**Functional Requirements:**

1. **Data Collection & Processing:**
   * Scrape or import user data (clicks, purchases, browsing history).
   * Clean, filter, and preprocess data for model training.
2. **Recommendation Engine:**
   * Implement **collaborative filtering** (user-based, item-based).
   * Implement **content-based filtering** (keyword similarity, metadata).
   * Implement **hybrid recommendation** (combining collaborative & content-based).
3. **Machine Learning Model:**
   * Train and optimize ML models (e.g., Matrix Factorization, Neural Networks).
   * Use real-time data updates for adaptive recommendations.
4. **Big Data Handling:**
   * Efficiently manage large-scale data using cloud storage or distributed databases.
   * Implement batch and real-time recommendation pipelines.
5. **API Integration:**
   * Develop REST APIs to allow third-party websites to integrate the recommendation engine.
   * Provide endpoints for user-item recommendations, trending items, and personalized suggestions.
6. **Performance Optimization:**
   * Optimize database queries and indexing for faster response times.
7. **UI/Dashboard for Visualization:**
   * Admin dashboard for monitoring model performance (accuracy, latency, top recommendations).
   * Data visualization tools for insights on user behavior and trends.

**Non-Functional Requirements:**

1. **Scalability:**
   * Ensure the system handles a growing number of users and data efficiently.
2. **Security:**
   * Encrypt sensitive user data.
3. **Availability & Reliability:**
   * Ensure high uptime with load balancing and failover mechanisms.
4. **Response Time:**
   * Recommendations should be generated within milliseconds for a seamless user experience.
5. **Interoperability:**
   * The engine should be platform-agnostic and easily integrate with various e-commerce platforms.
6. **Maintainability:**
   * Use modular, well-documented code for easy updates and improvements.
7. **Usability:**
   * The admin dashboard should have an intuitive interface for non-technical users.