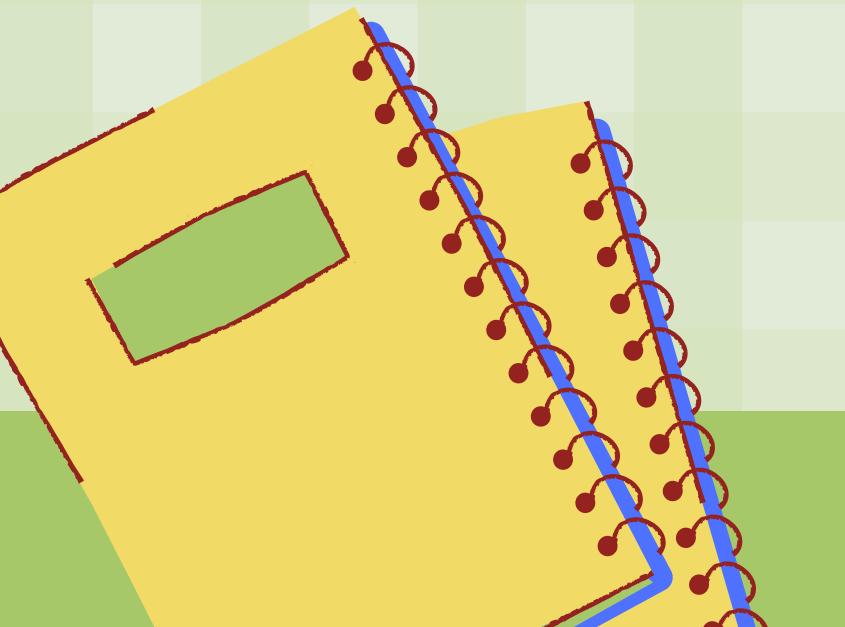


AI-POWERED PERSONALIZED MEAL PLANNER

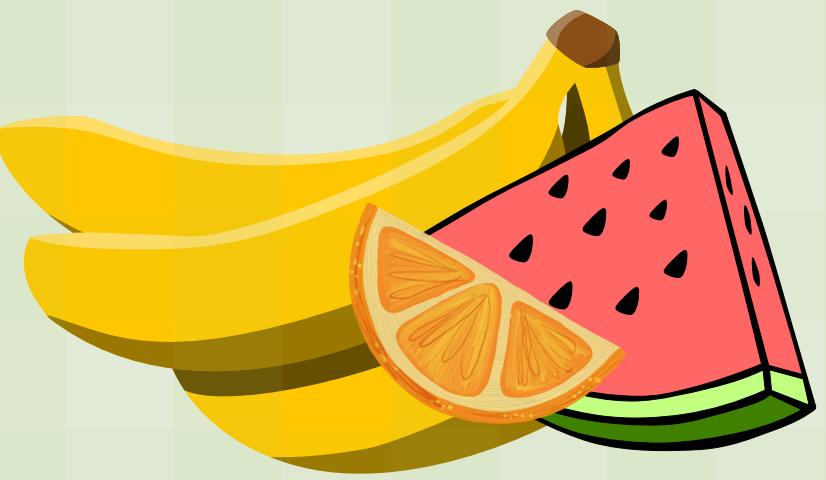
DATA 606: CAPSTONE IN DATA SCIENCE

Presented by: Madhu Priya P
Under the Guidance of Dr. Chaojie Wang



INTRODUCTION

- The AI-Powered Meal Planner generates personalized daily meal plans based on calorie needs and nutritional goals.
- Uses unsupervised learning (clustering) to group foods into meaningful nutritional categories.
- Employs a OLLAMA to generate customized meal plans, recipes, and grocery lists.
- Outputs include recipe suggestions, grocery lists, and a macros donut chart for balanced nutrition.

