Final Project Proposal:

Personalized Workout and Diet Planning System Using Algorithmic Optimization

CS5800 Final Project

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Context and Personal Relevance:

Maintaining a healthy lifestyle is challenging due to differences in fitness goals, health conditions, and dietary preferences. Generic workout and diet plan often fail to meet individual needs, leading to poor results and low adherence. Our project aims to create a personalized workout and diet planning system that uses algorithmic strategies to deliver tailored recommendations.

This problem is personally meaningful to our team.

Weifan's background in Human Nutrition has shown him the importance of personalized plans in improving health outcomes. Hui Zheng has experienced the difficulty of finding fitness plans that fit their unique schedule and diet, inspiring a data-driven solution. Ziqi Shao is passionate about optimization and machine learning and sees this project as an opportunity to apply algorithmic thinking to personal health management.

Scope of the Project

The primary goal of this project is to develop and evaluate algorithms that generate optimized workout and diet plans tailored to individual users. Our system will take into account personal data such as age, gender, body metrics, activity levels, fitness goals, dietary restrictions, and health conditions. Based on these inputs, it will generate a weekly workout schedule and meal plan aimed at achieving the user's specific objectives, such as weight loss, muscle gain, or endurance improvement.

In Scope:

- Development and comparison of multiple algorithms for personalized planning:
    - **Greedy algorithms** for immediate goal optimization (e.g., maximizing protein intake per meal for muscle gain).
    - **Dynamic programming** for balancing long-term goals (e.g., maintaining macronutrient balance over a week).
    - **Genetic algorithms** (GA) for multi-objective optimization, balancing competing goals like calorie control, nutrient density, and workout intensity.
    - **Collaborative filtering** for recommending workouts and meals based on user similarities and past preferences.
- Evaluation of algorithmic performance in terms of efficiency, scalability, and effectiveness.
- Testing with both real-world datasets and synthetic user profiles to simulate diverse scenarios.

Out of Scope:

Real-time biometric data tracking (e.g., heart rate monitoring), Integration with third-party devices or mobile applications, Medical diagnostics or clinical health advice, Food delivery or purchase systems.

Plans of Action

Accomplishments So Far

We have finalized the problem statement and project scope, conducted a literature review on relevant algorithms and personalization methods, identified datasets for nutrition and workout data, and delegated team roles. Weifan will focus on optimization algorithms and nutritional modeling, Hui Zheng will work on workout generation and evaluation metrics, and Ziqi Shao will handle data preprocessing and algorithm comparison.

Next 4 Weeks Plan

In **Week 1**, we will finalize system requirements, complete data preprocessing from sources like USDA Food Data Central and workout datasets, and implement a baseline greedy algorithm for meal and workout selection. During **Week 2**, we will develop dynamic programming algorithms to balance meals and workouts over time and begin prototyping a genetic algorithm for multi-objective optimization. In **Week 3**, we will implement collaborative filtering for personalized recommendations and start testing the algorithms on synthetic user data. By **Week 4**, we will analyze and compare the algorithms in terms of accuracy, efficiency, and scalability, refine them based on results, and prepare the final documentation, visualizations, and presentation.

Data:

We will use a combination of real-world datasets and synthetic user profiles for testing and evaluation:

1. **USDA Food Data Central** (https://fdc.nal.usda.gov/): Provides comprehensive nutritional information for a wide variety of foods, essential for meal plan generation and dietary optimization.
2. **Workout and Exercise Datasets** (sourced from Kaggle and other public repositories): Contain categorized exercises by muscle group, intensity, equipment, and duration, which will inform workout plan generation algorithms.
3. **Synthetic User Profiles**: We will create diverse profiles simulating different fitness levels, health conditions, and goals to test the adaptability and effectiveness of our algorithms.

By working with real-world datasets and designing multiple algorithmic strategies, this project provides an opportunity to explore the trade-offs between algorithm complexity, efficiency, and personalization. Additionally, it allows us to apply and evaluate multi-objective optimization and collaborative filtering techniques in a practical, health-related context.