A PROJECT REPORT

On

PRUS: Product Recommendation System Based on User Specification and Customer Reviews

Submitted in the partial fulfilment of requirements to

CS – 363 – Term Paper

By

Batch – 19

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Contents:

Goal of the Project

The research paper titled **"PRUS: Product Recommender System Based on User Specifications and Customers Reviews"** introduces a new and improved way to recommend products to users by understanding their specific needs more accurately. Most existing recommendation systems only focus on the overall sentiment of product reviews or highlight only the positive aspects. However, this approach can overlook important negative feedback that may affect a user's decision. To solve this problem, the proposed system, called **PRUS**, takes into account both **positive and negative sentiments** found in customer reviews.

One of the main features of PRUS is that it allows users to **specify exactly which product features they care about**, such as camera quality, battery life, or screen resolution. Instead of looking at the entire review as one opinion, the system breaks the reviews down into **individual sentences** and identifies opinions related to each feature. It then performs **aspect-level sentiment analysis**, which means it understands the user's opinion on each feature separately, rather than as a whole.

To rank the products effectively, the authors introduce a method called **RANK-ify**, which assigns scores to each product based on how often and how positively or negatively each feature is mentioned. This scoring method also gives users the flexibility to decide whether they want to prioritize positive feedback, negative feedback, or both equally.

Overall, the goal of the paper is to create a more **personalized, accurate, and useful product recommendation system** that helps users make better decisions by understanding detailed customer opinions, not just average ratings or general reviews.

Mechanism to be Followed

Here's the **step-by-step mechanism** of how the PRUS system works, explained in simple words:

Step 1: Collect Product Reviews

The system starts by collecting a large number of **customer reviews** from platforms like Amazon, focusing on products such as mobile phones.

Step 2: Clean and Prepare the Reviews

The reviews are **cleaned** by removing useless data like short or incomplete reviews, stopwords, punctuation, and numbers. Words are also simplified using techniques like **lemmatization** so that similar words are treated as the same.

Step 3: Break Reviews into Sentences

Each review is **split into sentences** to find specific opinions about different features (like battery, camera, etc.) rather than looking at the whole review.

Step 4: Extract Features and Sentiments

From each sentence, the system **identifies the product feature** being discussed (e.g., "battery") and the **sentiment** (positive, negative, or neutral) expressed about that feature using tools like **TextBlob**.

Step 5: Match Features with User Query

The user gives a **search query** specifying the features they care about (e.g., "good camera, long battery life"). The system matches these requested features with the features found in the reviews.

Step 6: Assign Scores to Features

Each product is assigned **scores** for each feature based on how many times that feature is mentioned positively or negatively. A formula is used to give more or less importance to positive or negative feedback, depending on what the user prefers.

Step 7: Rank Products (RANK-ify Algorithm)

The **RANK-ify algorithm** calculates a total score for each product by combining all feature scores. Products are then **ranked** from best to worst based on how well they match the user's needs.

Step 8: Display Recommended List

Finally, the system shows a **ranked list of recommended products** that best fit the user's specified features and preferences, considering both good and bad reviews.

Tools, and Algorithms needed for Implementation

🧩 Frontend (React.js)

Tool / Library	Purpose
React.js	Frontend JavaScript library to build UI
Axios or Fetch API	To send HTTP requests to backend
React Router	For page navigation (e.g., `/products`, `/home`)
Tailwind CSS / Bootstrap	UI styling and responsiveness
Vite / Create React App	For creating and managing the React app

🧠 Backend (Python)

Tool / Library	Purpose
FastAPI	REST API backend (highly recommended for modern APIs)
Flask (alt.)	Lightweight web framework (also suitable for REST APIs)
TextBlob / NLTK / spaCy	For sentiment and feature extraction in reviews
Pandas / NumPy	Data processing, managing review datasets
Uvicorn	ASGI server to run FastAPI
Pydantic	Request validation and type-checking in FastAPI
scikit-learn (optional)	For ML-based models if needed for ranking

🗃️ Database (if needed)

Tool	Purpose
MongoDB	If you prefer NoSQL-style document storage

🛠️ Development Tools

Tool	Purpose
VS Code	Recommended IDE for both React and Python
Postman	To test API endpoints during backend development
Git + GitHub	Version control and code hosting
Node.js + npm	Required to run React.js and install packages
Python 3.9+	For backend development

