**Recommendation Engine Development Summary**

This project focuses on developing a recommendation engine tailored for e-commerce websites, leveraging user and item interaction datasets to provide personalized product suggestions. The system integrates data from four sources:

1. **User Data**: Demographic and location details.
2. **Product Data**: Information about products, including categories, pricing, and availability.
3. **Transaction Data**: User-product purchase records and associated details like discounts and payment methods.
4. **Interaction Data**: User engagement beyond purchases, such as views, search queries, and reviews.

**Key Steps Undertaken**

1. **Exploratory Data Analysis (EDA)**:
   * Handled missing values using placeholders or medians.
   * Removed outliers using Z-score and IQR methods.
   * Scaled numerical features with Min-Max normalization and encoded categorical features for modeling.
2. **Feature Engineering**:
   * Derived new features like user age, total spending, and product effective prices.
   * Aggregated data to create interaction matrices and computed composite scores to capture user engagement.
3. **Model Development**:
   * **User-Based Collaborative Filtering**: Recommended products based on user similarity.
   * **Item-Based Collaborative Filtering**: Suggested items similar to those users interacted with.
   * **Neural Collaborative Filtering (NCF)**: Used deep learning to model complex user-item interactions.
4. **Hybrid Models**: Combined the strengths of individual models to enhance accuracy and user satisfaction.

**Results and Insights**

* The feature engineering pipeline enriched datasets with predictive features, enabling accurate modeling.
* Hybrid models outperformed standalone approaches, demonstrating improved precision and personalization.
* The recommendation system is adaptable for diverse e-commerce platforms, ensuring scalability and user satisfaction.

This project establishes a robust framework for recommendation systems, integrating traditional and modern approaches to deliver high-quality recommendations tailored to user preferences.