

MapMyMovies

Recommendation algorithms have become essential for enhancing user experience by curating content users are most likely to enjoy. However, modern recommendation systems often operate as black boxes, providing limited transparency or user control.



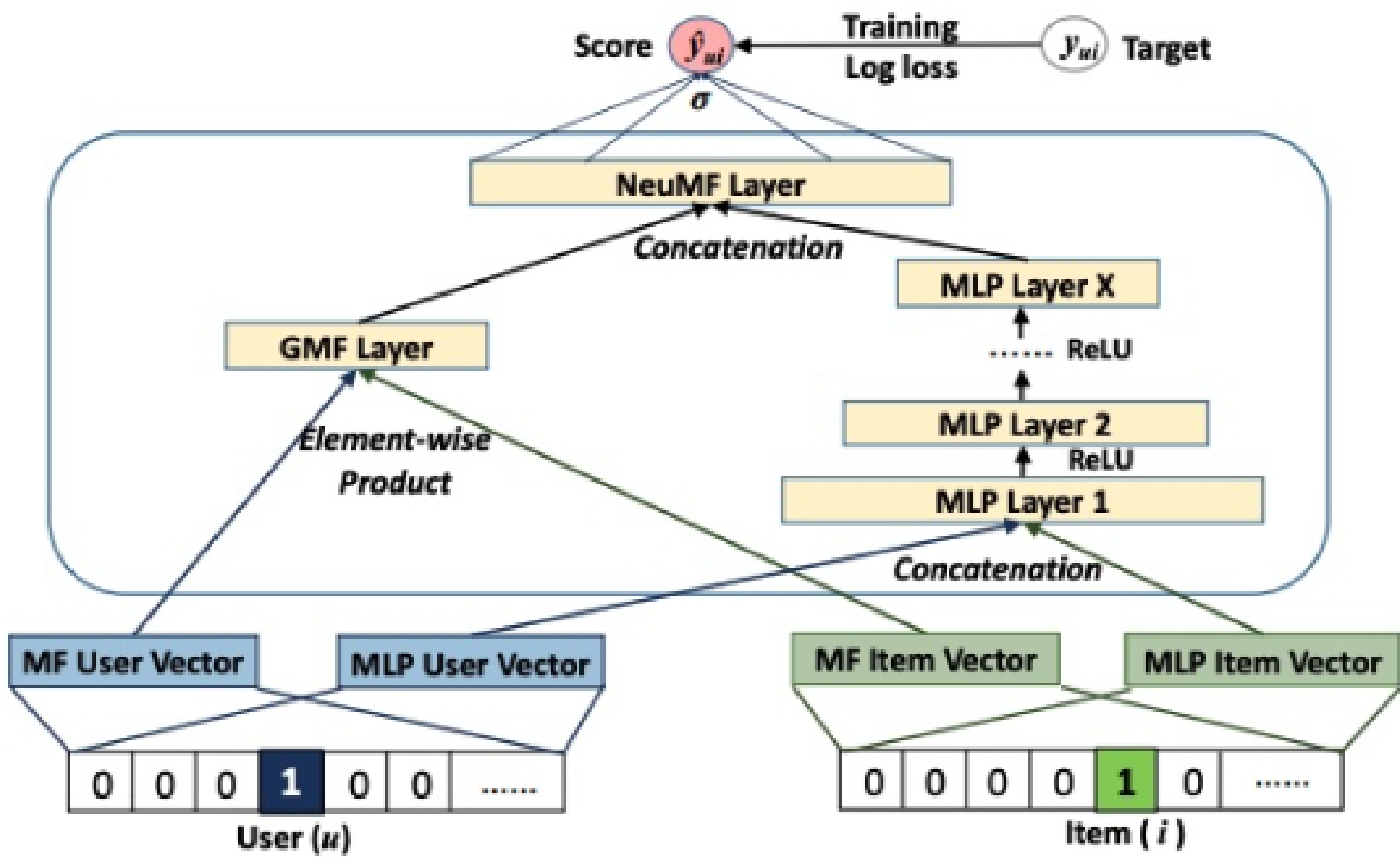
1 Our Approach

Our team (#23) developed a **more transparent** movie recommendation system that not only generates accurate and personalized suggestions, but also incorporates an interactive visualization to help users explore and understand their recommendations.

