Ranking Aggregation with Interactive Feedback for Collaborative Person Re-identification

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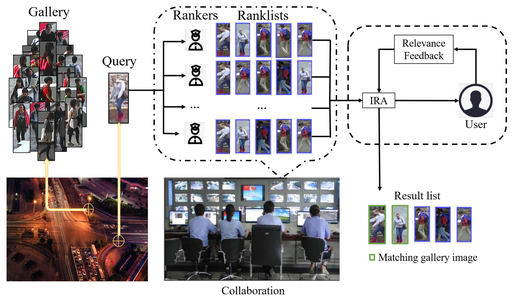
Introduction

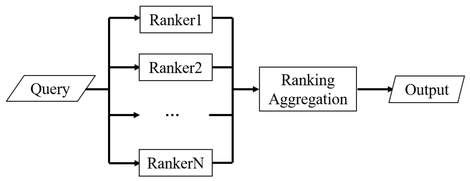
Ranking Aggregation:

Ranking aggregation (RA) is a method to aggregates multiple ranking results, inspired by multi-person cooperation, can further improve the accuracy in re-ID tasks.



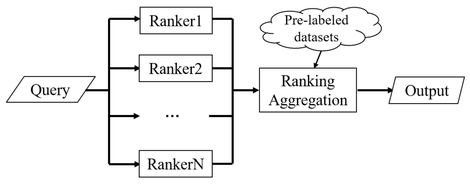
Collaborative Person Re-identification

Motivation:



Unsupervised

- Unsupervised RA methods lack external supervision, can hardly achieve the optimal results.



Supervised

- Fully-supervised RA methods need labeling data for training, which is expensive in practical application.

Key Contributions:

- We propose an interactive ranking aggregation (IRA) method for re-ID problem, enjoys the advantage of excellent performance without intensive labeling effort.
- We designe two IRA implementations, ranking-based and score-based, to adapt to diverse ranking scenarios.
- We compare IRA with both unsupervised methods and fully-supervised method, to validate both effectiveness and efficiency of proposed method.

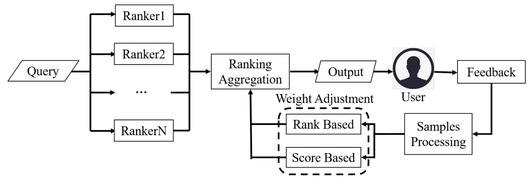
Method

Problem Definition:

Given a query image q and J galleries $\{g_j\}_{j=1}^{J}$, I rankers $\{r_i\}_{i=1}^{I}$ get the similarity score matrix s_{ij}, and the corresponding rank lists $\{\boldsymbol{l}_i\}_{i=1}^{I}$.

The goal of ranking aggregation method is to aggregate a final rank list $\boldsymbol{l}^*$ from the original score matrix or rank lists. To adapt to two different interaction scenarios where rankers only give rankings without similarity score or rankers give similarity scores, we propose two implementations of IRA, ranking-based and score-based respectively.

Main idea:



Interactive Ranking Aggregation

IRA mainly uses the galleries interacted by users to evaluate the reliability of each ranker, and gives them a weight. After each round of interaction, aggregate the rank lists again according to the weight.

Ranking-based:

The weight of ranking-based IRA is calculated as follow:

$$w_i^M = \sum_{g \in \mathbb{G}_M^+} f(\varphi(g, \boldsymbol{l}_i)) \tag{1}$$

in which $\varphi(g, \boldsymbol{l}_i)$ computes the ranking of postive gallery g in $\boldsymbol{l}_i$. The $f(\varphi(g, \boldsymbol{s}_i))$ is a is a function that converts the ranking position to score.The higher the postive gallery g is ranked, the higher ranker's score is.

