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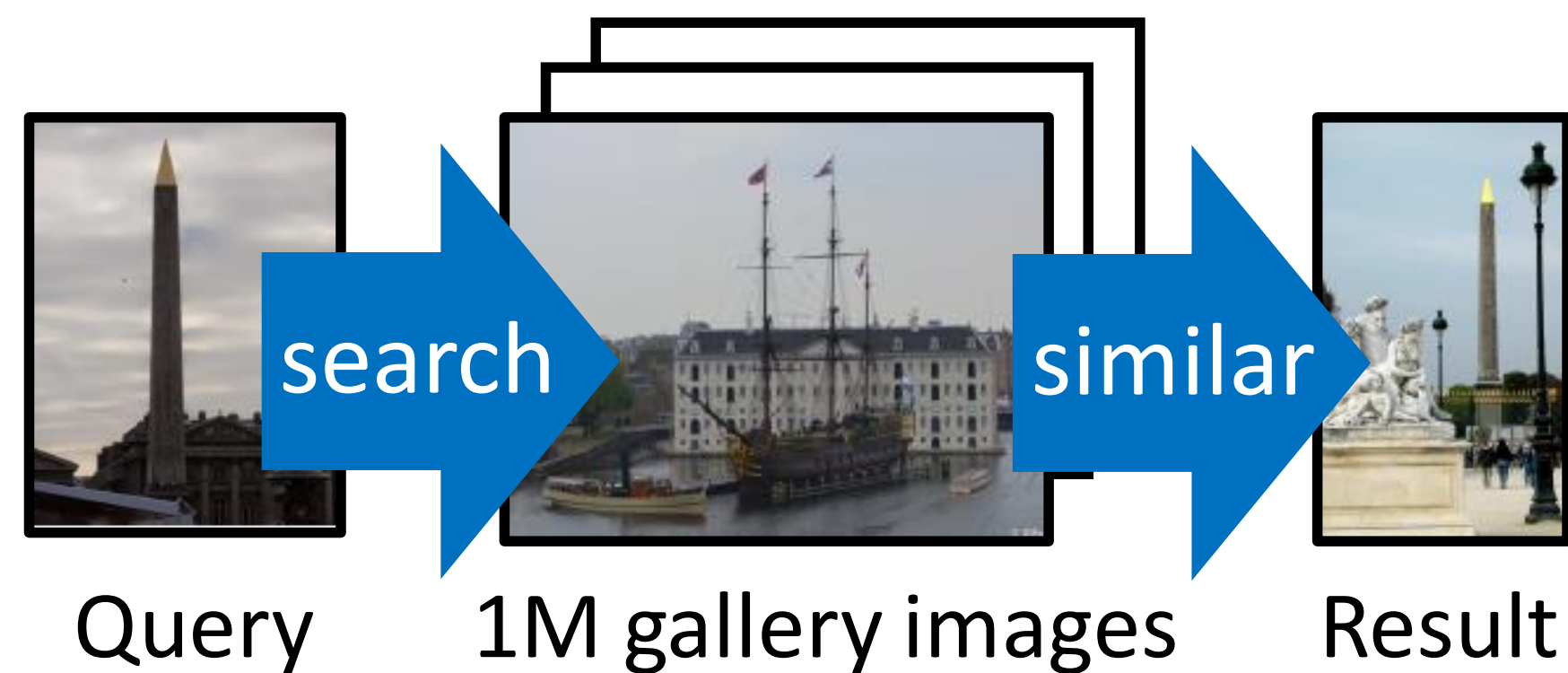
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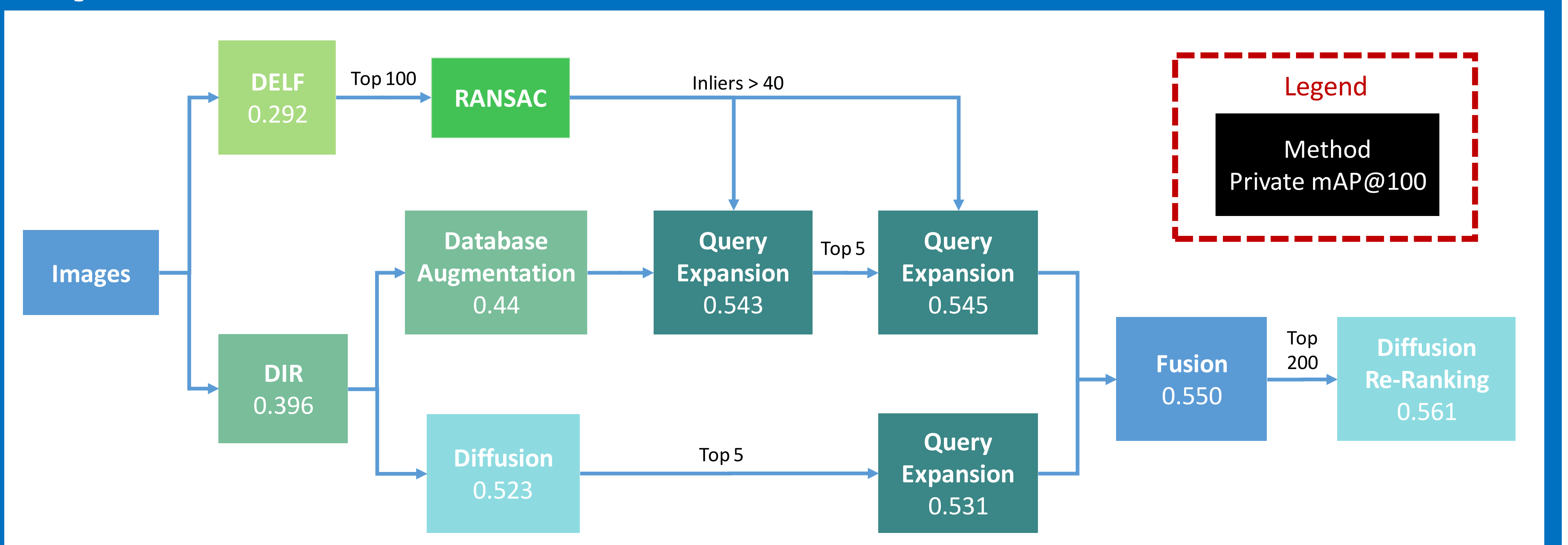


