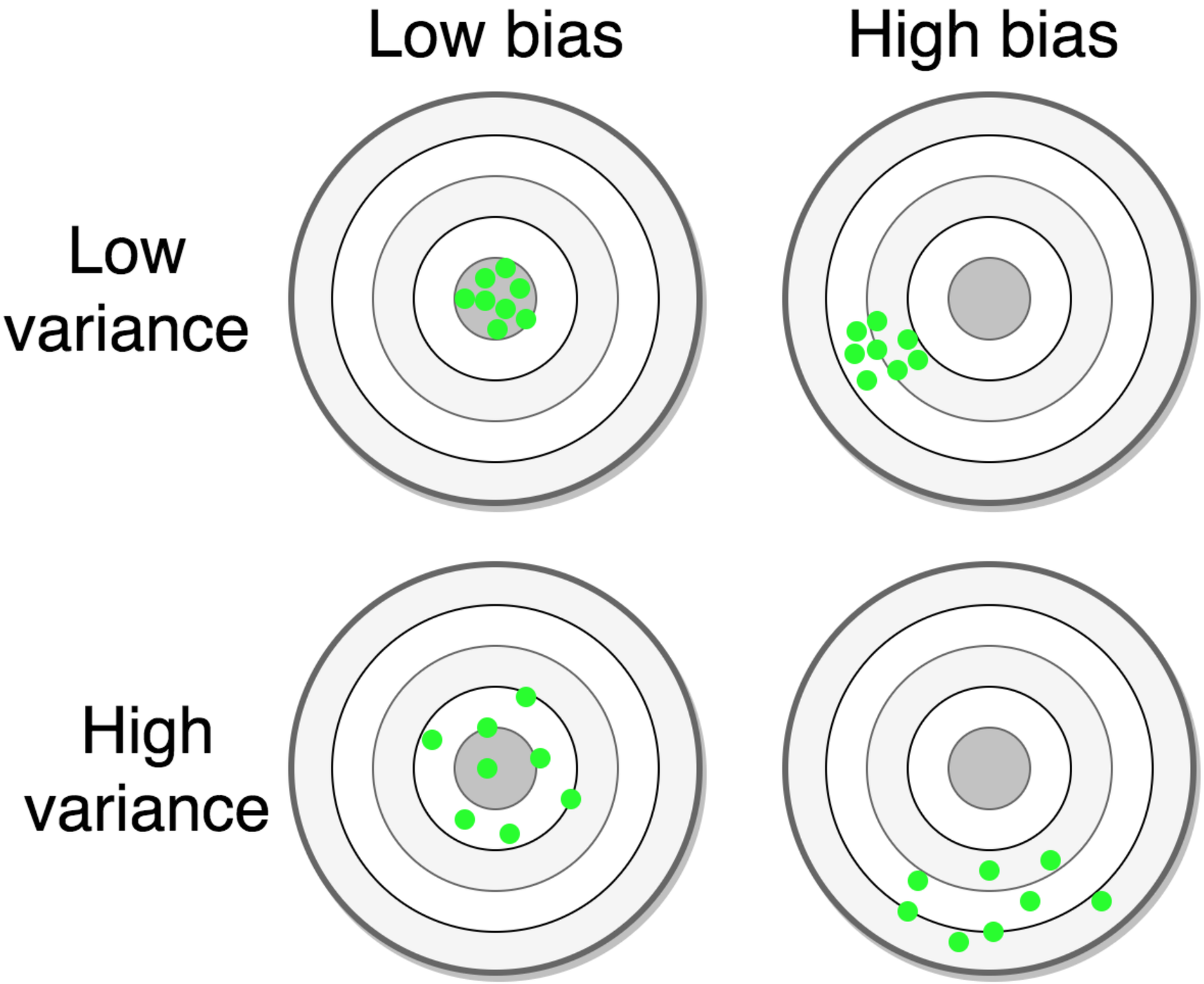
Just Right

High Variance
(Overfitting)

