**Smart Recipe Recommender Pro**

**Project Report**

**Introduction**

The **Smart Recipe Recommender Pro** is a desktop application designed to help users discover personalized cooking recipes based on their input ingredients, cuisine preferences, skill level, and previous feedback. The application leverages natural language processing techniques and a user profile system to provide tailored recipe recommendations.

**Technologies Used**

* **Python 3**
* **Tkinter** (for the graphical user interface)
* **Scikit-learn** (for TF-IDF vectorization and cosine similarity)
* **NumPy** (for numerical operations)
* **JSON** (for persistent storage of recipes, user feedback, and user profile)

**Features**

1. **Ingredient-Based Search:**  
   Users can input a list of ingredients, and the system finds recipes that match closely based on TF-IDF vectorization and cosine similarity.
2. **Personalized Recommendations:**  
   The system analyzes the user's liked recipes, favorite ingredients, and preferred cuisines to generate customized suggestions.
3. **Skill Level and Cuisine Filters:**  
   Users can filter recipes according to cooking skill levels (Beginner, Intermediate, Advanced) and cuisines (e.g., Italian, Indian, etc.).
4. **Feedback System:**  
   Users can like or dislike recipes. Feedback dynamically updates the user profile, influencing future recommendations.
5. **User Profile Management:**  
   A profile is maintained with:
   * Favorite ingredients
   * Liked and disliked recipes
   * Preferred cuisines
   * Cooking skill level
   * Allergy information (potential for future extensions)
6. **Favorites Section:**  
   Users can easily view and access their favorite recipes.
7. **Recipe Detail View:**  
   Upon selecting a recipe, a detailed view displays:
   * Ingredients
   * Cooking instructions
   * Nutritional information (if available)
8. **Persistence:**  
   All user interactions and feedback are stored in local JSON files for future sessions.

**How It Works**

* The app preprocesses all recipe data by creating a combined text of ingredients, cuisines, and nutritional keys.
* TF-IDF vectorization is applied to these texts.
* Cosine similarity measures are used to find recipes similar to the user's search query or liked recipes.
* Personalization is added by boosting scores for favorite ingredients and preferred cuisines.
* The user interface is fully interactive, providing intuitive controls and feedback mechanisms.

**Advantages**

* **User-centric design:** The app adapts to users’ tastes over time.
* **Scalable:** New recipes can be easily added by updating the recipes.json file.
* **Extendable:** The feedback system and profile system allow for future upgrades like allergy filters, seasonal recommendations, or even meal planning.

**Limitations and Future Improvements**

* **Cold Start Problem:** Users who haven't liked any recipes yet receive generic recommendations.
* **Limited Dataset:** The recommendation quality highly depends on the diversity and size of the recipe dataset.
* **No Real-Time Updates:** Updates to recipes or user profiles require restarting the application.

Future plans include:

* Adding machine learning models for better preference predictions.
* Introducing allergy filters and dietary restrictions (e.g., vegan, gluten-free).
* Implementing a more advanced UI framework for improved responsiveness and aesthetics.

**Conclusion**

This project demonstrates the application of **Natural Language Processing**, **basic Machine Learning techniques**, and **Graphical User Interface programming** to build an intelligent recipe recommendation system. The project can be further developed into a full-fledged recommendation platform by incorporating more sophisticated models and a larger dataset.