



Genetic Algorithm to reverse engineer ice cream product recipe from ingredient lists and nutrition information

Introduction

In the fast-moving goods sector, ice cream stands as a prominent dessert with a dynamic range of formulations. Staying updated with changes in competing products is paramount, given the competitive nature of the industry. A significant challenge is unraveling the specific compositions of these products, especially since manufacturers are mandated to disclose only limited information. This project aims to reverse-engineer ice cream products to determine ingredient quantities, a task of considerable commercial importance.

Methods

- USDA's "SR Legacy" and "FNDDS" datasets
- TF-IDF and cosine similarity for related food
- Prioritized and selected key ingredients
- DEAP's modules for Genetic Algorithm
- hyperparameter tuning
- Wall's Soft Scoop Vanilla, Tesco Neapolitan, Carte D'or Strawberry, Mars, and Tesco Strawberry & Vanilla Cones

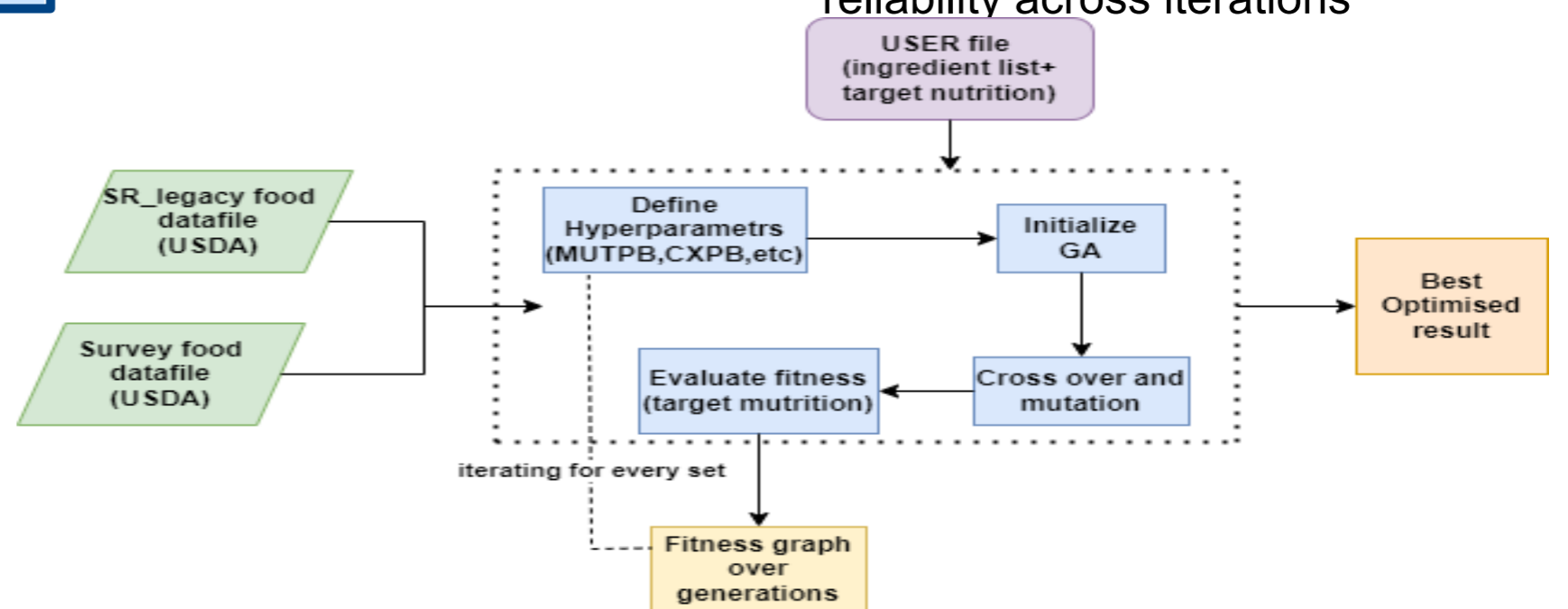


Fig1. Workflow of Genetic Algorithm-based Recipe Reverse Engineering

Results

- For the tested ice creams, consistent fitness values above 0.9 were achieved across 10,000 generations for most of them
- Optimized hyperparameters:
Crossover probability (CXPB): 0.8
Mutation probability (MUTPB): 0.3
Sigma for mutation: 10
Selection method: Tournament (size 5)

