RecipeFinder

Software code submission with documentation

by

Team “TasteBuddies”

Vijayaragavan Selvaraj (VS27) - Team Leader

Sathyanarayanan Gokarnesan (SG53)

Karthika Gopalakrishnan (KG24)

1. Application – Live Demo link

Please see the live demo of the “RecipeFinder” application running at the following location.

http://54.81.52.188/

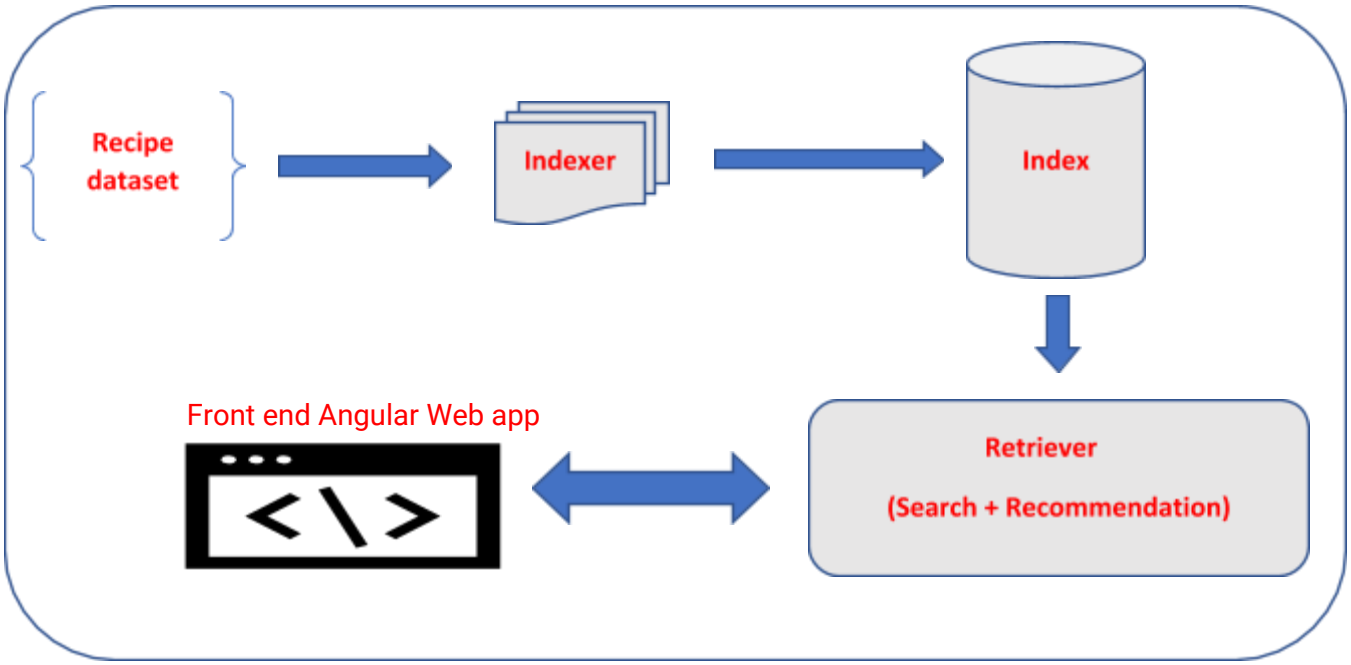
2. Overview

“RecipeFinder” is a web-based tool built using novel information retrieval techniques to search popular recipes.

It searches recipes based on the ingredients of the recipes. When the user searches with an ingredient name, it lists the top 20 recipes that contain the given ingredient. For each of the recipes in the search results, users can also see recipe details including the cooking directions, other ingredients of the recipe, nutritional values, timings, and ratings of the recipe. Users are also recommended with 4 similar recipes based on the nutritional value. Content based similarity approach has been used for this project.

3. Architecture and Source Code

Following is the high-level architecture of “RecipeFinder”.



Source code for the “Recipe Finder” application is present in the following github location:
https://github.com/vs27-illinois/CourseProject.git

Source code for our project can be broadly categorized into three sections.

- BackEnd
- FrontEnd
- Infrastructure

Backend:

Following are the main files in the backend system.

