Rules for Calculations in Code

1. Memory Usage Calculation

Rule Used: Memory is calculated based on the assumption that each element in the matrix (whether integer or float) takes 4 bytes.

Calculation:

- Memory Usage = Number of Rows x Number of Columns x 4 bytes

This formula is used to estimate the total space used by the matrix.

2. Sparsity Calculation

Rule Used: Sparsity represents the percentage of elements in a matrix that are zero.

Calculation:

- Total Elements = Number of Rows x Number of Columns
- Non-zero Elements = Count of elements != 0
- Sparsity = (1 - (Non-zero Elements / Total Elements)) x 100%

This calculation helps measure how sparse the matrix is, indicating the proportion of zero entries.

3. User-User and Item-Item Similarity Calculation

Rule Used: Cosine similarity is used to calculate the similarity between users or items.

Calculation:

- Dot Product = sum(A[i][k] * A[j][k])
- Norm Calculation:
    - Norm_i = sqrt(sum((A[i][k])^2))
    - Norm_j = sqrt(sum((A[j][k])^2))
- Similarity Score:
    - Similarity[i][j] = Dot Product / (Norm_i * Norm_j)

If either Norm_i or Norm_j is zero, similarity is set to 0 to avoid division by zero.

This calculation is repeated for all user pairs or item pairs to form the similarity matrix.

4. Time Complexity

Rule Used: The time taken to execute the similarity computation is measured using time.time().

Calculation:

- Time Complexity = End Time - Start Time

This metric indicates the duration of the similarity matrix computation.

5. Space Complexity

Rule Used: The space complexity refers to the memory used by the similarity matrix itself.

Calculation:

- Same as the memory usage rule explained above.

The space complexity indicates the storage required to hold the similarity matrix.

Explanation of Functions:

user_user_similarity(): Computes similarity between users by iterating over each user-user pair and applying cosine similarity.

item_item_similarity(): Computes similarity between items by iterating over each item-item pair and applying cosine similarity.

Both functions return the similarity matrix along with time complexity, space complexity, and sparsity of the computed matrix.