Birla Institute of Technology and Science-Pilani, Hyderabad Campus

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# Information Retrieval (CS F469)

# Design Document

# Assignment 3

Recommender Systems

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**Abstract:**

Through this assignment we implemented different recommender system techniques like collaborative filtering (with and without baseline), singular value decomposition and CUR decomposition. We have used a dataset that contains 10000 ratings for 4000movies from 6041 users.The recommended ratings are then evaluated using different metrics like RMSE, Spearman Correlation and precision at Rank k. Prediction times for each method has also been recorded. All these records are tabulated and presented below.

**Formulas:**

1. **Collaborative filtering:**
   1. **Without baseline:**

Where is the predicted rating, is the similarity between users i and j, is the rating of user on item j.

* 1. **With baseline:**

Where is the global baseline estimated calculated as sum of overall mean rating(), rating deviation of user x() and rating deviation of movie i().

1. **SVD decomposition:**

Where A, U, and V are matrices. A is the input matrix. matrix contains the singular values.

1. **CUR decomposition:**

Where A is the input matrix, C is the matrix obtained from random sampling of columns from A and R is the matrix obtained from random sampling of rows from A. U is the pseudo-inverse of intersection of C and R matrices from A.

1. **RMSE:**

Where is the predicted rating and is the true rating.

1. **Spearman Correlation:**

Where is the difference in user and predicted rating and n is the number of ratings.

1. **Precision:**

Precision at rank has been calculated as the ratio to number of predicted ratings that are greater than 3 which are truly greater than 3 to he number of actual ratings that are actually greater than 3.

**Results:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Recommender System Techniques** | **Root Mean Squared Error (RMSE)** | **Precision at rank K** | **Spearman Correlation ()** | **Time taken for prediction** |
| Collaborative | 0.937 | 0.621 | 0.543 | 141.74 |
| Collaborative along with Baseline approach | 0.843 | 0.672 | 0.638 | 158.51 |
| SVD | 0.992 | 0.298 | 0.0837 | 269.28 |
| SVD with 90 percent energy | 0.961 | 0.306 | 0.0835 | 257.86 |
| CUR | 3.215 | 0.031 | 0.025 | 15.99 |
| CUR with 90 percent energy | 0.741 | 0.74 | 0.226 | 27.74 |