

# Enhancing Sketch-Based Image Retrieval by Re-Ranking and Relevance Feedback

Heechan Shin

CS688

Student paper presentation

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  - Image Grouping
  - Visual Feature Verification
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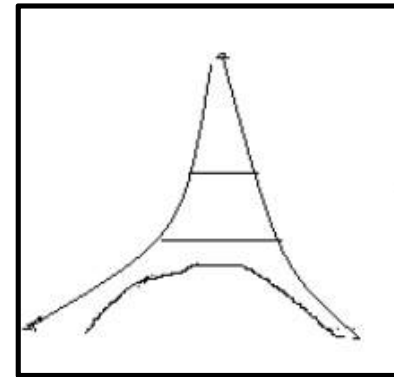
# Problems

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- Sketch Based Image Retrieval (SBIR)



What a user want to find



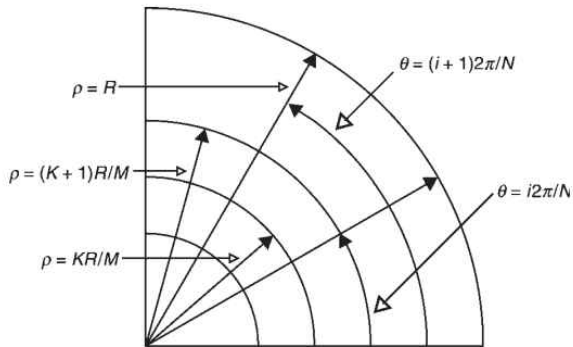
What a user queries

**How to measure the relevance of an image and a query sketch?**

# Problems

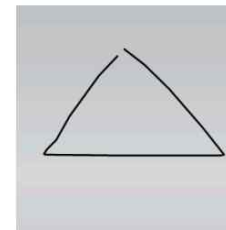
- To solve the problem..
  - Contour matching
  - Local feature matching

## Angular Radial Partitioning(ARP)



## Edgel index

Sketch Query



Decomposition



**Edgel index** : Cao, Yang, et al. "Edgel index for large-scale sketch-based image search." (2011): 761-768.

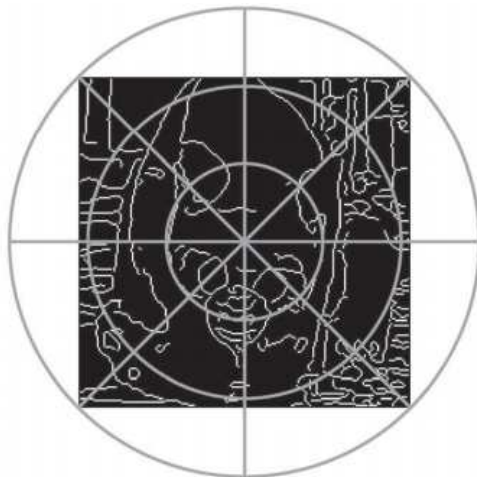
**ARP** : Chalechale, Abdolah, Alfred Mertins, and G. Naghdy. "Edge image description using angular radial partitioning." *IEE Proceedings-Vision, Image and Signal Processing* 151.2 (2004): 93-101.

# Related work

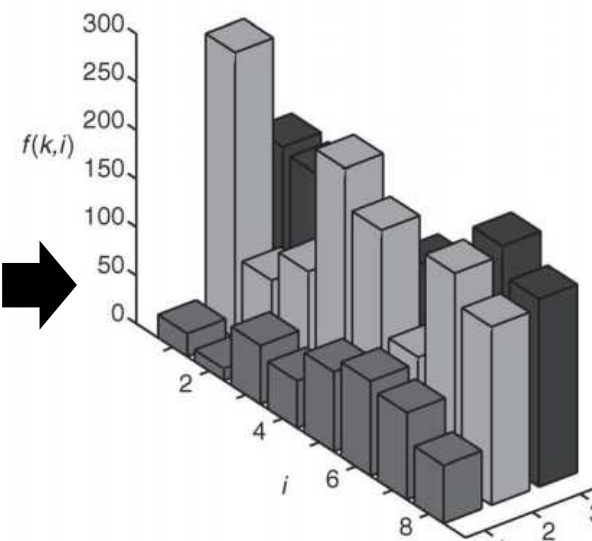
- Angular Radial Partitioning (ARP)



