Software Development Plan

Sophros

A Health Planning App

ECE 49595SD – Software Section – Fall 2025

Team 2

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1. Project Overview

Sophros aims to revolutionize personal health by empowering individuals to live a healthy lifestyle. First, Sophros provides visibility to individuals' personal health levels by collecting disparate data on fitness level, nutrition, sleep, and weekly schedule. Second, Sophros will use this data to generate insights for the user to live healthier, particularly by generating a schedule. Third, Sophros will engage users by gamification of health progress and providing social networking to encourage friends' success.

2. Scope

There are multiple facets to Sophros that make scoping the tool particularly interesting. Sophros collates holistic lifestyle data to try and generate insights, planning for people to make it easier to be healthy. The table below shows our scope decisions for the tool:

Topic	In Scope	Under Evaluating	Out of Scope
Nutrients & Data	Macronutrient tracking Sleep tracking Exercise tracking	Micronutrient tracking	Amino Acid Tracking Food Nutrient Testing
Scheduling	Meal Scheduling Nutrient Scheduling Workout Scheduling Sleep Scheduling	On-The-Fly Updates	
Compatibility	iOS Mobile App Android Mobile App	Web App	Smart Watch App
Content	Meal Suggestions Grocery List Healthiness Score	Novel Recipe Generation Full Social Network	

Table 1: Functionality Scope

Macronutrient tracking will allow users to log foods and will compute daily totals of proteins, carbohydrates, and fats using the USDA nutrition database. These values are used by our optimization engine and health score. Exercise tracking means it will allow users to log minutes of light, moderate, and vigorous exercises via manual logging or automatic syncing. This data is used to estimate energy use and adjust calorie/macronutrient targets as well as for the health score. Sleep tracking records average sleep duration and times for use in the scheduling engine. Meal scheduling, workout scheduling, and sleep scheduling optimizes the times for each of these activities around someone's age and work/school schedule, and nutrient scheduling schedules nutrient intake around these activities (ex. Optimizing for higher energy before a workout). iOS/Android mobile apps will be the primary method for users to interact with our application. Meal suggestions will be the meal plans generated by our optimization engine, and the grocery list will be computed from this meal plan. Healthiness score is a holistic score of nutrient intake, sleep, and workouts for a user's age, sex, and other factors. This is also the score that our application tries to maximize via scheduling and meal plans.

Since our audience is primarily focused on maintaining and steadily improving lifestyle well-being, the focus of our scope is providing insights from convenient collection of data. Time management assistance is critically in-scope for the project, while carefully tracking every micronutrient is under evaluation for feasibility within our ease-of-use constraint.

a. Assumptions & Constraints

Audience: *We assume our audience is people who care about their health and want to improve their well-being by eating better and tracking nutrients, but do not have the time to research and create plans independently.*

Based on this audience, we assume that the audience …

1. Feels comfortable sharing their health data online
2. Prefers mobile interfaces over web interfaces
3. Focuses primarily on food and nutrition in health
4. Values speed usage over granular accuracy

On the technical front, we also make a series of assumptions that drive our architecture:

1. Assume stable internet connection with capacity for high-bandwidth data transfer
2. Assume professional data API from the USDA for food nutrition data
3. Assume availability of public recipe databases
4. Assume providing this advice does not constitute medical advising, or that no licensing is needed
5. Assume that we have the right to cache recipes, nutrition data, etc. from our providers

We also face a variety of constraints:

1. Limited Budget constrains our server usage, AI integration options, and which databases we can use for recipes and health data
2. Capacity and Processing Ability of Mobile Hardware limits our ability to compute recommendations locally and cache large amounts of data locally.

3. Requirements

a. Functional Requirements

1. ID: FR-1 User Profile
    a. Statement: The system shall maintain a profile for each user containing biological information including gender, age, weight, height, and physical activity. The system will allow the user to periodically update this data and will save a historical record of this data.
    b. Rationale: A detailed user profile is critical for nutritionally helpful insights and meal plan generation.
    c. Test Method: Test the page with 100 entries from an online database of medical data. Test succeeds if 98% of entries are accepted by the system.
    d. Supporting Context: This requirement assumes the user already has an account created. Detailed information is defined as the data used by the USDA for DRI (Dietary Reference Intake) calculations [1]. Baseline physical activity is measured on a scale of 1 to 4 (inactive, low active, active, and very active) for DRI calculation purposes.
    e. Trace: User sign up, user profile creation
    f. Priority: Must Have
2. ID: FR-2 User Authentication
    a. Statement: The system shall allow a user to create an account or login via email or an OAuth provider through a Clerk interface.
    b. Rationale: User accounts are required for personalized nutritional information and automated scheduling.
    c. Test Method: Test the page in Clerk's development mode with 100 dummy accounts. Test succeeds if 98% of accounts are successfully created and can log in.
    d. Supporting Context: This requirement assumes Clerk is running at time of testing. This requirement only concerns identity and access management. It does not store biological or lifestyle data, which are handled in FR-1.
    e. Trace: User authentication
    f. Priority: Must Have
3. ID: FR-3 Schedule forecaster
    a. Statement: The system shall provide the user with a personalized schedule of meals, workouts, and sleep based on the user's biological data.
    b. Rationale: Forecasting meals and lifestyle events automates decision-making and improves adherence to healthy habits.