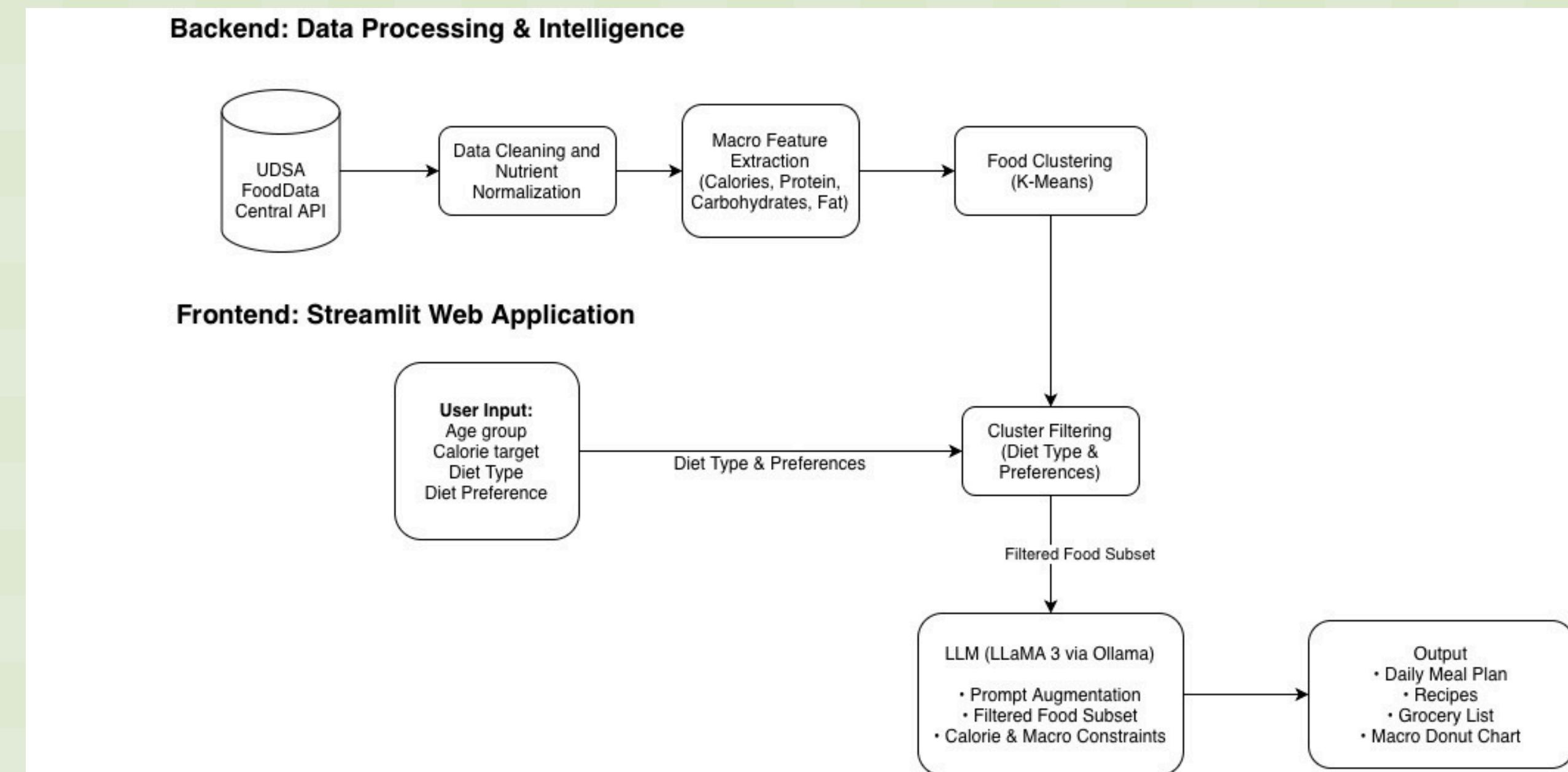


RESEARCH QUESTIONS

- * How can clustering group foods by nutritional similarity?
- * Can an LLM generate meal plans aligned with macro goals?
- * How can we make it actionable for users?



SYSTEM ARCHITECTURE OVERVIEW



DATA OVERVIEW

- Primary Source: USDA FoodData Central API.
- ~20,000 items, reduced to 19,000 cleaned food records.
- Key Features: calories, protein_g, carbs_g, fat_g, fiber_g.
- Engineered ratios: calorie-to-protein, macro percentages.