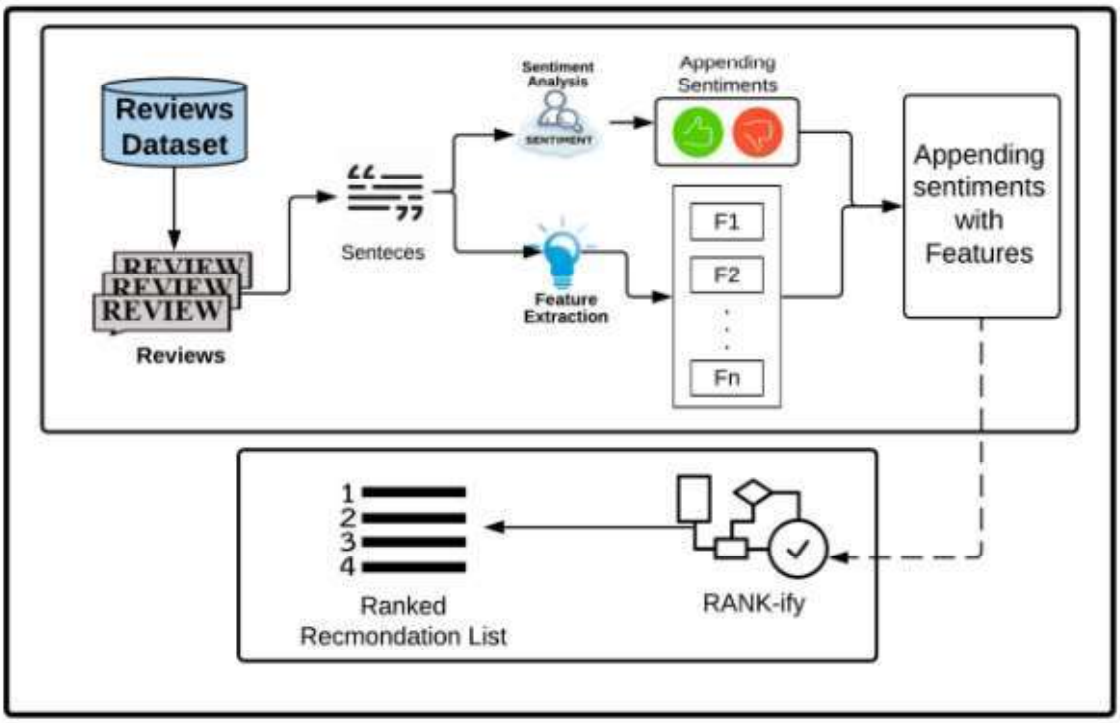
🌐 Deployment Tools (Later Stage)

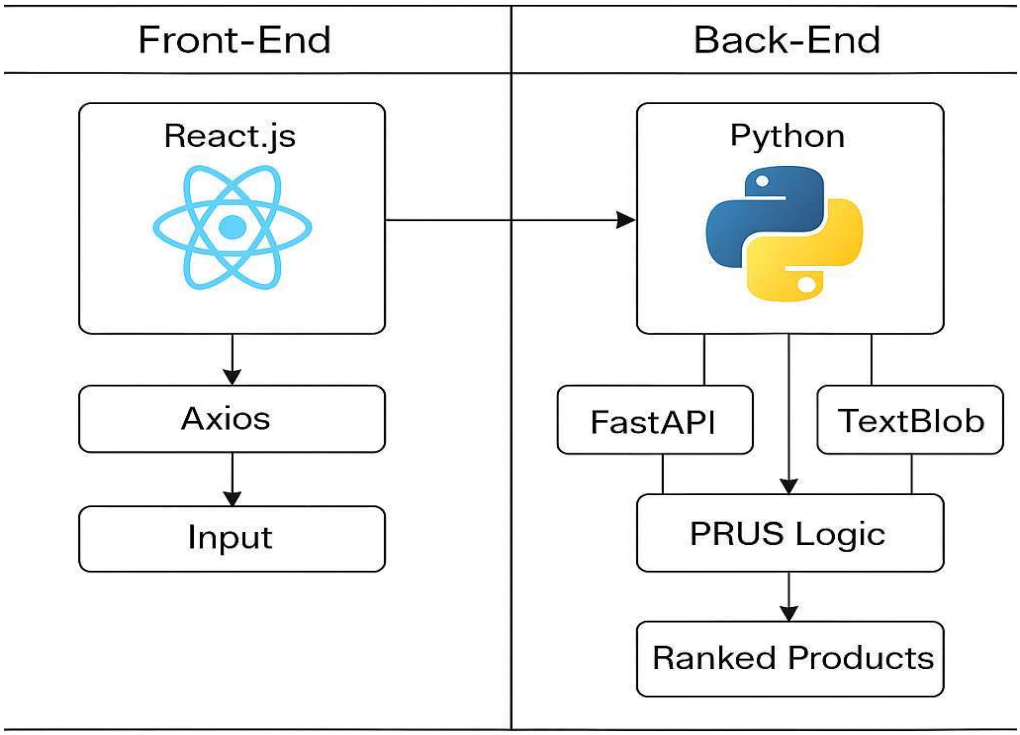
Tool	Purpose
Vercel / Netlify	To deploy React frontend
Render / Railway / Heroku	To deploy FastAPI/Flask backend

