

About

We've successfully developed a "Personalized Product Recommendation System", employing diverse algorithms which are documented in our submitted code.

Our web-page demonstrates our recommendation system's functionality:

- By inputting the `user_id`, you can access product recommendations based on what similar users have purchased and preference of that particular user.
- Upon conducting a product search, you'll receive suggestions for comparable items as recommendations.
- Upon `user_id` submission, our system analyzes their search history to offer recommendations aligned with products akin to their purchased items.

Use-cases

- **Use Case: Real-time Homepage Recommendations**

Description: Dynamically suggest personalized products on the homepage to engage users.

- **Use Case: In-App Search Enhancements**

Description: Provide personalized search results based on user preferences, improving search usability.

- **Use Case: Cart Enhancement Recommendations**

Description: Propose related products to customers after a purchase, encouraging repeat transactions.

- **Use Case: User Profile Recommendations**

Description: Tailor recommendations based on user profiles, enhancing relevance and engagement.

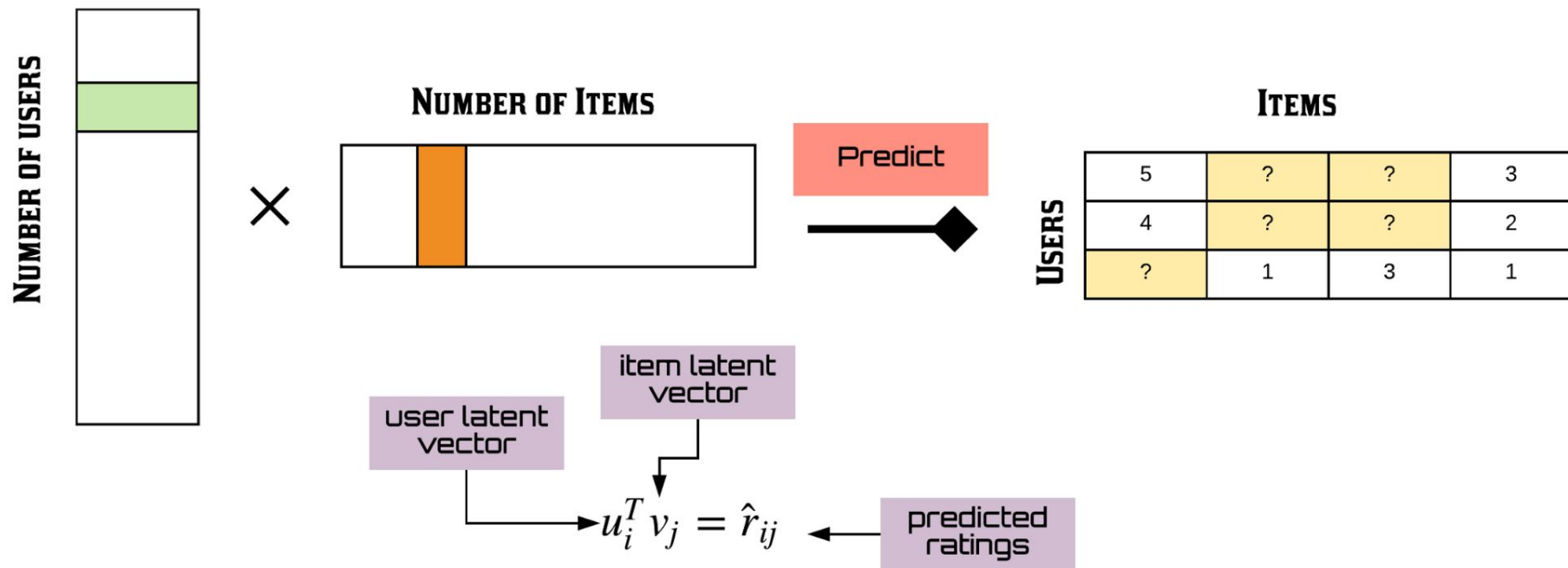
Solution statement/ Proposed approach

1. Collaborative Filtering

- We performed collaborative filtering, leveraging user interactions to formulate personalized product recommendations.
- This method taps into user behaviors like purchases and views to establish meaningful links between users and products.
- By employing collaborative filtering, we shape recommendations around collective user preferences, enhancing overall engagement and satisfaction.
- However, scalability challenges arise with larger user groups, and new products or users with limited interaction data can pose hurdles.