DATA CLEANING PIPELINE

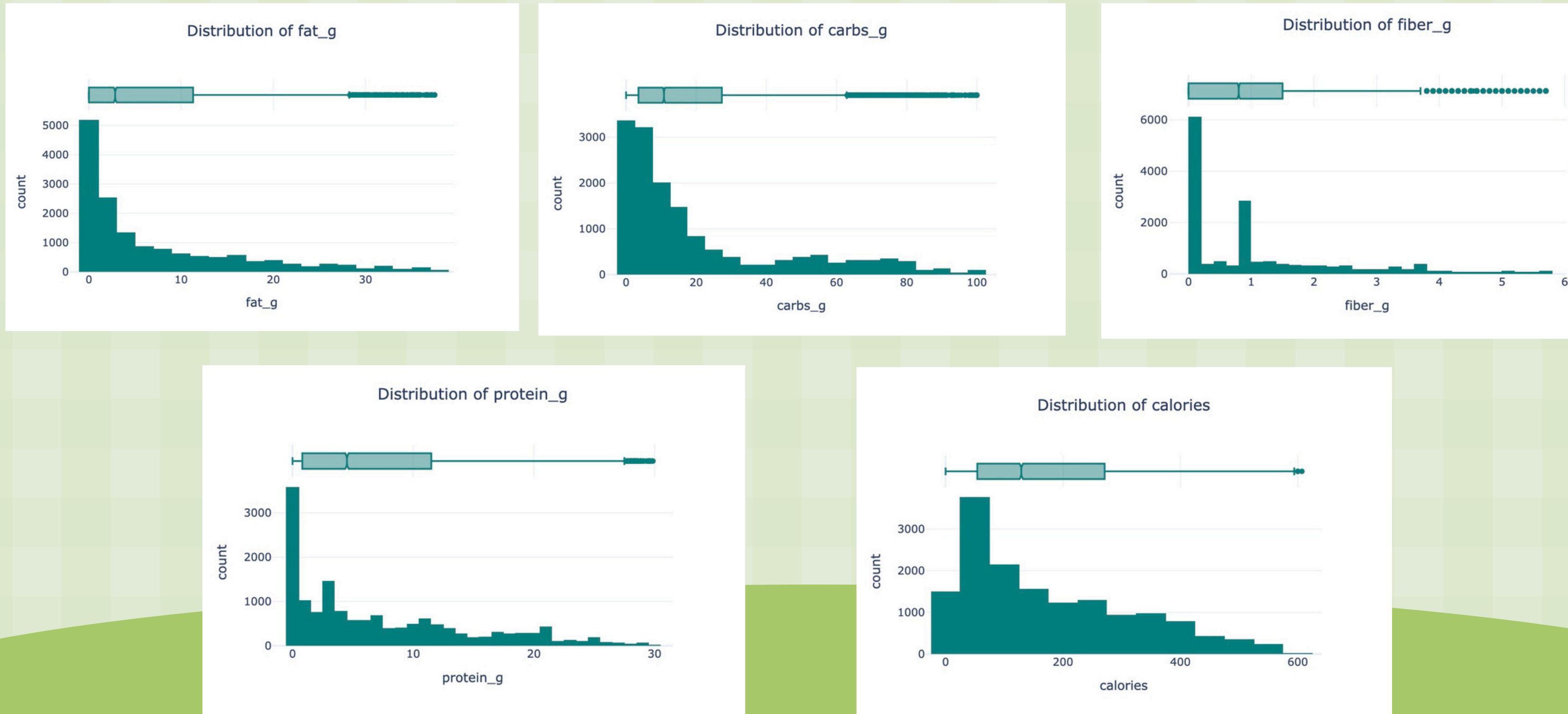
- Dropped all-null columns (sugar_g)
- Median imputation for partial missing values
- Calorie recomputation formula: Calories=4×(protein+carbs)+9×fat
- Scaled using z-score normalization



EDA



All nutrient distributions are right-skewed, showing that most foods are low in calories, fat, carbs, protein, and fiber, with a few high-value outliers.