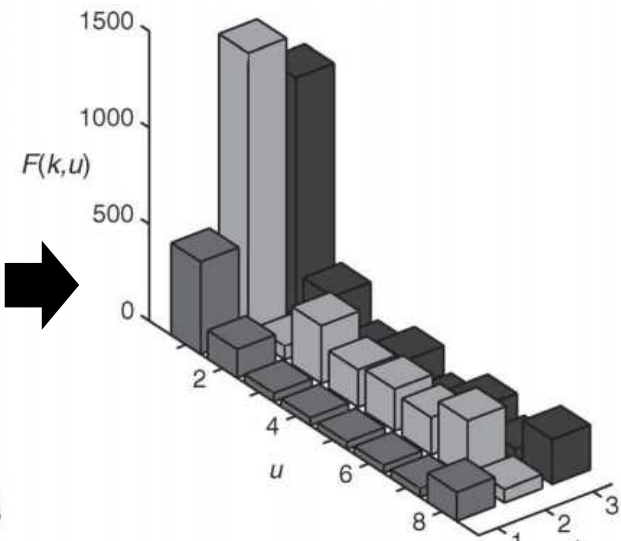
Image



Partitioning



Pixels in each partition

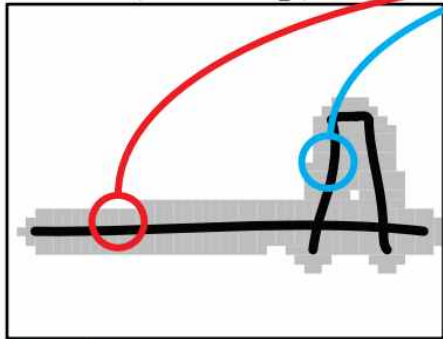


Fourier transformed

# Related work

- Edgel index ( Edgel : edge pixel )

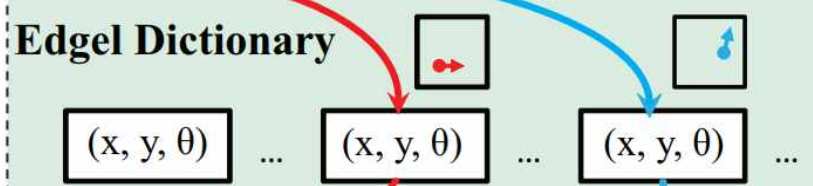
Sketch (Hit Map)