1. Indexer.py

This python file is responsible for taking the “Recipe Finder” dataset, parsing the csv file for different fields, creating indexes on different fields, and writing the same in an index document. We used Apache PyLucene to index the dataset. The indexed dataset contains 49,698 records in total.

We used the dataset from Kaggle at the following location for our project:
https://www.kaggle.com/elisaxxygao/foodrecsysv1?select=raw-data_recipe.csv

Following are the columns in the index.

S.No	Column	Index Type
1	id	IndexOptions.DOCS
2	name	IndexOptions.NONE
3	image	IndexOptions.NONE
4	avg_rating	IndexOptions.NONE
5	total_reviews	IndexOptions.NONE
6	ingredients	IndexOptions.DOCS_AND_FREQS_AND_POSITIONS
7	time_taken	IndexOptions.NONE
8	nutrition	IndexOptions.NONE
9	calories	IndexOptions.NONE

10	carbohydrates	IndexOptions.NONE
11	protein	IndexOptions.NONE
12	fat	IndexOptions.NONE

We used MMapDirectory to load the index files and indexed the ingredients and recipe id field by using EnglishAnalyzer since the dataset is in English. We stored the rest of the fields in the indexed document.

Following are some of the main code snippets of indexer.py.

```
def index_data():
    t1 = get_field_type()
    t1.setIndexOptions(IndexOptions.NONE)

    t2 = get_field_type()
    t2.setIndexOptions(IndexOptions.DOCS_AND_FREQS_AND_POSITIONS)

    t3 = get_numeric_field_type()
    t3.setIndexOptions(IndexOptions.DOCS)

    t4 = get_numeric_field_type()
    t4.setIndexOptions(IndexOptions.NONE)

    index = 0
    for df in pd.read_csv('dataset/recipe.csv', chunksize=3000, iterator=True):
        df.drop("reviews", axis=1, inplace=True)

        index += 1
        mm_dir = MMapDirectory(Paths.get('index'))
        writer = IndexWriter(mm_dir, IndexWriterConfig(EnglishAnalyzer()))
        print(f"Opening index {index} with {writer.numRamDocs()} docs...")

        for num, row in df.iterrows():
            print(f"Indexing row {num+1}...")

            doc = Document()
            doc.add(Field("id", row["recipe_id"], t3))
            doc.add(Field("name", row["recipe_name"], t1))
            doc.add(Field("image", row["image_url"], t1))
            doc.add(Field("avg_rating", row["aver_rate"], t4))
            doc.add(Field("total_reviews", row["review_nums"], t4))
```

2. Retriever.py

Following are the functionalities of retriever.py.

- It is responsible for taking the “ingredient” input from the user, searching the index for 20 popular recipes based on the ingredient, converting the results (list of recipes) into json format to be rendered in the UI.
- It is responsible for taking the recipe id from the user to provide a detailed view of the recipe.
- It also returns the list of top 4 recipes based on similar nutritional value for the recipe which the user wants to see the details.

Following are the API calls involved.

S.No	End Point	Method	Output
1	http://<ipaddress>/recipe/search/{ingredient} Ex: http://54.81.52.188/recipe/search/chocolate	GET	[{ "avg_rating": 4.34615373611, "calories": 274.0809, "carbohydrates": 45.78727, "fat": 10.5331, "id": 32482, "image": "https://images.media-allrecipes.com/userphotos/250x250/710487.jpg", "ingredients": ["chocolate chips", "powdered chocolate drink mix", "chocolate syrup", "scoops chocolate ice cream", "milk", "ice"], "name": "Chocolate Surprise Milkshake", "protein": 3.052425, "total_reviews": 17 },...]
2	http://<ipaddress> /recipe/details/{recipeId} Ex: http://54.81.52.188/recipe/details/220725	GET	{ "avg_rating": 4.26016616821, "calories": 123.5964, "carbohydrates": 19.74722, "directions": ["Prepare the cake mix according to package directions using any of the recommended pan sizes. When cake is done, crumble while warm into a large bowl, and stir in the frosting until well blended.", "Melt chocolate coating in a glass bowl in the microwave, or in a metal bowl over a pan of simmering water, stirring occasionally until smooth.", "Use a melon baller or small scoop to form balls of the chocolate cake mixture. Dip the balls in

