A Food Constraint Satisfaction System Based on Genetic and Random Walk Algorithms

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1.Introduction

The paper introduces a novel food constraint satisfaction system designed for obese individuals, utilizing Genetic Algorithms (GA) and Random Walk (RW) methods to generate suitable daily food recommendations based on an individual's Body Mass Index (BMI) and Basal Metabolic Rate (BMR). This system aims to help individuals adhere to a dietary regimen that meets their daily needed calorie intake (DNC) and saturated daily needed calorie intake (DNCsat) while considering their food preferences.

2.Problem

The study addresses the issue of overweight and obesity by focusing on a finite Constraint Satisfaction Problem (CSP) that involves selecting appropriate food items for breakfast, lunch, and dinner. The system's primary objective is to recommend food sets that satisfy the user's daily caloric needs and preferences without exceeding the DNCsat, calculated based on the individual's BMI and BMR values.

3.System Design and Methodology

The system estimates the user's overweight value using their BMI and BMR and then calculates their DNC and DNCsat values. The user can choose from a predefined set of food items for each meal, and the system then evaluates the total caloric intake (Overall Daily Calorie, ODC) from these selections. The aim is to match the ODC with the DNCsat using two approaches:

a.

Genetic Algorithm (GA): A population-based search algorithm that uses a non-binary string representation for food choices. The GA operations include:

Chromosome Initialization: Represents the initial food choices.

Fitness Calculation: Based on how closely the ODC matches the DNCsat.

Crossover and Mutation: Generate new food sets by swapping parts of parent chromosomes, with mutation changing food items to explore diverse choices.

b.

Random Walk (RW) Algorithm: This method involves randomly navigating through food choices until a set is found that meets the DNCsat. Each step in the random walk is evaluated based on its calorie content relative to the user's needs.

4.Results and Evaluation

The study's simulations demonstrated that the Random Walk algorithm outperformed the Genetic Algorithm in terms of speed and computational efficiency, effectively generating food sets that matched the users' caloric requirements and preferences. The GA, while effective in exploring diverse food sets, was found to be computationally expensive due to the large number of iterations and population size required for convergence.

5.Importance of BMI and BMR

BMI and BMR are critical in this system as they form the basis for calculating the DNC and DNCsat. The paper details the mathematical formulations for BMI and BMR and how these are used to determine the caloric deficit needed for weight loss, providing a scientific approach to dietary management.

6.Food Constraints and Data

The study incorporates a diverse set of food items, categorized into vegetarian and non-vegetarian options, to cater to different user preferences. A dataset of 500 food items, primarily from Asian (mainly Indian) and Western cuisines, is used to generate the daily food sets. The system defines 20 food constraint variables, which the user can select to ensure their dietary preferences are met.

7.Conclusion

The paper presents a robust solution to the food constraint satisfaction problem using both GA and RW algorithms. The RW algorithm, in particular, is highlighted for its efficiency in finding suitable food sets quickly. This system is a promising tool for dietary management, particularly for individuals with obesity, helping them adhere to a structured diet while considering personal food preferences.

8.Future Goal

The study suggests improvements in the mutation probabilities of GA and further exploration of RW methods to enhance the system's performance. Additionally, expanding the food dataset and incorporating more complex constraints like nutritional balance (e.g., protein, fat, and carbohydrate ratios) could improve the system's effectiveness.

References

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