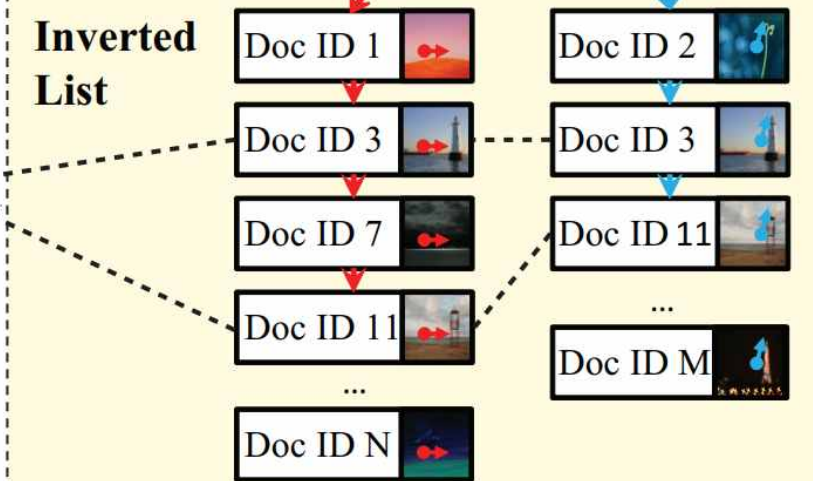
Results



Edgel Dictionary



Inverted List



# Problems

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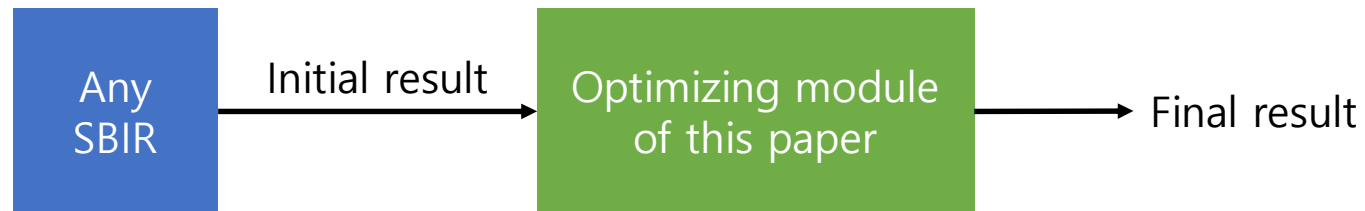
- Sketch should be fairly close to the image.
- Irrelevant image may be retrieved.

**Re-ranking and finding relevant images are important!**

# Solution

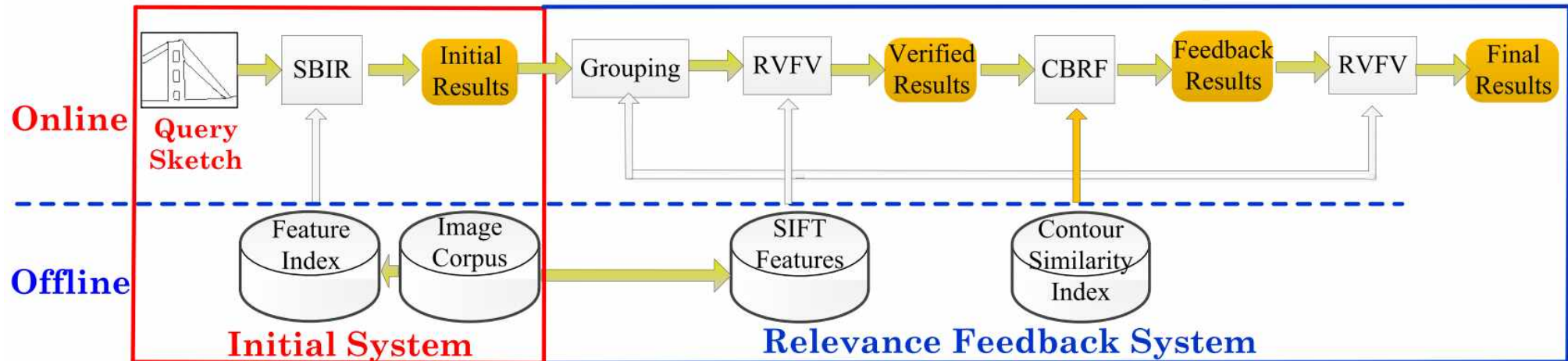
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- Contribution
  - **Optimizing module** with the search result of any SBIR framework



