DRO

$$\min_{\theta\in\Theta}\sup_{\mathcal{D}\in\mathcal{P}}\mathbb{E}_{(x,y)\sim D}[\ell(\theta,(x,y))]$$

Objective

$\Omega^A(\alpha_A,\alpha_P,\theta)$

$$=\min_{\alpha_A\alpha_P\theta_1\theta_2}(\alpha_A r_A+\alpha_P r_P)+\frac{1}{n_A n_P}\sum_{(i,j)\in M}(f(y_j^P\langle\theta,(x_j^P,a_i^A)\rangle)+\max(y_j^P\langle\theta,(x_j^P,a_i^A)\rangle-\alpha_P\kappa_P,0)-\alpha_A||x_i^A-x_j^P||)$$

$\Omega^P(\alpha_A,\alpha_P,\theta)$

$$=\min_{\alpha_A\alpha_P\theta_1\theta_2}(\alpha_A r_A+\alpha_P r_P)+\frac{1}{n_A n_P}\sum_{(i,j)\in M}(f(y_j^P\langle\theta,(x_i^A,a_i^A)\rangle)+\max(y_j^P\langle\theta,(x_j^P,a_i^A)\rangle-\alpha_P\kappa_P,0)-\alpha_P||x_i^A-x_j^P||)$$

Constrained by

$$C^A=\{(\alpha_A,\alpha_P,\theta):||\theta_1||_*\le\alpha_A+\alpha_P,||\theta_2||\le\kappa_A\alpha_A,\alpha_A<\alpha_P\}$$
$$C^P=\{(\alpha_A,\alpha_P,\theta):||\theta_1||_*\le\alpha_A+\alpha_P,||\theta_2||\le\kappa_A\alpha_A,\alpha_A>\alpha_P\}$$

Adversarial Loss

$$L(x_i^p,x_j^a,\theta)=w_1\cdot\ell(\theta,(x_i^p,y_i^p))+w_2\cdot\ell(\theta,(\tilde{x}_i^p,y_i^p))+w_3\cdot\ell(\theta,(x_j^a,y_i^p))+w_4\cdot\ell(\theta,(\tilde{x}_j^a,y_i^p))$$

Perturbed samples

$$\tilde{x}_i^p=\arg\max_{x\in\mathcal{B}(x_i^p)}||f(\theta,x)-f(\theta,x_j^a)||_2$$
$$\tilde{x}_j^a=\arg\max_{x\in\mathcal{B}(x_j^a)}||f(\theta,x)-f(\theta,x_i^p)||_2$$