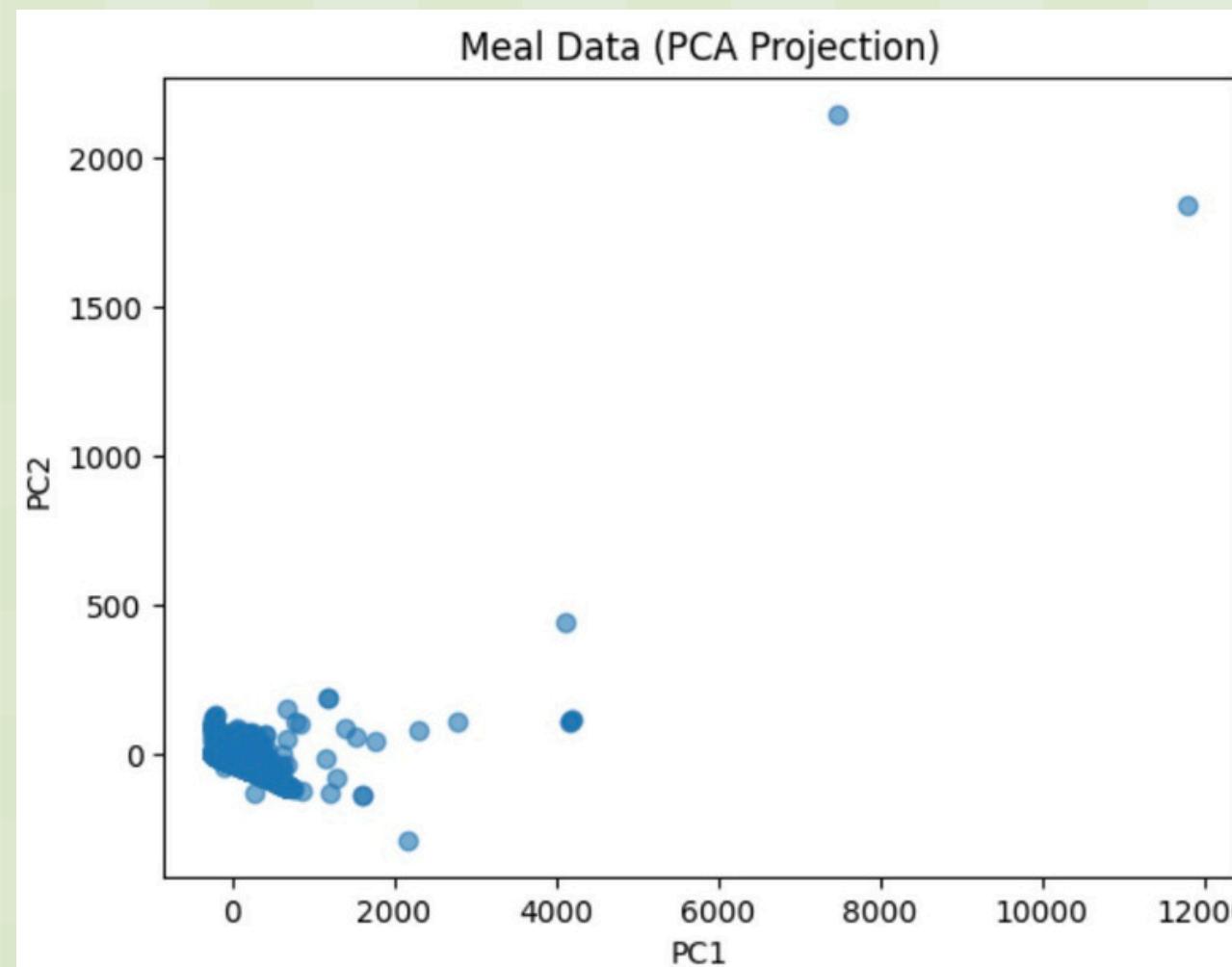


PCA ANALYSIS

Before Cleaning:

Outliers distorted variance (one