Conclusions

Genetic algorithms, fine-tuned with specific hyperparameters, were employed to reverse engineer ice cream recipes. With most scores surpassing 0.9 fitness, indicates the effectiveness of the method. A significant remark is the importance of starting with the right ingredients. Nevertheless, with the proper domain knowledge, genetic algorithms can be a valuable tool for deciphering complex recipes and serve as a precursor for further exploration in the field.

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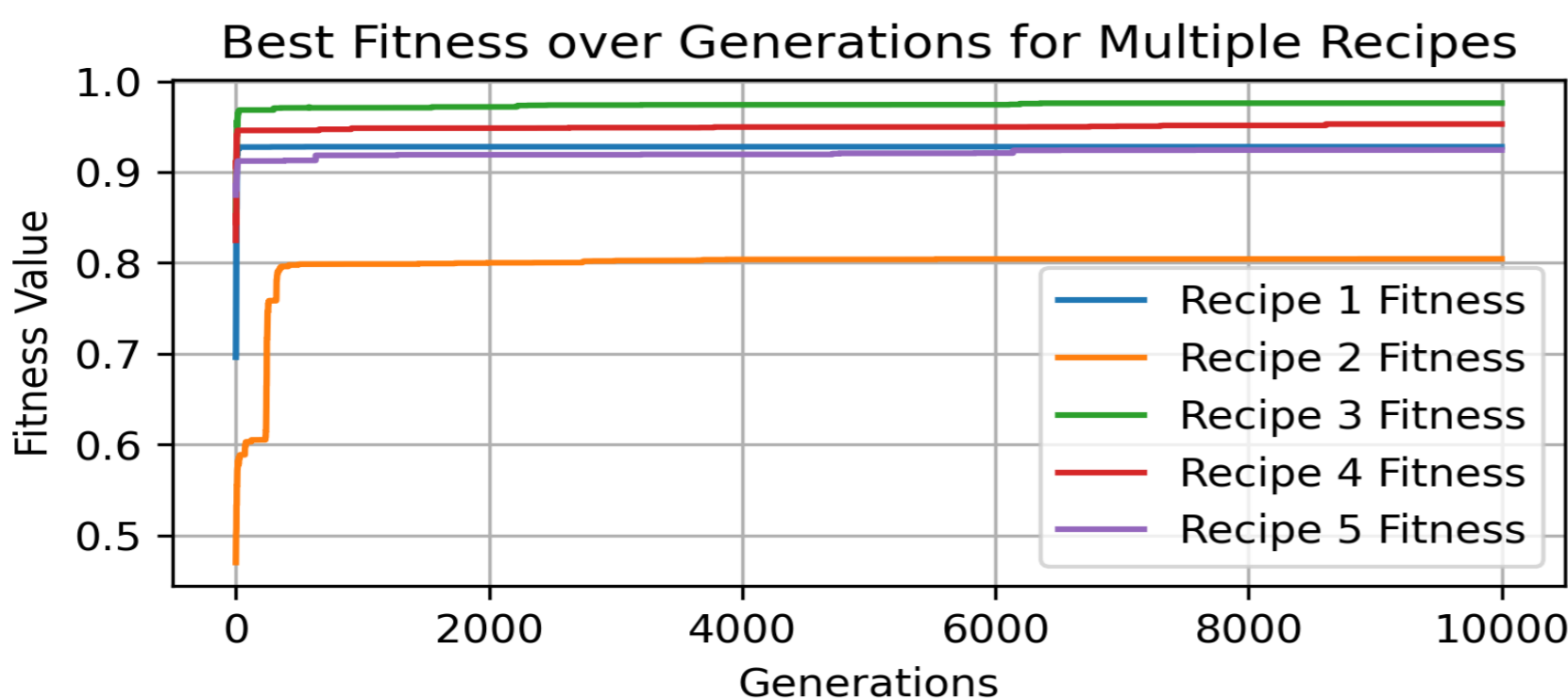


