

# Meal Classification and Recipe Recommendation

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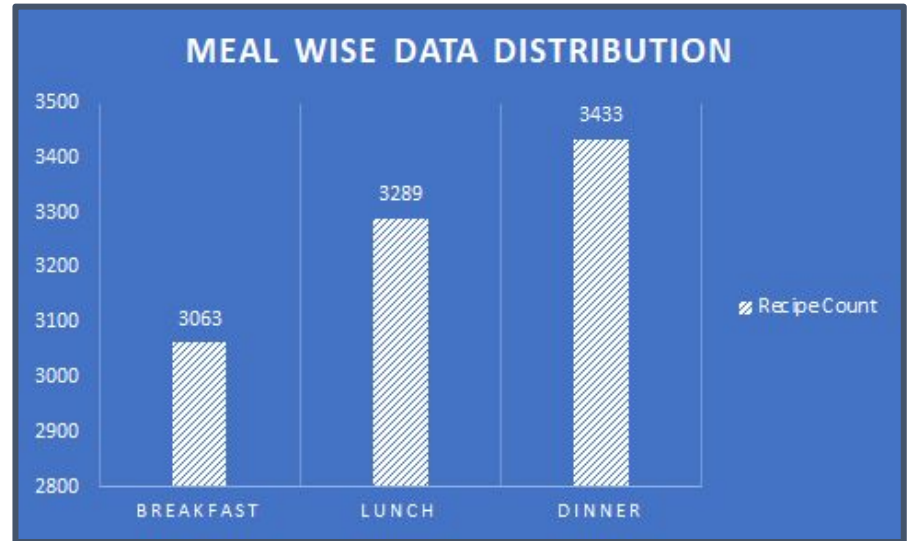
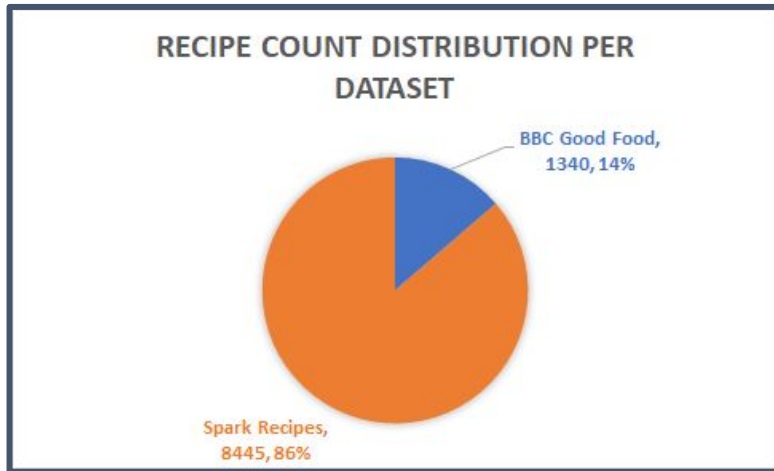
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# Tasks performed

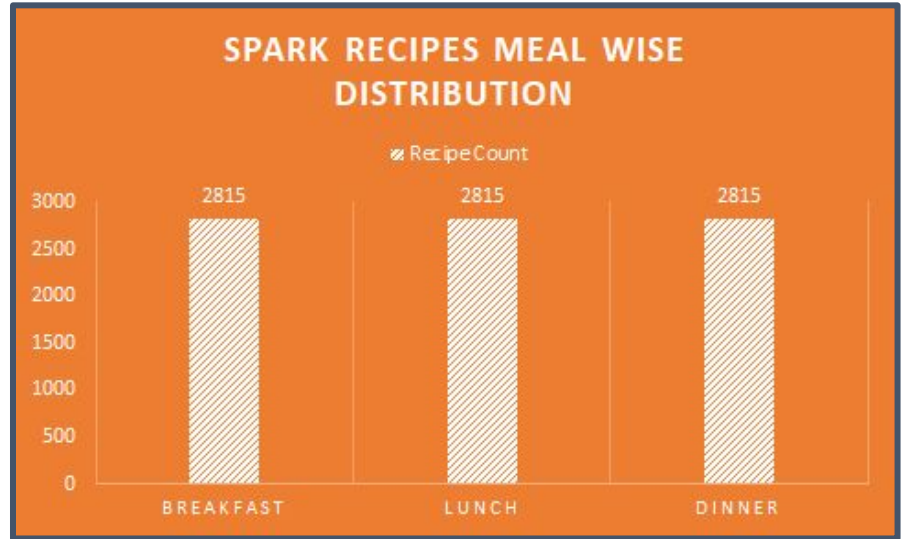
- Scraping data from different sources and merging them with pre-processing.
- Classification models such as SVM, Decision Tree, Random Forest, KNN applied to predict the meal, given a set of ingredients.
- Recommending a meal to the user given a set of ingredients.
- Frequently co-occurring ingredients search for a given ingredient.
- Statistical plots such as frequency rank distribution and recipe size distribution for the dataset.
- GUI (Graphical User Interface) which integrates and binds all the above mentioned modules.