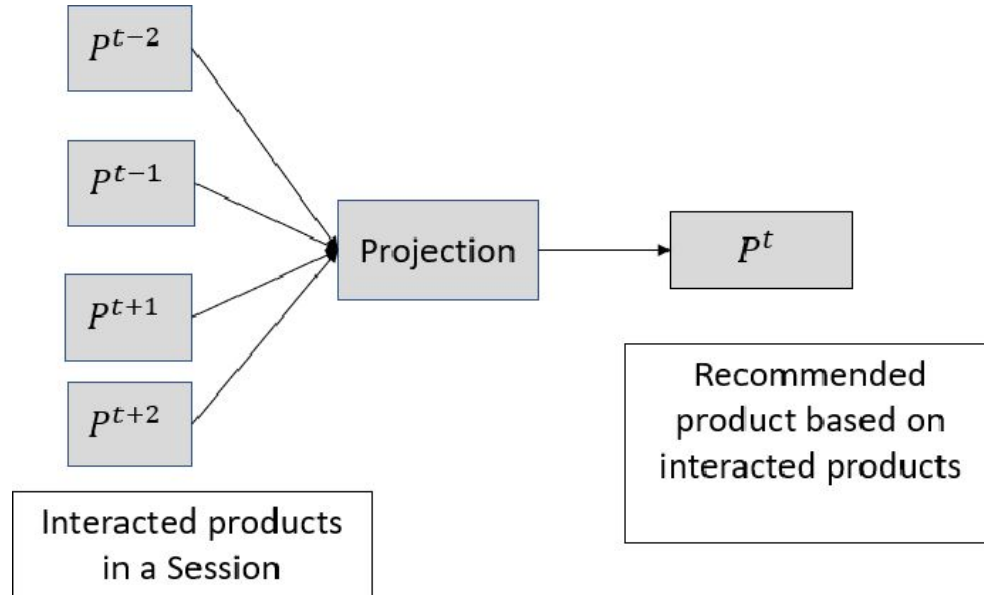
Illustration of Collaborative filtering

MATRIX FACTORIZATION



2. Word2Vec

- Word2Vec is a technique used for recommending products to users. It involves finding the most similar product embeddings to all the products embedding that the user has previously purchased.
- This method leverages the relationships between products based on their embeddings to suggest items that align with the user's preferences, making recommendations more personalized and relevant.