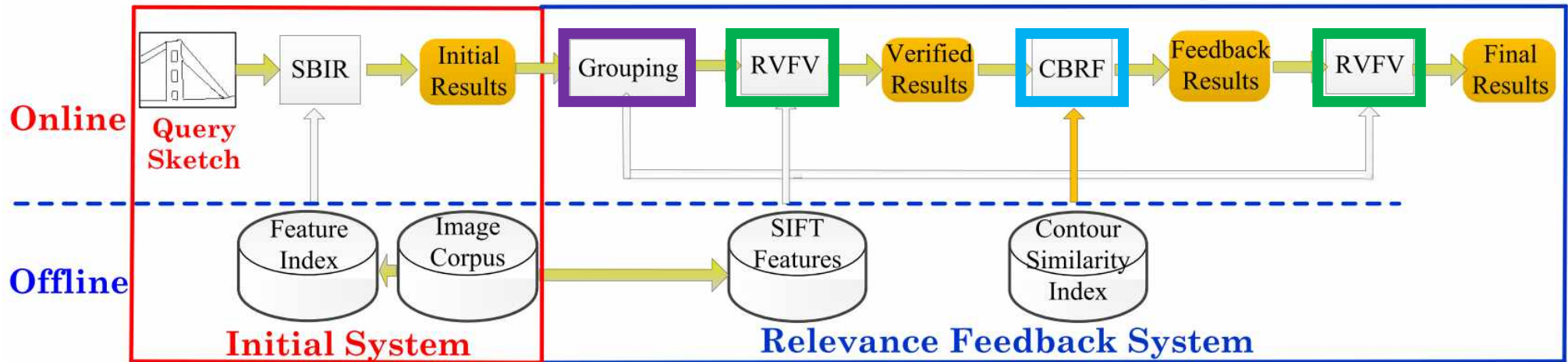


# Solution



- **Image Grouping**
  - Fining more relevant images
- **RVFV**
  - Removing irrelevant images
- **CBRF**
  - Making new queries to find relevant images using contours

