

Reciprocal Rank Fusion in Hybrid GraphRAG

1 Reciprocal Rank Fusion

Reciprocal Rank Fusion (RRF) is a rank aggregation method used to combine results from multiple retrieval systems. Instead of comparing raw scores, RRF combines rank positions.

This is useful when combining Redis Vector Search and Neptune Graph Retrieval because their raw scores are not directly comparable.

For an evidence item d , the RRF score is:

$$\text{RRF}(d) = \sum_{i=1}^m \frac{1}{k + \text{rank}_i(d)} \quad (1)$$

where:

- m is the number of retrieval systems.
- $\text{rank}_i(d)$ is the rank of evidence item d in retrieval system i .
- k is a smoothing constant.

In this framework, we use:

$$k = 60$$

2 Example Calculation

Suppose one evidence item appears in both Redis and Neptune.

$$\text{Redis Rank} = 2$$

$$\text{Graph Rank} = 1$$

Then:

$$\text{RRF} = \frac{1}{60 + 2} + \frac{1}{60 + 1} \quad (2)$$

$$= \frac{1}{62} + \frac{1}{61} \quad (3)$$

$$= 0.01613 + 0.01639 \quad (4)$$

$$= 0.03252 \quad (5)$$

Now consider another evidence item that appears only in Redis.

$$\text{Redis Rank} = 1$$

Then:

$$\text{RRF} = \frac{1}{60 + 1} = 0.01639 \quad (6)$$

Another evidence item appears in both systems:

Redis Rank = 3

Graph Rank = 2

Then:

$$\text{RRF} = \frac{1}{60 + 3} + \frac{1}{60 + 2} \quad (7)$$

$$= \frac{1}{63} + \frac{1}{62} \quad (8)$$

$$= 0.01587 + 0.01613 \quad (9)$$

$$= 0.03200 \quad (10)$$

3 Final Fused Ranking

Evidence	Redis Rank	Graph Rank	RRF Score
Evidence B	2	1	0.03252
Evidence C	3	2	0.03200
Evidence A	1	–	0.01639
Evidence D	4	–	0.01562

Table 1: Example RRF scoring

4 Key Insight

Evidence A is ranked first by Redis, but Evidence B receives the highest final score because it is ranked highly by both Redis and Neptune.

This is the main idea behind RRF:

Agreement between independent retrievers increases confidence.

RRF avoids comparing incompatible raw scores and instead rewards evidence that appears near the top of multiple ranked lists.