



Semi-supervised Partial Multi-Label Learning

Partial Multi-Label Learning

An example for Multi-Label Learning



The Label Set

house tree
car light
cloud

Partial Multi-Label Learning

An example for Partial Multi-Label Learning



The Candidate Set

house tree

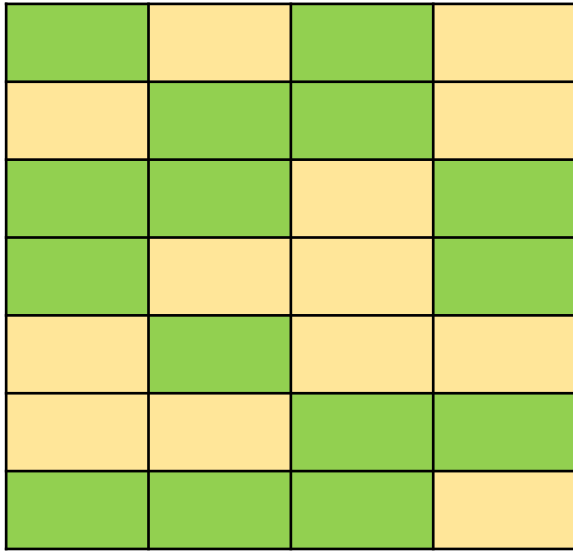
car light

cloud

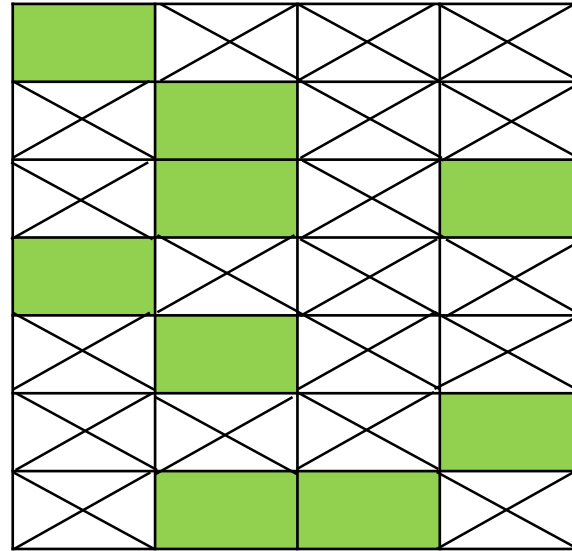
flower cat

people

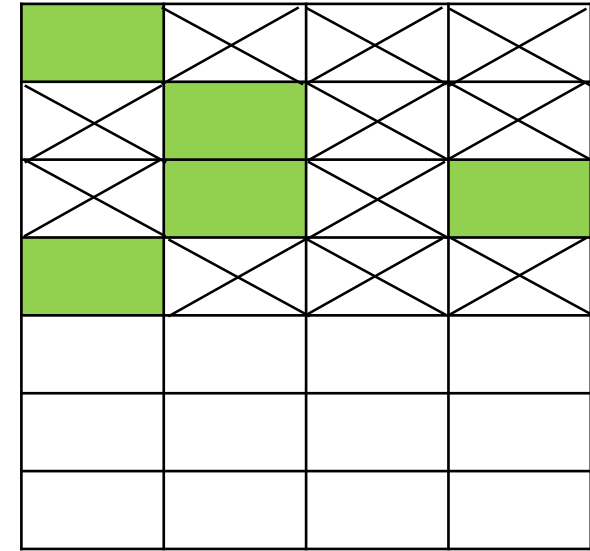
Partial Multi-Label Learning with Unlabeled Data



Multi-Label Learning



Partial Multi-Label Learning



Semi-supervised Partial Multi-Label Learning

The Proposed Method

Motivation: Similarity tends to maintain consistency between feature space and label space

Learning a similarity in the feature space

$$\min_S \sum_{i=1}^n \|A_i s_i - \mathbf{x}_i\|_2^2 + \lambda \|S\|_1$$

$$A_i = [\mathbf{x}_1, \dots, \mathbf{x}_{i-1}, \mathbf{x}_{i+1}, \dots, \mathbf{x}_n]$$

$$s_i = [s_{1i}, s_{i-1,i}, s_{i+1,i}, \dots, s_{ni}]^\top$$

Such similarity is expected to hold in the label space

$$\min_P \sum_{i,j=1}^n (s_{ij} - \mathbf{p}_i^\top \mathbf{L} \mathbf{p}_j)^2$$

The Proposed Method

The final loss function:

$$\begin{aligned} & \min_{S, P, W} \sum_{i=1}^l \sum_{Y_{ik}=0} \ell(Y_{ik}, \mathbf{p}_{ik}) + \lambda_1 \sum_{i=1}^n \|\mathbf{A}_i \mathbf{s}_i - \mathbf{x}_i\|_2^2 \\ & + \lambda_2 \sum_{i,j=1}^n \left(\mathbf{s}_{ij} - \mathbf{p}_i^\top \mathbf{L} \mathbf{p}_j \right)^2 + \lambda_3 \|P - WX\|_F^2 + \lambda_4 \|W\|_F^2 + \lambda_5 \|S\|_1 \\ & \text{s.t. } 0 \leq \mathbf{p}_{ik} \leq 1, \forall 1 \leq i \leq n, 1 \leq k \leq q \end{aligned}$$

can be solved by alternating optimization.

The Proposed Method

Updating S :

$$\min_S \sum_{i=1}^n \lambda_1 \|A_i s_i - \mathbf{x}_i\|_2^2 + \lambda_2 \sum_{i,j=1}^n (s_{ij} - \mathbf{p}_i^\top \mathbf{L} \mathbf{p}_j)^2 + \lambda_3 \|S\|_1$$

The optimization can be effectively solved by ADMM.

Updating P :

$$\min_P \|J \circ ((1 - Y) \circ P)\|_F^2 + \lambda_2 \|S - P \mathbf{L} P^\top\| + \lambda_3 \|P - W X\|_F^2$$

Updating W :

$$\lambda_3 \|P - W X\|_F^2 + \lambda_4 \|W\|_F^2$$

Experiments

To do list:

- Comparison with partial multi-label learning methods
- Comparison with semi-supervised multi-label learning methods.
- Ablation Analysis

Thanks