Algorithm 1 RANK-Ify Algorithm

k =Number of Products in Dataset
L_p =List of Products in Dataset
Q =Features in User Query
for $p \in L_p$ **do**
  for $U_f \in Q$ **do**
    if $U_f \in p$ **then**
      $FS(U_f) = FeaSco(U_f)$
    end if
  end for
  $RS(p) = \sum_{U_f \in Q} FS(U_f)$
end for
Sort L_p w.r.t. RS
Return top-k from L_p

Architecture Diagram



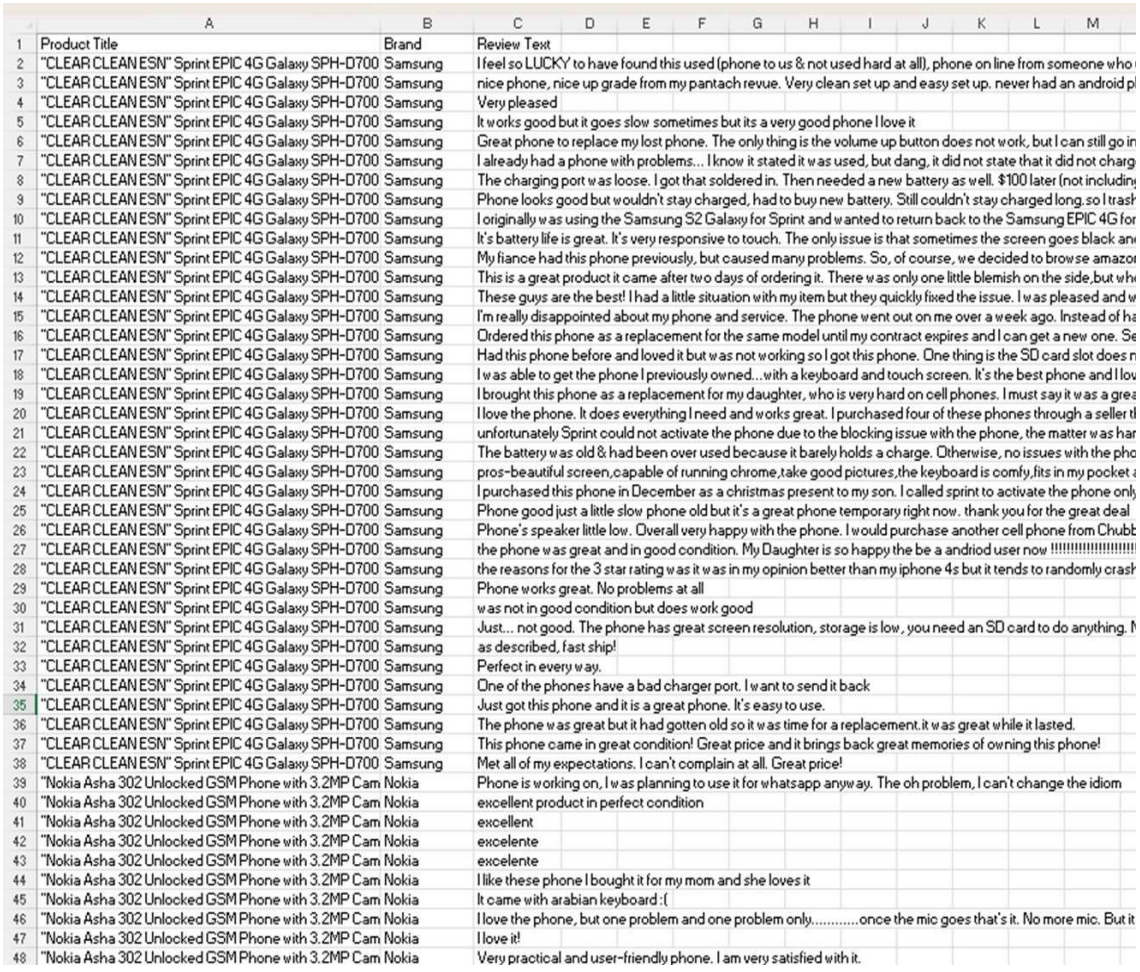


Architecture Overview

The architecture of the proposed product recommendation system is divided into two main components: the **frontend** developed using **React.js**, and the **backend** built with **Python** using frameworks like **FastAPI**. On the frontend, users interact with a clean and responsive interface built in React. They enter specific product preferences, such as “long battery life” or “high-resolution screen,” through input fields or forms. Once the user submits their preferences, the React application uses a library called **Axios** to send an HTTP POST request to the backend API. This request contains the user-specified features and optionally assigned weights that indicate the importance of positive or negative sentiments. The React app is also responsible for displaying the final list of recommended products returned by the backend in a user-friendly format.

On the backend side, **FastAPI** receives the incoming request and forwards the data to the **core PRUS logic**, which is implemented in Python. The backend system uses **TextBlob** (or similar NLP tools) to process a large number of customer reviews, breaking them into sentences, extracting product features, and assigning sentiment polarity (positive or negative) to each feature. This information is then fed into the **RANK-ify algorithm**, which calculates a ranking score for each product based on how well it matches the user’s query, considering both the frequency and sentiment strength of each feature. The products are sorted accordingly, and a top-N list is created. This ranked list is then sent back through the FastAPI response to the React frontend, where it is rendered for the user. This architecture ensures a modular, scalable, and highly personalized product recommendation experience based on actual customer feedback.

Data Set Description



	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Product Title	Brand	Review Text										
2	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	I feel so LUCKY to have found this used (phone to us & not used hard at all), phone on line from someone who										
3	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	nice phone, nice up grade from my pantach revue. Very clean set up and easy set up. never had an android p										
4	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	Very pleased										
5	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	It works good but it goes slow sometimes but its a very good phone I love it										
6	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	Great phone to replace my lost phone. The only thing is the volume up button does not work, but I can still go in										
7	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	I already had a phone with problems... I know it stated it was used, but dang, it did not state that it did not charg										
8	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	The charging port was loose. I got that soldered in. Then needed a new battery as well. $100 later (not includin										
9	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	Phone looks good but wouldn't stay charged, had to buy new battery. Still couldn't stay charged long, so I trash										
10	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	I originally was using the Samsung S2 Galaxy for Sprint and wanted to return back to the Samsung EPIC 4G for										
11	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	It's battery life is great. It's very responsive to touch. The only issue is that sometimes the screen goes black an										
12	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	My fiance had this phone previously, but caused many problems. So, of course, we decided to browse amazo										
13	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	This is a great product it came after two days of ordering it. There was only one little blemish on the side, but wh										
14	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	These guys are the best! I had a little situation with my item but they quickly fixed the issue. I was pleased and w										
15	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	I'm really disappointed about my phone and service. The phone went out on me over a week ago. Instead of ha										
