

# AllerGenie

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# AllerGenie Team Introductions



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# Problem Space



# Daily Challenges



## Limited Restaurant Options

Fear of cross-contaminations



## Endless Label Reading

Time-consuming ingredient checks



## Grocery Shopping Anxiety

Complex ingredients verification



## Impact on Daily Life

These challenges do not just restrict diet – they restrict life, travel, and daily activities for **33 million Americans**.

# Eight Most Common Allergies

According to the Food and Drug Administration



EGGS



SOY



MILK



WHEAT



PEANUTS



TREE NUTS



SHELLFISH



FISH

*These allergies are prevalent across many foods and cuisines*



SARAH

# Customer journey map

A 34-year-old working mother, juggles her career with raising a family. She is highly organized but often feels time-constrained. Her son's severe peanut allergy influences many of her choices, especially related to meal planning and grocery shopping.



## Key Activities



**Phase 1**  
Easy Web Access

### Seamless Onboarding

Easy access, fast loading, intuitive design—no access barriers.



**Phase 2**  
Select Allergens

### Allergens & Dietary Configuration

Easy selection and management of allergens and preferences without account creation.



**Phase 3**  
Barcode Scanning

### Effortless Scanning

Accurate scanning, fast response, clear issue handling, seamless product ID.



**Phase 4**  
Allergen Alerts

### Clear and Accurate Alerts

Accurate detection, rapid response—users feel reassured.



**Phase 5**  
Recipe Generation

### Tailored Meal Suggestions

Personalized, accurate recipe suggestions—easy to follow with allergen-safe alternatives.

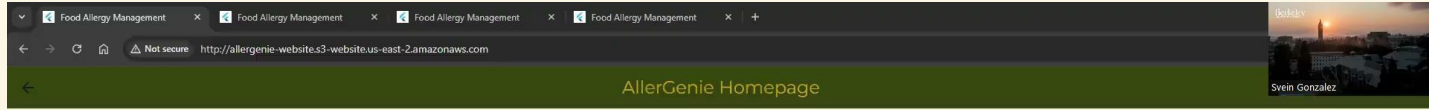




# Demo



# Live Demo/Recorded Demo



## Welcome to AllerGenie!



Check for Allergens in Your Favorite Foods!



Hungry for an Allergy Friendly Meal?







# Data & Pipeline

# Datasets

## Allergy Detection



3.4 million products from [OpenFoodFacts](#)

A total of **656K products**, representing **19%** of the collection, are used in the allergy detection feature.



Limitations and Potential Challenges:

1. The inclusion of only U.S. based products
2. ~ 88% of U.S. products have missing values in the allergens column

### Sample Data Record for **Nutella Mini Cups**

Code	0009800801107
URL	<a href="http://world-en.openfoodfacts.org/product/0009800801107/nutella-mini-cups">http://world-en.openfoodfacts.org/product/0009800801107/nutella-mini-cups</a>
Product Name	Nutella Mini Cups
Brands	Nutella, Ferrero
Countries Tags	United States
Ingredients	Sugar, palm oil, hazelnuts, cocoa, skim milk, whey (milk), lecithin as emulsifier (soy), vanillin: an artificial flavor
Allergens	Milk, Nuts, Soybeans

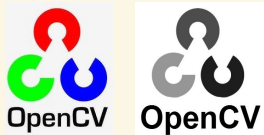


# Data Pipeline: Allergy Detection

## Step 1: Barcode Scanning



User uploads an image of a product's barcode



Barcode image processed using OpenCV to convert to grayscale



Use pyzbar to decode the barcode into numeric values

## Step 2: Database Lookup



The app checks the decoded barcode against OpenFoodFacts dataset (xlsx.)



A manually defined dictionary maps allergens to possible ingredient terms

## Step 3: User Input



The app retrieves user input(s) for allergies they want to check

## Step 4: Safety Evaluation



If a match is found, the app flags the product as **unsafe**.

# Datasets

## Recipe Generation



74,465 unique recipes from [Hugging Face](#) with no missing values

A total of **15K recipes**, representing **20%** of the collection, are stored in our RAG pipeline, forming a well-balanced recipe knowledge base. Recipes are stored in **AWS S3 buckets as csv files**, enabling optimized retrieval.



Wide-ranging diversity in culinary styles and allergy types

Cuisine Type	# of Recipes <small>Note: A recipe may belong to multiple cuisine types</small>
American	52K (69%)
Italian	15K (20%)
French	8.9K (12%)
European	5.2K (7%)
Other: Mexican, Mediterranean, Asian, Southern, Middle Eastern, British, Indian, Caribbean, Chinese, Spanish, Japanese...	