			chocolate using a toothpick or fork to hold them. Place on waxed paper to set."
			],
			"fat": 5.188236,
			"id": 67656,
			"image":
			"http://images.media-allrecipes.com/userphotos/720x405/599097.jpg",
			"ingredients": [
			"chocolate cake mix",
			"prepared chocolate frosting",
			"bar chocolate flavored confectioners coating"
			],
			"name": "Cake Balls",
			"nutrition": {
			"calcium": {
			"amount": 27.23583,
			"displayValue": "27",
			"hasCompleteData": true,
			"name": "Calcium",
			"percentDailyValue": "3",
			"unit": "mg"
			},
			"calories": {
			"amount": 123.5964,
			"displayValue": "124",
			"hasCompleteData": true,
			"name": "Calories",
			"percentDailyValue": "6",
			"unit": "kcal"
			},..
			},
			"protein": 1.122792,
			"time_taken": [
			"Prep",
			"40 m",
			"Cook",
			"30 m",
			"Ready In",
			"3 h 10 m"
			],
			"total_reviews": 1867
			}

3	http://<ipaddress>/recipe/recommend/{recipeId} Ex: http://54.81.52.188/recipe/recommend/220725	GET	[{ "avg_rating": 3.5, "calories": 124.4117, "carbohydrates": 19.98162, "fat": 4.989575, "id": 15463, "image": "http://images.media-allrecipes.com/userphotos/720x405/1115423.jpg", "ingredients": ["canola oil", "honey", "packed brown sugar", "egg whites", "vanilla extract", "water", "wheat flour", "all-purpose flour", "baking powder", "salt", "ground cinnamon", "semisweet chocolate chips"

			], "name": "No Cholesterol Chocolate Chip", "protein": 1.515088, "total_reviews": 15 },

We maintained the IndexSearcher object as a global variable to boost the performance of the search. We used Lucene Highlighter to highlight the search terms in the search results in the website. We maintained a global variable of pandas dataframe with all the records that is the L2 normalized form of nutritional values that we used in the recommendation service. The recommendation is done based on the nutritional values of calories and macronutrients (i.e., protein, carbohydrates and fat) by calculating euclidean distance between the record of the given recipe id and the other records.

