

Ensemble Learning:-

idea

Core of EL:-

Given N models $\{h_1(x), h_2(x), \dots, h_N(x)\}$,
the ensemble combines their outputs to make
a prediction.

For classification,

$$\rightarrow \hat{y} = \text{mode} \{h_1(x), h_2(x), \dots, h_N(x)\}$$

For regression:-

$$\hat{y} = \frac{1}{N} \sum_{i=1}^N h_i(x)$$

Bias Variance Trade off:-

$$\text{Prediction Error} = \text{Bias}^2 + \text{Variance} + \text{Noise}$$

Types of EL:-

A) Bagging:-

$$\hat{y} = \frac{1}{N} \sum_{i=1}^N h_i(x)$$

Reduces Variance without increasing bias.

B) Boosting:-

$$\hat{y} = \text{Sign} \left(\sum_{t=1}^T \alpha_t h_t(x) \right)$$

Reduces both bias & variance.

C) Stacking:-

$$Z = \{h_1(x), h_2(x), \dots, h_N(x), y\}$$

Leverages the strengths of different algorithms
to achieve better performance.

Ensemble performance:

$$P(\text{Error}) = \sum_{k=\lceil N/2 \rceil}^N \binom{N}{k} e^k (1-e)^{N-k}$$