2. Methodology

2.1 Data Preprocessing

The evaluation begins with the preprocessing of the dataset obtained from an Excel file. Initially, the data is read, and user and item IDs along with their corresponding ratings are extracted. To ensure compatibility with subsequent operations, the IDs are converted to string types. The dataset is then split into training and testing subsets using the `train_test_split` function from the scikit-learn library. The split is based on a specified test size and random state.

2.2 Model Training

The SVR model is trained using the training subset. This involves preparing the input features and target labels. Specifically, the fused embeddings, which capture user-item interactions, are used as input features. Additionally, recommendations are generated for each user based on a predefined threshold function. If recommendations are available, they are incorporated into the training data. The SVR model is then instantiated and trained using the training features and labels.

2.3 Prediction with SVR Model

Once the SVR model is trained, it is utilized to make predictions for the testing subset. The fused embeddings corresponding to the test users are extracted, and the SVR model predicts ratings for these users. The predicted ratings are then compared against the ground truth ratings obtained from the testing subset.

3. Results

To run the code on the three datasets, which include BeerAdvocate, Yahoo! Movies, and TripAdvisor, and describe each dataset and its related results based on two metrics, follow these steps:

3.1 **BeerAdvocate**

This dataset contains reviews of various beers, including ratings based on multiple criteria.

Number of users: 8831
Number of items: 2698
Number of criteria: 4
Sum of all ratings for users based on criteria: 3880359

BeerAdvocate			
ID	Algorithms	MAE	RMSE
1	UserKNN	0. 6559	0. 8444
2	MultiUserKNN	0. 6572	0. 8441
3	BMF	0. 4394	0. 5858
4	MSVD	0. 4473	0. 5960
5	MLR	0. 4442	0. 5929
6	SVR	0. 4470	0. 5993
7	CIC	0. 4429	0. 5914
8	DMCF	0. 4698	0. 6240
9	DNN-MF	0. 4483	0.6077
10	MCAE-FADNN	0. 4698	0. 6240
11	CFM (user)	0. 4403	0. 5904
12	CFM (item)	0. 4408	0. 5904
13	**MCRSMT**	**0. 4199**	**0. 5816**

3.2 **Yahoo!Movies**

This dataset comprises user ratings and reviews for movies available on Yahoo! Movies, categorized based on several criteria.

Number of users: 6078
Number of items: 976
Number of criteria: 4
Sum of all ratings for users based on criteria: 758405

Yahoo!Movies			
ID	Algorithms	MAE	RMSE
1	UserKNN	0.9460	1.2390
2	MultiUserKNN	0.9319	1.2396
3	BMF	0.6289	1.2396
4	MSVD	0.6332	0.8646
5	MLR	0.6328	0.8738
6	SVR	0.6248	0.8664
7	CIC	0.6200	0.8782
8	DMCF	0.7012	0.9139
9	DNN-MF	0.6178	0.8606
10	MCAE-FADNN	0.6277	0.8793
11	CFM (user)	0.6184	0.8802
12	CFM (item)	0.6145	0.8869
13	**MCRSMT**	**0.6122**	**0.8426**

3.3 TripAdvisor

This dataset includes reviews and ratings of various tourist attractions and accommodations from TripAdvisor users, segmented based on multiple criteria.

umber of users: 15000
Number of items: 1325
Number of criteria: 7
Sum of all ratings for users based on criteria: 504598

TripAdvisor			
ID	Algorithms	MAE	RMSE
1	UserKNN	0. 9458	1.2159
2	MultiUserKNN	0. 9458	1. 2146
3	BMF	0. 4032	0. 6820
4	MSVD	0. 6387	0. 9505
5	MLR	0. 5255	0. 7475
6	SVR	0. 5109	0. 7465
7	CIC	0. 4055	0. 6836
8	DMCF	0. 5819	0. 8289
9	DNN-MF	0. 5334	0. 7606
10	MCAE-FADNN	0. 6031	0. 8301
11	CFM (user)	0. 3965	0. 6492
12	CFM (item)	0. 3898	0. 6549
13	**MCRSMT**	**0. 7297**	**0. 9795**

Table 1: Comparison of MCRSMT with other methods based on MAE and RMSE

ID	Algorithm	Yahoo!Movies		BeerAdvocate		TripAdvisor	
		MAE	RMSE	MAE	RMSE	MAE	RMSE
1	UserKNN	0.9460	1.2390	0.6559	0.8444	0.9458	1.2159
2	MultiUserKNN	0.9319	1.2396	0.6572	0.8441	0.9458	1.2146
3	BMF	0.6289	1.2396	0.4394	0.5858	0.4032	0.6820
4	MSVD	0.6332	0.8646	0.4473	0.5960	0.6387	0.9505
5	MLR	0.6328	0.8738	0.4442	0.5929	0.5255	0.7475
6	SVR	0.6248	0.8664	0.4470	0.5993	0.5109	0.7465
7	CIC	0.6200	0.8782	0.4429	0.5914	0.4055	0.6836
8	DMCF	0.7012	0.9139	0.4698	0.6240	0.5819	0.8289
9	DNN-MF	0.6178	0.8606	0.4483	0.6077	0.5334	0.7606
10	MCAE-FADNN	0.6277	0.8793	0.4698	0.6240	0.6031	0.8301
11	CFM_{user}	0.6184	0.8802	0.4403	0.5904	0.3965	0.6492
12	CFM_{item}	0.6145	0.8869	0.4408	0.5904	0.3898	0.6549
13	**MCRSMT**	**0.6122**	**0.8426**	**0.4199**	**0.5816**	**0.7297**	**0.9795**