Following are some of the main code snippets for retriever.py.

```
# Initializes the Flask App and Lucene Searcher
app = Flask(__name__)
vm = lucene.initVM()
mmDir = MMapDirectory(Paths.get('index'))
searcher = IndexSearcher(DirectoryReader.open(mmDir))


def convert_to_list(doc, key, highlight=False, query=None):
    if key == "ingredients" and highlight is True and query is not None:
        analyzer = EnglishAnalyzer()
        hl = Highlighter(SimpleHTMLFormatter('<strong>', '</strong>'), QueryScorer(query))

        values = []
        for text in doc.getValues(key):
            ts = analyzer.tokenStream("ingredients", StringReader(text))
            value = hl.getBestFragment(ts, text)
            if value is None:
                values.append(text)
            else:
                values.insert(0, value)

        return values
    else:
        return [value for value in doc.getValues(key)]
```

```
def get_all_recipes():
    hits = searcher.search(MatchAllDocsQuery(), 50000)

    recipe_list = {}
    recipes = []
    for hit in hits.scoreDocs:
        doc = searcher.doc(hit.doc)

        recipe = convert_to_json(doc)
        recipe_id = recipe['id']
        recipe_list[recipe_id] = recipe

        new_recipe = {
            'id': recipe['id'],
            'calories': recipe['calories'],
            'protein': recipe['protein'],
            'carbohydrates': recipe['carbohydrates'],
            'fat': recipe['fat']
        }
        recipes.append(new_recipe)

    df_pre = pd.DataFrame(recipes)
    df = df_pre.drop('id', axis=1)
    df.index = df_pre['id']
    df_norm = pd.DataFrame(normalize(df, axis=0))
    df_norm.columns = df.columns
    df_norm.index = df.index

    return recipe_list, df


# Initializes the Recipe List and Normalized Dataframe for the Recommendation Service
all_recipes, data_frame = get_all_recipes()
```

```
@app.route('/recipe/search/<ingredient>')
def get_recipes(ingredient):
    vm.attachCurrentThread()
    recipes = []
    ingredient = re.sub('[^a-zA-Z0-9 ]', '', ingredient).strip()
    if len(ingredient) > 0:
        query_parser = QueryParser("ingredients", EnglishAnalyzer())
        query_parser.setSplitOnWhitespace(True)
        query_parser.setAutoGeneratePhraseQueries(True)

        sort = Sort([SortField.FIELD_SCORE,
                     SortField("total_reviews", SortField.Type.FLOAT, True),
                     SortField("avg_rating", SortField.Type.FLOAT, True)])

        query = query_parser.parse(ingredient)
        hits = searcher.search(query, 20, sort)

        for hit in hits.scoreDocs:
            doc = searcher.doc(hit.doc)
            recipe = convert_to_json(doc, highlight=True, query=query)
            recipes.append(recipe)

    return jsonify(recipes)
```

```
@app.route('/recipe/details/<recipe_id>')
def get_recipe_details(recipe_id):
    vm.attachCurrentThread()
    query_parser = QueryParser("id", StandardAnalyzer())
    query = query_parser.parse(recipe_id)
    hits = searcher.search(query, 1)

    recipe = {}
    for hit in hits.scoreDocs:
        doc = searcher.doc(hit.doc)
        recipe = convert_to_json(doc)
        recipe['time_taken'] = convert_to_list(doc, "time_taken")
        recipe['directions'] = convert_to_list(doc, "directions")
        recipe['nutrition'] = json.loads(doc.get('nutrition'))

    return jsonify(recipe)


@app.route('/recipe/recommend/<recipe_id>')
def get_recommended_recipes(recipe_id):
    base_id = int(recipe_id)
    indices = pd.DataFrame(data_frame.index)
    indices = indices[indices.id != base_id]
    indices['distance'] = indices['id'].apply(lambda x: euclidean(data_frame.loc[base_id], data_frame.loc[x]))
    result = indices.sort_values(['distance']).head(4).sort_values(by=['distance', 'id'])

    recipes = []
    for index in result.id:
        recipes.append(all_recipes[index])

    return jsonify(recipes)
```

Frontend:

The frontend of the code to display the search results and recommended recipes are based on Angular 11. It makes http GET requests to the backend to retrieve the search results, recipe details and recommended recipes. The frontend is a single page application and the code is located in the “src/app” folder. We used the Angular Material module as a base to build the UI.

Infrastructure:

Following are the infrastructure related files.

1. DockerFile

   We used Docker to containerize our application and used the following image as the base to install PyLucene: https://hub.docker.com/r/coady/pylucene. The Dockerfile in the project folder copies all the required backend and frontend files and deploys them in a standalone container.

2. startup.sh

   This shell script file is responsible for creating the docker image (recipefinder:1.0) and running the image as a docker container.

4. Setup and Installation Instructions

Following are the technologies used in the project.

- Python 3.9.0
- Apache PyLucene 8.6.1
- Flask 1.1.2
- Angular 11.0
- Docker 2.5

Some of the python packages used are:

- Numpy 1.19.4
- Pandas 1.1.5
- scikit-learn 0.23.2
- sklearn
- scipy 1.5.4

Angular modules used:

- angular-material
- ng-bootstrap

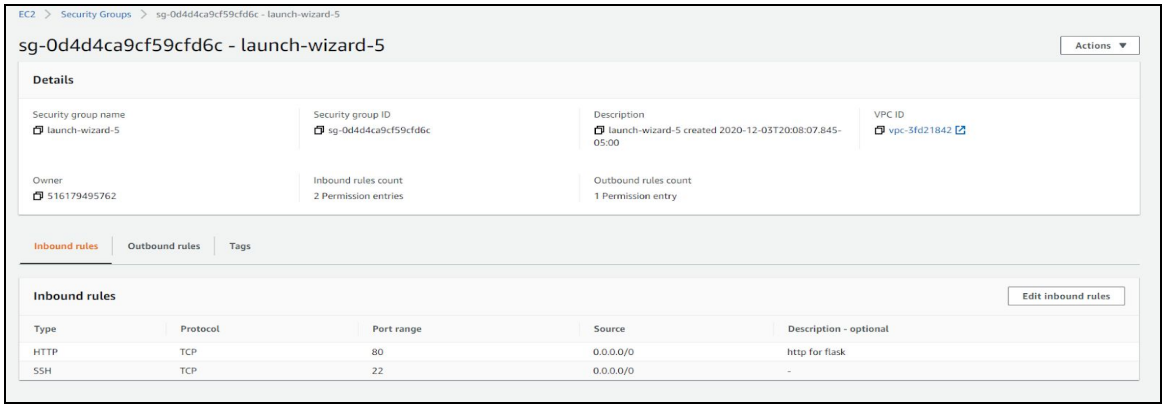
Since we used Docker, the project can be installed in either a local environment or on any cloud instances. Following are the steps:

1. Install and set up Docker.

2. Clone the project from the github location https://github.com/vs27-illinois/CourseProject.git

3. Open the shell script and run the following command: sh startup.sh

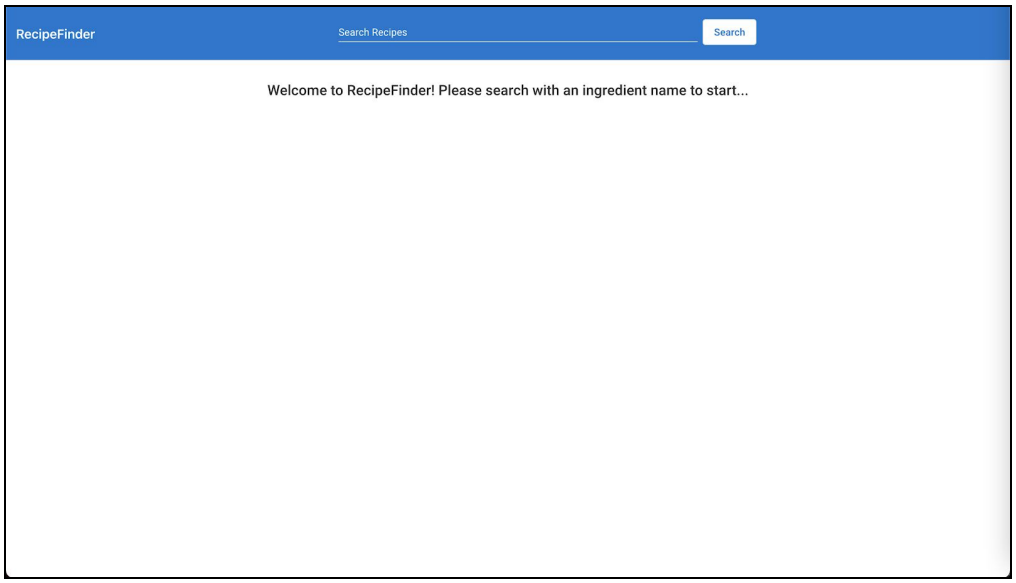
4. If the application is running on a cloud environment, enable the http port (80) in the host machine, so that the Flask application running in the docker container can be exposed to the internet. Sample image below.