# Food Data Sources and Distribution Plots

- BBC Good Food [<https://www.bbcgoodfood.com/>]
- Spark Recipes [<https://recipes.sparkpeople.com/>]



# Meal wise distribution in datasets



# Features of the dataset

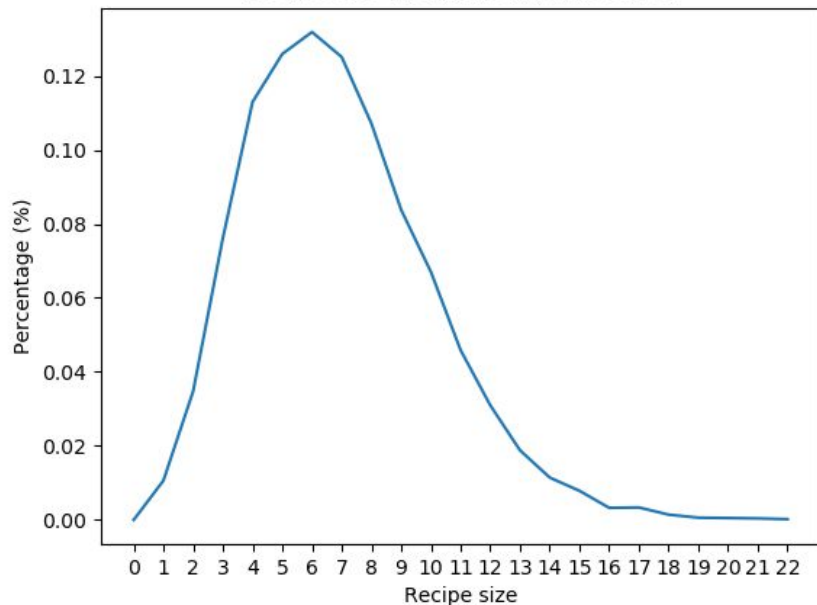
Recipe ID	Title	URL	Meal
Rating	Preparation Time	Cooking Time	Serves
Calories	Fat	Cholesterol	Carbs
Fiber	Protein	Ingredients	Lookup Ingredients
Rating Score	Cooking instructions		

# Pre-processing

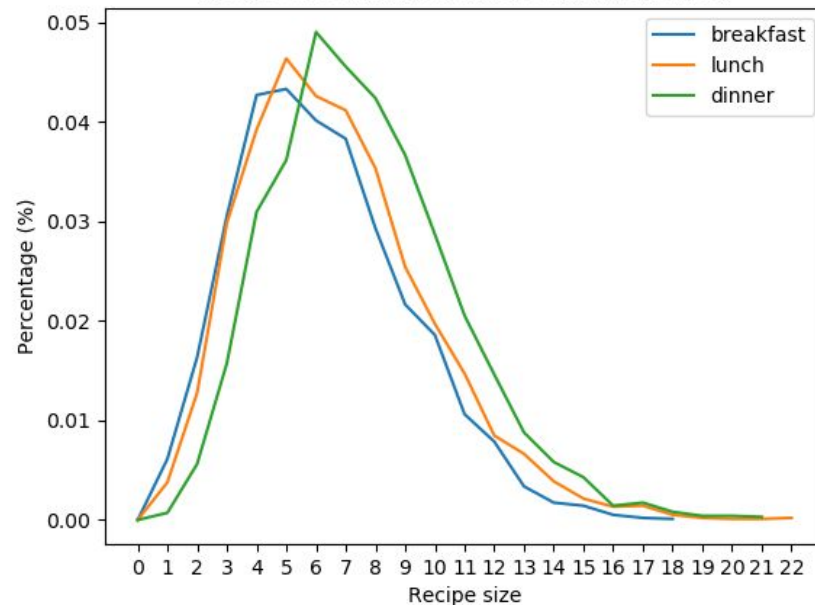
1. Data is scraped from multiple sources, hence all common features are merged and converted to same metric.
2. Ingredients are extracted from the scraped dataset and lemmatized.
3. Numerical features such as Ratings, Calories, Fat, Fiber, Protein, etc are normalized for unbiased classification and recommendation.
4. Some variation of preprocessing is performed separately for the required task at hand.

