

KRR PROJECT

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**E-Commerce Product Recommendation System**

**Overview**

This web-based system provides personalized product recommendations to customers based on their preferences using **First Order Logic (FOL)** and **Large Language Models (LLM)**. The system incorporates the following key features:

* **First Order Logic (FOL)** for recommending products from liked categories and price ranges.
* **LLM-based Recommendations** powered by **Google Generative AI** to offer more personalized suggestions.
* **Saliency Mapping** to assess and display the importance of different product features like categories and price ranges.

**Features**

1. **Customer Product Selection**:
   * Customers can view available products and choose those they like by marking them with a "like" checkbox.
2. **Personalized Product Recommendations**:
   * **FOL Recommendations**: Uses first-order logic to recommend products based on the selected categories and price ranges.
   * **LLM Recommendations**: Uses **Google Generative AI** to generate recommendations based on the customer’s preferences, including brief explanations for each suggestion.
3. **Saliency Mapping**:
   * Analyzes the importance of product categories and price ranges based on the customer's selected products. This provides a map showing which product features are most important to the user.
4. **Customer-Specific Experience**:
   * Personalized experience for each customer based on their selection history, allowing them to receive product recommendations aligned with their preferences.

**Technical Stack**

* **Backend**: Flask (Python web framework)
* **AI**: Google Generative AI (for LLM-based recommendations)
* **Frontend**: HTML, CSS (Clean and responsive design)
* **Data Storage**: JSON files containing customer and product information

**Key Components**

**1. Google Generative AI Integration**

* The system integrates with **Google Generative AI** (specifically, **Gemini-1.5-Flash**) to generate personalized product recommendations. The system sends a query to the model based on the categories and price ranges the customer prefers and retrieves product suggestions.

**2. First-Order Logic (FOL) for Product Recommendations**

* **First-Order Logic (FOL)** is used to recommend products from the categories and price ranges that the customer has previously liked. This approach ensures that the recommendations align with the user's existing preferences.

**3. Saliency Calculation for Feature Importance**

* **Saliency Mapping** calculates the importance of different product attributes, such as category and price range, based on the user's interactions. This helps to highlight which product features are most relevant to the user.

**System Flow**

1. **Customer Selection**:
   * Customers start by selecting their ID from a dropdown list.
   * After selecting a customer, they are shown a list of products and can "like" the ones they are interested in.
2. **Product Selection and Preferences**:
   * Customers choose products they like, and the system stores their preferences.
3. **Product Recommendations**:
   * **FOL-based Recommendations** are generated by filtering products based on the selected categories and price ranges.
   * **LLM-based Recommendations** are generated using the Google Generative AI model, providing personalized suggestions with explanations.
4. **Saliency Score Calculation**:
   * After generating recommendations, the system calculates saliency scores to show the relative importance of product categories and price ranges for the customer.

**Routes in the Flask Application**

1. **/ (Home Page)**:
   * Displays a form where customers can select their ID from a list of available customers.
2. **/products (Product Display)**:
   * After selecting a customer, this route shows a list of available products. Customers can then select products they like by checking checkboxes next to the product names.
3. **/recommend (Product Recommendations)**:
   * After selecting products, the system generates both **FOL-based** and **LLM-based** product recommendations, as well as calculates saliency scores for each product feature (category, price range).

**HTML Templates**

1. **Customer Selection Page (index\_template)**:
   * Displays the available customers in a dropdown list where a customer can be selected.
2. **Product Selection Page (products\_template)**:
   * After a customer is selected, this page shows the available products with checkboxes to "like" the products.
3. **Recommendation Page (recommend\_template)**:
   * Displays the recommended products based on the selected categories and price ranges using both **FOL-based** and **LLM-based** approaches.
   * Shows **saliency maps** indicating the importance of categories and price ranges.

**Saliency Scores**

* **Saliency Scores** are used to quantify the importance of different product attributes. The scores are calculated based on the products the customer has liked:
  + **Category Importance**: Shows how important different product categories are to the user.
  + **Price Range Importance**: Shows how important different price ranges are to the user.

These scores are visualized in tables to help the customer understand which product features are most relevant to them.

**Conclusion**

This E-Commerce Product Recommendation System provides a rich, personalized experience for customers. By combining traditional **First Order Logic (FOL)** and **LLM-based** recommendations, the system offers meaningful suggestions tailored to individual preferences. The inclusion of **saliency maps** provides valuable insights into which product features are most important to customers, helping businesses improve their recommendation strategies.