    c. Test Method: For 20 fictional user profiles, compute reference calorie and macronutrient targets using the USDA DRI calculator [1]. Requirement passes if at least 90% of the days in each generated weekly meal plan keep macronutrient and micronutrient within the recommended ranges [1], and all plans schedule at least 7 hours of sleep per night and place workouts within the user's available time windows.
    d. Supporting Context: Forecasting is defined as AI-driven generation of weekly plans integrating nutritional and scheduling data.
    e. Trace: Health schedule generation, predictive meal planning
    f. Priority: Must have
4. ID: FR-4 Personalized insights
    a. Statement: The system shall generate adaptive insights based on the user's tracked performance and historical data to recommend behavior adjustments.
    b. Rationale: Personalized feedback increases engagement and supports long-term health outcomes.
    c. Test Method: Run 10 fictional test users for a simulated two-week period. Confirm that each user receives at least one adaptive recommendation aligned with tracked data changes.
    d. Supporting Context: Insights refer to auto-generated summaries and recommendations informed by stored biological and behavioral data. Historical data refers to information stored in the user database (FR-10) including user profile (FR-1) changes, daily nutrient intakes, and workout logs.
    e. Trace: Analytics, personalized recommendations.
    f. Priority: Should Have.
5. ID: FR-5 Progress tracking system (gamified UI)
    a. Statement: The system shall display user progress through gamified elements such as streaks, badges, and leaderboards based on activity adherence.
    b. Rationale: Gamification fosters user motivation and retention by rewarding consistent engagement.
    c. Test Method: Simulate user activity logs over a 4-week period and verify that badges, streak counters, and the leaderboard update correctly 95% of the time.
    d. Supporting Context: Gamified progress tracking includes elements like streak counters, badge unlocks, and leaderboards. Streaks will be based on daily use of the application. Badges will be based on milestones such as following a meal plan for 30 days or logging 100 workouts. Leaderboards will use streak length to rank users.
    e. Trace: Progress visualization, user retention system.
    f. Priority: Should Have.
6. ID: FR-6 Recipe API Connection

    a. Statement: The system shall connect to a recipe database API to retrieve meals that meet users' macronutrient and dietary preferences.
    b. Rationale: Automated recipe retrieval saves time and ensures meal plans align with nutritional requirements.
    c. Test Method: Query the API 100 times with different nutritional constraints. Requirement passes if 95% return valid recipes matching parameters.
    d. Supporting Context: "Valid recipe" means one that includes full nutritional data and ingredient lists compatible with USDA nutritional models.
    e. Trace: External data integration, nutritional content sourcing.
    f. Priority: Must Have.
7. ID: FR-7 Nutrition Optimization Engine
    a. Statement: The system shall use a Gurobi-style optimization engine to generate optimal meal and activity schedules based on a user's biological data, user preferences, and time constraints.
    b. Rationale: Optimization ensures that schedules and meal plans are efficient, realistic, and aligned with user-defined objectives.
    c. Test Method: Run the optimization for 20 distinct user profiles. Requirement passes if each resulting schedule satisfies all user constraints and achieves ≥95% adherence to nutritional goals.
    d. Supporting Context: Gurobi is a mathematical optimization library used to balance variables such as nutrition, schedule timing, and activity availability. The optimization engine uses DRI-based targets [1] and a user's schedule to distribute nutrients across meals and days.
    e. Trace: Recipe generation and scheduling optimization.
    f. Priority: Must Have.
8. ID: FR-8 LLM integration
    a. Statement: The system shall use an LLM to generate recipe suggestions, motivational insights, and adaptive schedules based on user input.
    b. Rationale: Natural language generation increases personalization and user understanding of data-driven results.
    c. Test Method: Provide 20 distinct input prompts to the LLM API; verify that ≥90% of responses are contextually accurate, readable, and match intended functions.
    d. Supporting Context: LLM refers to the OpenAI API integrated with the backend through FastAPI.
    e. Trace: Recipe generation, insight creation.
    f. Priority: Should Have.
9. ID: FR-9 Data cache
    a. Statement: The system shall locally cache USDA and recipe API query results to reduce repeated requests and improve performance.

b. Rationale: Caching reduces API latency, minimizes request limits, and increases data access speed.
c. Test Method: Perform 200 repeated API calls for 20 unique foods. requirement passes if the second set of calls retrieves ≥90% of data from the cache rather than the API.
d. Supporting Context: Cached data refers to locally stored API responses for foods, recipes, and nutrient metadata updated within the last 24 hours.
e. Trace: Performance optimization, data retrieval efficiency.
f. Priority: Should Have.