# Recipe Size Distribution

Recipe size distribution (all recipes)

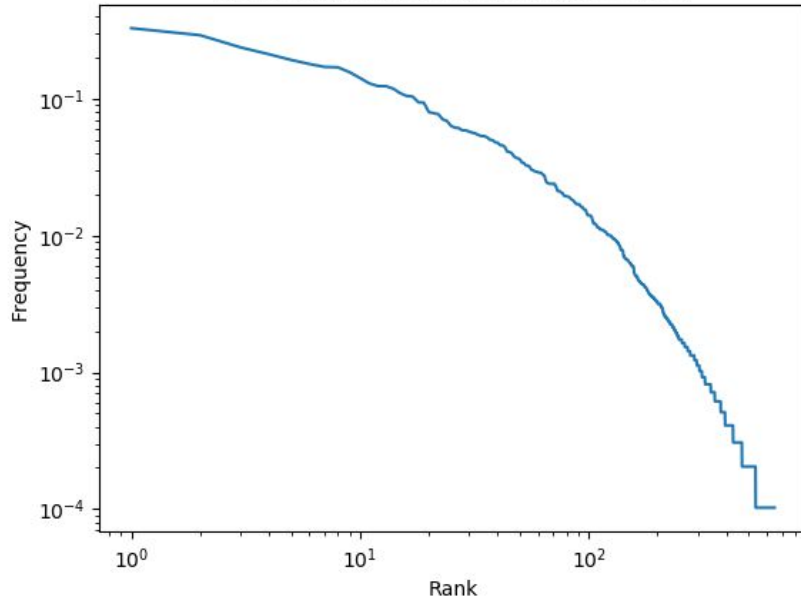


Recipe size distribution (specific meal type)

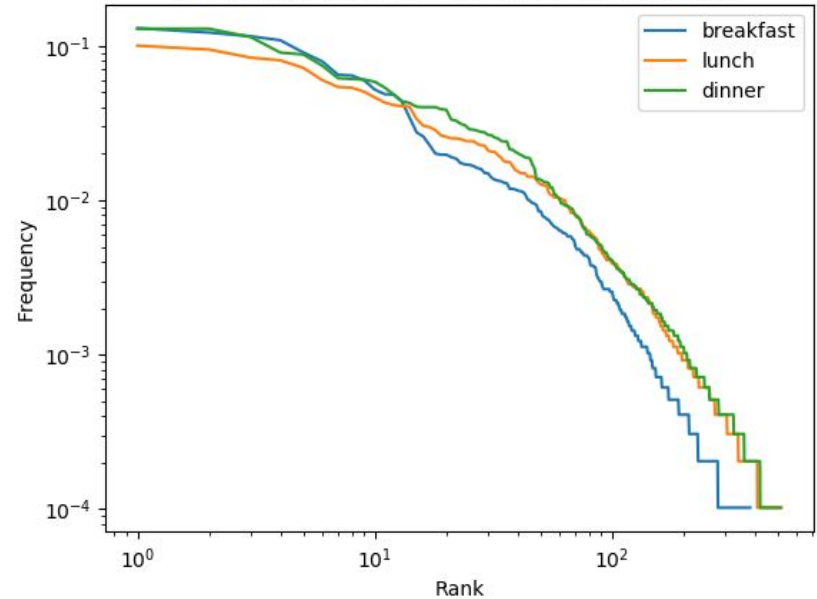


# Frequency Rank Distribution

Frequency-rank distribution (all recipes)



Frequency-rank distribution (specific meal type)





