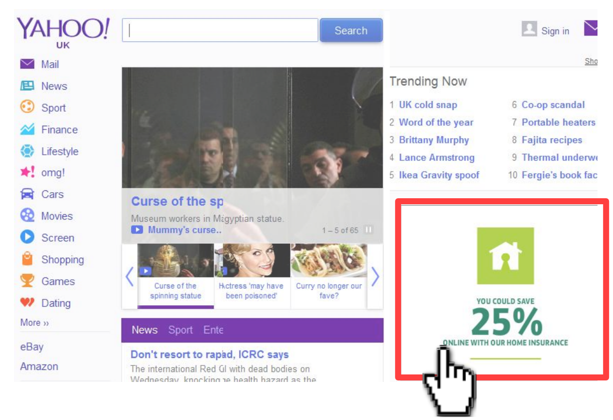
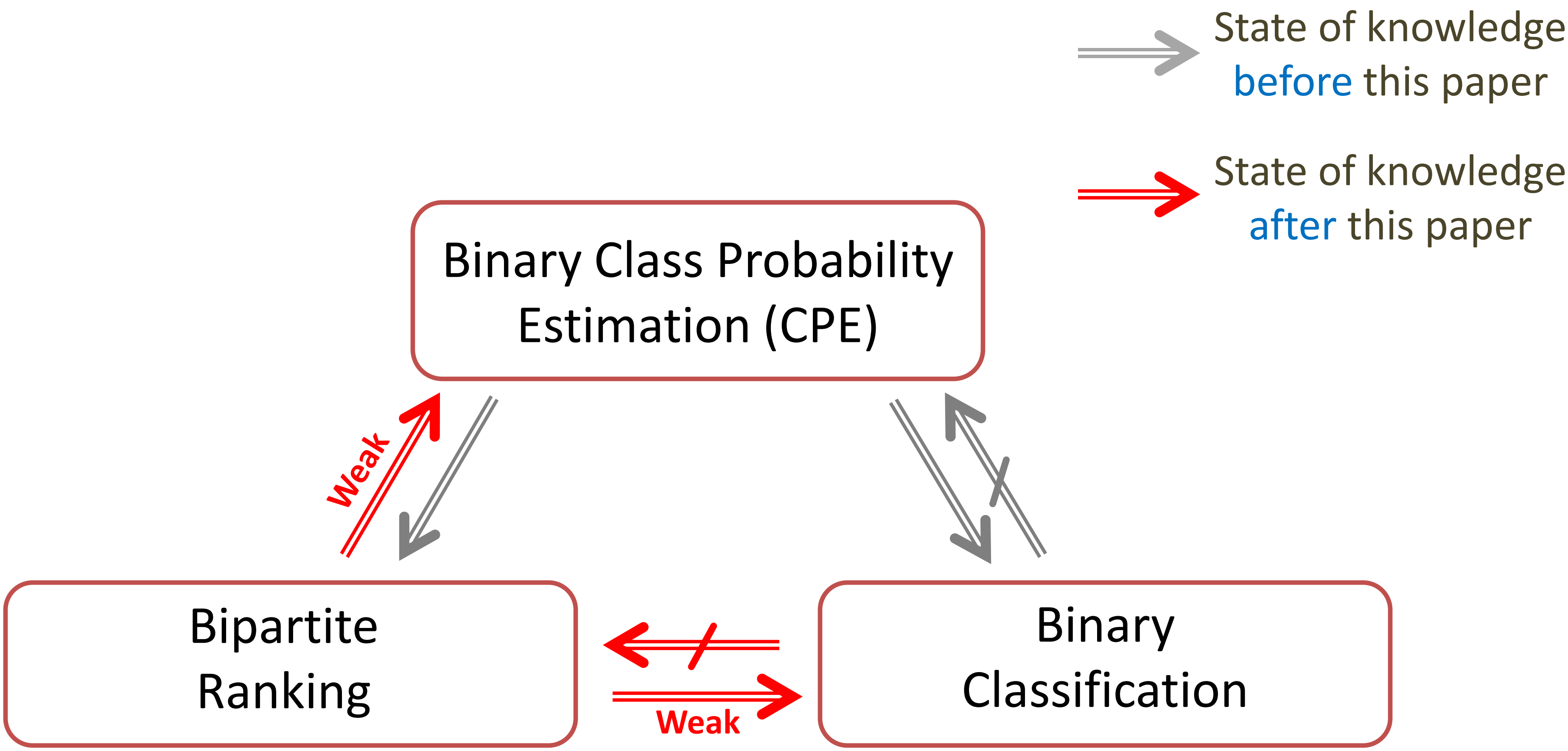
On the Relationship Between Binary Classification, Bipartite Ranking, and Binary Class Probability Estimation



Harikrishna Narasimhan and Shivani Agarwal

Department of Computer Science and Automation
Indian Institute of Science, Bangalore



State of knowledge before this paper
State of knowledge after this paper
Binary Class Probability Estimation (CPE)
Weak
Bipartite Ranking
Binary Classification
Weak

