

Multi-Label Image Recognition with Graph Convolutional Networks



Person, Sports Ball,
Tennis Racket



Person, Tie

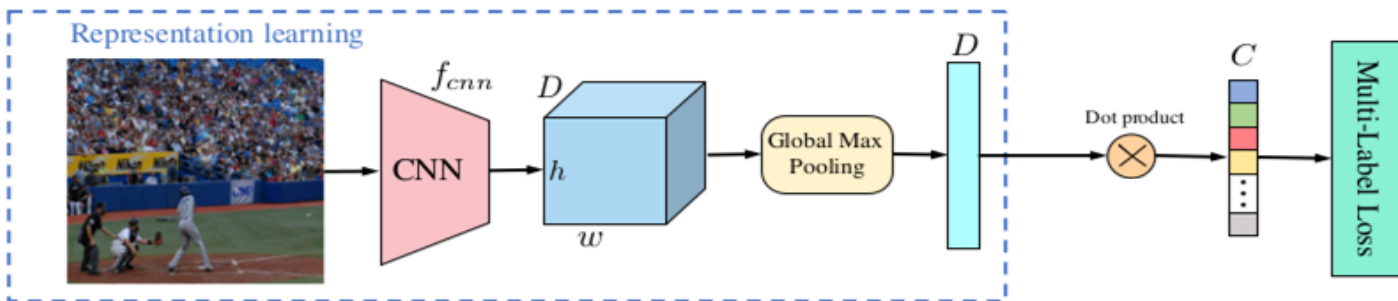


Person, Ski

전기정보공학부 홍채은

Chen, Zhao-Min and Wei, Xiu-Shen and Wang, Peng and Guo, Yanwen. "Multi-Label Image Recognition with Graph Convolutional Networks", CVPR, 2019, pp. 5177-5186

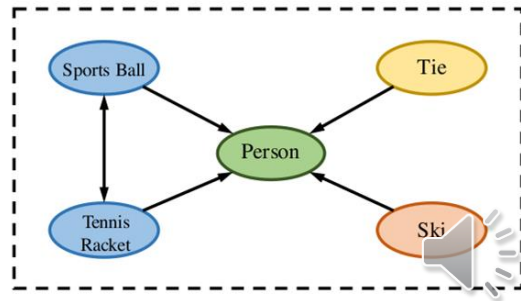
Idea



With GCN, learn to map “label-graph”
to “interdependent object classifiers”

GCN

Label Graph



Implementations

GCN: trained by propagating information between the nodes based on “**correlation matrix**”

Which correlation matrix should we use?

Data-driven Matrix

$$P_{ij} = P(L_j | L_i)$$

- how much the 2 labels co-occur
- (-) noisy outliers

Binary Matrix

$$A_{ij} = \begin{cases} 0, & \text{if } P_{ij} < \tau \\ 1, & \text{if } P_{ij} \geq \tau \end{cases},$$

- use threshold τ to filter noise
- (-) oversmoothing

Rewighted Matrix

$$A'_{ij} = \begin{cases} p / \sum_{i \neq j}^C A_{ij}, & \text{if } i \neq j \\ 1 - p, & \text{if } i = j \end{cases},$$

- fixed weight for the node itself
- can control the weights for correlated nodes



Results

MS COCO, VOC 2007: **SOTA < Binary < Reweighted**

Table 1. Comparisons with state-of-the-art methods on the MS-COCO dataset. The performance of the proposed ML-GCN based on two types of correlation matrices are reported. “Binary” denotes that we use the binary correlation matrix, cf. Eq. (7). “Re-weighted” means the correlation matrix generated by the proposed re-weighted scheme is used, cf. Eq. (8).

Methods	All							Top-3					
	mAP	CP	CR	CFI	OP	OR	OF1	CP	CR	CFI	OP	OR	OF1
CNN-RNN [28]	61.2	–	–	–	–	–	–	66.0	55.6	60.4	69.2	66.4	67.8
RNN-Attention [29]	–	–	–	–	–	–	–	79.1	58.7	67.4	84.0	63.0	72.0
Order-Free RNN [1]	–	–	–	–	–	–	–	71.6	54.8	62.1	74.2	62.2	67.7
ML-ZSL [15]	–	–	–	–	–	–	–	74.1	64.5	69.0	–	–	–
SRN [36]	77.1	81.6	65.4	71.2	82.7	69.9	75.8	85.2	58.8	67.4	87.4	62.5	72.9
ResNet-101 [10]	77.3	80.2	66.7	72.8	83.9	70.8	76.8	84.1	59.4	69.7	89.1	62.8	73.6
Multi-Evidence [6]	–	80.4	70.2	74.9	85.2	72.5	78.4	84.5	62.2	70.6	89.1	64.3	74.7
ML-GCN (Binary)	80.3	81.1	70.1	75.2	83.8	74.2	78.7	84.9	61.3	71.2	88.8	65.2	75.2
ML-GCN (Re-weighted)	83.0	85.1	72.0	78.0	85.8	75.4	80.3	89.2	64.1	74.6	90.5	66.5	76.7

Ablation studies : choose the best τ , p