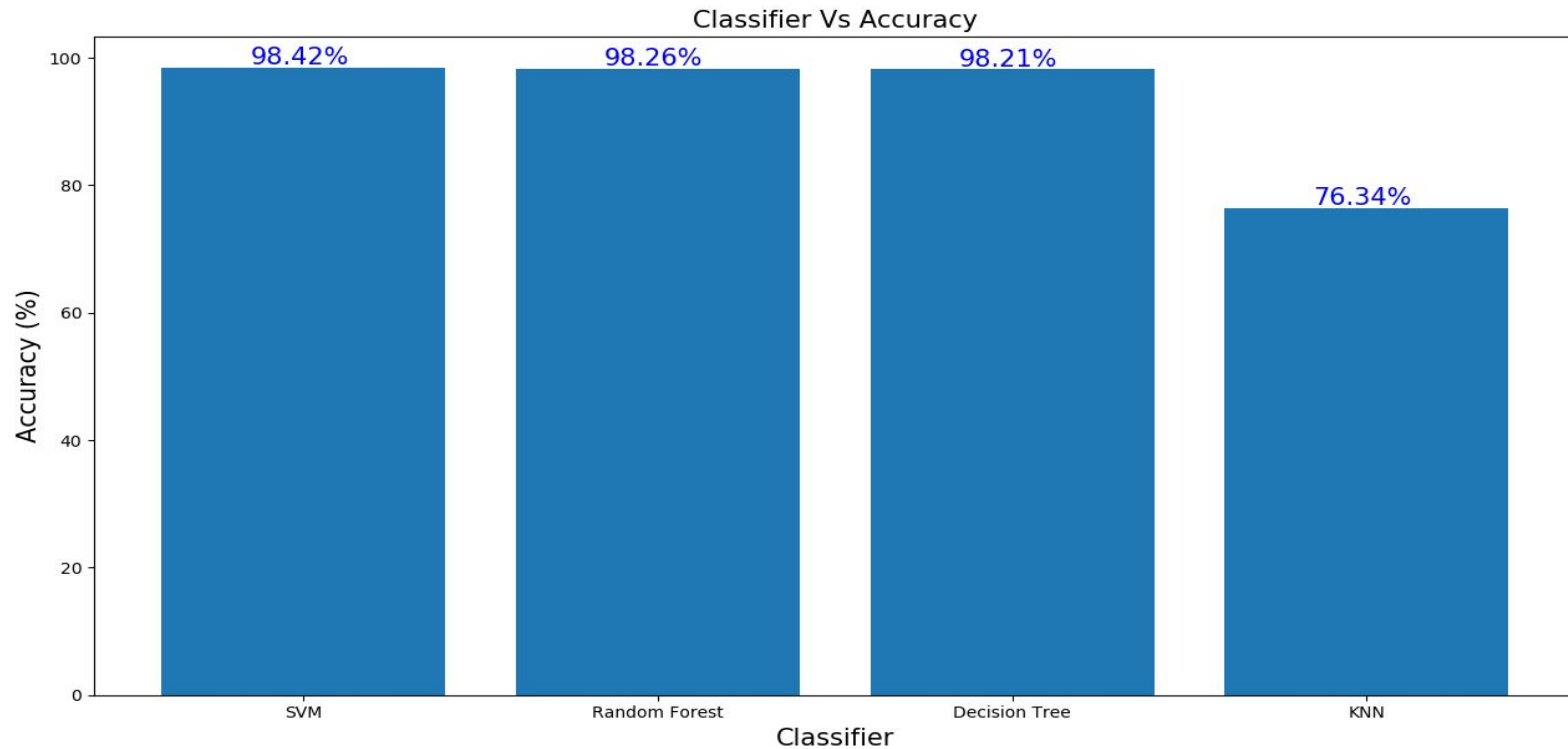
# Main screen GUI Screenshot



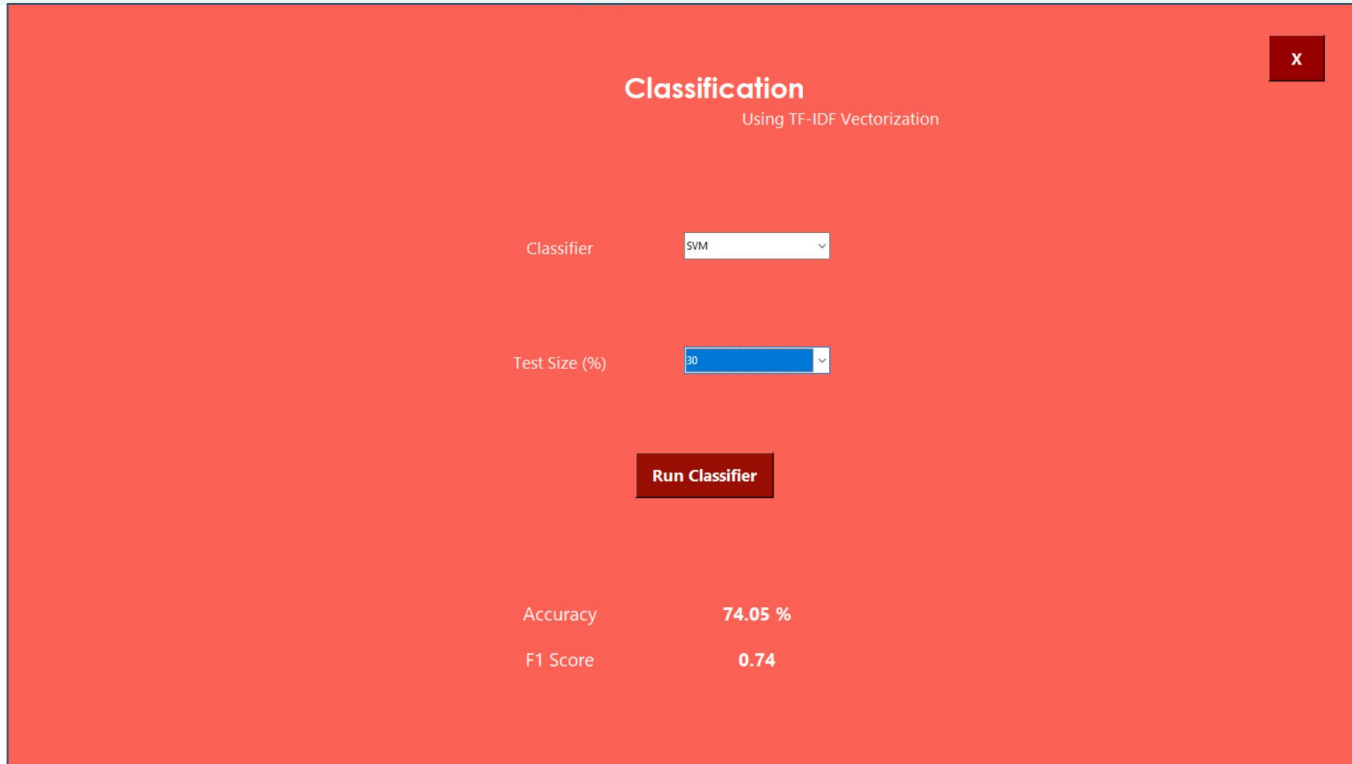
# Task: Classification

- For classification of recipes in one of the meal category (Breakfast, Lunch, Dinner), several machine learning models are applied. Random Forest, Decision Tree, K Nearest Neighbor and Support Vector Machine are applied.
- GUI includes 2 screens, one for evaluation of the performance of various models by split the data into train and test and other for classifying a new recipe's meal category based on the ingredients.
- Best accuracy of 98.42 % was obtained with SVM which is used for classifying new recipes.

