Hierarchical Online Instance Matching for Person Search

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Task & Challenge

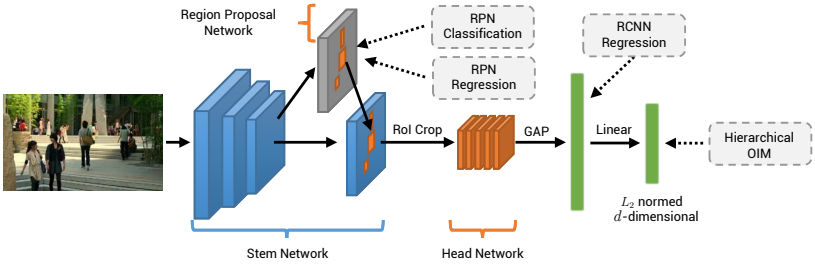
Person Search:

- Find a query person among a set of scene images
- A hybrid task of *pedestrian detection* and *re-identification*

The Challenge:

- Contradictory objectives of detection (find person commonness) and re-ID (find person uniqueness)
- Make use of unlabeled persons and hard mining

The Joint Model



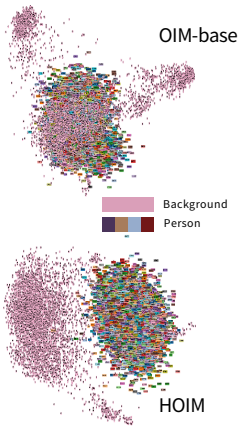
Ablation & Analysis

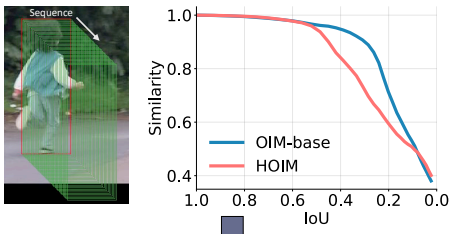
Method	mAP(%)	top-1(%)	Δ(%)
OIM	75.5	78.7	
OIM-base	83.6	87.4	
+ Focal Loss	85.1	87.6	(+1.5, +0.2)
+ SMR	85.5	88.2	(+0.4, +0.6)
HOIM	**89.7**	**90.8**	(+4.2, +2.6)

- HOIM and SMR improves performance over a strong baseline

- HOIM yields better detection performance than the baseline

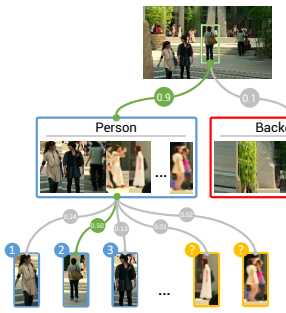
Method	RPN		Faster R-CNN	
	Recall(%)	AP(%)	Recall(%)	AP(%)
detector	89.27	69.07	93.12	87.02
OIM-base	-9.1	-21.69	-12.01	-11.18
HOIM	-0.73	-12.66	-1.36	-1.35





- HOIM embeddings are more robust under false detections
- HOIM embeddings are more discriminative

Basic Idea



$$P_{\text{person}} = \sum_{\text{id}=1}^{N} P_{\text{id}} + \sum_{\text{id}\in\{?\}} P_{\text{id}}$$

$$P_{\text{bg}} = \sum_{j\in\{\text{bg}\}} P_j$$

The HOIM Loss

$$\mathcal{L}_{\text{HOIM}} = \mathcal{L}_{\text{det}} + \lambda\mathcal{L}_{\text{OIM}}$$

where:

$$\mathcal{L}_{\text{det}} = -y\log(P_{\text{person}}) - (1-y)\log(P_{\text{bg}})$$

$$\mathcal{L}_{\text{OIM}} = -\mathbb{E}[\log(P_{\text{id}=t})], \quad t = 1, 2, \ldots, N$$

$$\lambda = 2P_{\text{person}}^2$$

Selective Memory Refreshment

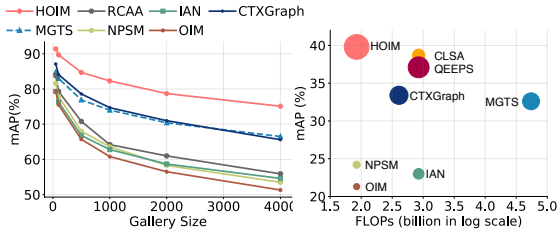
Pop out embeddings with low ωeights

$$\omega = \frac{\text{sim w/ known persons}}{\text{sim w/ unknown persons}} \cdot k^{\iota}$$

$$\tilde{\omega} = \frac{\text{sim w/ all persons}}{\text{sim w/ bg clutters}} \cdot k^{\iota}$$

Performance Comparison

Method	CUHK-SYSU		PRW	
	mAP	top-1	mAP	top-1
DPM + IDE w. CWS	-	-	20.5	48.3
CNN + MGTS	83.0	83.7	32.6	72.1
CNN + CLSA	87.2	88.5	38.7	65.0
OIM	75.5	78.7	21.3	49.9
IAN	76.3	80.1	23.0	61.9
NPSM	77.9	81.2	24.2	53.1
RCAA	79.3	81.3	-	-
CTXGraph	84.1	86.5	33.4	73.6
QEEPS	88.9	89.1	37.1	76.7
Ours	**89.7**	**90.8**	**39.8**	**80.4**



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