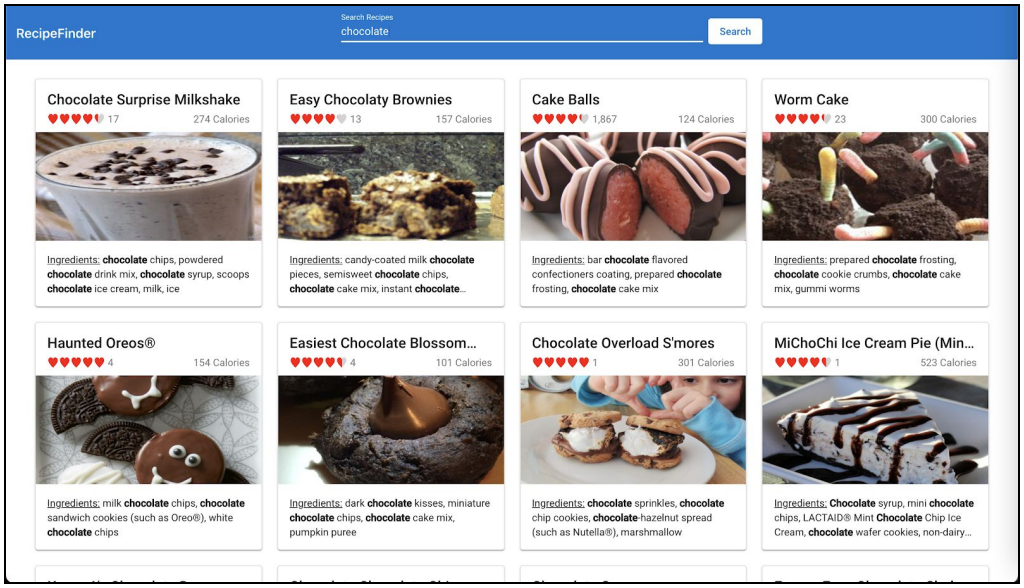


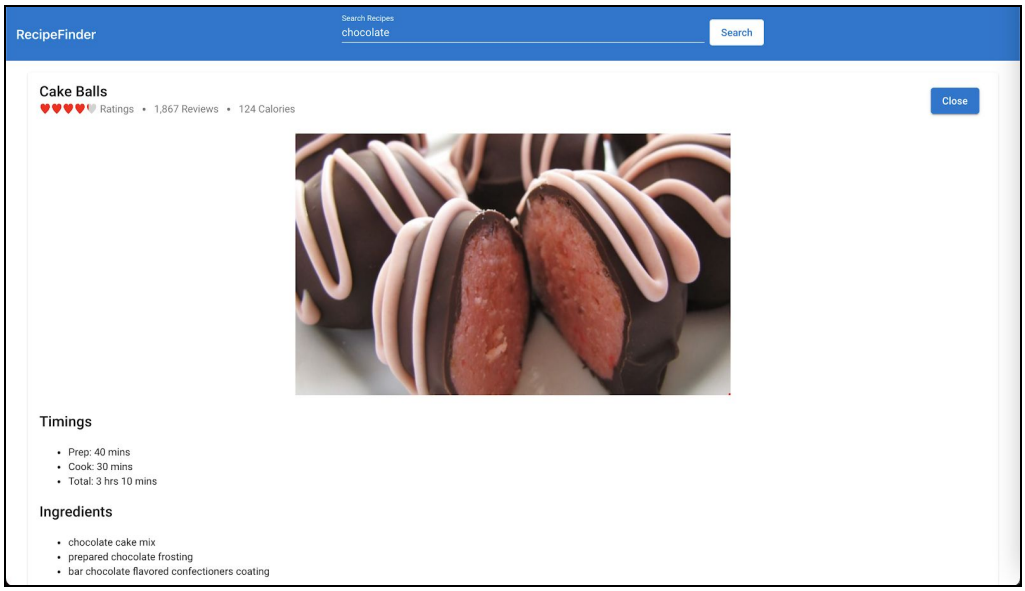
5. Open your favorite browser and go to http://127.0.0.1/ (if the app is running in a local environment) or http://<ipaddress>/ (if the app is running in a cloud environment).