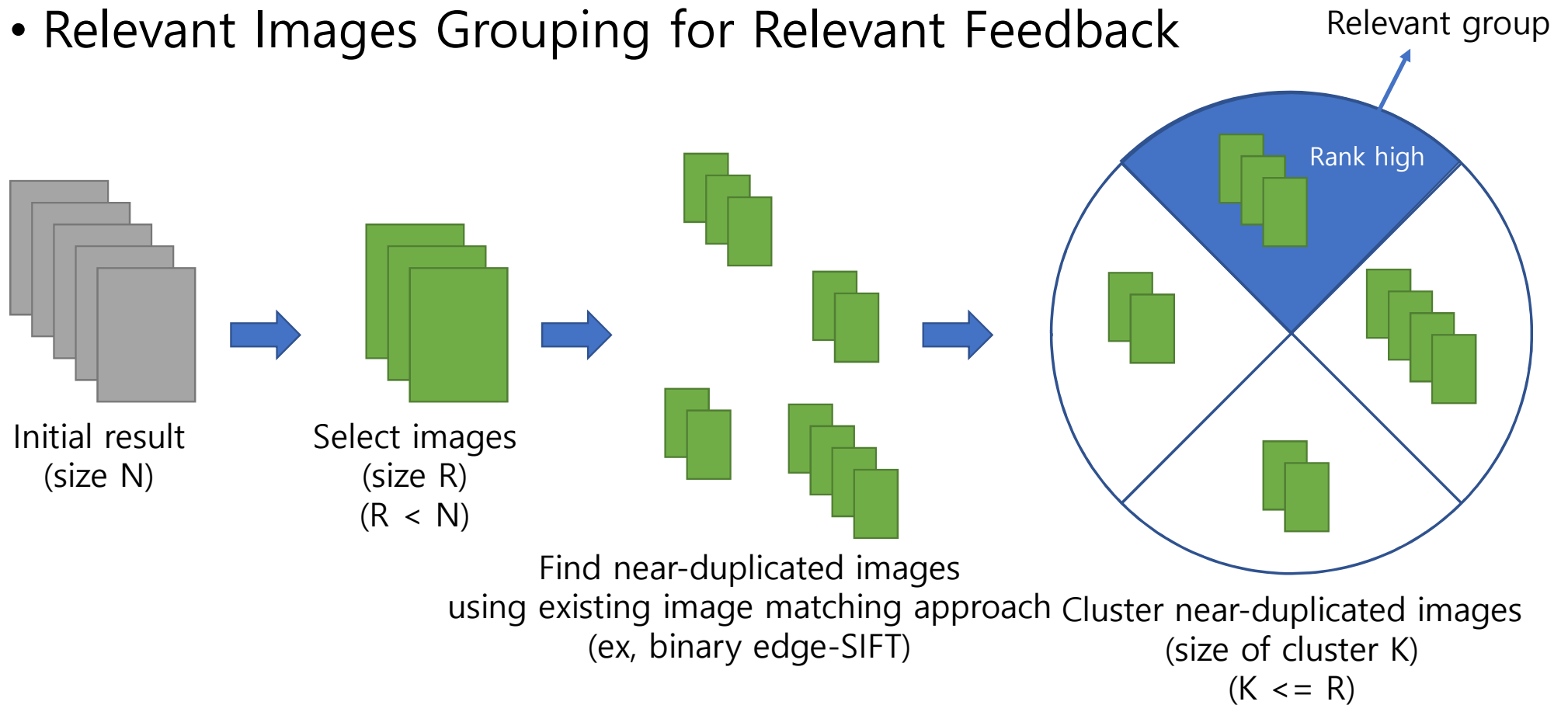
# Solution



- **Image Grouping**
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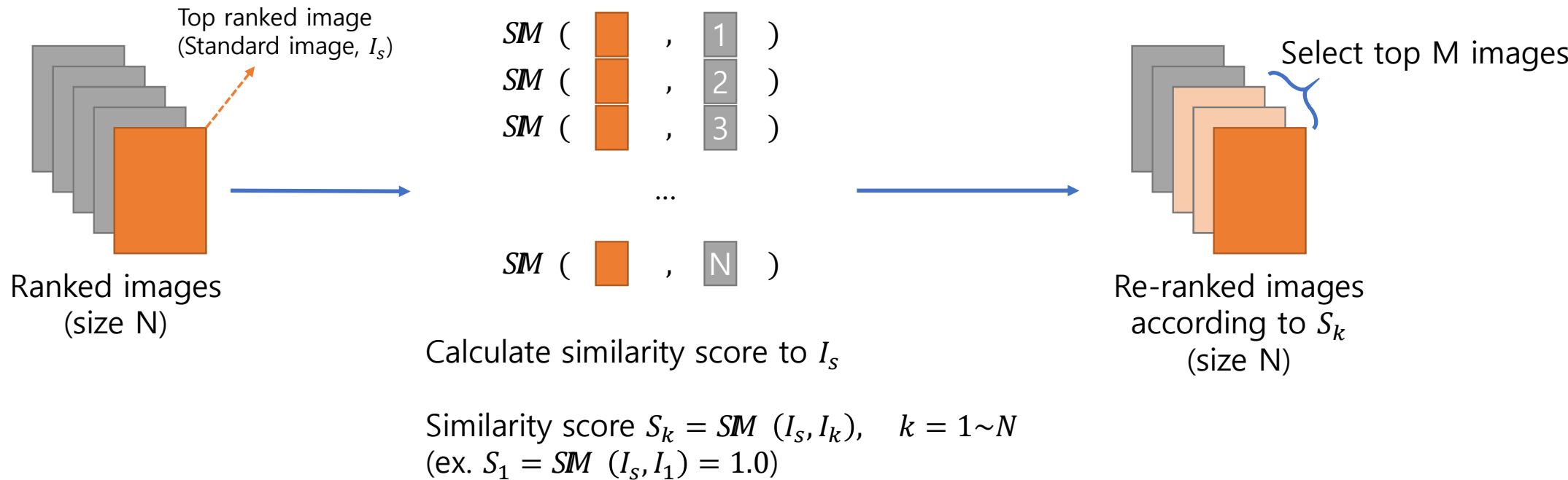
# Solution

- Relevant Images Grouping for Relevant Feedback



# Solution

- Re-ranking via Visual Feature Verification (RVFV)