Fig2. Ice cream recipe fitness over 10000 generations

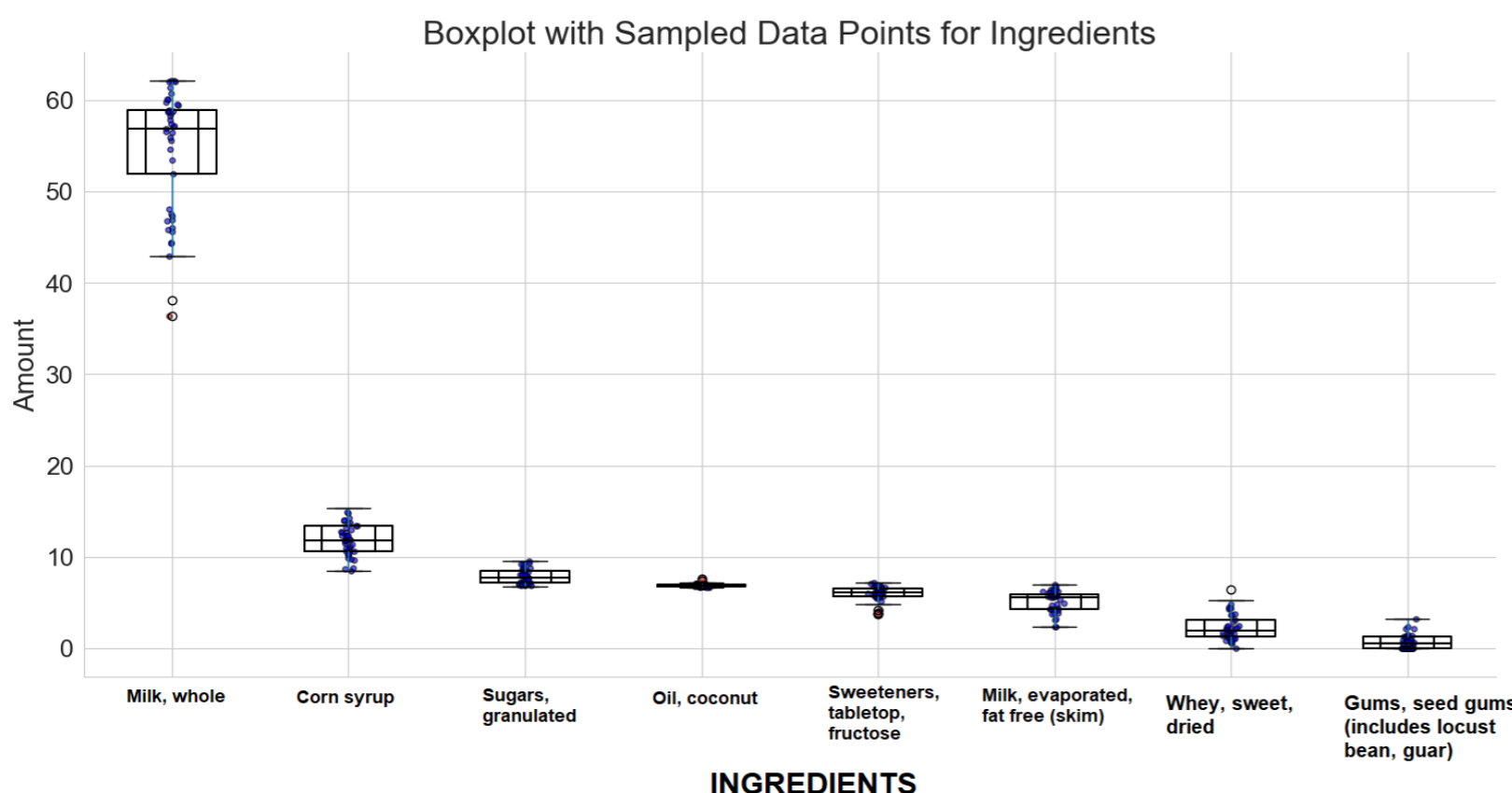


Fig3. Distribution and Outliers of Ingredient Amounts