extreme point).

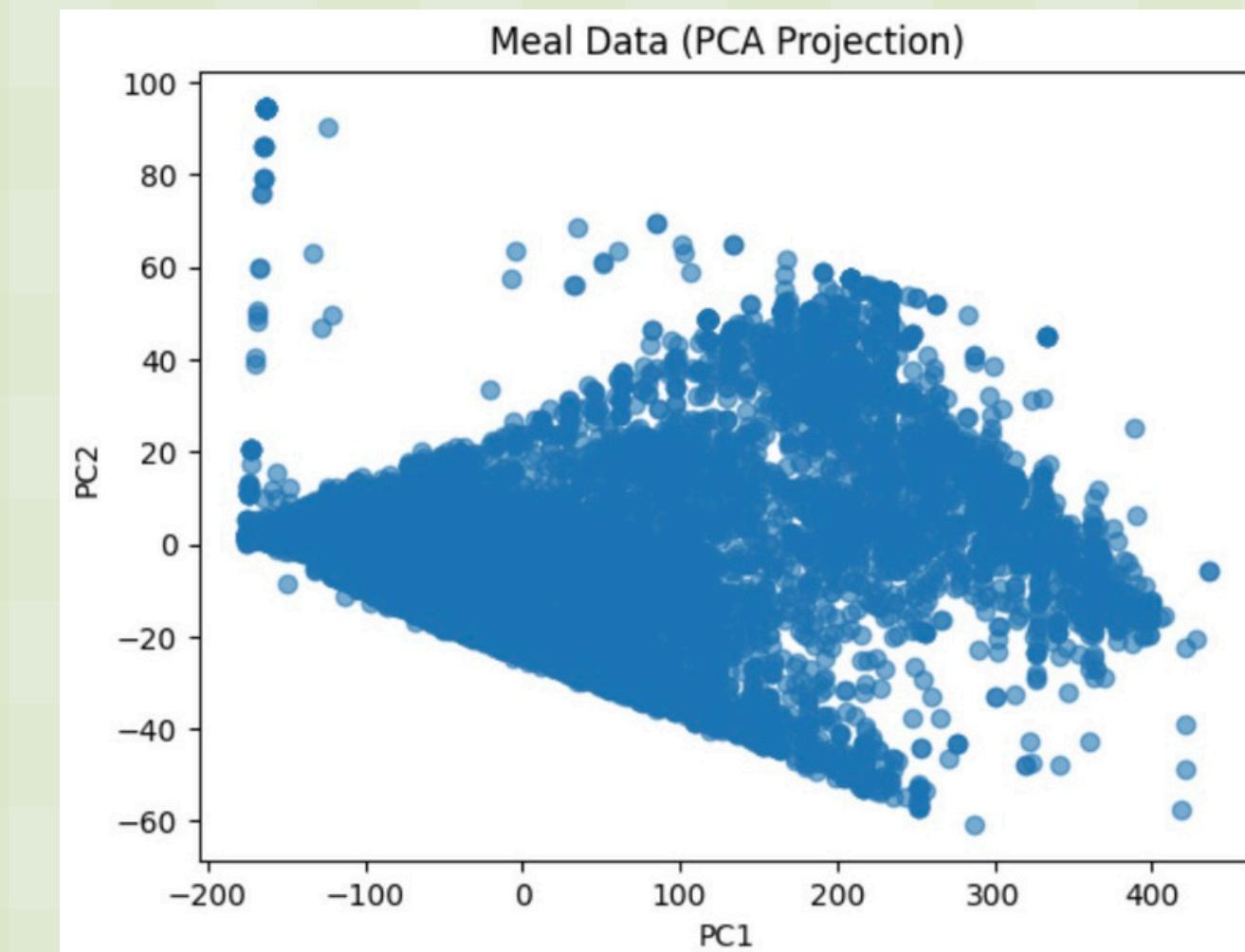
Data heavily skewed by high-calorie foods.



