

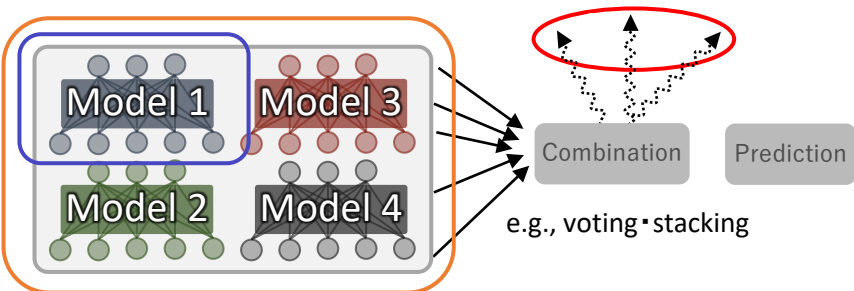
# Lemma

$$p_{\text{err}} \geq \mathcal{B}^{\text{tight}}(\mathcal{E}), \quad \mathcal{E} = \underbrace{I_{\text{relev}}}_{\text{Accuracy}} - \underbrace{I_{\text{redun}}}_{\text{Redundancy (inverse of diversity)}} - \underbrace{I_{\text{combloss}}}_{\text{Combination loss}}$$

Accuracy

Redundancy  
(inverse of diversity)

Combination loss



**Lemma 3.1** (Decomposition of error rate lower bound into three metrics). Let  $\mathcal{U}(p) = \mathcal{H}_2(p) + p \log_2(Y_{\max} - 1)$  and  $\mathcal{U}'(p) = \frac{d\mathcal{U}}{dp}(p)$ , and let  $p_0 \in [0, 1]$  be the approximate error rate. Then, for any  $p_0$ , the error rate  $p_{\text{err}}$  is bounded as

$$p_{\text{err}} \geq \mathcal{B}_{p_0}^{\text{tight}}(\mathcal{E}(\mathbf{O}, Y, \hat{Y}))$$

$$:= p_0 + \frac{\mathcal{U}'(p_0)}{4} \left\{ 1 - \sqrt{1 - 8 \frac{H(Y) - \mathcal{E}(\mathbf{O}, Y, \hat{Y}) - \mathcal{U}(p_0)}{\mathcal{U}'(p_0)^2}} \right\}$$