Introduction

- Google Landmark Retrieval Challenge
- Given a query, find similar landmark images from one million gallery images
- 7th place out of 209 teams

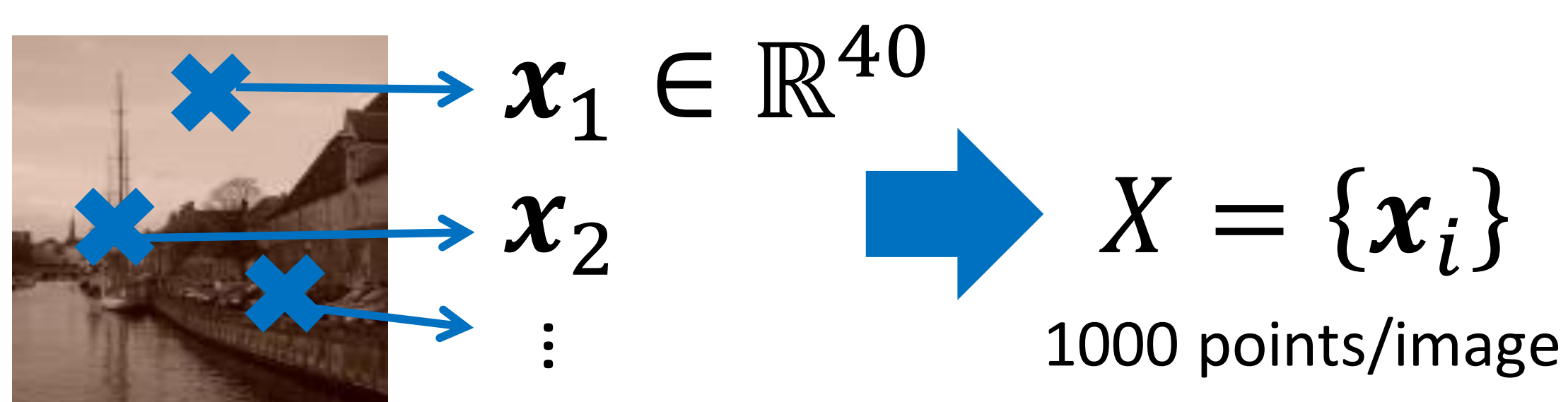


Pipeline



DELF Search

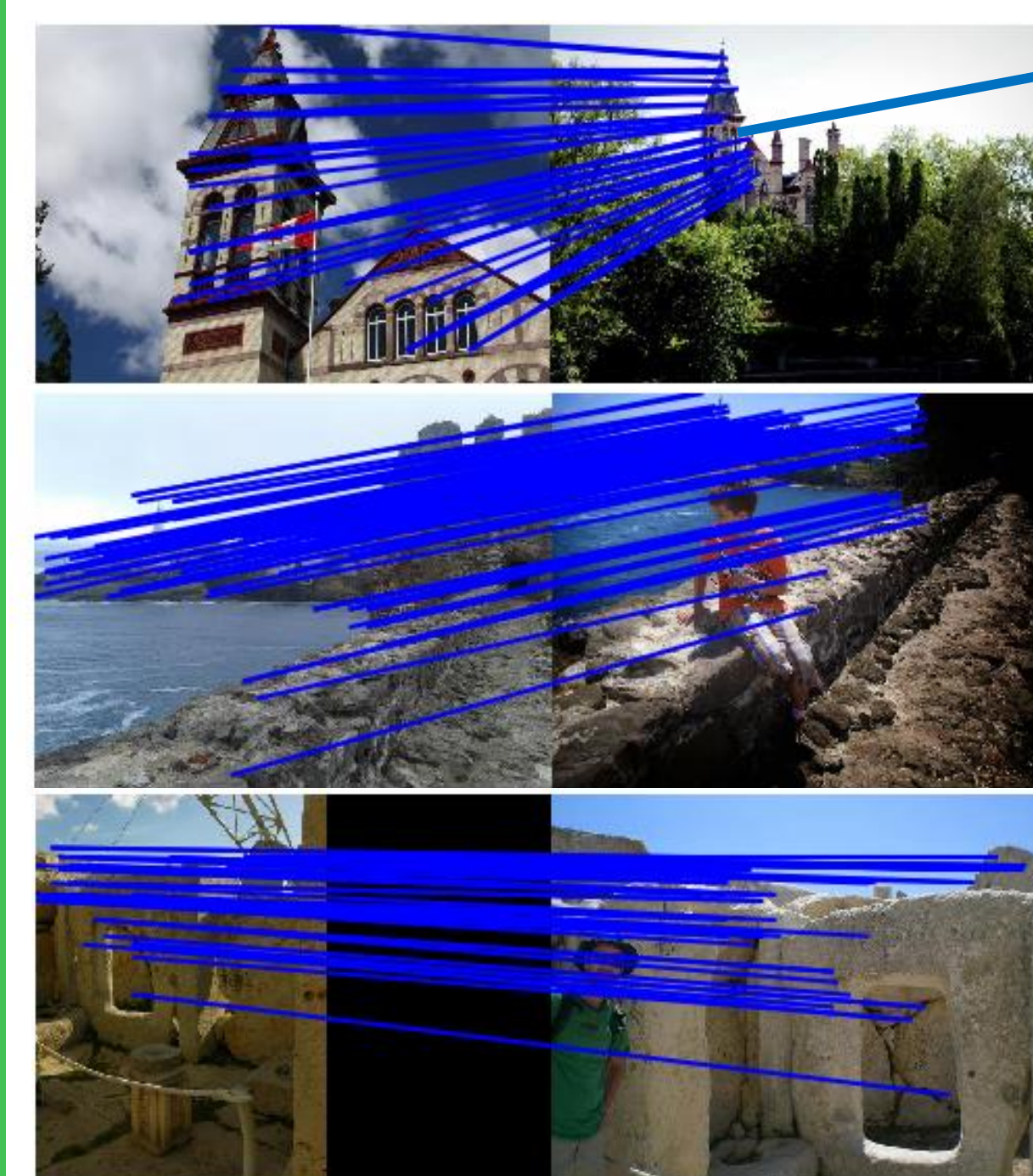
- Deep local features (DELF) [Noh+, ICCV 17]