After Cleaning:

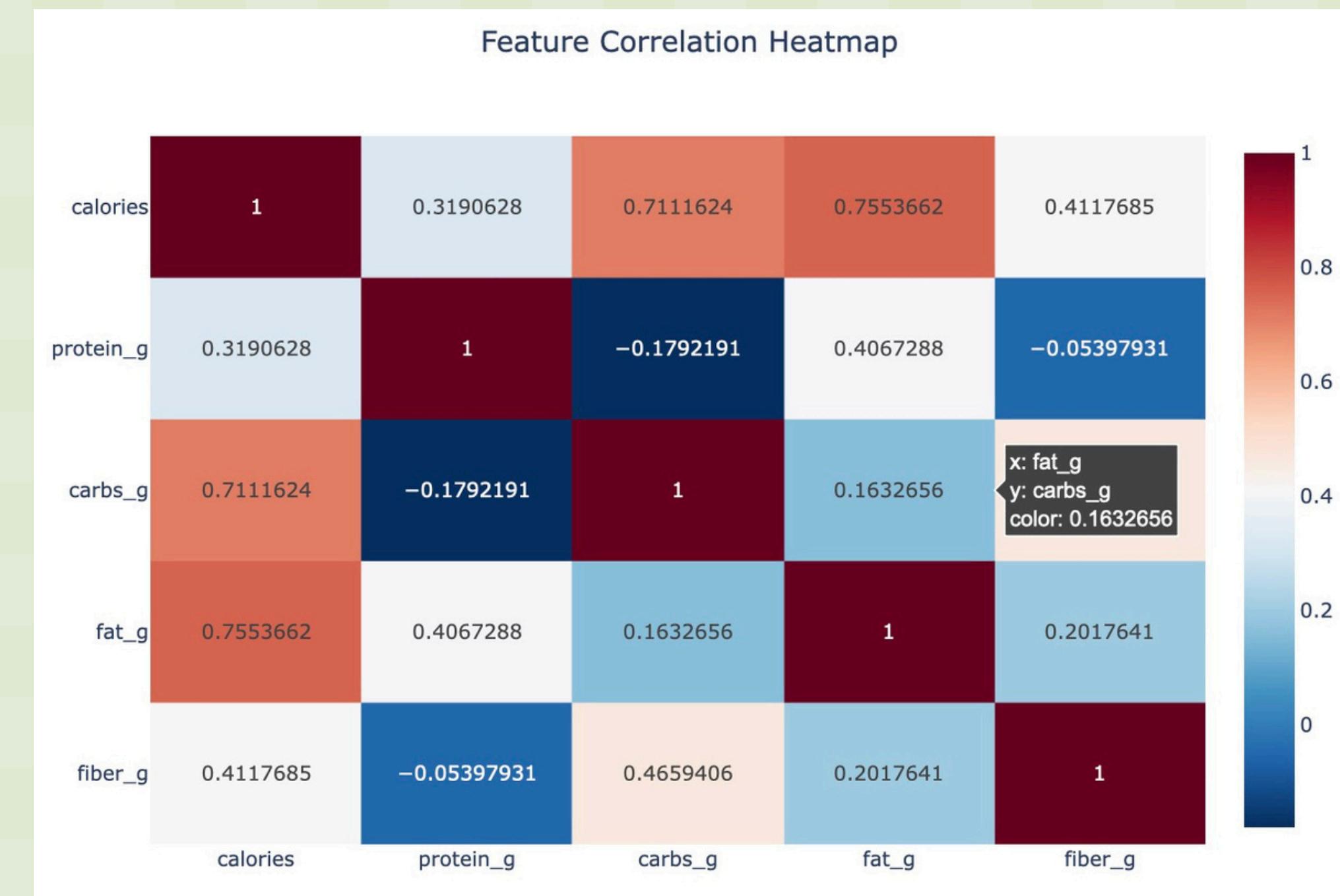
Compact, balanced distribution.