Allergy Type	# of Recipes <small>Note: A recipe may contain multiple allergies.</small>
Egg	20K (27%)
Milk	20K (27%)
Nut	17K (23%)
Dairy	17K (22%)
Wheat	13K (18%)
Other: Meat, Fish, Pepper, Spice, Cheese, Garlic, Grain, Cow's Milk, Onion, Peanuts	

# Data Pipeline: Recipe Generation

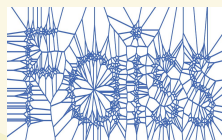
## Step 1: Build Vector Store



Recipes Datasets  
stored in S3 Buckets



Embedding Model bge-large-en-v1.5



FAISS Index

## Step 2: Get Embeddings for User Query



Embedding Model bge-large-en-v1.5

## Step 3: Retrieve Relevant Recipes



## Step 4: Pass prompt with query and relevant documents to LLM

Query  
+  
Prompt  
+  
Retrieved Docs



LLM Model  
Meta-Llama-3-8B-Instruct

## Step 5: Extract titles from recipe outputs and generate images

`/(regex/`

Title Extraction



Image Generation Model  
stable diffusion 2.1

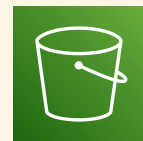


Image Storage in s3 Buckets



# Evaluating: LLM Outputs

# Five Evaluation Scenarios

We wanted to challenge the LLM with difficult allergy scenarios...



MARIA

## Allergy



PEANUTS NUTS

## Wants to Cook

Thai Curry



JASON

## Allergy



EGGS MILK

## Wants to Cook

Brownies



MICHAEL

## Allergy



FISH SHELLFISH

## Wants to Cook

Japanese Dumplings



NORA

## Allergy



WHEAT

## Wants to Cook

Italian Chicken  
Parmesan



FATIMA

## Allergy







SOY

## Wants to Cook

Vegan Tacos

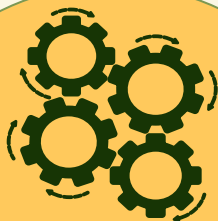
# Evaluation Metrics

	20%	20%	20%	40%
				
<b>FOCUS</b>	EFFECTIVENESS OF MODEL		READABILITY	ALLERGEN SCORE
<b>METRIC USED</b>	BLEU SCORE (Precision)	ROUGE SCORE (Recall)	FLESCH SCORE	1 / (ALLERGIES REFERENCED + 1)
<b>COMMENT</b>	LLM OUTPUT COMPARED TO "GOLD ANSWER"		QUANTIFIES READABILITY	ALLERGEN LISTS FROM JOHN HOPKINS

**SCORES WERE WEIGHTED FOR FIVE DIFFERENT SCENARIOS**



# Parameters Fine-tuned



## Model & Model Features

Evaluated Language Learning Models, embeddings, temperature settings, and top\_p

High Impact



## Prompt Engineering

Experimented with different queries and prompt formats

Very High Impact



## Documents Used

Different document sizes, chunk and chunk overlaps

Low Impact

# Model Evaluation Results

Optimized Model Output

Model	Llama3 8b	Mistral 7B	Mistral 7B-Instruct
BLEU Score (20%)	<b>0.4016</b>	0.3544	0.2144
Rouge Score (20%)	<b>0.5497</b>	0.4994	0.3414
Readability Score (20%)	0.5792	<b>0.6242</b>	0.6176
Allergen Score (40%)	<b>1.0000</b>	0.9000	<b>1.0000</b>
<b>Final Score</b>	<b>0.7061</b>	0.6556	0.6347



# Highest Performing Combination

**Scenario 3:** Create a recipe for Japanese Dumplings without *FISH* or *SHELLFISH*

## Generated Output

### Pork Dumplings with Soy-Ginger Sauce

#### Ingredients:

- 1 pound pork butt, coarsely ground
- ...
- Soy-Ginger Sauce (recipe follows)**
- ...
- 1 tablespoon peeled, julienned gingerroot, soaked in ice water

#### Instructions:

1. In a large bowl, combine the pork, scallions, soy sauce, sesame oil, and gingerroot. Mix well so that the flavors will penetrate the meat.
2. Then add the cabbage and mix until all the ingredients are thoroughly combined.
3. Place 1 dumpling wrapper on a plate or a board. Place 1 scant tablespoon of pork mixture in the center.
4. Fold the wrapper over the filling to form a half-moon shape, and press the edges together to seal the dumpling.
5. Repeat with the remaining wrappers and filling.
6. Cook the dumplings in a large pot of boiling water for 5-7 minutes, or until they float to the surface.
7. Serve with Soy-Ginger Sauce.