- Given a query $Q = \{q_i\}$, find similar DELF features from all images (one billion)
- HNSW [Malkov+, arXiv 16] + IVFPQ [Jégou+, TPAMI 11]
- Aggregate scores to return initial results

RANSAC

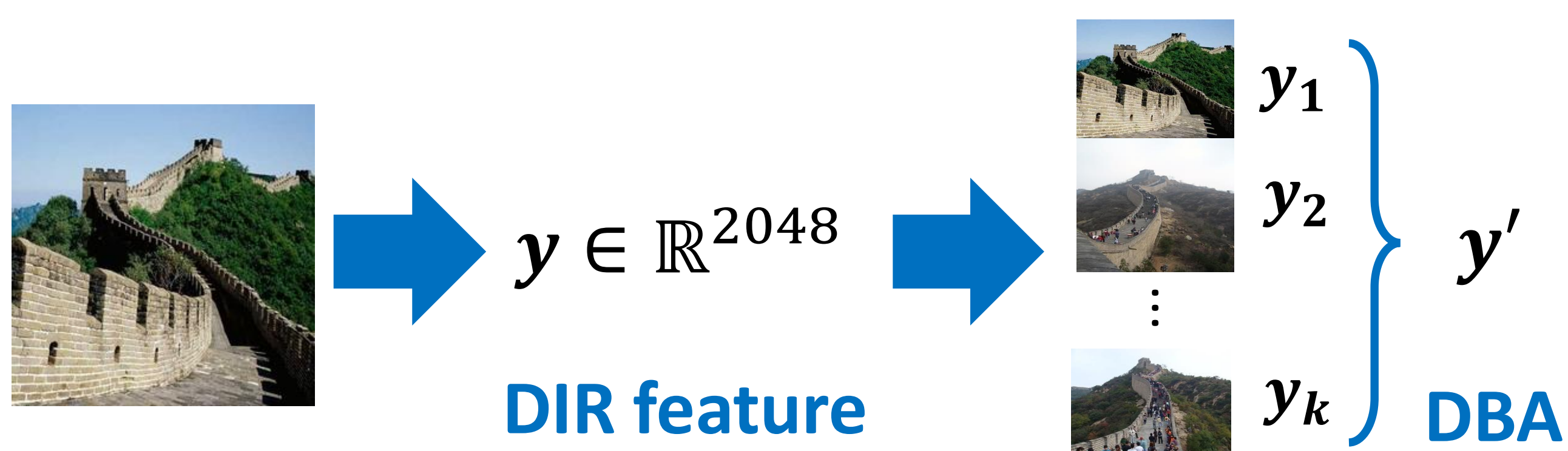
Image Matching based on # of Inliers



Inliers threshold is set to 40 based on experiments

- The most commonly used method to perform spatial verification
- Match correspondences of DELF features for query and database images
- Exclude outliers and employ number of inliers as a score
- Images containing the same landmark are matched despite changes in scales, illumination, and different points of view