Nutrient patterns clearly visible for clustering.



CORRELATION HEATMAP

Calories show strong positive correlations with fat ($r \approx 0.76$) and carbs ($r \approx 0.71$), indicating these nutrients are the main contributors to energy content.

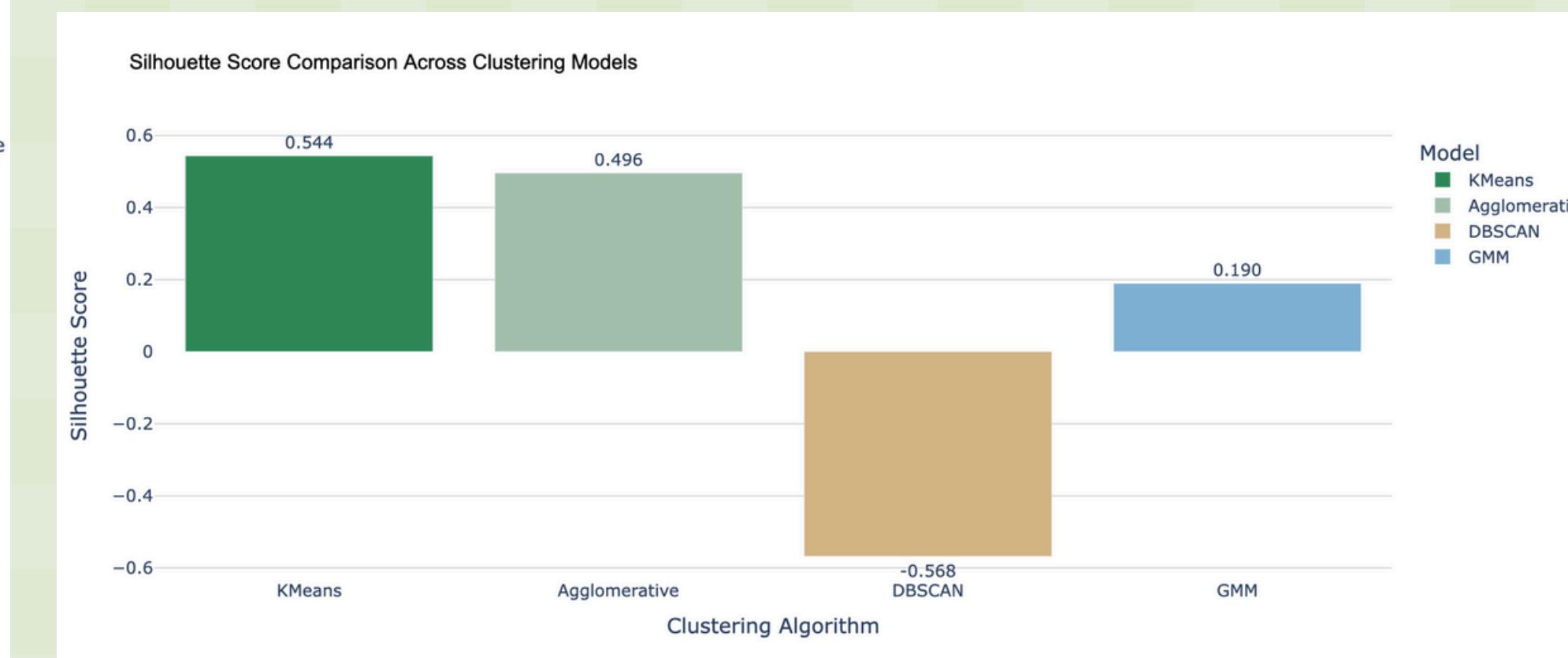
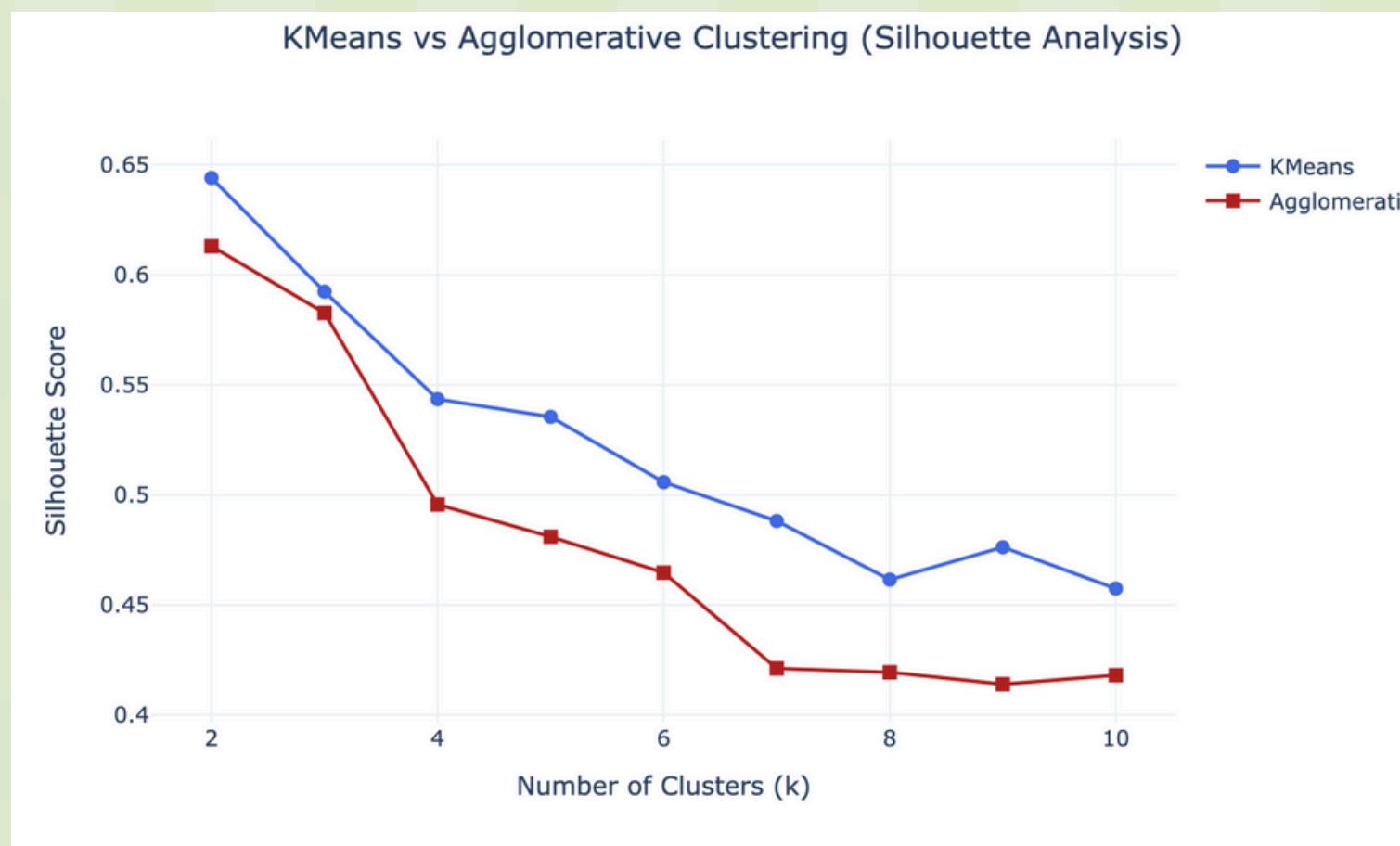


MODELING APPROACH & CLUSTER INSIGHTS

Evaluated model quality using:

- Silhouette Score
- Elbow Method

Final choice: K-Means with $k = 4$ clusters



FINAL CLUSTERS

Cluster names were assigned based on the mean nutrient values within each cluster, reflecting their dominant nutritional characteristics.

