

Cost-Effective Active Learning for Hierarchical Multi-Label Classification

Objective:

$$\min_{H, \alpha} - \sum_{i=1}^n U_i \left(H \square (Z_1 Y_i + Z_2 \bar{Y}_i) + I \right) \square P_{1i} \square \alpha_i + \lambda_1 c(P_2 \square \alpha) \mathbf{1} + \lambda_2 \|H_0 - H\|^2$$

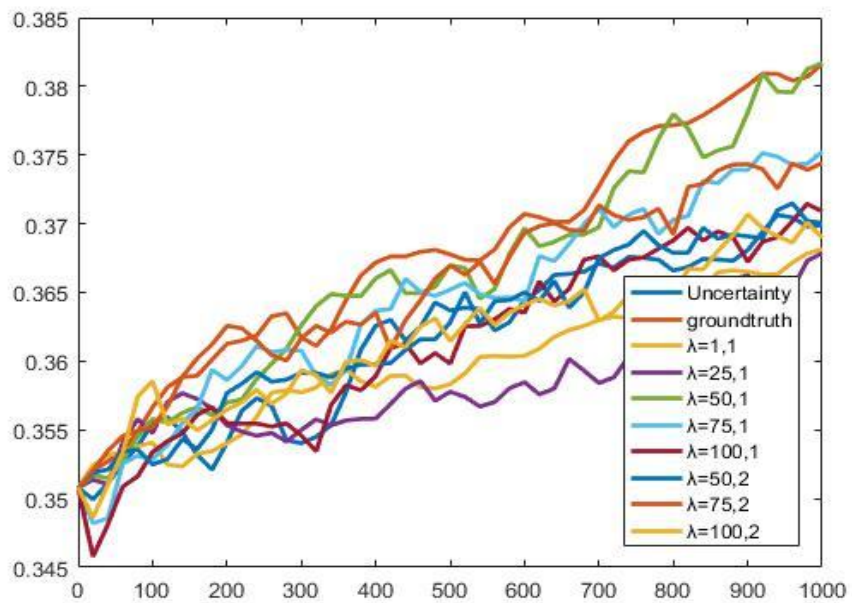
$$s.t. \quad 0 \leq \alpha_{ij} \leq 1, \quad \sum \alpha_{ij} = k, \quad 0 \leq h_{ij} \leq 1$$

where

$$Y_i = \begin{bmatrix} y_{i1} \\ \dots \\ y_{il} \end{bmatrix}, \quad \bar{Y}_i = I - Y_i, \quad Z_1 = \begin{bmatrix} 1 & 1 & 1 \\ \dots & 1 \\ 1 \end{bmatrix}, \quad Z_2 = \begin{bmatrix} 1 \\ 1 & \dots \\ 1 & 1 & 1 \end{bmatrix}.$$

Comparison method

- **Uncertainty:** 选择Uncertainty最大的batch查询;
- **Groundtruth:** Y是样本的groundtruth;
- **$\lambda=\mathbf{a}, \mathbf{b}$:** λ_1, λ_2 的不同设置;



