

## Bias - Variance and Error.

### 1. Bias - Variance Tradeoff.

Mean squared error :  $\mathbb{E}_{(x,y) \sim \text{test set}} |f(x) - y|^2$  too high.

- Overfitting: the model is too closely related to the training set, thus not so generalize to other examples.
- Underfitting: the model doesn't gather enough information from training set thus can't predict right result. (doesn't capture the link between features and targets)
- Data is simply noisy, too much noise in the dataset

$$\begin{aligned} 1.2. \text{MSE} &= \mathbb{E} ( (y - \hat{f}(x))^2 ) \\ &= \mathbb{E} ( (\epsilon + f(x) - \hat{f}(x))^2 ) \\ &= \mathbb{E} (\epsilon^2) + \mathbb{E} ( (f(x) - \hat{f}(x))^2 ) + \text{Var} (f(x) - \hat{f}(x)) \\ &= \sigma^2 + (\text{Bias } \hat{f}(x))^2 + \text{Var}(\hat{f}(x)) \end{aligned}$$

High Bias : Underfitting  
High Var : Overfitting

### 2. Error analysis & ablation analysis.