# Solution

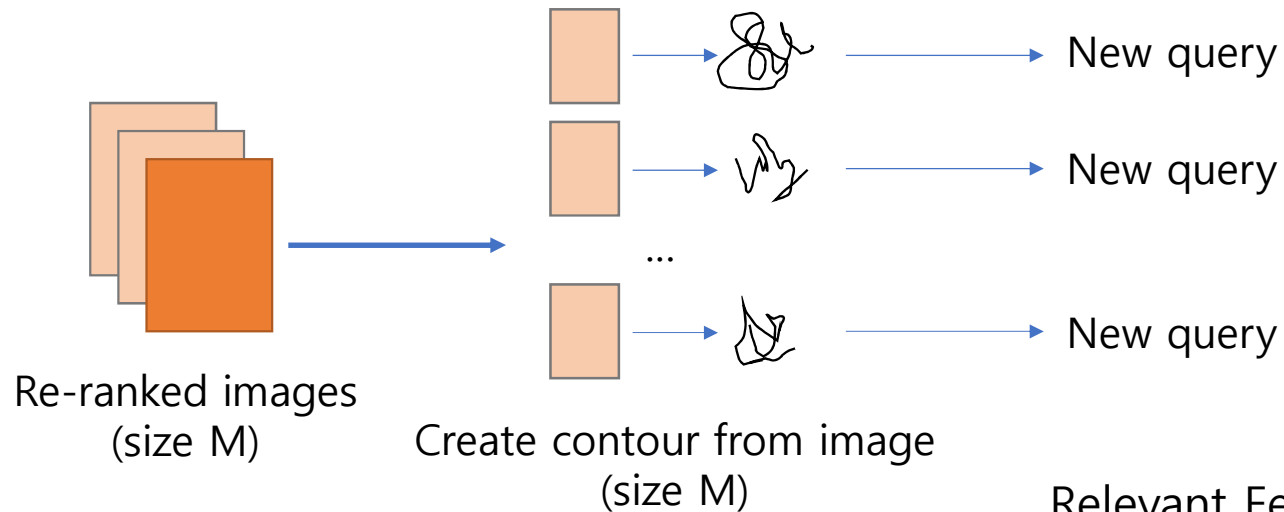
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- Similarity score  $S_k$ 
  - $d_A$ : SIFT descriptor of image A
  - L2 norm of two descriptor  $|d_A - d_B|_2^2 = 2 - \sum_l d_A^l d_B^l$   
since  $|d_A|_2^2 + |d_B|_2^2 = 2$ ,  $SM(d_A, d_B) = \sum_l d_A^l d_B^l$
  - $SM(I_A, I_B) = \sum_m SM(d_A, d_B)W(m)$

*W here,  
 $m$  is  $m^{th}$  SIFT pair between  $I_A$  and  $I_B$   
 $W(m)$  is weight*

# Solution

- Contour-Based Relevance Feedback



Relevant Feedback Score

$$S_{RF}(\mathbf{k}) : \sum_{m=1}^M S_D(m, k) \times S_N(m); \quad k = 1, \dots, T$$

Where  $T$  is size of entire image data

# Solution

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- Contour-Based Relevance Feedback

- Relevant Feedback Score

$$S_{RF}(k) : \sum_{m=1}^M S_D(m, k) \times S_N(m); \quad k = 1, \dots, T$$

*Where  $T$  is size of entire image data*

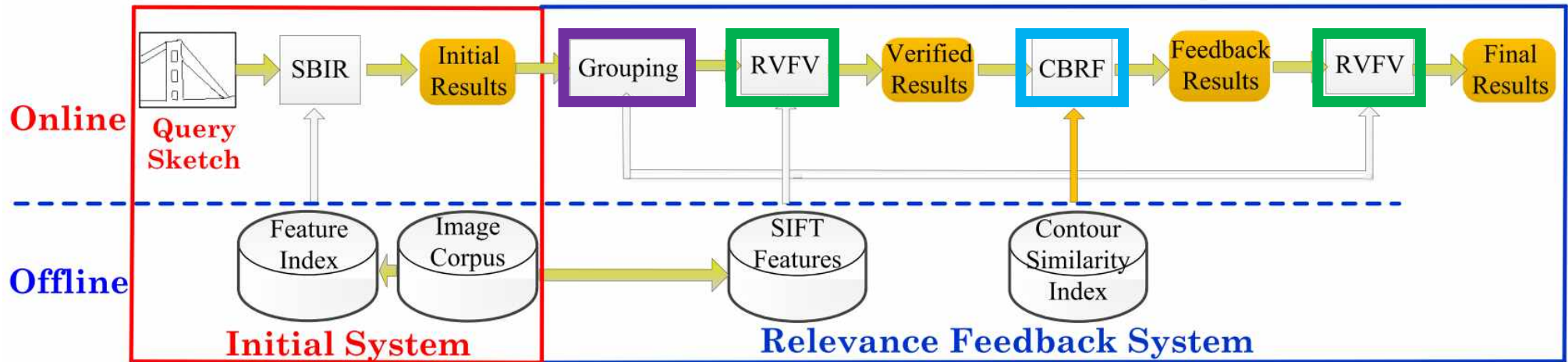
- $S_N(m)$  : Initial score of image  $m$