Note: You can also pan-fry the dumplings with a small amount of oil until golden brown on the bottom **before boiling**.

## Gold Answer

### Pork Dumplings with Soy Ginger Sauce

#### Ingredients:

- 1 pound pork butt, coarsely ground
- ...
- 1 tablespoon peeled, julienned ginger root, soaked in ice water

#### Instructions:

1. In a large bowl, combine pork, scallions, soy sauce, sesame oil, and ginger root. Mix well.
2. Add cabbage and mix until all ingredients are thoroughly combined.
3. Place 1 dumpling wrapper on a plate or board. Place 1 scant tablespoon pork mixture in the center.
4. Moisten the edges of the wrapper with water and fold into a half moon shape.
5. Stand the dumplings upright and pleat the sides.
6. Repeat steps 3-5 with the remaining dumpling wrappers and pork filling.
7. To pan fry dumplings, heat corn oil in a large non-stick skillet. Cook dumplings over low heat until golden and crisp.
8. To boil dumplings, fill a large stockpot with water and bring to a boil. Add dumplings and cook until they float. Taste to check doneness.
9. Combine all ingredients in a small bowl and mix thoroughly. Serve.
10. To make sauce, combine all ingredients in a small bowl and mix thoroughly. Keep in the refrigerator up to 1 week without ginger root. Add ginger root when ready to serve.

BLEU Score	Rouge Score	Readability	Allergen Check	Total Score
0.5906	0.7411	0.5695	1.0000	0.7800

# Examples of Poor Performing Outputs

## Extra Sections

Lower scoring recipes included extra sections:

- Title
- **Allergen Information**
- **Cuisine Authenticity**
- **Recipe Differentiation**
- Ingredients
- **Allergen-Safe Substitutions**
- **Cross-Contamination Prevention**
- Instructions
- **Servings & Storage**
- **Final Safety Check**

## Includes the Allergen

In one nut-free recipe, the following items were included:

- 1/2 cup macadamia nuts (omitted)
- 1 teaspoon shrimp paste (optional, omit for nut-free)
- Peanut oil

Peanut oil should have been removed to be extra safe, and the nuts should have been automatically removed from the recipe.

The flag for nuts on shrimp paste was not required.



# Evaluating: A.I. Images

# Evaluating Generative A.I. Images

## Easy Pad Thai Recipe Without Peanuts



Real Image



AI Image

How well does the Artificial Intelligence (AI) image reflect the real image and label?

Very Bad Representation

Very Good Representation

0	1	2	3	4	5	6	7	8	9	10
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## Experiment Overview

- An A/B Experiment was conducted with 120 participants.
- Respondents were asked to rate five A.I images on a scale of 0 to 10 (Bad → Good).
- Two variables were adjusted in the survey:
  - Model (1.5 vs. 2.1)
  - Prompt (Title vs. Recipe)
- Respondents were randomly shown an image for each of the five scenarios.
- Highest scoring combination was used in our model.

# Highest performing image model...

## ★ Stable Diffusion 2.1 Model with a Short Prompt ★

	<i>Dependent variable:</i>			
	Respondent Score (0 to 10)			
	Model Only	Prompt Only	Model and Prompt	Interaction Added
	(1)	(2)	(3)	(4)
Model 2.1	0.272 (0.222)	<b>Positive &amp; NOT Statistically Significant</b>	0.263 (0.222)	0.339 (0.308)
Short Prompt		0.468** (0.234)	0.463** (0.222)	0.538* (0.313)
Model / Prompt Interaction				<b>Positive &amp; Statistically Significant</b> -0.156 (0.443)
Constant	5.460*** (0.157)	5.362*** (0.202)	5.238*** (0.189)	5.202*** (0.217)
Observations	600	600	600	600
R <sup>2</sup>	0.002	0.007	0.010	0.010
Adjusted R <sup>2</sup>	0.001	0.006	0.006	0.005

*Note:* \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Our number of observations (5 x 120) exceeds the power requirements to calculate significance

# Project Summary



1

Combined image generation model with RAG system for the recipe generation

2

Platform combined two features to cover broader spectrum of food preparation

3

Leveraged AWS SageMaker to facilitate collaboration





# User Feedback on Website



23 Respondents

100%

Generated recipes  
excluded allergens

100%

Relevant recipes

73%

Users had trouble  
scanning barcode \*

\* Prior to coding update



# Aspirational Roadmap



**Add Dietary Preferences, Expand Products Database**

Based on user feedback



**Link Two Features**

Ability to generate recipe with the scanned product



**Improve Image Generation**

Explore additional image generation models

# Project Mission



“Turning **food fear** into **food freedom**,  
**one meal at a time**”

# Q&A

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