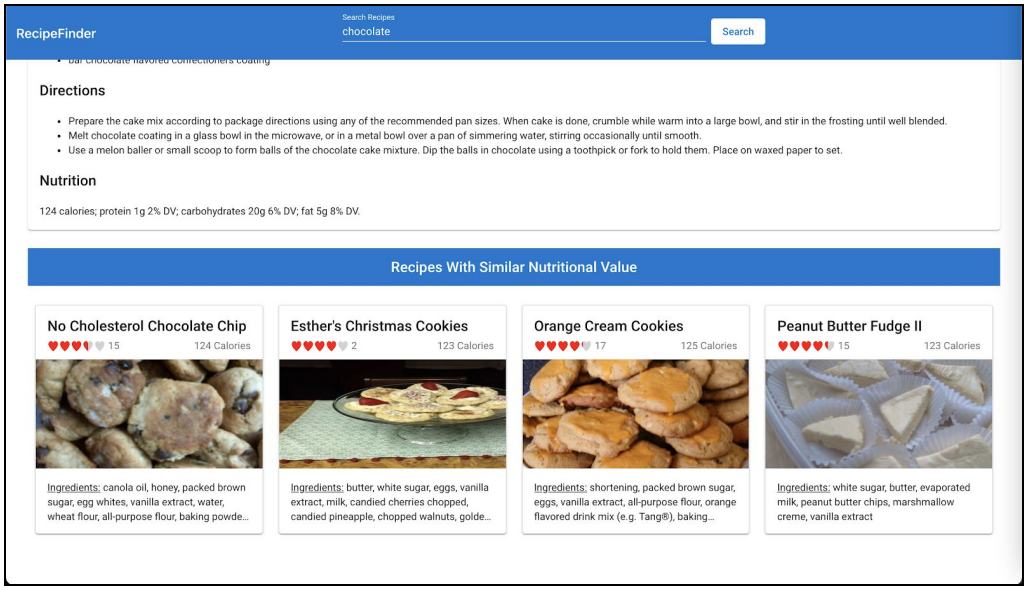
5. Snapshots

Following are the snapshots of the “Recipe Finder” application.




RecipeFinder
Search Recipes
chocolate
Search
Chocolate Surprise Milkshake
17
274 Calories
Ingredients: chocolate chips, powdered chocolate drink mix, chocolate syrup, scoops chocolate ice cream, milk, ice
Easy Chocolaty Brownies
13
157 Calories
Ingredients: candy-coated milk chocolate pieces, semisweet chocolate chips, chocolate cake mix, instant chocolate...
Cake Balls
1,867
124 Calories
Ingredients: bar chocolate flavored confectioners coating, prepared chocolate frosting, chocolate cake mix
Worm Cake
23
300 Calories
Ingredients: prepared chocolate frosting, chocolate cookie crumbs, chocolate cake mix, gummi worms
Haunted Oreos®
4
154 Calories
Ingredients: milk chocolate chips, chocolate sandwich cookies (such as Oreo®), white chocolate chips
Easiest Chocolate Blossom...
4
101 Calories
Ingredients: dark chocolate kisses, miniature chocolate chips, chocolate cake mix, pumpkin puree
Chocolate Overload S'mores
1
301 Calories
Ingredients: chocolate sprinkles, chocolate chip cookies, chocolate-hazelnut spread (such as Nutella®), marshmallow
MiChoChi Ice Cream Pie (Min...
1
523 Calories
Ingredients: Chocolate syrup, mini chocolate chips, LACTAID® Mint Chocolate Chip Ice Cream, chocolate wafer cookies, non-dairy...


RecipeFinder
Search Recipes
chocolate
Search
Cake Balls
Ratings • 1,867 Reviews • 124 Calories
Close
Timings
Prep: 40 mins
Cook: 30 mins
Total: 3 hrs 10 mins
Ingredients
chocolate cake mix
prepared chocolate frosting
bar chocolate flavored confectioners coating



6. Further Improvements

Within the given timeframe, we implemented all the functionalities that we have initially proposed for this project. We even fairly optimized the response time of the APIs by improving the performance of the search and recommendation service of the application. As a future enhancement, the performance of the recommendation service can be improved (currently it takes ~20 seconds to provide results). Moreover, we attempted to modify the recommendation service to use other fields like ingredients and faced memory limitations in our EC2 instance (we used free tier). It can also be tried as a further development of this project.

7. References

https://lucene.apache.org/core/8_6_1/

https://docs.scipy.org/doc/scipy/reference/spatial.distance.html

https://www.kaggle.com/elisaxxygao/foodrecsysv1

https://github.com/coady/docker

https://material.angular.io/

8. Contribution of Team Members

Vijayaragavan Selvaraj (VS27) - Team Leader

- Retriever (Search)
- Docker
- Angular

Sathyanarayanan Gokarnesan (SG53)

- Indexer
- EC2 setup
- Angular

Karthika Gopalakrishnan (KG24)

- Retriever (Recommendation service)
- Documentation
- Presentation