16	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	Ordered this phone as a replacement for the same model until my contract expires and I can get a new one. Se										
17	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	Had this phone before and loved it but was not working so I got this phone. One thing is the SD card slot does n										
18	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	I was able to get the phone I previously owned...with a keyboard and touch screen. It's the best phone and I lov										
19	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	I brought this phone as a replacement for my daughter, who is very hard on cell phones. I must say it was a grea										
20	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	I love the phone. It does everything I need and works great. I purchased four of these phones through a seller t										
21	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	unfortunately Sprint could not activate the phone due to the blocking issue with the phone, the matter was har										
22	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	The battery was old & had been over used because it barely holds a charge. Otherwise, no issues with the pho										
23	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	pros-beautiful screen,capable of running chrome,take good pictures,the keyboard is comfy,fits in my pocket										
24	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	I purchased this phone in December as a christmas present to my son. I called sprint to activate the phone only										
25	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	Phone good just a little slow phone old but it's a great phone temporary right now. thank you for the great deal										
26	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	Phone's speaker little low. Overall very happy with the phone. I would purchase another cell phone from Chubb										
27	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	the phone was great and in good condition. My Daughter is so happy the be a andriod user now !!!!!!!!!!!!!!!!!!!										
28	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	the reasons for the 3 star rating was it was in my opinion better than my iphone 4s but it tends to randomly crash										
29	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	Phone works great. No problems at all										
30	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	was not in good condition but does work good										
31	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	Just... not good. The phone has great screen resolution, storage is low, you need an SD card to do anything. N										
32	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	as described, fast ship!										
33	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	Perfect in every way.										
34	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	One of the phones have a bad charger port. I want to send it back										
35	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	Just got this phone and it is a great phone. It's easy to use.										
36	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	The phone was great but it had gotten old so it was time for a replacement.it was great while it lasted.										
37	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	This phone came in great condition! Great price and it brings back great memories of owning this phone!										
38	"CLEAR CLEAN ESN" Sprint EPIC 4G Galaxy SPH-D700	Samsung	Met all of my expectations. I can't complain at all. Great price!										
39	"Nokia Asha 302 Unlocked GSM Phone with 3.2MP Cam	Nokia	Phone is working on, I was planning to use it for whatsapp anyway. The oh problem, I can't change the idiom										
40	"Nokia Asha 302 Unlocked GSM Phone with 3.2MP Cam	Nokia	excellent product in perfect condition										
41	"Nokia Asha 302 Unlocked GSM Phone with 3.2MP Cam	Nokia	excellent										
42	"Nokia Asha 302 Unlocked GSM Phone with 3.2MP Cam	Nokia	excelente										
43	"Nokia Asha 302 Unlocked GSM Phone with 3.2MP Cam	Nokia	excelente										
44	"Nokia Asha 302 Unlocked GSM Phone with 3.2MP Cam	Nokia	I like these phone I bought it for my mom and she loves it										
45	"Nokia Asha 302 Unlocked GSM Phone with 3.2MP Cam	Nokia	It came with arabian keyboard :(										
46	"Nokia Asha 302 Unlocked GSM Phone with 3.2MP Cam	Nokia	I love the phone, but one problem and one problem only.....once the mic goes that's it. No more mic. But it										
47	"Nokia Asha 302 Unlocked GSM Phone with 3.2MP Cam	Nokia	I love it!										
48	"Nokia Asha 302 Unlocked GSM Phone with 3.2MP Cam	Nokia	Very practical and user-friendly phone. I am very satisfied with it.										