DIR Search with DBA

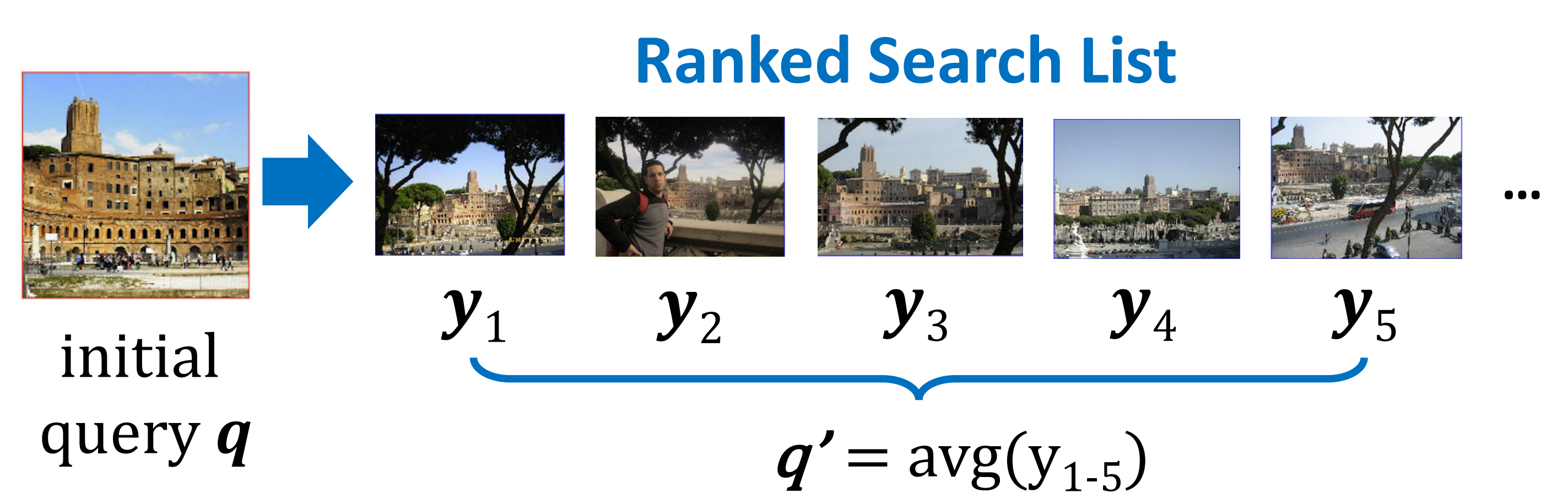


- Find similar images by k-NN search on global image feature (deep image retrieval feature (DIR) [Gordo+, IJCV17])
- Database-side feature augmentation (DBA) [Arandjelovic+, CVPR12]
- Replace gallery features y using its k-NN features $\{y_1, \dots, y_k\}$