Bias Variance Trade-off



Bias Variance Trade-off



https://elitedatascience.com/bias-variance-tradeoff

DICE ANALYTICS

Regularization / Shrinkage

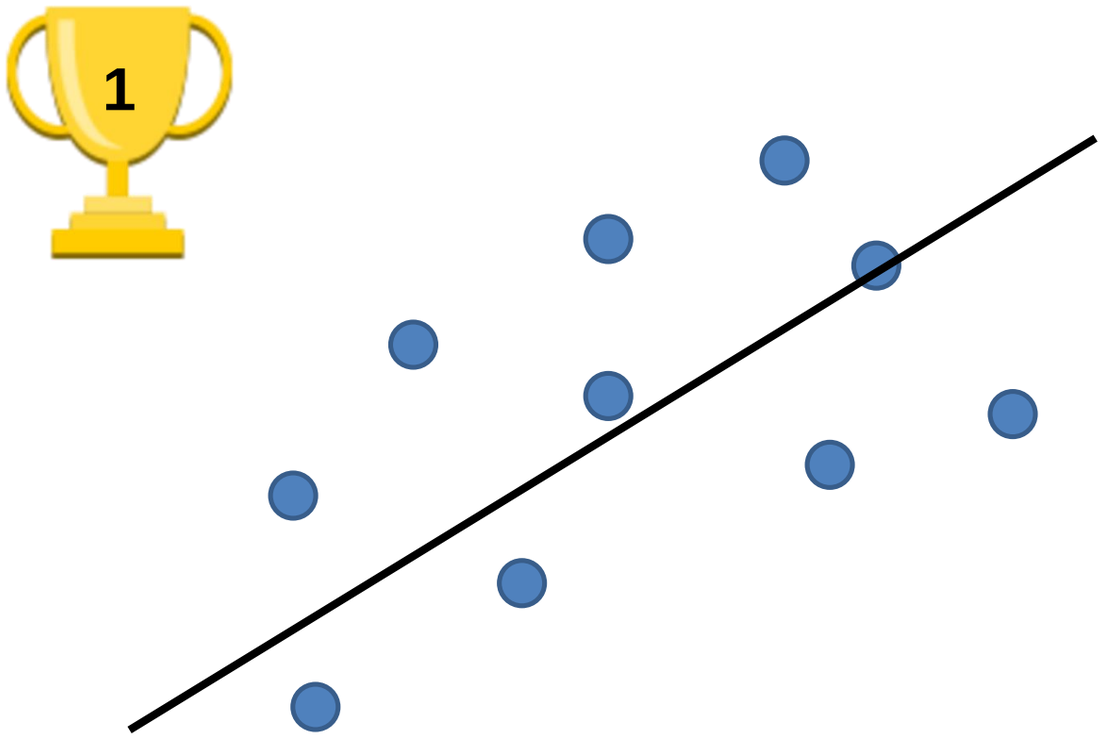
Ridge / L2

$$\sum_{i=1}^{n}\left(y_i-\beta_0-\sum_{j=1}^{p}\beta_j x_{ij}\right)^2+\lambda\sum_{j=1}^{p}\beta_j^2=\mathrm{RSS}+\lambda\sum_{j=1}^{p}\beta_j^2$$

Lasso / L1

$$\sum_{i=1}^{n}\left(y_i-\beta_0-\sum_{j=1}^{p}\beta_j x_{ij}\right)^2+\lambda\sum_{j=1}^{p}|\beta_j|=\mathrm{RSS}+\lambda\sum_{j=1}^{p}|\beta_j|$$