- **Name:** Amazon Unlocked Mobile Review Dataset
- **Total Entries (Rows):** 413,840
- **Total Columns (Features):**3
- *Source*: **Kaggle Data set**
- *Data_set_Link*: **https://www.kaggle.com/datasets/PromptCloudHQ/amazon-reviews-unlocked-mobile-phones/data**

Functional Requirements

These define **what the system should do**:

1. **User Input of Preferences**
   Users should be able to enter specific product features (e.g., "battery life", "camera") via a web form.

2. **Submit Query to Backend**
   The system should send the user preferences and sentiment weights (positive/negative) to the backend API using Axios.

3. **Sentiment Analysis of Reviews**
   The backend should process reviews, perform sentiment analysis on each sentence, and identify feature-level sentiment using NLP tools like TextBlob.

4. **Feature Matching and Scoring**
   The backend should match user-specified features with review data and calculate ranking scores using the RANK-ify algorithm.

5. **Generate Ranked Product List**
   Based on user input and sentiment analysis, the system should return a list of ranked products.

6. **Display Results on Frontend**
   The ranked list of recommended products should be displayed in a clear and user-friendly way (e.g., cards, list, table).

7. **Handle Errors and Invalid Input**
   The system should validate input and gracefully handle missing data, API failures, or incorrect user queries.

Non-FunctionalRequirements

These define **how the system should behave**:

1. **Performance**
   The system should return ranked results within a few seconds of receiving the user input.

2. **Scalability**
   The backend should be designed to handle large datasets (e.g., thousands of reviews) and many users simultaneously.

3. **Security**
   Input should be sanitized to prevent injection attacks. Secure communication (e.g., HTTPS) should be used in production.

4. **Usability**
   The frontend should be intuitive, responsive (mobile-friendly), and easy to use for non-technical users.

5. **Maintainability**
   The codebase should be modular and well-documented to allow future updates or improvements to the algorithm or UI.

6. **Reliability**
   The system should remain available and correctly function even if one part (e.g., review sentiment) encounters errors.

7. **Portability**
   The application should be deployable across various environments (local, cloud platforms like Vercel/Render).