# Classification Model performance



# Classification Screenshot

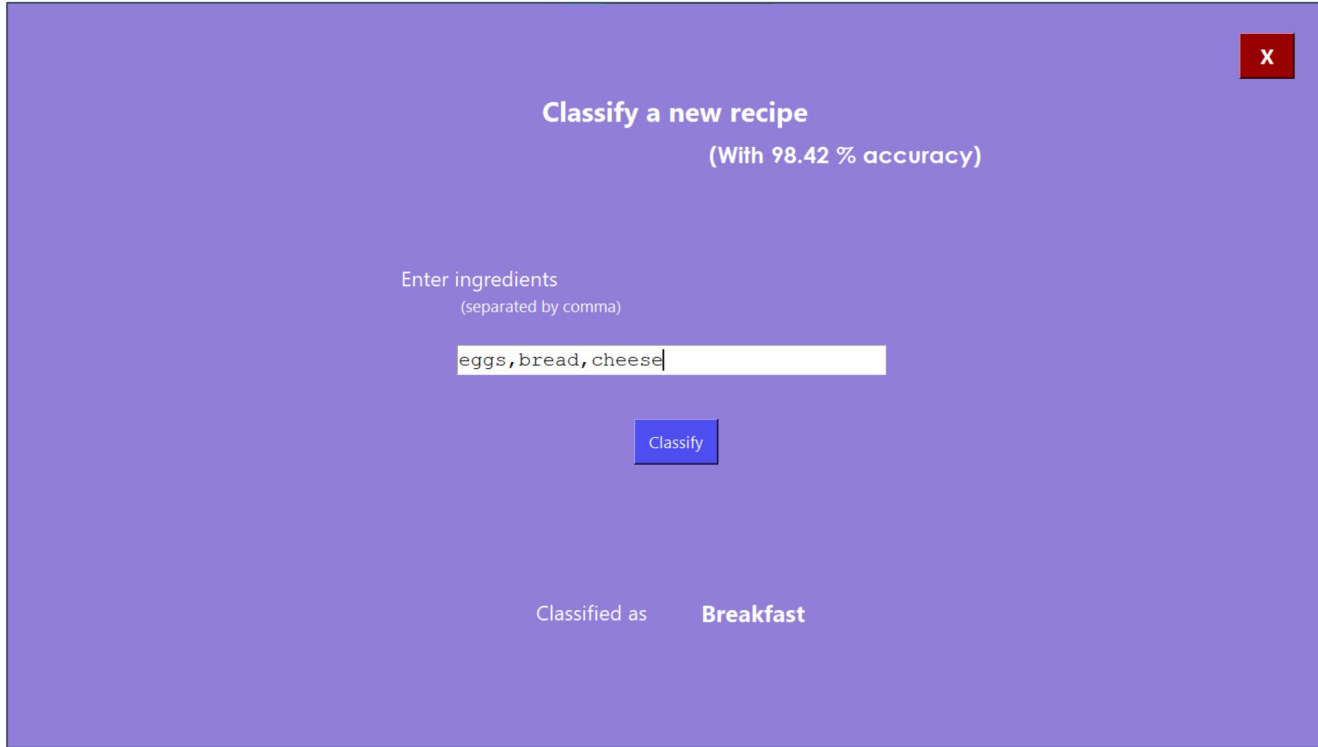


The screenshot shows a web application titled "Classification" with the subtitle "Using TF-IDF Vectorization". It features two dropdown menus for "Classifier" (set to "SVM") and "Test Size (%)" (set to "30"). A red "Run Classifier" button is positioned below these controls. At the bottom, the results are displayed: "Accuracy" is 74.05 % and "F1 Score" is 0.74. A red close button with an 'x' is in the top right corner.

Classifier	Test Size (%)	Run Classifier	Accuracy	F1 Score
SVM	30	Run Classifier	74.05 %	0.74

User can select any model and test size from given drop downs and evaluate the model performance.

# Classify a New recipe screenshot – Breakfast



The screenshot shows a web application interface with a purple background. At the top right, there is a red square button with a white 'X'. The main heading is 'Classify a new recipe' in white, followed by '(With 98.42 % accuracy)' in a smaller white font. Below this, the text 'Enter ingredients' is shown, with '(separated by comma)' in a smaller font underneath. A white text input field contains the text 'eggs, bread, cheese'. Below the input field is a blue button with the word 'Classify' in white. At the bottom, the text 'Classified as' is followed by the word 'Breakfast' in a bold white font.

Classify a new recipe  
(With 98.42 % accuracy)

Enter ingredients  
(separated by comma)


eggs, bread, cheese

Classify

Classified as **Breakfast**

Input Ingredients are vectorized and meal type is predicted using pre-trained SVM model.

# Classify a New recipe screenshot – Lunch




**Classify a new recipe**  
(With 98.42 % accuracy)

Enter ingredients  
(separated by comma)

Classify

Classified as **Lunch**

# Classify a New recipe screenshot – Dinner



**Classify a new recipe**  
(With 98.42 % accuracy)

Enter ingredients  
(separated by comma)

chicken,onions,beef

Classify

Classified as **Dinner**

# Recommending a meal

- For recommendation of the recipes for a specified meal type, recommendation system uses data features ( Rating Score, Carbs, Fiber, Protein, Calories, Fat, Cholesterol) to calculate a recommendation score.
- Features were divided into two categories positive and negative category and tuned the model for the best recommendations for input ingredients.
- Based on the recommendation score, top 10 recipes for selected meal type and input ingredients are recommended by the system.
- We made our model flexible to adapt any changes if suggested by some fitness expert.



# Recommendation Screenshot – Breakfast

Recommendation of Recipes

Select meal type  
Breakfast

Enter Ingredients  
milk, eggs

Submit Co-occurring Ingredient Search

Top 10 Recommended recipes for Breakfast

- Baked Banana Bread Oatmeal
- Upside down apple pancake
- Personal Sized Baked Oatmeal Cups
- Whole Wheat Waffle
- Chocolate Banana Strawberry muffins
- Stuffed French Toast
- Apple Banana Bread
- English Pancakes
- Shelly's Banana Coconut Protein Breakfast Souffle
- Baked Garlic-Cheese Grils

Based on selected meal type and input ingredients a recommendation score is calculated based on the corresponding recipe features and top 10 recipes are recommended.