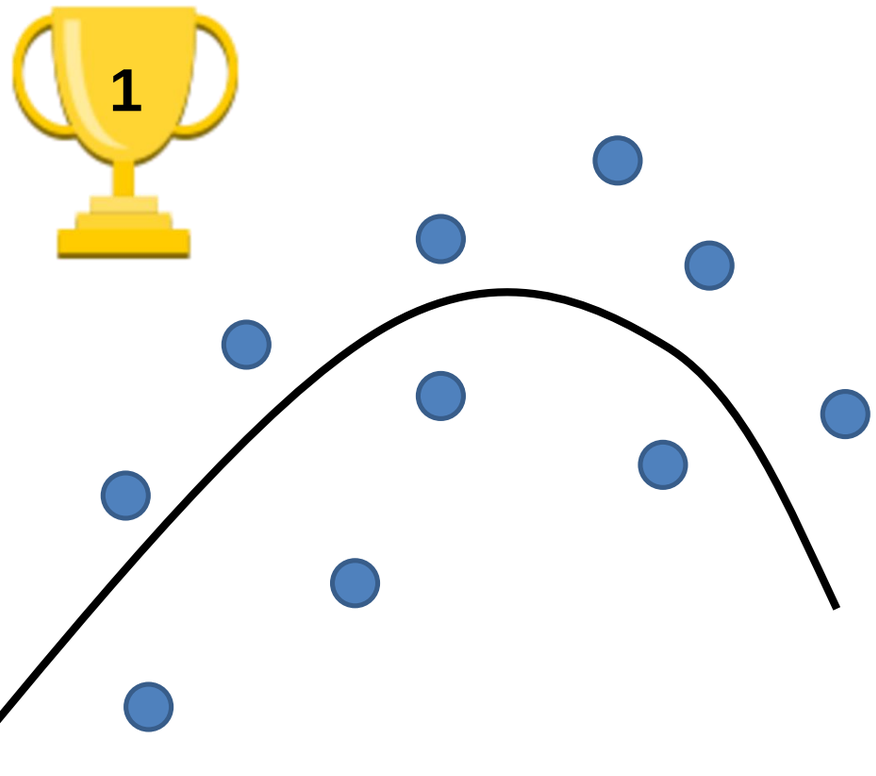
SIMPLE MODEL



ERROR:

$$3x_1 + 4x_2 + 5$$

COMPLEX MODEL

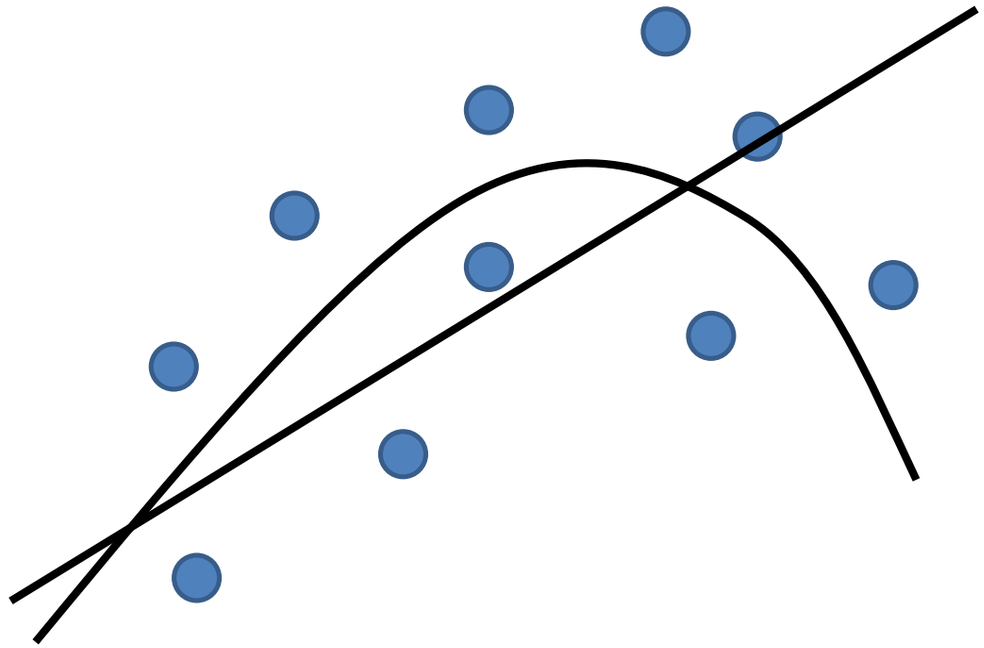


ERROR:

$$2x_1^3 - 2x_1^2x_2 - 4x_2^3 + 3x_1^2 + 6x_1x_2 + 4x_2^2 + 5$$

DICE ANALYTICS

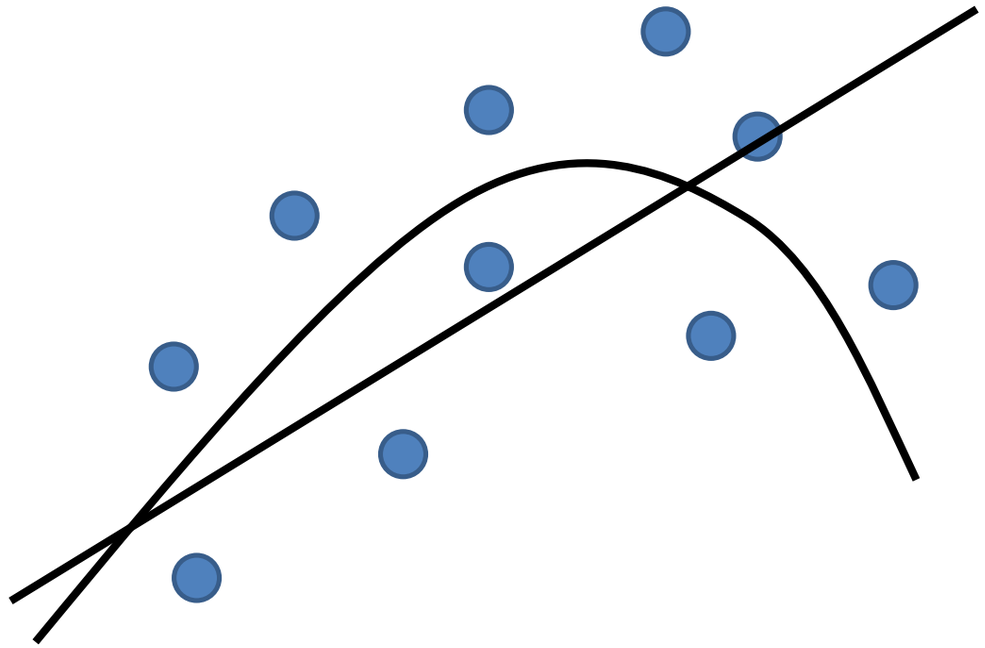
L1 (Lasso) Regularization



$$2x_1^3 - 2x_1^2x_2 - 3x_1x_2^3 + 4x_1^2 + 6x_1x_2 + 4x_2^2 + 5$$

$$|2| + |-2| + |3| + |4| + |4| + |6| + |4| = 21$$

L2 (Ridge) Regularization



$$2x_1^3 - 2x_1^2x_2 - 3x_1x_2^2 + 4x_1^2 + 6x_1x_2 + 4x_2^2 + 5$$

$$2^2 + (-2)^2 + 3^2 + 4^2 + 6^2 + 4^2 = 85$$

Simple vs Complex Models

Requires LOW ERROR
OK if it's COMPLEX

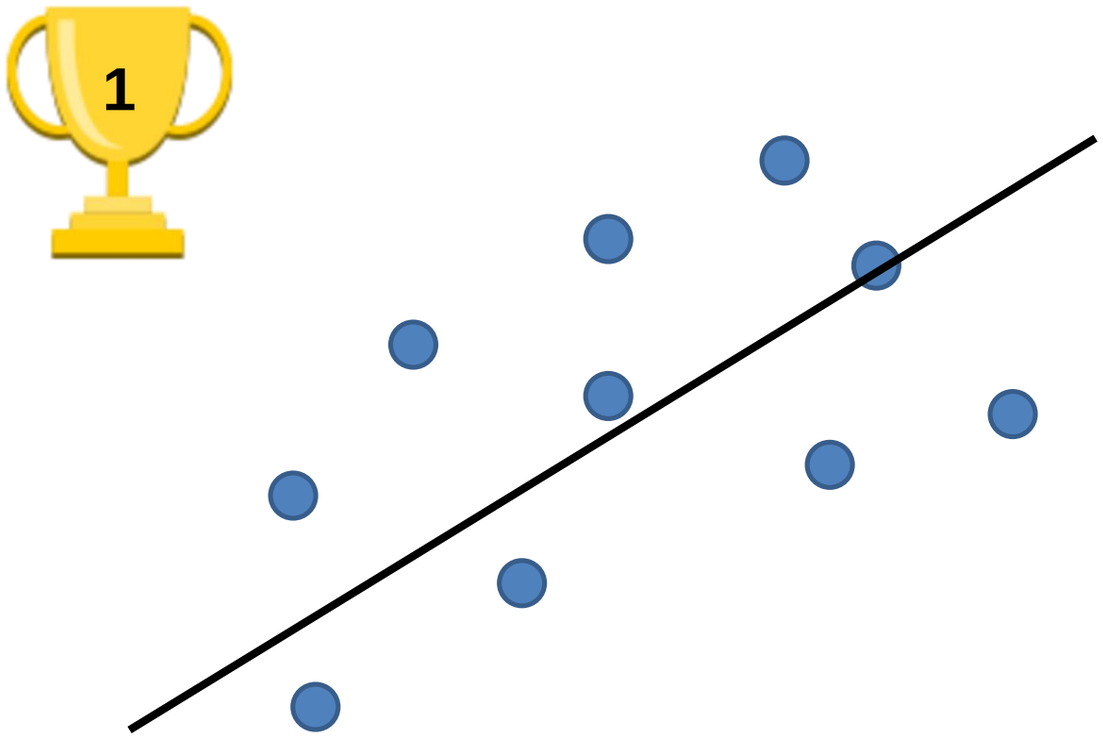
PUNISHMENT on COMPLEXITY should be SMALL