10. ID: FR-10 User database
    a. Statement: The system shall store all user-related data, including profiles, plans, progress, and preferences, in a PostgreSQL database.
    b. Rationale: Centralized storage ensures data persistence, scalability, and secure access.
    c. Test Method: Perform 1,000 read/write/delete operations. Test succeeds if all complete with <1% error rate.
    d. Supporting Context: Progress refers to historical profile data, logged nutrients and workouts, and other historical data.
    e. Trace: Data management and persistence.
    f. Priority: Must Have.
11. ID: FR-11 Nutrition API Connection
    a. Statement: The system shall retrieve nutritional data for ingredients and meals using the USDA FoodData Central API to support accurate DRI calculations and nutrient breakdowns.
    b. Rationale: Using verified nutritional data ensures accuracy in dietary recommendations and compliance with dietary standards.
    c. Test Method: Perform 100 queries with different food items; requirement passes if ≥95% of responses return valid nutrition data including macronutrient values.
    d. Supporting Context: USDA FoodData Central API provides nutritional data including macronutrients, micronutrients, and caloric content for common foods.
    e. Trace: Data integration, nutritional information retrieval.
    f. Priority: Must Have.
12. ID: FR-12 Social Element
    a. Statement: The system shall allow the users to add friends and view leaderboards that compare streak lengths among those friends.
    b. Rationale: Social comparison encourages accountability and motivation.
    c. Test Method: Create 20 test accounts, define friendship relationships, and simulate activity to generate streaks. Requirement passes if each user's leaderboard shows their friends and rankings based on streak length.
    d. Supporting Context: "Friends" are mutually accepted connections.

    e. Trace: Social engagement, progress visualization
    f. Priority: Could Have.

b. Non-functional Requirements

1. ID: NFR-1 Performance
    a. Statement: The system shall respond to user actions within 2 seconds under normal load, excluding external API delays.
    b. Rationale: Fast response times improve usability and user satisfaction.
    c. Test Method: Simulate 50 concurrent users and measure response latency. Requirement passes if ≥95% of actions complete in under 2 seconds.
    d. Supporting Context: Normal load defined as 50 concurrent users performing typical operations.
    e. Trace: Frontend performance and responsiveness.
    f. Priority: Must Have.
2. ID: NFR-2 Reliability
    a. Statement: The system shall maintain 99.5% backend service uptime each month.
    b. Rationale: Reliable uptime ensures consistent user access and trust in the product.
    c. Test Method: Monitor system uptime with AWS CloudWatch over 30 days. Passes if uptime ≥99.5%.
    d. Supporting Context: Uptime includes API, database, and hosting availability.
    e. Trace: Backend service reliability.
    f. Priority: Must Have.
3. ID: NFR-3 Security
    a. Statement: The system shall encrypt all user data in transit using TLS 1.3 and at rest using AES-256.
    b. Rationale: Strong encryption is essential to protect sensitive health and personal data.
    c. Test Method: Perform security audit and confirm encryption via OWASP-compliant penetration testing [2].
    d. Supporting Context: TLS (Transport Layer Security) protects data in transit; AES (Advanced Encryption Standard) protects data storage.
    e. Trace: Data protection and privacy.
    f. Priority: Must Have.

4. Deliverables

1. Deliverable Description: A production-quality mobile application published to the iOS App Store and Google Play Store that allows users to capture and learn from their health data.
    a. Relevant Requirements: FR-1 User Profile, FR-2 User Authentication, FR-3 Schedule forecaster, FR-5 Progress tracking system (gamified UI), NFR-1 Performance, NFR-2 Reliability, NFR-3 Security
2. Deliverable Description: A high-reliability AWS server that processes user data and provides recommendations, while interfacing with datasets to determine recipes and nutritional content.
    a. Relevant Requirements: FR-2 User Authentication, FR-4 Personalized insights, FR-6 Recipe API Connection, FR-7 Nutrition Optimization Engine, FR-8 LLM integration, FR-9 Data cache, FR-10 User database, FR-11 Nutrition API Connection, NFR-2 Reliability, NFR-3 Security

5. Development Methodology

We chose scrum as our development methodology. Scrum fits Sophros because it is a complex, feature-rich mobile app with a cloud backend with many uncertainties around UX, optimization, and LLM behavior. We also have a fixed semester interval with maps naturally to sprints as well as pre-planned sprints in the form of a Gantt chart. We have prioritized “Must have” and “Should have” requirements which aligns with scrum’s incremental planning. Scrum will let us deliver working increments that we can demo and adapt to feedback and testing incrementally throughout the semester.

6. Verification and Validation Plan

Team 2 - Verification & Validation Plan

7. Gantt Chart

Team 2 - Gantt Chart.xlsx

8. Bibliography

[1] U.S. Department of Agriculture, "DRI Calculator for Healthcare Professionals," [Online]. Available: https://www.nal.usda.gov/human-nutrition-and-food-safety/dri-calculator. [Accessed 2 December 2025].

[2] The OWASP Foundation, "OWASP Application Security Verification Standard," 12 November 2025. [Online]. Available: https://github.com/OWASP/ASVS?tab=readme-ov-file. [Accessed 2 December 2025].