- $S_D(m, k)$  : Score after first RVFV of image  $k$ , when a query is contour of image  $m$

- Final score  $S(k) = (1 - w) \times S_N(k) + w \times S_{RF}(k); \quad k = 1, \dots, T$

- With  $S(k)$ , we have new ranked list

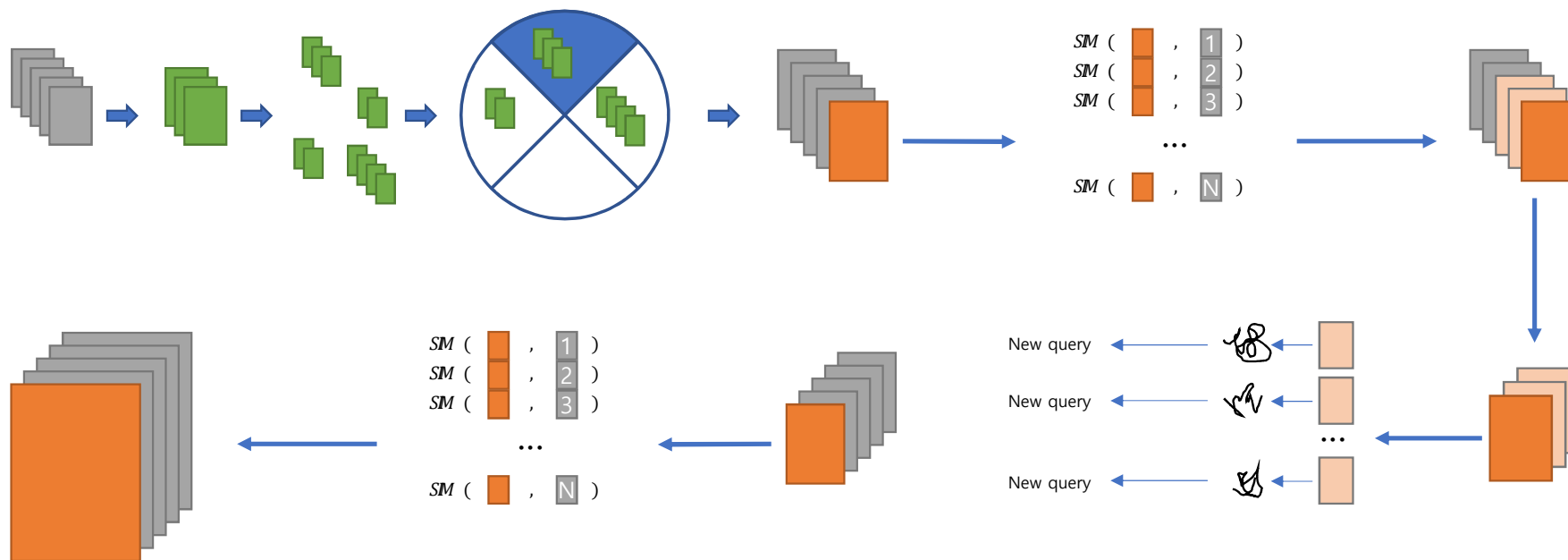
# Solution



- **Image Grouping**
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# Solution