Score-based:

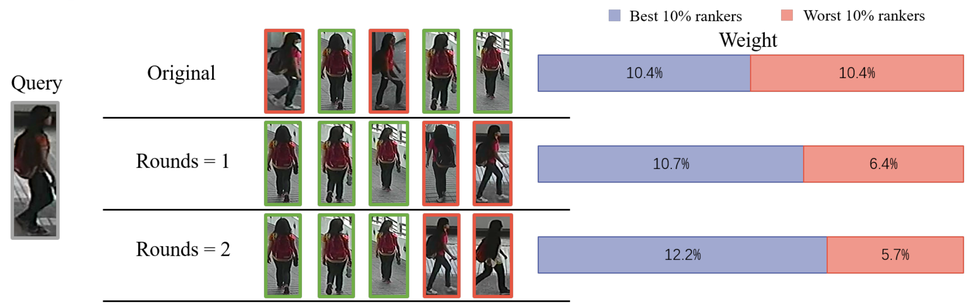
The score based IRA is to calculate the standard deviation of the scores of all positive galleries. Small standard deviation indicates that the ranker can extract the feature of the positive galleries, thus a higher reliability and a higher weight. So the weight can be calculated as:

$$w_i^M = \frac{1}{\sigma + \beta} \tag{2}$$

where σ is the standard deviation.

Experiments & Results

Interaction example:



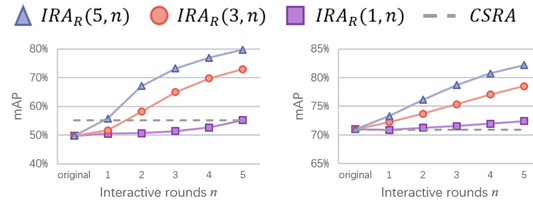
Positive galleries are gradually ranked to the highest position, and the weights of best 10% rankers remain high.

Comparison:

We compared IRA with a popular fully-supervised method, CSRA. IRA_R and IRA_S indicates ranking-based and score-based respectively, and $\text{IRA}(m, n)$ means interact m samples per round, and conducts n rounds of interaction.

Performance:

We set $m = 1$, 3 and 5. IRA_R and IRA_S carry out five rounds of feedback respectively.



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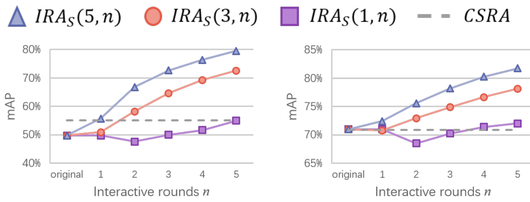

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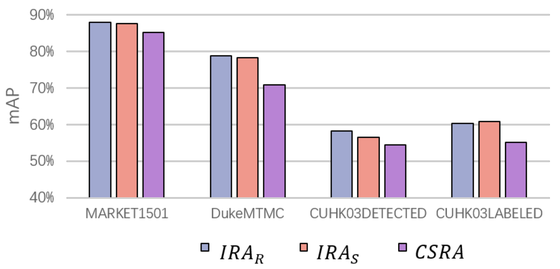
Time cost comparison:

Average time cost of IRA and CSRA with similar mAP.

Method	mAP(%)	Train/Interact(s)	Aggregate(s)	Average(s)
CSRA	55.09	16.47	0.22	16.69
$\text{IRA}_R(1,5)$	55.21	15.00	0.03	15.03
$\text{IRA}_R(3,2)$	58.18	18.00	0.03	18.03
$\text{IRA}_R(5,1)$	55.73	15.00	0.01	**15.01**
$\text{IRA}_S(1,5)$	54.99	15.00	0.02	**15.02**
$\text{IRA}_S(3,2)$	58.22	18.00	0.02	18.02
$\text{IRA}_R(5,1)$	55.67	15.00	0.01	**15.01**

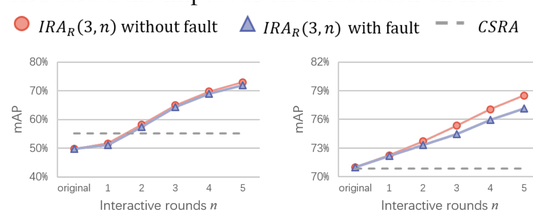
Labeling cost comparison:



The mAP of IRA and CSRA with same labeling cost

Interaction with error feedback:

We also tested the impact of error feedback on IRA.



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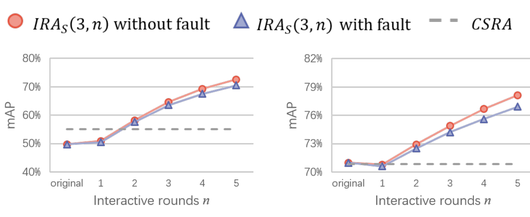

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