$$\text{new gallery feature } y' = \frac{1}{k} \sum_{r=1}^k \frac{k-r}{k} y_r$$

y_r : r^{th} nearest feature
weight of y_r

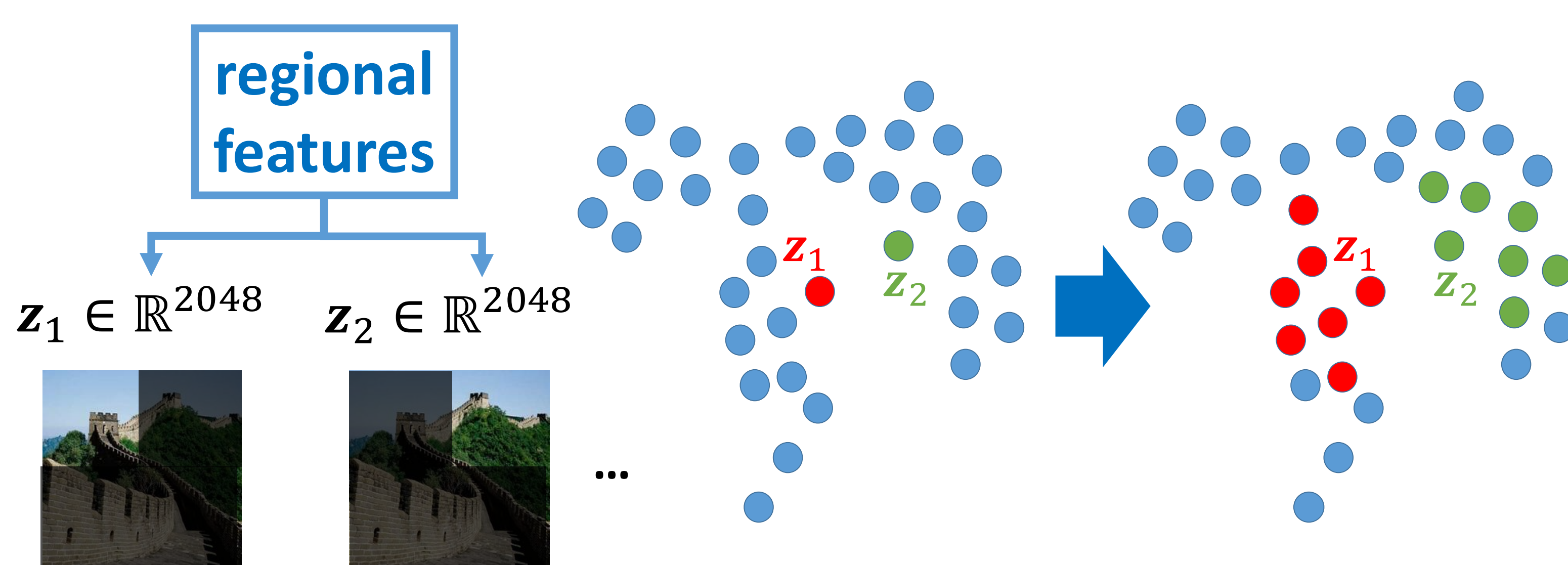
Query Expansion



$$\text{New Query Feature Vector} = q + q'$$

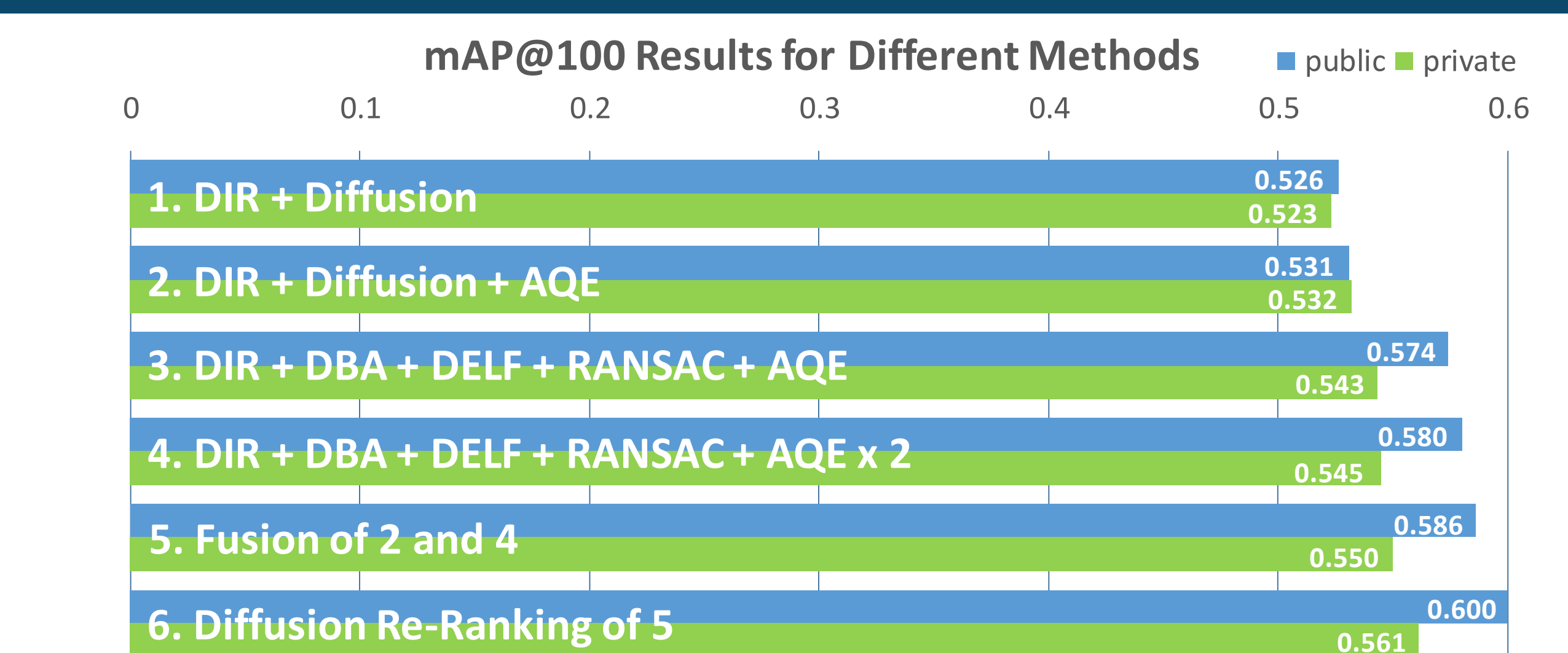
- The top-k search results taken from the gallery are averaged to form a new vector.
- This new vector is appended to the original query's feature vector.

Regional Diffusion



- Find manifold's nearest neighbor for each regional feature of DIR
- Aggregate NN results of all regional features as image-level result [Ischen+, CVPR2017]

Results



- 270 public and 540 private images
- Private score much lower than the public score
- Second query expansion not as effective
- Possible overfitting issues