Yeast-go

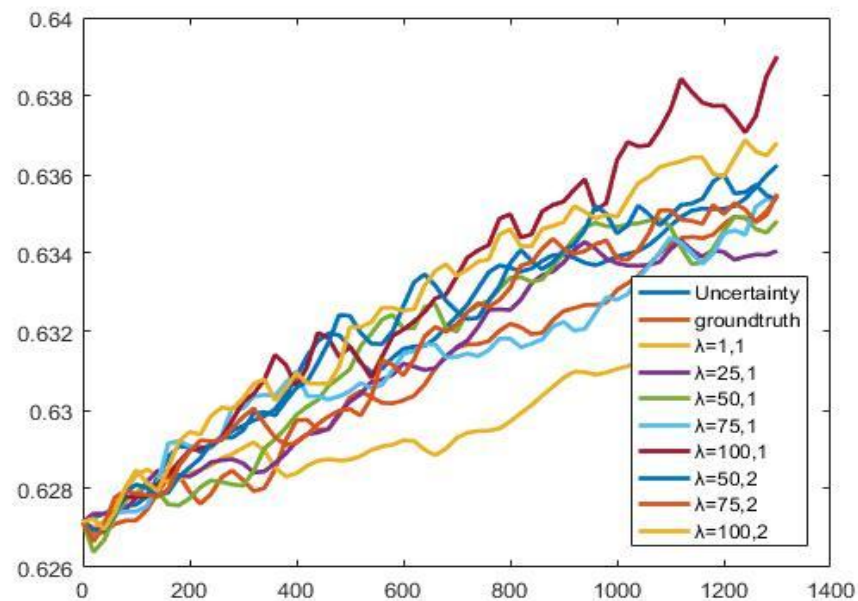
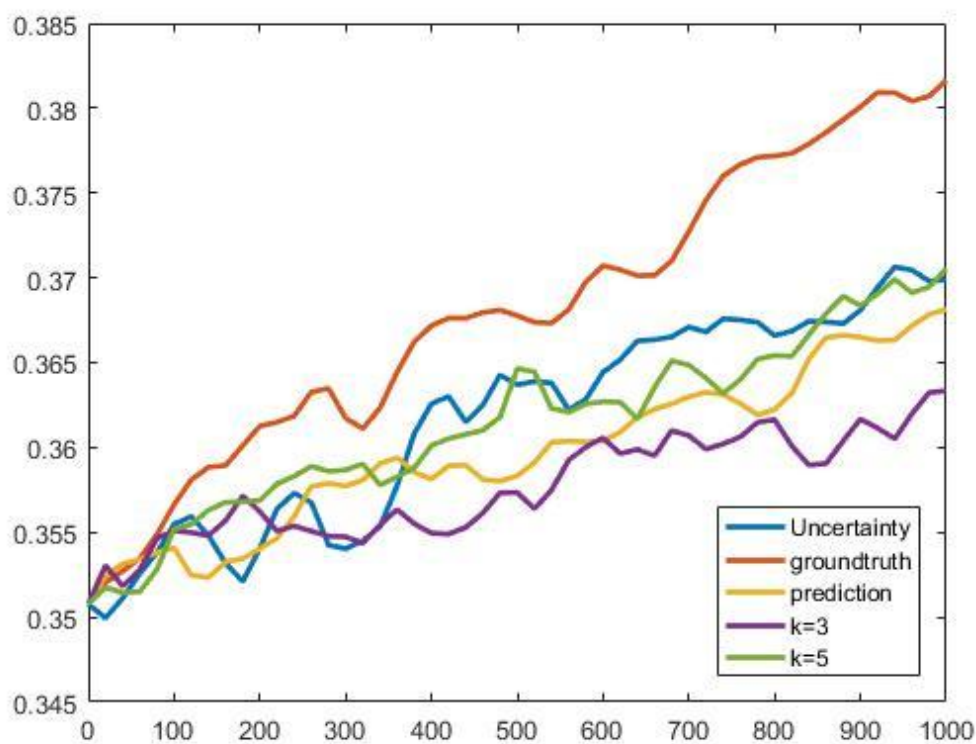


Image07D

- **Uncertainty**: 选择Uncertainty最大的batch查询;
- **Groundtruth**: Y是样本的groundtruth;
- **Prediction**: Y是样本在模型上的预测值;
- **K=3**: Y用HALC的方法, 选择近邻投票进行预测, 近邻个数为3;
- **K=5**: Y用HALC的方法, 选择近邻投票进行预测, 近邻个数为5;



Yeast-go

与POSS方法结合:

Objective:

$$1、 \min_{H, \alpha} - \sum_{i=1}^n U_i \left(H \square (Z_1 Y_i + Z_2 \bar{Y}_i) + I \right) \square P_{1i} \square \alpha_i + \lambda_2 \| H_0 - H \|^2$$

$$s.t. \quad 0 \leq h_{ij} \leq 1$$

where

$$Y_i = \begin{bmatrix} y_{i1} & & \\ & \dots & \\ & & y_{il} \end{bmatrix} \quad \bar{Y}_i = I - Y_i \quad Z_1 = \begin{bmatrix} 1 & 1 & 1 \\ & \dots & 1 \\ & & 1 \end{bmatrix} \quad Z_2 = \begin{bmatrix} 1 & & \\ 1 & \dots & \\ 1 & 1 & 1 \end{bmatrix}$$

$$2、 POSS \left(\left\{ U_i \mid U_i \left(H \square (Z_1 Y_i + Z_2 \bar{Y}_i) + I \right) \square P_{1i} \right\}, C \right)$$