DATASET

We sampled 200k records from the MovieLens database on GroupLens, which contains 33 million movie ratings provided by over 300,000 users. Each row in the dataset consists of a user ID, a movie ID, and the corresponding rating assigned by the user.

2 Neural Collaborative Filtering



NCF overcomes limitations of traditional methods by capturing both linear and non-linear behavior through deep learning.

Neural Matrix Factorization (**NeuMF**) combines Generalized Matrix Factorization with a Multi-Layer Perceptron, modified from its original implicit feedback design to predict continuous ratings using MSE loss with a popularity bias penalty to improve recommendation diversity.

3 User & Item-based Systems

- User-based Collaborative Filtering (UBCF)** recommends items by finding users with similar preferences (using cosine similarity) and computing a similarity-weighted-average of their ratings to predict unseen items.
- Item-based Collaborative Filtering (IBCF)** operates similarly to UBCF but compares items (via the transposed user-item matrix) to recommend items similar to those a user has rated.
- Our **hybrid model** discovers the optimal mix of recommendations by linearly combining predictions from both UBCF and IBCF models using the following equation: $\text{pred} = \alpha \cdot \text{ubcf_pred} + (1 - \alpha) \cdot \text{ibcf_pred}$, where alpha is tuned to minimize overall error.

$$\text{sim}(u, v) = \frac{\sum_{i \in I_{uv}} r_{u,i} r_{v,i}}{\sqrt{\sum_{i \in I_{uv}} r_{u,i}^2} \sqrt{\sum_{i \in I_{uv}} r_{v,i}^2}} \quad \hat{r}_{u,j} = \frac{\sum_{v \in N_u} \text{sim}(u, v) \cdot r_{v,j}}{\sum_{v \in N_u} |\text{sim}(u, v)|} + \bar{r}_u$$