# Recommendation Screenshot – Lunch

Recommendation of Recipes

Select meal type

Lunch

Enter Ingredients

dal

Submit

Co-occurring Ingredient Search

Top 10 Recommended recipes for Lunch

Sambar Rice

Veggie 1/2 LB Burger

Spinach Molagootal

Pongal

Cabbage Dal

Pumpkin lentils stew

Dal Thoy

Kobichi bhaji

Bulgur Quinoa Lunch Bowls

Feta Clementine Lunch Bowl

# Recommendation Screenshot – Dinner

X

## Recommendation of Recipes

Select meal type

Dinner

Enter Ingredients

chicken, beef

Submit

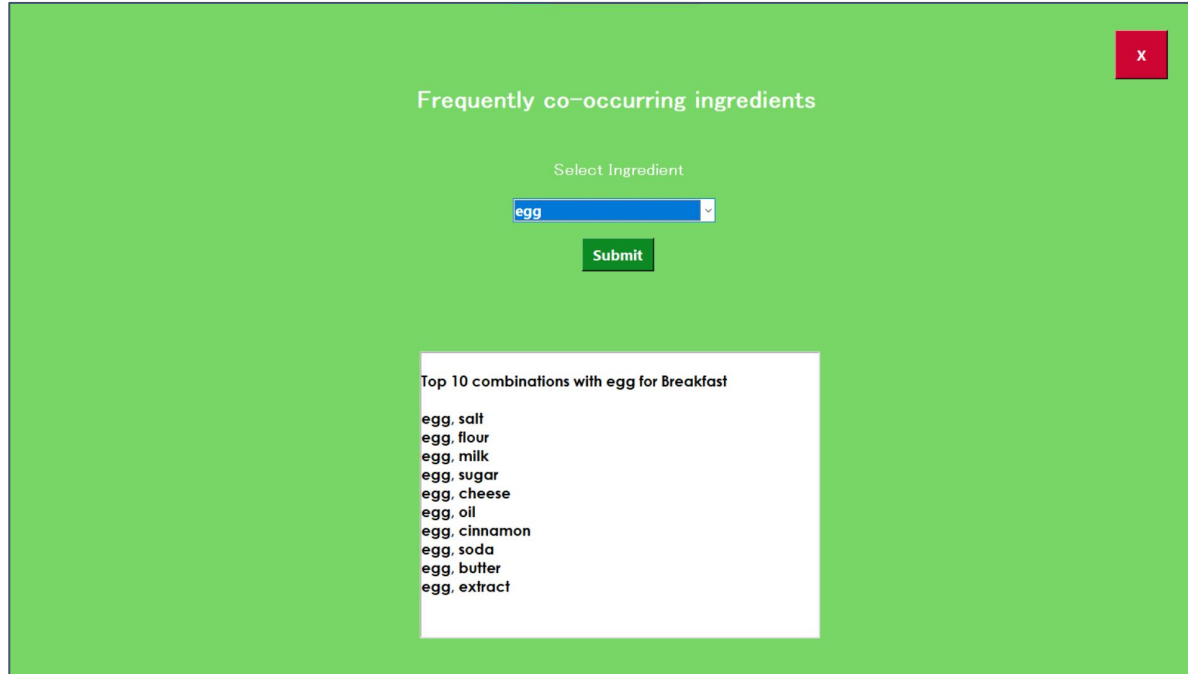
Co-occurring Ingredient Search

Top 10 Recommended recipes for Dinner

Asian-Style Beef and Vegetable Noodles  
Cottage Pie  
Authentic Chinese Stir Fry  
Remember Me Coq Au Vin  
Shrimp Fried Rice  
Braised Beef Short Ribs  
chicken (or Paneer, or Tofu) palak  
Kasey's Black & White Chicken Chili  
No Stress Gravy  
Maple Flavored Barbeque Chicken - Crock Pot

# Additional Functionality

## Co-occurring Ingredient Search



Frequently co-occurring ingredients

Select Ingredient

egg

Submit

Top 10 combinations with egg for Breakfast

- egg, salt
- egg, flour
- egg, milk
- egg, sugar
- egg, cheese
- egg, oil
- egg, cinnamon
- egg, soda
- egg, butter
- egg, extract

Based on meal type and ingredients entered in recommendation screen, frequently co-occurring ingredients are shown with the help of Apriori Algorithm frequent itemset mining.

# More information for a recommended recipe

## Baked Banana Bread Oatmeal

URL

[https://recipes.sparkpeople.com/recipe\\_detail.asp?recipe=1913211](https://recipes.sparkpeople.com/recipe_detail.asp?recipe=1913211)

Ingredients

- 1 1/2 cups mashed banana.
- 1/3 cup brown sugar, unpacked.
- 2 eggs.
- 1/2 tsp salt.
- 1/2 tsp. vanilla extract.
- 1/2 tsp. baking powder.
- 1/2 tsp. baking soda.
- 2 cups SILK Light Soy Milk, Original (or milk)

Instructions

- STEP 1: Begin preheating the oven to 350 degrees.
- Mash the bananas well with a fork.
- Measure the bananas to make sure you have about 1.
- 5 cups.
- STEP 2: Whisk the mashed bananas together with the bro
- Next whisk in the milk, then stir in the oats.
- Roughly chop the walnuts and stir them in as well.
- STEP 3: Spray the inside of a glass baking dish (11x7 inch o
- Pour in the oat mixture.
- Cover with foil and bake in the preheated oven for 30 r