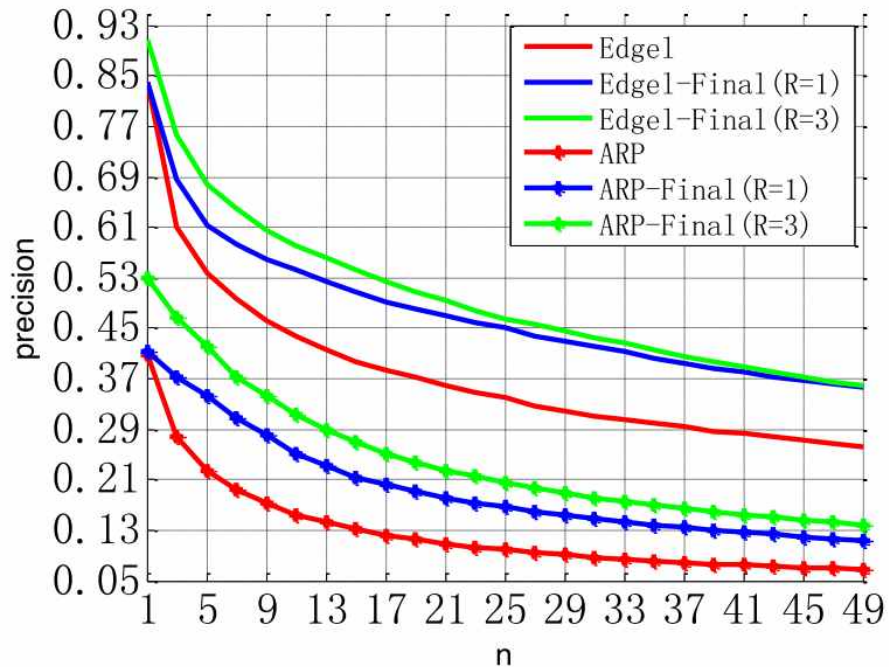
# Experimental Result

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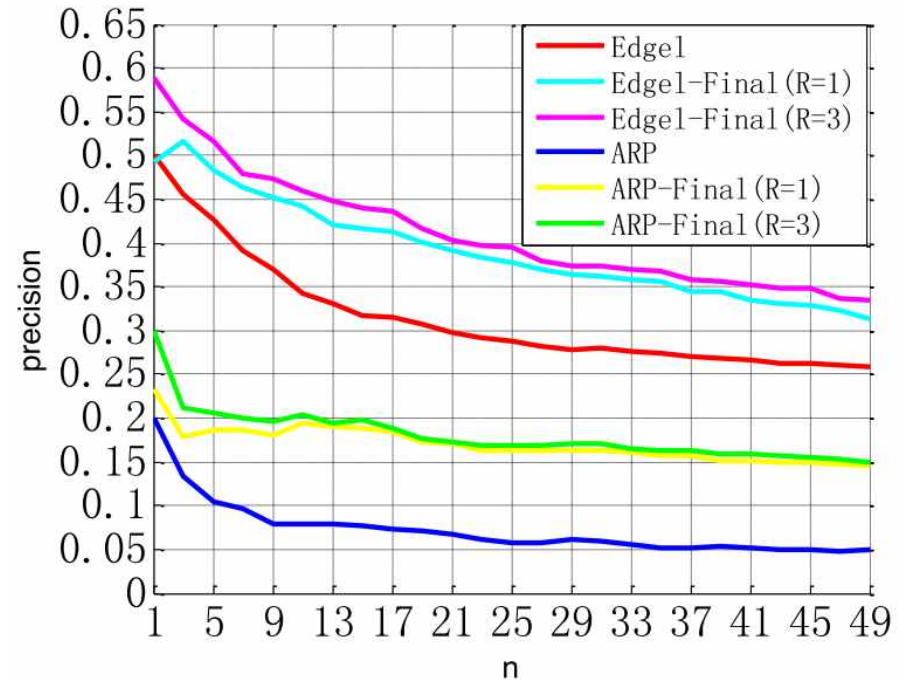
- Experimental setting
  - Dataset
    - SBIR\_100K Dataset : 1,240 images for 31 sketches and 100,000 noise images
    - Authors' own Dataset : from Google keyword search 296,562 images with 68,647 sketch-describable images + 523 sketches

# Experimental Result

## • Result 1. Performance Evaluation



Result of authors' dataset



Result of SBIR\_100K dataset

# Experimental Result

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- Result 2. Computational cost

	Initial	ours					
	SBIR	Clustering	RVFV1	CBRF	RVFV2	Total	
Edgel	9.77	0.017	0.73	0.14	0.41	11.06	+1.28s
ARP	0.64	0.015	0.53	0.10	0.26	1.55	+0.91s

# Conclusion

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- Image Grouping
  - Find which images are more relevant
- Re-ranking via Visual Feature Verification (RVFV)
  - Filter out irrelevant images
- Contour-Based Relevance Feedback (CBRF)
  - Explore deeply to retrieve what does not be found with original SBIR
- Improved result with low time cost