Binary Classification

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

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

Bipartite Ranking

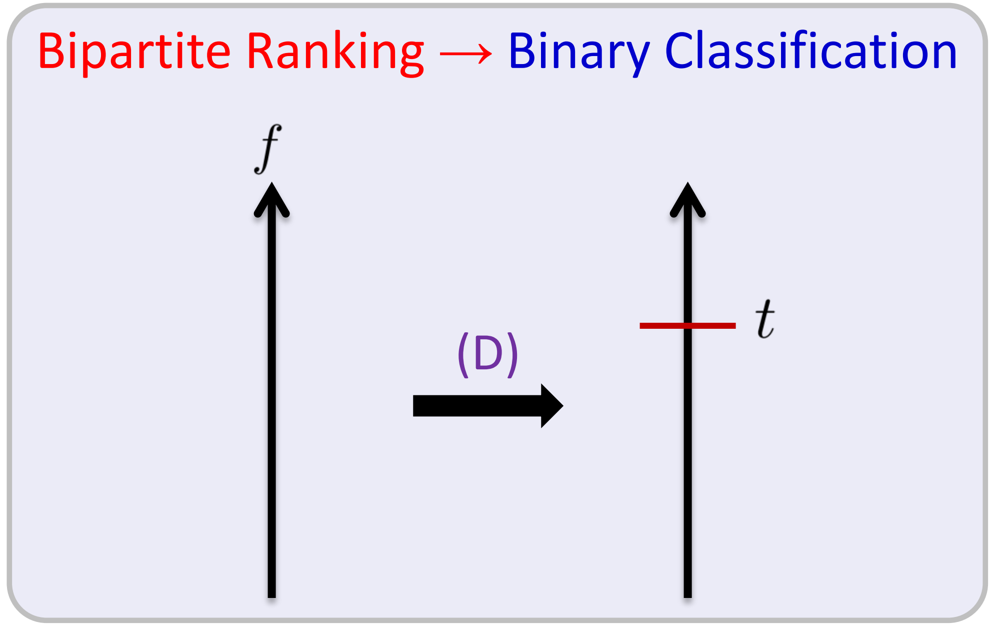
$$f : X \to \mathbb{R}$$

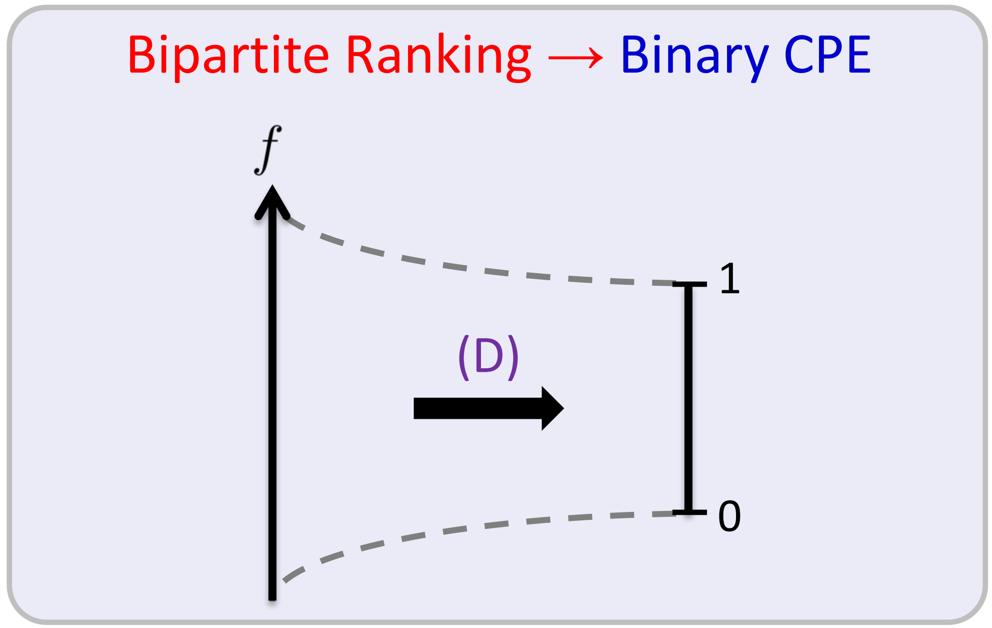
$$\mathrm{er}_D^{\mathrm{rank}}[f] = \mathbf{E}_{x,x' \mid y>y'}\big[\mathbf{1}\big(f(x) < f(x')\big)\big]$$

Binary CPE

$$\widehat{\eta} : X \to [0,1]$$

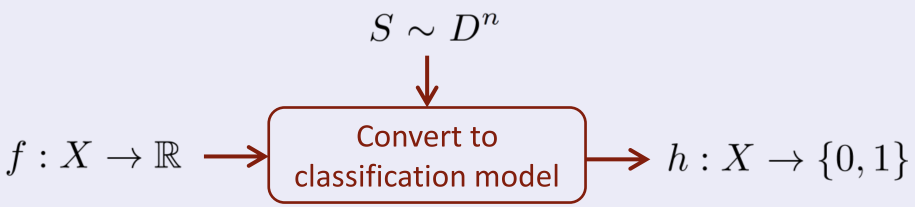
$$\mathrm{er}_D^{\mathrm{CPE}}[\widehat{\eta}] = \mathbf{E}_{(x,y)\sim D}\big[\big(\widehat{\eta}(x) - y\big)^2\big]$$





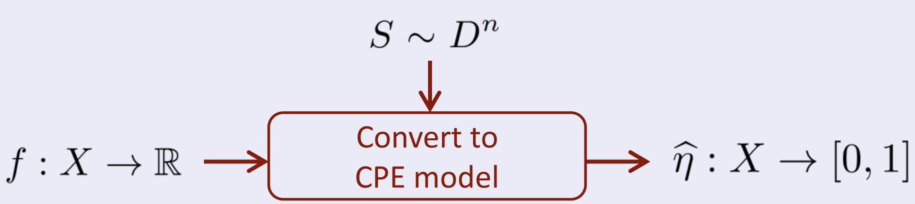
Weak Regret Transfer Bounds

Bipartite Ranking ⟶ Binary Classification



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

Bipartite Ranking ⟶ Binary CPE



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

Poster Sat36
Today