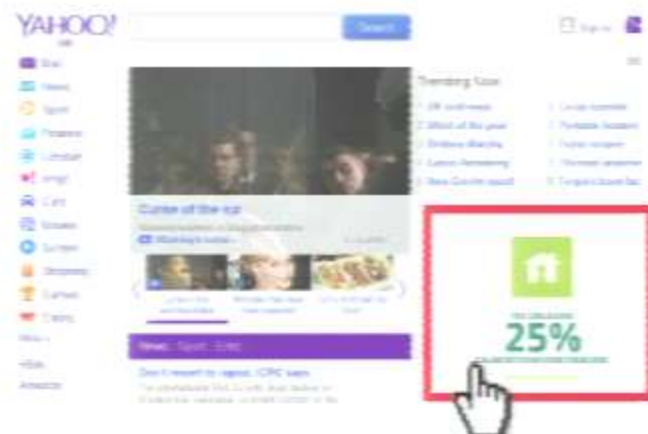


On the Relationship Between Binary Classification, Bipartite Ranking, and Binary Class Probability Estimation



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⇒ State of knowledge
before this paper

⇒ State of knowledge
after this paper

Binary Class Probability
Estimation (CPE)



Bipartite
Ranking



Binary
Classification

Binary Classification

$$h : X \rightarrow \{0, 1\}$$

$$\text{er}_D^{\text{class}}[h] = \mathbf{E}_{(x,y) \sim D} [\mathbf{1}(h(x) \neq y)]$$

Bipartite Ranking

$$f : X \rightarrow \mathbb{R}$$

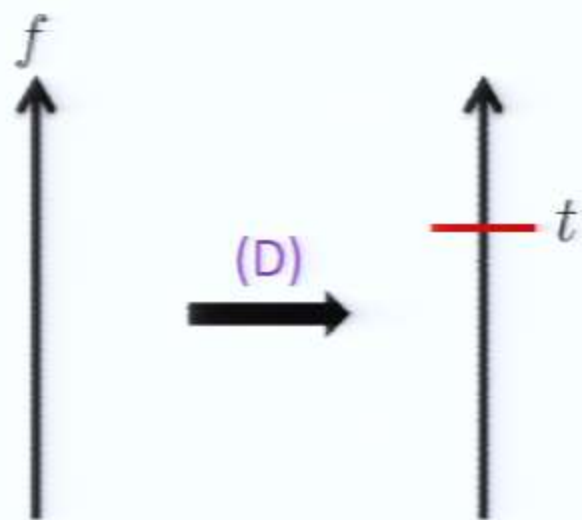
$$\text{er}_D^{\text{rank}}[f] = \mathbf{E}_{x,x' | y > y'} [\mathbf{1}(f(x) < f(x'))]$$

Binary CPE

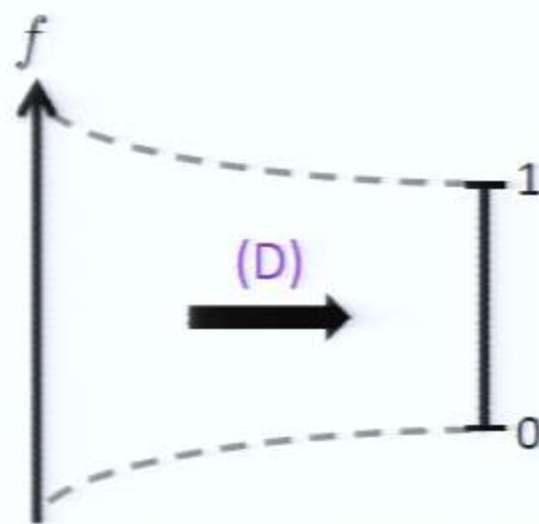
$$\hat{\eta} : X \rightarrow [0, 1]$$

$$\text{er}_D^{\text{CPE}}[\hat{\eta}] = \mathbf{E}_{(x,y) \sim D} [(\hat{\eta}(x) - y)^2]$$

Bipartite Ranking \rightarrow Binary Classification

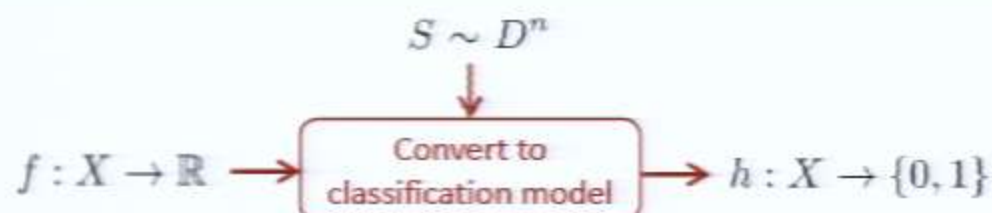


Bipartite Ranking \rightarrow Binary CPE



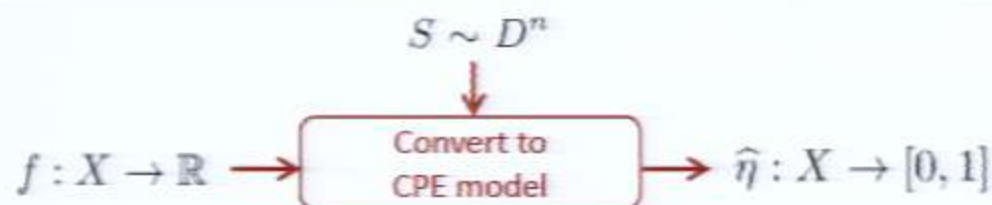
Weak Regret Transfer Bounds

Bipartite Ranking \rightarrow Binary Classification



$$\text{w.h.p. } \text{regret}_D^{\text{class}}[h] \leq C \sqrt{\text{regret}_D^{\text{rank}}[f]} + O\left(\sqrt{\frac{\ln(n)}{n}}\right)$$

Bipartite Ranking \rightarrow Binary CPE



$$\text{w.h.p. } \text{regret}_D^{\text{CPE}}[\hat{\eta}] \leq C' \sqrt{\text{regret}_D^{\text{rank}}[f]} + O\left(\left(\frac{\ln(n)}{n}\right)^{1/3}\right)$$

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