4 Visualizations

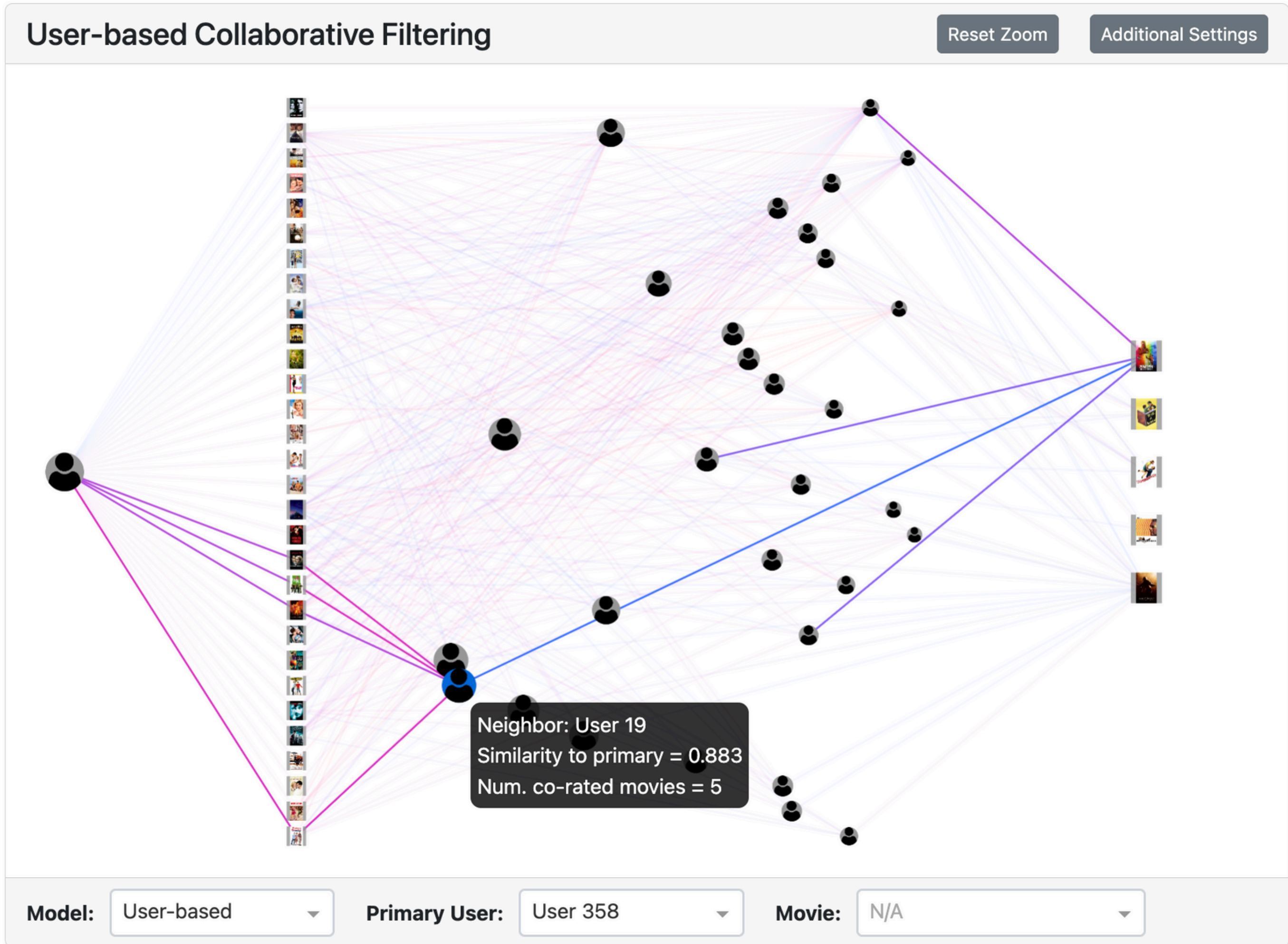
For transparency, the interactive network graph displays each model (UBCF, IBCF, NCF) separately on our interface.

INTERACTIVITY

- Visual elements reflect model outputs:** Node size, edge color, and opacity represent similarity scores, rating strength, or magnitude.
- UBCF:** Click to highlight connection paths, inspect co-rated movies of neighbors, and switching between models.
- NCF:** Explorable architecture reveals which latent dimensions influence predicted scores.

Top Recommendations for User 358			
#1		Heathers (1989)	
#2		Star Trek II: The Wrath of Khan (1982)	
#3		Muppet Movie, The (1979)	
#4		Singin' in the Rain (1952)	

Co-rated movies with User 382		
Movie	Primary Rating	Neighbor Rating
	★★★★★	★★★★★
	★★★★☆	★★★★★
	★★★★☆	★★★★☆
	★★★★☆	★★★★★
	★★★★☆	★★★★★



5 Results & Evaluation

VISUALIZATION EVALUATION

- Format:** Google Forms Survey
- Ease of Interaction: 5Q, Likert Scale
 - Trust in Recommendation: 2Q, Likert Scale
 - Free Response: 2Q

Question Score	Ease of Interaction	Trust in Recommendation
*Average Score	4.23/5	4.2/5

*Average mean score per question across all users in the category

MODEL EVALUATION

Leave-one-out evaluation, one interaction per user held out

Ratings are on a 0.5-5 scale

Model Metric	UBCF	IBCF	NCF
RMSE	0.7673	0.4962	0.9624
MAE	0.5856	0.3636	0.74
Runtime	5.24m	50.1m	0.8m

$\alpha = 0.09$