Requires SIMPLICITY
OK with ERRORs

PUNISHMENT on COMPLEXITY should be BIG

DICE ANALYTICS

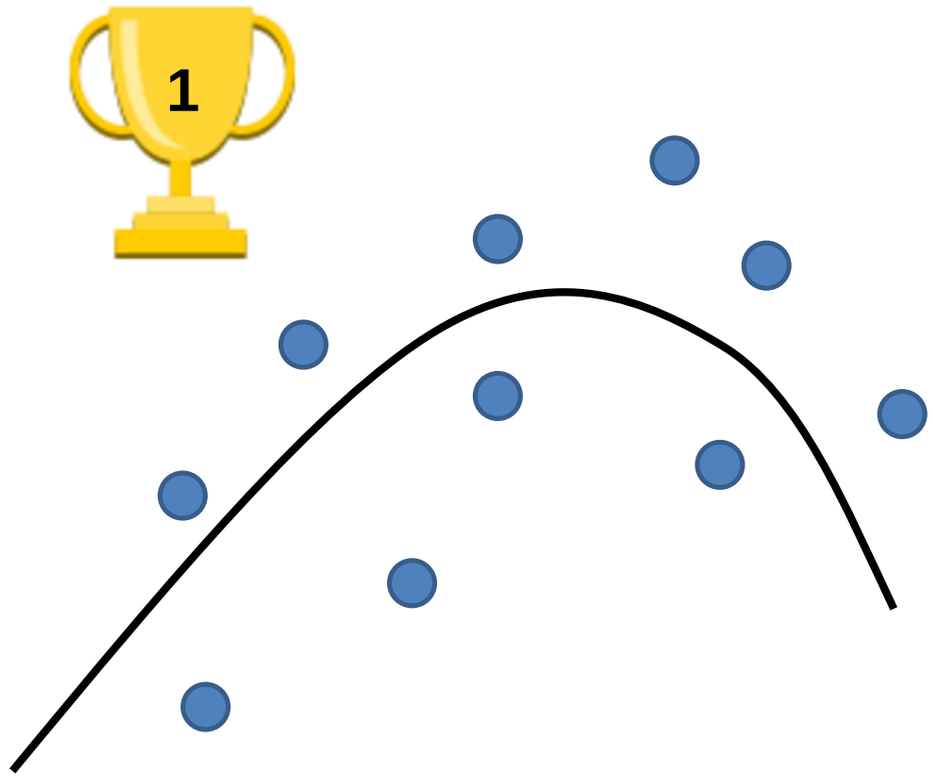
The λ Parameter



λ

ERROR:

$3x_1 + 4x_2 + 5$



λ

ERROR:

$2x_1^3 - 2x_1^2x_2 - 4x_2^3 + 3x_1^2 + 6x_1x_2 + 4x_2^2 + 5$

SAVAGE λ

DICE ANALYTICS