Cluster	Calories	Protein (g)	Carbs (g)	Fat (g)	Fiber (g)	Category Label
0	479.47	7.19	59.23	23.51	2.56	Carb-Dense Balanced Meals — Ideal for Weight Gain
1	55.02	4.07	7.39	1.23	0.62	Low-Calorie Light Foods — Ideal for Weight Loss
2	332.71	9.56	45.49	12.49	1.46	Protein-Rich Balanced Meals — Ideal for Maintenance
3	188.33	11.34	15.15	9.03	1.05	High-Protein Energy Meals — Ideal for Maintenance or Muscle Gain

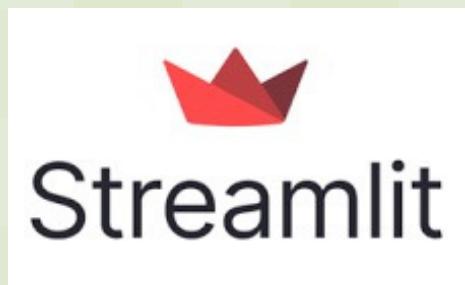
INTEGRATION WITH LLM

- Used structured prompt containing cluster stats + calorie targets + age group + use preference.
- LLM generated:
 - 3 meals per day.
 - Recipe descriptions, Grocery list.
 - Macro details.
- Ensures contextual consistency with nutrition data.



TECH STACK

Frontend



Machine Learning & LLM



LLaMA 3 via Ollama

Data Source

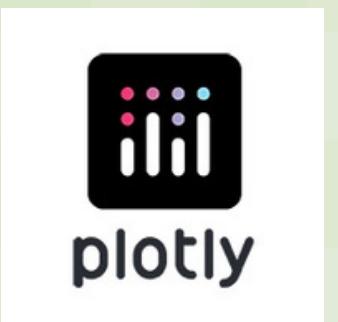


FoodData Central API

Core Application & Orchestration



Visualization



STREAMLIT WEB APP

- Built interactive dashboard for user-friendly planning.
- Generates visual macros with Plotly.

The screenshot displays a Streamlit web application interface. On the left, a sidebar titled "Meal Plan Settings" contains fields for age group (26-35), daily calorie goal (1800 kcal, set via a slider from 1200 to 2500), diet type (High-Protein Energy Meals), and diet preference (Pescatarian). On the right, the main dashboard is titled "AI Meal Planner Assistant". It features a navigation bar with "Meal Plan & Macros" (highlighted in red), "Recipes", and "Grocery List". A "Generate Meal Plan" button is present. Below it, a section titled "Generating meal plan for: High-Protein Energy Meals — Ideal for Maintenance or Muscle Gain (Target: 1800 kcal)" is shown. Under this, the "AI-Generated Meal Plan" section details a 1-day meal plan for a 26-35 year old following a Pescatarian diet with a 1800 kcal target. The "Breakfast" section lists a "Tuna Scramble" dish with its ingredients, description, and nutritional values (Calories, Protein, Carbs, Fat). The "Lunch" section is partially visible at the bottom.

Meal Plan Settings

Select your age group:

26-35

Select your daily calorie goal (kcal):

1800

Diet Type

High-Protein Energy Meals — Ideal for Maintenance or Muscle...

Diet Preference

Pescatarian

Deploy :

AI Meal Planner Assistant

Meal Plan & Macros Recipes Grocery List

Generate Meal Plan

Generating meal plan for: High-Protein Energy Meals — Ideal for Maintenance or Muscle Gain (Target: 1800 kcal)

AI-Generated Meal Plan

Here is a detailed 1-day meal plan for a 26-35 year old who follows a Pescatarian diet and has a daily calorie goal of 1800 kcal:

Breakfast

Meal Name	Ingredients	Description	Calories (kcal)	Protein (g)	Carbs (g)	Fat (g)
Tuna Scramble	1/2 cup cooked tuna, 1 egg, 1/4 cup spinach, 1 tablespoon olive oil, salt and pepper to taste	Scrambled eggs with tuna, spinach, and a hint of Mediterranean flavor	340	30.5	6.5	20

Lunch

APPLICATIONS

- Personal & fitness nutrition apps
- Healthcare diet planning
- Wellness and lifestyle platforms

LESSONS LEARNED

- Cleaning & scaling = better clustering
- ML + LLMs → human-like nutrition insights



LIMITATIONS

- Limited to USDA foods
- Macros only, no micronutrients
- LLM portion estimates may vary

FUTURE WORK

- Add global food data
- Streamlit cloud deployment
- User feedback & mobile app
- Fine-tune LLM for nutrition

THANK YOU