Nutrient Information

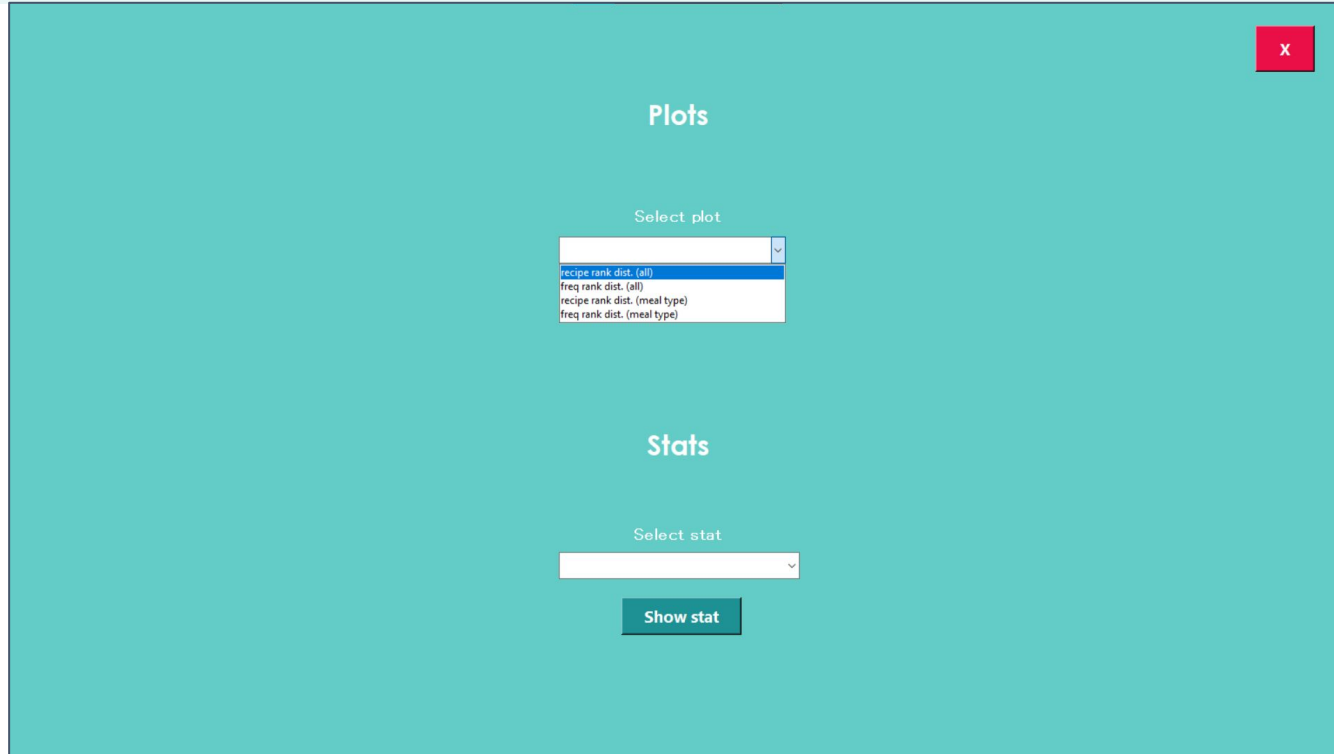
8 Serves

185.0 Calories  
3.3g Fat  
0.05g Cholesterol  
51.5g Carbs  
6.4g Fiber  
6.2g Protein

More information about a recipe such as URL, complete list of ingredients, cooking instructions, etc. can be obtained by clicking on the recipe name.

URL can be directly clicked to visit the recipe webpage for complete information and recipe images.

# Plots and Stats Screenshot



Various Plots for analyzing the dataset can be obtained using the dropdown menu for corresponding plot. All plots are mentioned in earlier slides.

# Stats

## Stats

Select stat

Top ingredients Overall



Show stat

Top ingredients Overall

salt, oil, cheese, garlic, milk, flour, red, sugar, water, sauce

Interesting stats from the dataset were calculated and displayed.

# Stats (contd..)

## Stats

Select stat

Top 10 Breakfast ingredients ▾

Show stat

Top 10 Breakfast ingredient

**milk, salt, flour, sugar, cinnamon, eggs, cheese, oil, soda, butter**

Top 10 Lunch ingredients

**oil, salt, cheese, red, garlic, water, tomatoes, onions, pepper, celery**

Top 10 Dinner ingredients

**oil, garlic, salt, cheese, sauce, red, tomatoes, pepper, chicken, black pepper**



# Contributions

- Rahul Maheshwari - Preprocessing, Classification, GUI.
- P. Akshay Kumar - Dataset scraping, Preprocessing, Plots & Stats, Co-occurring ingredient search.
- Gaurav Lodhi - Preprocessing and Recommendation.

Thank You!