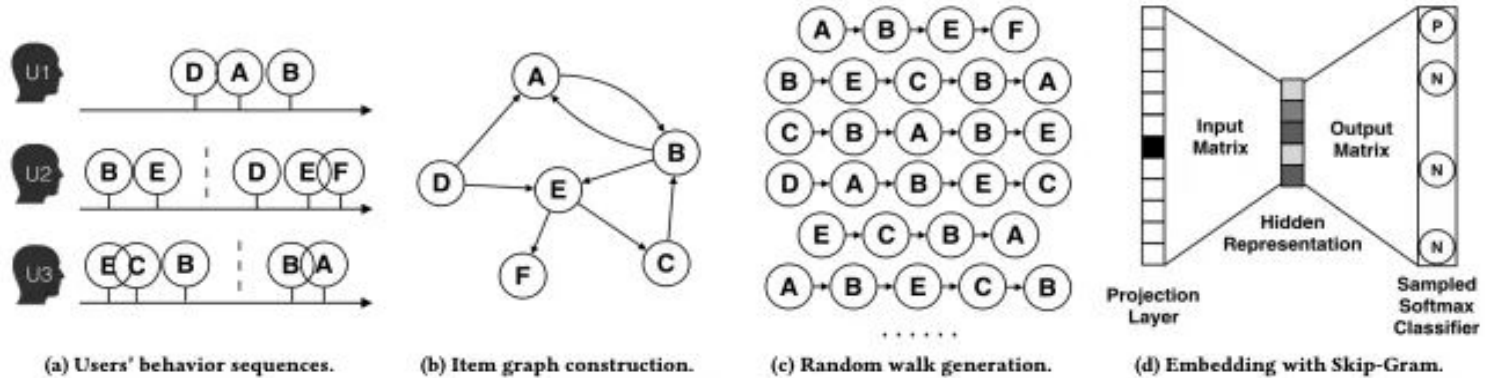
3. TF-IDF for Product Embeddings

- Utilizing TF-IDF, we created explicit product embeddings, enabling us to measure product similarity via cosine similarity. This enabled us to recommend the top K similar products for each item in our inventory.
- Our approach incorporated product attributes like descriptions, tags, categories, and heuristics, with TF-IDF assigning word weights based on their context significance.
- However, TF-IDF-produced embeddings, reaching lengths of up to 30K, introduced computational challenges due to their high dimensionality.

4. Prod2Vec

- We introduce "**Prod2Vec**," an extension of the renowned Word2Vec architecture, adapted to the e-commerce domain.
- In this method, products are treated as word tokens, and user sequences (analogous to sentences) are used to learn product embeddings.
- Like Word2Vec, Prod2Vec captures the semantics of words, which is essential for gauging similarity between products.

Implementation of Prod2Vec



- The implementation follows a stepwise process, as illustrated in the graphical representation.
- Synthetic user journeys are fabricated instead of using actual user data, using Markov chain methodology for generating next states.
- Transition probabilities between products are calculated, leveraging unique user counts.
- For each product, N sequences of length L are generated. These sequences serve as the corpus for training the Word2Vec (Skip Gram) architecture.
- Embeddings are learned by predicting context tokens from target tokens, treating products as word tokens.

Limitations

- **Synthetic Dataset:**

Description: Project used synthetic dataset due to lack of suitable real data for personalized recommendations.

Impact: Synthetic data might not capture actual user behavior, affecting recommendation quality and validity.

- **Multiple Model Creation:**

Description: Multiple models developed due to varying properties in synthetic dataset, catering to diverse recommendation scenarios.

Impact: Using multiple models could complicate deployment, maintenance, and introduce recommendation inconsistencies.

Note: While the project showcases innovative personalized recommendation strategies, acknowledge limitations of synthetic data and lack of authentic user behavior. Future work may involve realistic datasets and streamlined model consolidation for improved implementation and management.

Future Scope

- **Hybrid Model Integration:**

Develop a unified hybrid model by integrating the strengths of multiple individual models. This will enhance recommendation accuracy and cover a wider range of user preferences.

- **Scalability Enhancement:**

Focus on optimizing the personalized product recommendation system for scalability, enabling it to handle larger datasets and user base seamlessly.

- **Category-Based Recommendations:**

Incorporate category-based recommendation strategies to align suggestions with users' specific interests, thereby improving relevance and user satisfaction. This can be incorporated by using advanced clustering techniques.

Future Scope

- **Personalized Buying Capacity:**

Explore recommending products to users based on their buying capacity. This approach will add an essential dimension of personalization, making the recommendations more relevant and actionable.

- **Real-World Data Utilization:**

Incorporate genuine user behavior and interactions from real-world data to refine and validate the recommendation models. This will lead to more accurate and effective suggestions.

Note: As the project advances, these future directions will propel personalized product recommendations towards greater accuracy, scalability, and relevance. By addressing these aspects, the system will be better equipped to meet the diverse needs of users in practical e-commerce scenarios.